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**Proceedings of the goINDIGO 2022 International Graffiti Symposium**

Geert J. Verhoeven, Jona Schlegel, Benjamin Wild, Stefan Wogrin, Massimiliano Carloni (Eds.)

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Proceedings of the goINDIGO 2022 International Graffiti Symposium

Held in the framework of project INDIGO, funded via the Heritage Science Austria programme of the Austrian Academy of Sciences

Editors:

Geert J. Verhoeven

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LUDWIG BOLTZMANN INSTITUTE
Archaeological Prospection and Virtual Archaeology

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# Finding Listeners for Walls that Speak

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**1. Modern Graffiti—Objects to Study or a Study to Object**

Colourful and quickly changing: graffiti can be considered the chameleon skin of any urban landscape (Curtis, 2005). Two millennia ago, people were already writing their thoughts on the urban surfaces of Greek Aphrodisias in present-day Turkey (Chaniotis, 2011) or Roman Pompeii in Italy (Garrucci, 1856), and this practice has lived on throughout many cultures until this very day (Lovata & Olton, 2015; McDonald, 2013). Because of this long history and the multitude of surfaces on which graffiti have appeared, defining 'graffiti' is complicated. A safe but overly general definition could be that graffiti are a multifaceted, 'self-authorised' (Blanché, 2015) form of personal mark-making that exploits the public space using a visual intervention. 'Graffiti' can thus be an umbrella term for many ancient and contemporary mark-making practices, including engravings, paintings, sprayings, stickers, and other personal expressions attached to public (urban) surfaces in legal or illegal ways. [Note that we use the adjective 'ancient' instead of the commonly found 'historic' since the latter excludes prehistoric paintings and inscriptions from the graffiti definition. For more info on how to define 'graffiti', see Schlegel *et al*. in this volume].

Many modern graffiti might evoke the feeling of violating basic principles of acceptable social behaviour while providing colour to a city and displaying artistic skill. This tension between vandalism and art explains why contemporary graffiti can be so polarising and why they intrigue. That appeal is even reinforced by graffiti's usually unsanctioned and volatile character. Graffiti simply represent ambivalence, friction, and contrast: between legal and illegal, tangible and intangible, subversive and humorous, textual and graphical, condemning and apathetic, pleasing and disturbing. Few present-day phenomena embody so many different values, are characterised by this multitude of expression forms and have such a long history. In that sense—and going by the definition of ICOMOS (ICOMOS International Committee on Cultural Tourism, 2022)—both ancient and modern graffiti must be considered cultural heritage.

Although others increasingly share this viewpoint (e.g., Forster et al., 2012; Ronchi, 2009; The European Task Force on Culture and Development, 1997), graffiti still have a dubious relationship with(in) the cultural heritage sector. Many books on urban heritage (e.g., Colavitti, 2018; Longstreth, 2008; Obad Šćitaroci et al., 2019) do not mention them, and some heritage professionals explicitly exclude graffiti from the heritage realm. In her text on heritage resource management policies implemented in the South African National Heritage Resources Act (NHRA), Janette Deacon writes: "Staff members responsible for implementing the NHRA often find it impossible, however, to identify graffiti artists who damage heritage places" (Deacon, 2010, p.167). Note that even though graffiti creators are labelled as 'artists', Deacon considers their work by default 'damage'. A similar tone can be heard by conservation specialist Sáiz Jiménez, who remarks that "rock art in shelters is often vandalised, such as with modern graffiti that cover or obscure the

paintings" (Sáiz Jiménez, 2010, p. 9). In his monumental "The past is a foreign country – revisited", David Lowenthal tells his readers that "graffitists avid for nominal immortality defaced monuments in ancient Greece and Pompeii, as did Renaissance scribblers in the Catacombs" (Lowenthal, 2015, p. 504). Note that the latter three authors consider different aspects of the graffiti phenomenon: whereas Deacon and Sáiz Jiménez likely refer to contemporary sprayed graffiti, Lowenthal uses a more moderate vocabulary to talk about ancient inscriptions.

This ambivalent value judgement of graffiti also surfaces in various graffiti documentation projects. Documenting ancient graffiti (like Barber, 2007; Cosentino et al., 2015; Sou, 2016; Valente & Barazzetti, 2020) typically raises fewer critical questions, as if these would have an inherent greater value than modern graffiti. Present-day graffiti might not address future historians, but neither did ancient graffiti. They served a contemporary audience which could only understand those graffiti if they knew the names and the social, cultural and political contexts. Only when framed

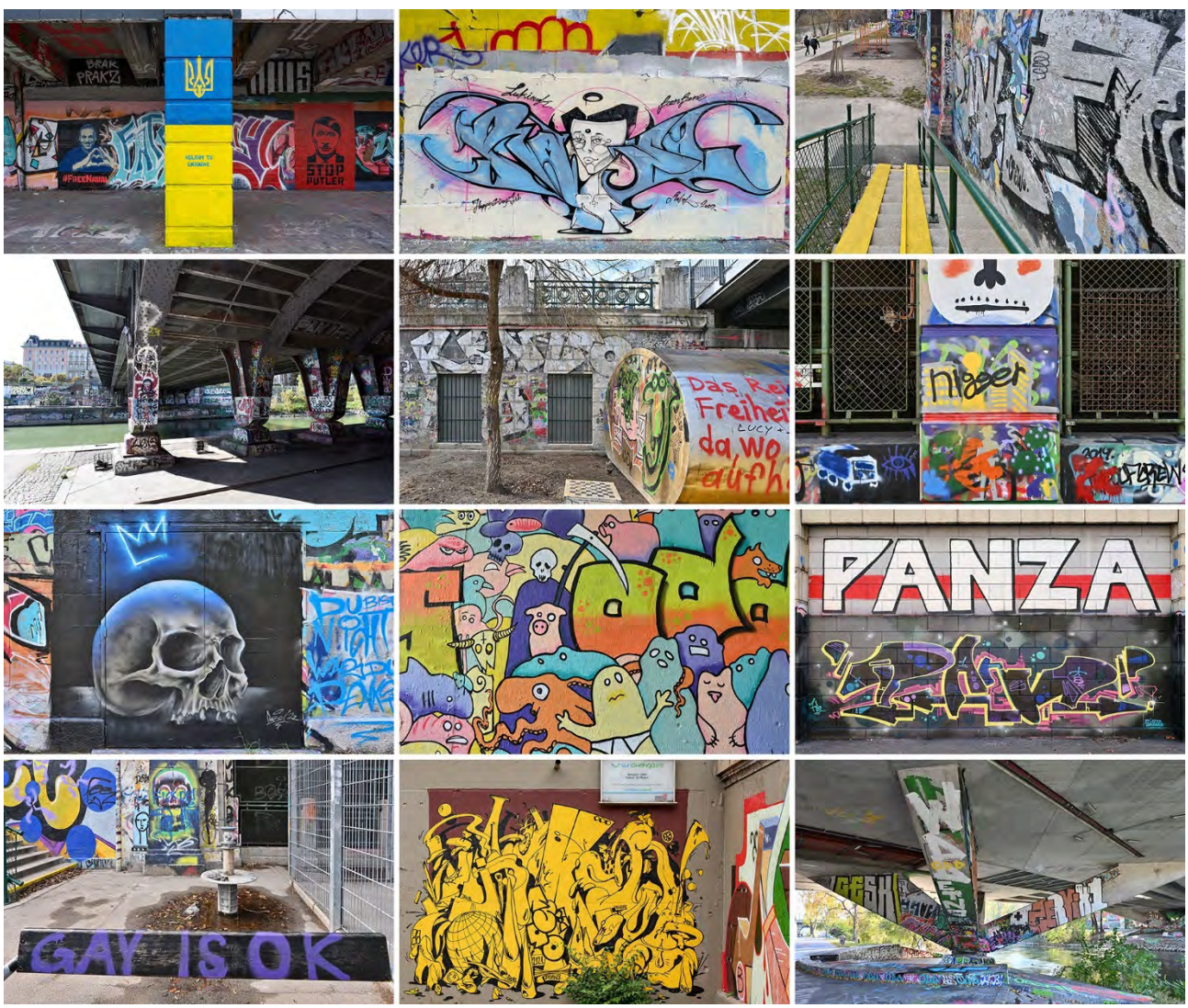



**Figure 1.** The wide variety of graffiti and graffitied surfaces found along the Donaukanal.

within these (pre)historic contexts and combined with other data sources, ancient graffiti do become archaeologically valuable. So why would this rule not hold for contemporary graffiti, for which such contexts are commonly well-known and for which the (spray)painted pieces, murals, and characters often exhibit a clear(er) artistic merit?

The authors share with de la Iglesia (2015), Holler (2014) and Novak (2014; 2015) the opinion that proper documentation of contemporary graffiti should get more academic attention. Without a digital record as a surrogate for a real-world object, any research is bound by graffiti's ephemerality. And without long-term archival goals, these digital surrogates are constrained by the impermanence of digital technology. Even though the lack of a digital record can represent the vision that graffiti are and should remain temporary, it also makes for partial and biased research: comparing graffiti based on dimensions, colour, or spatio-temporal dynamics is virtually impossible, while contentual classification and contextual interpretation remain reserved for eyewitnesses exclusively.

**2. Project INDIGO**

In the summer of 2020, the idea arose to document, digitally safeguard, and analyse a large part of the graffiti-scape in Vienna, Austria. The city centre of Vienna is characterised by the relatively bendy *Donaukanal* (Eng. Danube Canal), of which the surrounding public surfaces have constituted a graffiti hotspot since the early 1980s (Ringhofer & Wogrin, 2018). Every day new graffiti appear along the Donaukanal, ranging from colourful pieces and eye-catching characters on large unobstructed walls to political symbols and monochrome writing on bins, bridge pillars, and staircases (see Figure 1).

The initial idea and project drafts culminated approximately one year later in the international and interdisciplinary academic project INDIGO. Besides being a colour, the project's name stands for IN-ventory and Disseminate G-raffiti along the d-O-naukanal. Project INDIGO was launched in September 2021. Funded by the Heritage Science Austrian programme of the Austrian Academy of Sciences (ÖAW), this two-year project aims to build the basis to systematically document, monitor, disseminate, and analyse a large part of the graffiti-scape along Vienna's Donaukanal in the next decade.




**Figure 2.** An illustration to answer INDIGO's "What?", "Where?", "Why?" and "Who?" questions.

Although the project title discloses the "what" and "where" of this research project, it does not cover "why" project INDIGO was initiated and "who" is involved. Figure 2 clarifies that the core staff of INDIGO consist of researchers hosted at different academic institutes and non-academic organisations. All their combined inventorying and dissemination efforts aim to A) digitally preserve the Donaukanal's distinctive graffiti-scape and B) provide unique analytical pathways for anyone interested in contemporary graffiti to disclose new socio-political-cultural research questions and graffiti-specific insights. Although these two feats characterise the "why" aspect of INDIGO, Figure 3 graphically shows that INDIGO is essentially built around four specific goals. Creating a graffiti inventory incorporates **documenting** newly produced graffiti and their **long-term digital archiving**. The unrestricted, interactive, and online **dissemination** of these digital records must empower creators, academics and non-specialists to **analyse** them.

### 3. INDIGO goes goINDIGO

INDIGO thus aims to mirror the actual public urban surfaces in the virtual public world of the internet to digitally preserve and investigate an urban graffiti-scape in time and space. This means that the project has both a technical- and more humanistic-oriented aspect. The first draft of INDIGO's project proposal already put forward the idea to cover both aspects in two different symposia. Although the COronaVIrus Disease 2019 (COVID-19) was still wreaking havoc across the world, the hope was nurtured to physically bring together specific subsections of the (scholarly) graffiti community in Vienna. The initial timing of both symposia accounted for INDIGO's project schedule to maximise the relevancy of the discussions and insights gained (see also Figure 3).

- goINDIGO2022 had been planned to take place six months into the project and tackle all the technical, logistic, legal, and ethical aspects of documenting, archiving, and disseminating graffiti. The idea of gathering experts and experience so early on was to help avoid pitfalls on various more technical topics further down INDIGO's road.
- A second symposium—goINDIGO 2023—is planned for the end of the project. This gathering should focus on graffiti's socio-political and cultural impact. goINDIGO 2023 will also mark the launch of INDIGO's online platform and showcase how the graffiti (meta)data stored in it enable societal and cultural insights. In this way, specialists from many different fields such as art history, philosophy, cultural studies, law, urbanism, psychology,

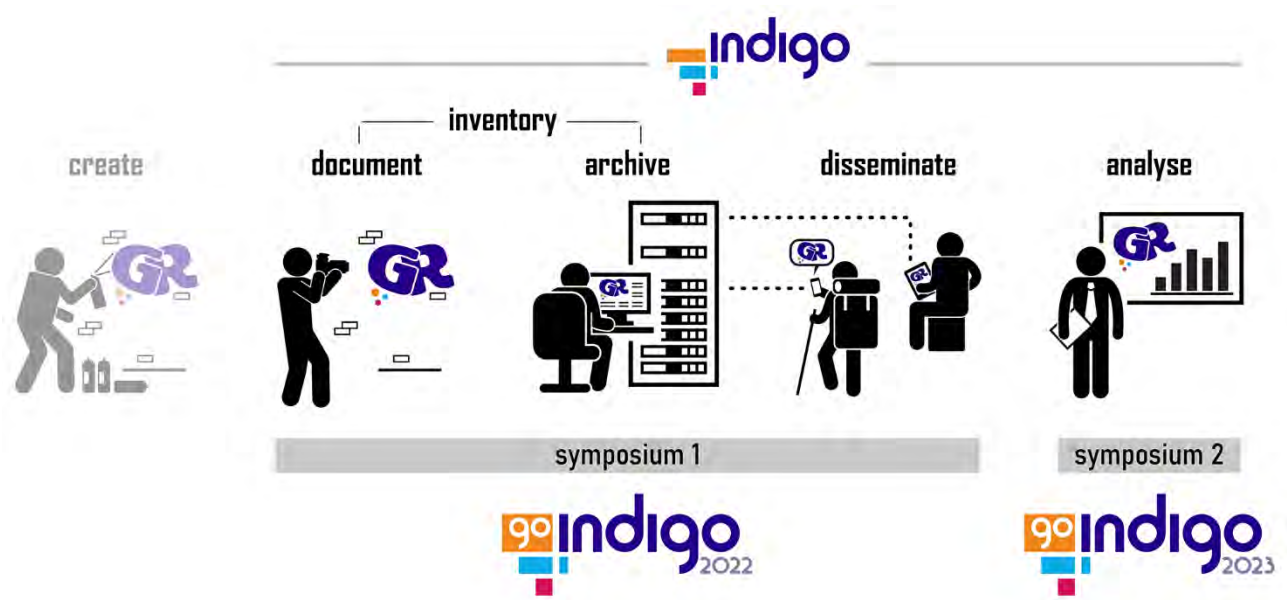



**Figure 3.** The main goals of INDIGO and how they fit within the two goINDIGO symposia.

and communication will see the potential of this massive open-access archive, thereby ensuring the transdisciplinary sustainability of this project.

**4. goINDIGO 2022**

Although the uncertainty created by the COVID-19 pandemic slightly delayed the goINDIGO 2022 symposium and made a hybrid event inevitable, these proceedings are the direct result of this relatively small but successful gathering. From the 11th to the 13th of May, a mixed group of sixty participants (graffiti creators, heritage professionals and graffiti academics) from twelve countries met in Vienna or online to learn from each other and build proverbial bridges.

Throughout two and a half days, two keynote lectures and eighteen presentations touched upon many facets of documenting, archiving and disseminating graffiti records. The word cloud generated from the goINDIGO 2022 book of abstracts reflects this topical diversity (Figure 4). Still, it fails to represent the various viewpoints that speakers put forward. Such variety should always be sought after, as robust strategies for inventorying and sharing graffiti records can only be obtained when soft sciences meet hard sciences, legal experts discuss with specialists on ethics, archivists get to know web programmers and graffitists connect with academics. INDIGO considers these inter- and intra-project collaborations an essential feature because they hold an unlimited potential to draw inspiration from peers and experts in entirely different domains.

That is why the goINDIGO 2022 organising team is proud




**Figure 4.** The word cloud extracted from the goINDIGO 2022 book of abstracts.

to have pulled off two highly interactive discussion sessions between those who create graffiti and those who document/archive/disseminate them. Both discussion sessions were joined by six graffiti creators operating in Vienna. This led to some fascinating insights which are also reflected in these proceedings.

### 5. Overview of This Volume

We have divided all papers across three sections which correspond to the main themes of goINDIGO 2022: documenting, archiving, and disseminating. It is helpful to consider the INDIGO research pillars (Figure 5) to understand the exact scope of these terms.

- **Documenting**, in INDIGO's view, is different from 'recording'. Many techniques exist to record the various characteristics of heritage data: a laser scanner, a photo camera, a piece of paper and a pencil, a thermal camera, and a balance. One can record data with all five, but their output will be vastly different. In a typical workflow, one expects this output to adhere to certain criteria, since it should answer or solve the problem for which data were generated in the first place. For example, answering a specific research question might need digital surface topography with mm-level spatial detail and a given georeferencing accuracy. Such goal-oriented data acquisitions are denoted as 'documenting', while 'recording' refers to mere data gathering (Verhoeven, 2019). Because data are raw and typically need more or less treatment to yield usable products, data processing naturally falls under the umbrella term 'documentation'. However, Figure 5 shows that archiving also encompasses processing, so where does the boundary lie?
- **Archiving** is the act of establishing a well-curated (and openly available) archive. Like documenting, archiving should be purpose-oriented. However, the content of an archive typically needs much management, so that the stored documents are findable and can still be opened after a decade. The border between such necessary archival and documentation-related processing is not always clear-cut. For instance, adding IPTC (International Press Telecommunications Council) photo metadata is typically done before any other image processing step. Still, these IPTC values are essential from an archival point of view.
- **Dissemination** is the action of spreading data, information, knowledge or wisdom, whether in analogue, digital, or hybrid form. Scientific papers, a website, an exhibition, an archive, and a non-specialist presentation are all valid ways to disseminate (scholarly) results.

Even though many papers in these proceedings deal with two or more topics, the intention was to order the texts according to their primary focus. However, before opening the floor to those who aim to document, archive and

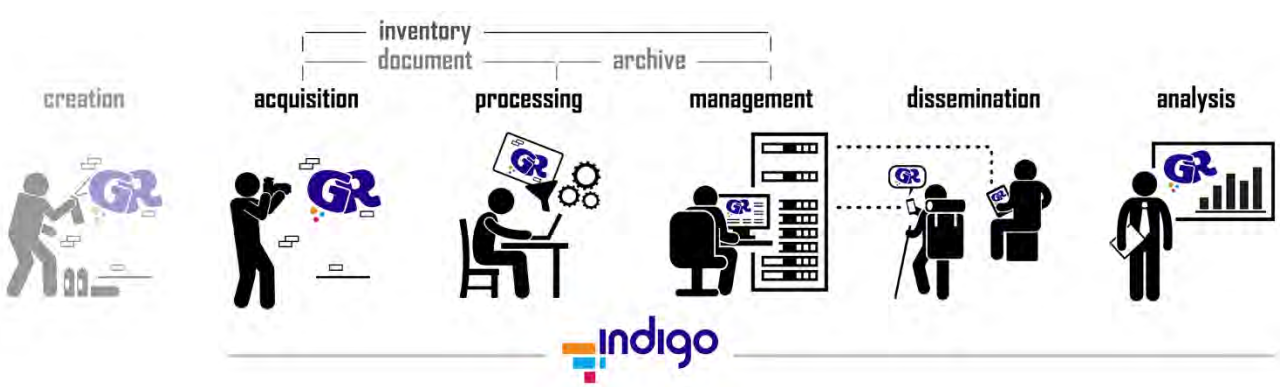



**Figure 5.** The INDIGO research pillars.

disseminate graffiti, we—the editors—think it is opportune to reflect on these three activities. Do those who engage in documenting, archiving and disseminating graffiti act out of self-interest, or do the graffitists also think that these activities are of value? Graffiti creators know that they balance on (and cross) an often fuzzy legal line. But are we—the documenters, archivers, and disseminators—always considering the potential legal and ethical implications of our actions? Because these questions often remain unanswered, this volume starts with an extensive **REFLECTING** section, comprising the symposium-opening keynote address of *Alex Hale* and a reproduction of the two discussion sessions: «Creators vs Academics» and «Ethics & Legality in Graffiti (Research)».

In his text, Alex touches upon a range of topics. He voices concern on how modern tools can sustain the space between researcher and researched; he questions the role and very nature of graffiti archives, and wonders if the attempts to mass-document graffiti still rhyme with climate priorities. Due to the broad scope of his thought-provoking musings, Alex's text is an ideal proceedings opener and a good launch for the following two articles, which are slightly edited transcripts of goINDIGO 2022's discussion sessions. Both contributions are longer than the texts that follow. Still, we believe that—in combination with the opinions of Alex—they set the much-needed tone and reflective framework for everything that follows, as these discussions originated from the encounter of peers and experts in entirely different domains, and hold the potential to inspire an equally wide range of scholars, creators and other interested individuals. In addition, it is hard to find such written-out discourse between those that 'make walls speak' and those that 'listen to them'. We hope these two 'papers' provide the reader equally much pleasure and insight as they gave all discussion participants.

Kicking off the **DOCUMENTING** part are three INDIGO papers. In the first of those, *Geert Verhoeven et al*. detail project INDIGO's labour- and data-intensive approach to discovering and documenting new graffiti. The text also explores new avenues for improving the existing workflows, many of which rely on a vast number of photos. However, having a mere collection of photographs does not facilitate detailed and robust documentation of the spatio-temporal variations in the urban chameleon skin. That is why project INDIGO develops colourimetric and geometric image processing pipelines, described in the papers by *Adolfo Molada-Tebar & Geert Verhoeven* and *Benjamin Wild et al.*, respectively. Both articles introduce a freely available, open-source software tool to work with digital photos. Whereas Adolfo & Geert make a case for accurate image colours when documenting graffiti (facilitated by the novel Python-based toolkit COOLPI), Benjamin and colleagues resort to photogrammetric engineering and the automated generation of graffiti orthophotographs to tackle decontextualisation and documentation issues. After introducing the orthophotography concept, the authors present AUTOGRAF, a free add-on for Agisoft's image-based modelling software Metashape Professional. Since both COOLPI and AUTOGRAF use raw photographic data as input to yield qualitative archiveable outputs, these papers reside in the Documenting section.
The last two papers in this section throw a slightly different light on graffiti documentation. *Gabriele Goffriller* uses historical sources in her quest to find the two-centuries-old tags left by Joseph Kyselak. As a result of her documentation, Gabriele hypothesises that Josef Kyselak is likely the first modern graffiti tagger. The paper by *Laura Luque Rodrigo & Carmen Moral Ruiz* balances on the borderline between the Documenting and Archiving sections. The authors start by challenging the standard notion of urban art and provide a reflection on its ephemerality, which in turn guides the development of a cataloguing card suitable to document and efficiently archive this art.

By harvesting content from often forgotten online and printed sources, *Martin de la Iglesia* shows yet another way of acquiring (meta)data on graffiti. His paper addresses the paradox that, despite all the published literature, it is still hard to find comprehensive and structured graffiti metadata records. Since the article mainly focuses on all operations necessary to turn these collected graffiti records into a usable database with clean and complete metadata, Martin's writing opens the **ARCHIVING** section. The importance of proper metadata, and more specifically, unambiguous and unified terminology, is also stressed in the following papers. *Chiara Ricci et al*. elaborate on how the CAPuS project first

worked on a multilingual illustrated glossary of graffiti and street art-related terms to define a common language between different stakeholders. These terms support better teaching and more objective documentation of graffiti and street art, materialised in the open-source and online digital CAPuS repository, which archives and disseminates information about contemporary murals and metal sculptures. With their attempt to establish a commonly-accepted graffiti thesaurus, *Jona Schlegel et al*. elevate the glossary idea. The text outlines the technical differences between a glossary, a thesaurus and other knowledge organisation systems. At the same time, the authors try to develop a robust framework to define graffiti within the broader 'mark-making' concept. The paper first reviews the history of the Italian term *graffiti* to determine later that it constitutes a triple entity. Various examples then challenge the solidity of the new definition. Such a thought exercise is valuable and much-needed, not only because of the multiple meanings attributed to the term graffiti (as is evident in these very proceedings), but also to precisely define the overarching thesaurus term. The paper ends with an outlook on semantic technologies that can store this thesaurus. Although organisation schemes like thesauri help to (hierarchically) manage information and knowledge of a specific domain, a knowledge representation scheme or formal ontology aims to structure that particular field semantically. In the digital humanities, the Conceptual Reference Model (CRM) is the best established, but still underused, formal ontology. *Nina Richards et al*. detail how the CRM can enable the semantic integration of various humanities data sets, and why it is the underlying framework for the OpenAtlas database that will store project INDIGO's data.

The final two papers in this section form great examples—each in their own way—of extensive graffiti archives. We learn from *Sven Niemann*, the symposium's second keynote speaker, how INGRID or the Information System on Graffiti in Germany collects its photographs and how the database records are curated. Examples showcase how INGRID's neatly managed metadata enable the analysis of graffiti's stylistic and linguistic aspects while also supporting the study of long-term graffiti developments. Whereas only a part of INGRID's records is available online so far (and exhaustive access is possible solely for research purposes), the extensive Spraycity archive is entirely open-access. Spraycity contains two decades of photos primarily shot by the archive's owner *Stefan Wogrin*. Stefan's text first provides a historical introduction to various graffiti archives, later explaining Spraycity's documentation approach and its challenges concerning categorising, geotagging and hosting large quantities of data. Through unique online graffiti maps, an extensive website blog and the Offline Graffiti Magazine, Spraycity also engages in various graffiti dissemination activities. The paper thus bridges nicely to the last section of these proceedings: **DISSEMINATING**.

Whether they disseminate graffiti as analogue real-world representations, Virtual Reality (VR) entities, or hybrid Augmented Reality (AR) pictures, all papers in this section present exciting ways to spread information about graffiti. *Rita L. Amor Garcia* opens this last section by discussing the ethics and practice of *in-situ* graffiti conservation. Those people claiming that graffiti are, and should stay, ephemeral might be surprised that many creators interviewed by Rita do not consider this a given and even use specific materials to make their creations last longer. And although the latter attitude might not be universal, creators and conservators generally agree that 'location' or 'place' is central to their decision-making process. From this viewpoint, it makes sense to develop solid ethical and practical frameworks to guide decision-making on *in-situ* preservation (especially knowing how upset graffitists and non-graffitists can become when works get relocated—and thus decontextualised—from their place of origin to a museum).

How the analogue, *in-situ* reality can be augmented with a digital layer to combat the decontextualisation of graffiti and increase their understanding, gets explored by *Flaminia Cavallari et al*. Using a case study in Rome (Italy), the paper provides quantitative and qualitative insights into the current technical capabilities and limitations of graffiti communication via such AR solutions. When the real-world representation is entirely removed from the graffiti communication, one ends up with a VR depiction. *Ljiljana Radošević* presents the process of setting up such a VR graffiti gallery for Belgrade (Serbia), with all the logistical and technical challenges it can bring along: from selecting suitable photographs to getting specific urban surfaces digitised.

Although some of the described technical struggles (like creating a photo-based digital 3D surface of a long and tall wall) are solvable, the text does bring into focus the ever-increasing and ever-widening technical savviness and expertise required from curators and exhibition teams wanting to meet particular changing museological needs.

However, the latter do not have to be only digital. The last two contributions of these proceedings exemplify this nicely. *Klaudia Kreslehner* sketches the history of graffiti in Linz (Austria), documented in the "Graffiti & Bananas" exhibition, which she curated. *Christine Koblitz* turned the former historical museum of Vienna into an urban playground with her "Takeover" initiative. Although both exhibitions had a slightly different focus ("Graffiti & Bananas" being more history- and information-oriented, with "Takeover" more street-culture tailored via the inclusion of skateboarding), each initiative questioned if and how (a) typical outdoor activity(ies) can function in a standard museological setting without losing the original spirit. Even though documenting and archiving graffiti also have a role to play, truly (re) defining and exploring the boundaries of graffiti (as a phenomenon, as a process, as an object) primarily occur via dissemination initiatives like those of Klaudia and Christine, but equally-well those of Flaminia and colleagues, Ljiljana, and Rita. After all, graffiti are created for an audience. They are—as Reynolds (1975) called them—the 'Magical Symbols' that fill our lives in one way or another.

**6. Conclusion**

goINDIGO 2022 has managed to bring various disciplines together; that is why the editors hope that the contributions in these proceedings can collectively be considered a proper methodological status quo on the inventorying and dissemination of graffiti records. Because most academic efforts always focused on the analyses of graffiti, these proceedings also hope to kickstart further discussion and interdisciplinary scholarly action on the (need for) proper documentation and dissemination of graffiti. Critical, maybe even uncomfortable, reflections like those vented in the discussion sessions or covered by Alex Hale form an essential part of this discourse.

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**Conflict of Interests**

The authors declare no conflict of interest.

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# Graffiti Some Times: Archaeology, Artefacts and Archives

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**Abstract**
This keynote address for the goINDIGO 2022 symposium aims to act as an introduction to the exciting complexities that graffiti can present to archaeologists and others who are interested and choose to research this subject. The paper considers graffiti through three lenses: as a subject for archaeological investigation, as artefacts from time past, time now and time as unfolding surfaces; and it asks how should we develop our archival practices in the wake of digital profusion challenges and the 6th extinction event, in the contemporary archaeological timeframe?

**Keywords**
archaeology; archives; artefacts; graffiti; between practice and collaboration

## 1. Graffiti and archaeology

I am making a big assumption, but indulge me for a moment, that at some point graffiti emerged as a suitable subject to most of us and we realised that this unknown, potentially unruly, or even feral phenomena could open up new research possibilities—including those beyond the academy. I use the term feral in this context to remind us that graffiti is not something to be tamed by research, but with the view that it can enable new conceptualisations of approaches and practices, with people and places, that archaeology and archaeologists have rarely explored. Things get interesting when we consider that not only is graffiti a way of life for writers, but also how our involvement in this domain can affect it. We are not the first to tread here, this feral landscape comprises a much deeper timespan, from cave paintings and rock art to expressions within contemporary culture, ranging from language and music to performance and graffiti (Ross, 2021). So, we should recognise and acknowledge those who have trodden this path before us and walk in their footsteps into this feral territory.

Recently published edited volumes, amongst others, have brought together multiple disciplines from around the globe (e.g., Lovata & Olton, 2015; Ross, 2016) and have done much to demonstrate the breadth and history of graffiti and its role in past and contemporary cultures. These contributions provide multidisciplinary research that extends for nearly 100 years, with early exponents such as Brassai photographing graffiti in Paris between the 1930s and 1960s (Brassaï, 1960). Of course, this does not mark an origin point for graffiti; historical and archaeological studies have demonstrated the long durée of graffiti since prehistory to present (Frederick, 2009; Hale, Forthcoming; Oliver & Neal, 2010). However, within many of these studies it is the people who are an absent presence that cannot be directly engaged with. Whereas within contemporary graffiti studies, writers are very much present. When engaging with graffiti today, we should be attentive to the central agency of the writers and similarly our effects within research practices when engaged in this work. As Herbert

Khol explained in 1969, 'The more I attended to that particular wall, the more I felt like a voyeur spying on the lives of children who were strangers to me,' (Kohl & Hinton, 1969). I too am guilty of something similar, when I photographed the changing graffiti on a wall, every week over the course of a year, in Edinburgh, Scotland (Hale, 2018).

Early research into contemporary graffiti, such as that by Nancy Macdonald (2001) have adopted anthropological, immersive, practice-based work and set standards in good practice, that fully recognise the practitioner's role. These earlier approaches have enabled more recent researchers to consider expanding archaeological approaches, archival practices, heritage conceptualisations and fruitful collaborations. For example, work by Martha Cooper and Henry Chalfant, Jeff Ferrell, Ursula Fredrick, Laima Nomiekaite, Susan Hansen, Martyn Reed, Samuel Merrill and many more, some of whom were able to attend the goINDIGO 2022 symposium, have raised the bar in terms of how contemporary practices can inform interdisciplinary, collaborative projects that broaden academic accessibility and create learning opportunities beyond the walls of our

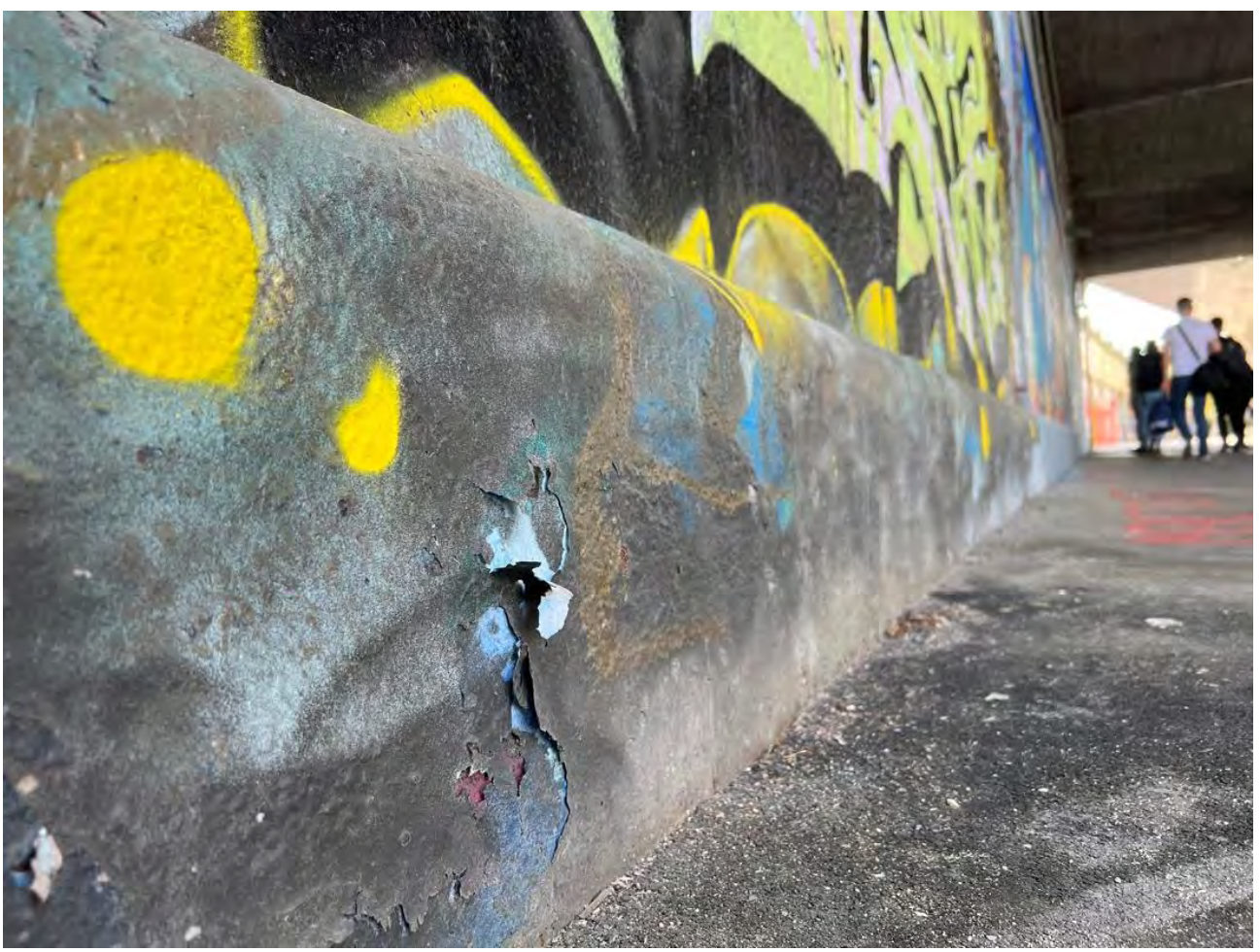


**Figure 1.** Walking along the Donaukanal, Vienna, whilst experiencing the micro to macro scales of the graffitiscape.

organisations.

On top of this, I would personally like to thank graffiti writers for their hard work, ongoing endeavours and artistic abilities, because they create an unruly subject that has opened our eyes and ears to worlds beyond our working lives. Their craft, that is the subject of this symposium, appears to be the world's largest (unofficial) art movement and one which doesn't appear to be diminishing. It is this feral, subversive, pleasurable expression of writing, that enables projects like INDIGO, to not only document and archive this living craft, but it also opens up debates around urban spaces, enables us to consider the precarity of the commons and public realm, and why modes of research need adapting, in order to become public, creative and collaborative. I'd like to focus on a few archaeological approaches that have been undertaken with graffiti as the subject, which will perhaps expand our conceptualisations of our roles within the graffiti world, if we choose to follow some of these paths (Figure 1).

**2. Graffiti, time and artefacts**

It is incredibly powerful to think that a lifestyle, like graffiti writing, can affect change; remember the recent seismic political disruptions across the Mediterranean since 2013, that we are still experiencing (see Naeem (2013) for a summary).

I feel honoured to stand up in front of people and say that I am an archaeologist. But what does it mean to be archaeological in today's world? Like many friends and colleagues, I began as a Prehistorian; proud to create data from primary sources, combine them with secondary material, analyse datasets and then interpret it to present stories of past lives, from thousands of years ago. Nowadays, I'm not so sure as to how I can speak about past lives. Today, I recognise that everyone is archaeological in one practice or another; that being archaeological has become a way of being, seeing and engaging with our weird wide world (Holtorf, 2016). I consider archaeology to be a practice linked with citizenship, that seeks to uncover worlds, through a broad range of approaches and as Doug Bailey urges us, to disrupt our perceived views, to unsettle our comfortable positions, risk new practices and reflect on our actions (Bailey, 2017). New practices can take us beyond the past tropes of treasure hunting that filled museums with artefacts and into the realms of entanglements between material culture, people and more than humans. These collaborations and their impacts should be carefully considered, co-created and co-produced, to enable others to positively participate. Sometimes, this can be confusing and unsettling, but we are not alone and feeling supported is an important aspect in all our lives today. For an excellent example see Rachael Kiddey's research on working with people experiencing homelessness (Kiddey, 2017). Rachael's politically-oriented work demonstrates the importance of recognising agency across a range of people and places, and how archaeology can provide an enabling framework to engage with complex contemporary issues.

Clearly with changing social, political and ethical shifts within our lifetimes we are recognising that recasting our archaeological approaches are increasingly necessary (Haeckel, 2021; Hicks, 2020). One such approach is the concept of time in archaeology. If we follow Karan Barad's research on quantum physics and time, we can consider that time is neither linear nor unrepeatable but comprises rhythms and multiplicity (Barad, 2007). Time for archaeologists is often used as a hook on which we hang much of our work, but one which we often get snagged on for a variety of reasons. We strive to define the extent of a phenomena through dating, typologies, seriation and stratigraphic positioning, all of which are linked to time, but as Gavin Lucas discusses in his recently updated book 'Making Time', artefacts are time, rather than existing 'in time' (Lucas, 2021). For example, the artefacts of graffiti are intertwined through time by past actions of writers and the present dissemination and reception of images of graffiti, which can occur at multiple times both synchronously and asynchronously, via social media and the internet. This multiple time dimension can take the form of a passer-by walking along the Donaukanal and looking at the graffiti, and at the same time somebody swiping on their Instagram feed and seeing images of the same pieces. The latter can also take place on multiple occasions and repeatedly. Add to this the possibility of the writer looking back over their black books and remember-




**Figure 2.** Throwie on a door in Edinburgh. (©Alex Hale).

ing when they came up with the letterforms, defined their colour scheme, planned the spot to hit and then created the piece, and we are confronted with artefacts that comprise multiple times in multiple places, which can be both digital and in-place.

Another example of time(s) enclosed within the visual artefacts of contemporary graffiti is the inclusion of dates. In Figure 2, we see a throwie accompanied by the number '14'. As an archaeologist my assumption would be that the 14 represents an origin date of 2014. But if that is the case, what does the date represent? Is it the date when Youts, the

writer, hit the spot? Or does it represent a significant moment in their life, which involved something that they wanted to commemorate? Or is it part of their crew number? The archaeological mind can be distracted by the temptation to fall back on a known date and assume that it is an origin point. However, it would be better to consider the date with the other components of the throwie and recognise that they are components of the performative materiality, which encompasses intent, action, materials, time and archive, that forms to create a dynamic, unfolding assemblage.

Today we are overburdened with metadata, which helps improve our archival actions and the INDIGO project is unique in its aims to set new standards in this arena. Before I come on to archives, I'd like to consider some specific approaches to graffiti artefacts, from the spray cans to the artworks themselves and photographic representations of the works. The creativity is for all to see on walls around the world, the spray cans and the walls are artefacts associated with the artworks, but it is perhaps photography that has had some of the most significant impact on our reception to both graffiti and archaeology. Some of the most recent thinking around this has been published by Lesley McFadyen and Dan Hicks in their book, 'Archaeology and Photography' (2020). Specifically, the agency of contemporary photography within archaeological practices that can enable us to go beyond the ocular-centric, representational tropes of 19th century and present new directions (see Hale and Anderson (2020), with specific reference to photographing graffiti). With the development of digital recording, photography has become a crucial tool in not only geo-spatially positioning artefacts, but seeing beyond the visual spectrum, that can lead us into places beyond the eye can see. We heard much more about this during the symposium and some of which is published in this volume.

But these exciting advances in research tools and methods could, if not carefully considered sustain the space between researcher and researched. For a specific discussion around some of these issues in a community heritage context see the work on the ACCORD project (Jones et al., 2018) and for one specific Scottish example of a potential approach, see Hale (2017). Without community engagement and participation this can lead to uncomfortable, voyeuristic positions for a researcher, which we should strive to avoid for ethical, moral and social reasons. I suppose, when it comes to graffiti writing, an alternative approach is to become immersed in the culture: to become a participant in the artefact assemblage, perhaps even by practicing our handstyles (see Graffiti Grannies: http://artnote.eu/graffiti-grannies-come-to-aberdeen-for-the-nuart-festival)? Within this form of participatory research we can begin to experience and explore this culture by learning with writers (Fransberg, 2020; Macdonald, 2001; NuArt journal, https://nuartjournal.com). The following section considers immersive graffiti territories as unfolding archives.

**3. Graffiti archives**

Just as the Parisian arcades inspired Walther Benjamin to explore the physical remains of the city and at the same time use the architecture to critique his contemporary world (Benjamin & Tiedeman, 2002), we can be encouraged to explore our worlds through the artistic interventions we find on the streets, scratched in tree bark, laid out in fields and carved on hillsides, and use them to critique our world. The locations of graffiti, these places of performance are critical in our understanding of why people engage with space and make it a place (Nomeikaite, 2020). Across time, people leaving marks on the landscape have left behind artefacts for us to engage and explore. Within these artefacts are temporal rhythms and spatial performances, so as we walked along the Donaukanal (https://www.youtube.com/watch?v=TjEBPMYn3ac) on our graffiti tour during the symposium, we observed the colours, shapes, styles, letters and image forms, juxtaposed with the water of the canal, the sunshine and the changing canvases that the writers have adopted.

The positions of the pieces, throwies, tags, street art and paste-ups converse with each other, with us and their surroundings (Figure 3). These are not static artworks hanging in a void and waiting for us to give them layers of meaning through our academic practices. These are performed texts that were not written for us, they are beyond our control and part of a wilder-ness that we can explore. But these artefacts should not be hidden in archives, their very presence is the archive.




**Figure 3.** A small section of the graffiti on the Donaukanal (©Alex Hale).

If we are lucky, we sometimes encounter some of the other effects of these archival presences, such as caps and cans (Figure 4). These artefacts are indicators that enable writers to assemble their own timescales. Between painting and buffing there may be what we call days, weeks or even months, but within painting time these events can form quite different rhythms. Between creating a sketch in a black book, planning where to place the work, hitting the spot and the piece being buffed, is not a 9–5 job, the practices create their own cadences. Perhaps we should consider 'graffiti time' as a scale that we have previously not recognised or measured? It is projects such as INDIGO that aim to research not only the colours, forms and positions of the artefacts, but also to document and surface these new cadences within graffiti.

Graffiti is always at the point of becoming, gathering layers of paint because of writers 'biting' or over-writing, and this can appear to disrupt the order of the wallscape where it is placed. But aggregating information and collecting objects with a view to placing them into archives, is one of our keenest human instincts. Rather than thinking about graffiti as a phenomenon to be archived into a museum full of artefacts, we should consider it as an ongoing archival practice, as an act of archiving through doing, what Henck Slager and more recently Gina Wall and myself have referred to as 'pa-



**Figure 4.** Discarded cap, found behind a bridge support, by the Donaukanal (©Alex Hale).

ra-archiving' (Slager, 2015; Wall & Hale, 2020). In this way the writing not only forms an archive but it provides assemblages of materials to be reused and re-purposed into new ways, that are yet to be surfaced and emerge.

Lachlan MacDowall has discussed how archiving has become a world-wide lifestyle, especially within our online lives that are predicated on algorithms, designed to create personal archives, without our consent, by way of giving away our data (MacDowall, 2019). But para-archiving, whilst acknowledging and critiquing the power systems that exist in archival practices, based on Derrida's 1995 essay, 'Archive Fever: a Freudian impression', aims to expand the creative opportunities that assemblages present (Derrida & Prenowitz, 1995). So, consider the possibility that graffiti presents us with an archive that is constantly in a

state of becoming assembled, but which is feral, unwieldy and something not to be tamed. Within this para-archive are artefacts that are continuing to be in a state of becoming that contain multiple contradictions and opportunities.

**4. Future graffitiscapes**

So, to finish this ramble through graffiti, I wanted to quickly remark on our era of data profusion and at the same time the climate emergency. There is a tension here that should make us ask difficult questions of our actions; for example, does the ongoing amassing of data enable people to live more sensitive, compassionate, and caring lives? And at the same time, we know that museum stores are bursting with artefacts, and archives are actively considering de-accessioning aspects of their collections. Add to this, the ongoing drive to mass digitisation, which is demanding vast quantities of electrical power, in some cases generated from finite resources. We should all be thinking about these tensions and how we address them on a range of scales. Emerging from this are interesting possibilities that we are only just beginning to consider, and it is interdisciplinary symposia such as this, that provide opportunities to dive deeper into this aspect of (graffiti) research and being. Within our subject area, graffiti artists, such as Bordalo II, are making their art using recycled materials and everyday remains, and addressing some of these issues by being, 'focused on questioning the materialistic and greedy society of which he is (also) part. The excessive production and consumption of stuff, which results in the continuous production of "garbage" and consequently in the destruction of the Planet, are the central themes of his production' (Bordalo, 2022).

So, I will finish by posing two questions, challenges if you like for us as global citizens, graffiti archaeologists and archivists:

- How do we ensure that graffiti writers share in the pleasure of research, just as we share the pleasure of their creativity and art?
- How do we conceptualise and develop complementary archival practices that address current global environmental, social and moral issues?

In addressing these and other questions we should be sure to always act collaboratively, sensitively and with others in mind. Luckily for us graffiti writers create art that asks many questions, not only of themselves, their craft, but also of how we want to engage with art, performance and transgression. This can lead us towards conversations about curated social media feeds, blogs, vlogs and podcasts; to symposia, workshops, graffiti jams, bombing nights and beautifully crafted books (Acker, 2013), amongst an amazingly diverse assemblage of graffiti archives. So, I wish everyone a most enjoyable symposium proceedings and here's to many more collaborative, unfolding graffiti journeys through archaeology, artefacts and expanding archival practices!

**Conflict of Interests**

The author declares no conflict of interests.

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# 'Different Folks, Different Strokes': goINDIGO 2022's « Creators vs Academics »

Discussion Round

Samuel Merrill, Geert J. Verhoeven, Benjamin Wild, JANER ONE, MANUEL SKIRL, SERT, SNUF, Massimiliano Carloni, Martin de la Iglesia, Francisca Fernández Merino, Ljiljana Radošević, Chiara Ricci, Jona Schlegel, Stefan Wogrin

## 1. Introduction

During the first discussion round of goINDIGO 2022, which took place on Thursday, 12 May and was called *Creators vs Academics*, four local graffiti creators were invited to consider a series of (potentially provocative) statements in discussion with symposium participants (joining in-person and online). The statements, compiled by Geert Verhoeven in consultation with Samuel Merrill, were:

- Academia CHANGES graffiti
- Graffiti MUST be recorded
- ALL graffiti are archive-worthy
- Decontextualisation MATTERS
- Graffiti NEED categorisation
- Digital media are ESSENTIAL

The four attending graffiti creators agreed to participate following their contact and invitation via Instagram. When introducing themselves, each conveyed their own, often close, relationship to the Donaukanal as well as their different levels of experience and exposure within Vienna's wider graffiti scene. **JANER ONE** (active since 2012), for instance, took hope from doing graffiti in "tough times" and identified the Donaukanal as a really big playground—"it does not have many rules, and the few rules it has, you must pick up by yourself"—and a site of graffiti history. **MANUEL SKIRL** (active since 2006) meanwhile recounted how the openness and inclusiveness of the Donaukanal offered the chance to begin creating and, in time, to develop a personal style in "more artistic" directions. **SERT** (active since 2009) highlighted moving to Vienna partly to be close to the Donaukanal after growing up in a "pretty small village" in the countryside. **SNUF**'s (active since 2012) first piece was at the prestigious Donaukanal, the "best art gallery of the city with almost daily changing exhibitions". Each of the four brought their personal, 'inside' perspectives to the discussion of the selected statements that is recorded in the following text. This text is not, however, a verbatim nor sequential account of that discussion. Firstly, although retaining the 'feel' of the discussion has been prioritised, the text has been edited for readability, and some superfluous content removed. Secondly, as is often the way with the most exploratory of dialogues, the main topic of conversation shifted quickly and regularly. Thus, although the six statements were originally detailed by Merrill (in his capacity as moderator) following a preamble at the start of the discussion round, in this text these statements (and their more detailed elaborations) have been chronologically redeployed to structure the text in a manner that might better serve the reader. The reordering of the transcription in this way means that in some places the text does not always flow consecutively in the way it did during the discussion. These places are indicated by […] and they do not only represent hops forward, but also hops backward in time.

Finally, it is essential to know that all authors—of which none was a minor—have read this text and confirmed in writing that they were fine with their statements. This agreement notwithstanding, one must understand that these statements were raised in a lively discussion and must also be understood and treated this way.

**2. Discussion Preamble**

**Samuel Merrill:** I want to start by thanking Geert and the INDIGO team for the opportunity to moderate this discussion session, the title of which got me super excited. My excitement stems from a tension that I have felt on and off since I started researching the heritagisation of graffiti and street art as a master student. Namely, that my academic study of street art and graffiti was somehow, contributing to the broader social and cultural re-evaluation of these phenomena in ways that might not always be desired by those creating them.

This tension is usefully further conveyed by two quotes. One from bell hooks, borrowed from black feminist theory, and another from one of New York's founding figures of subcultural graffiti, PHASE 2. This is the first quote:

> "*When we write about the experience of a group to which we don't belong, we should think about the ethics of our actions and considering whether or not our work will be used to reinforce or perpetuate domination.*" (hooks, 1989, 43)

This quote comes from a very specific context that I would argue has much wider salience beyond just the context of what bell hooks was writing about. The second quote from PHASE 2:

> "*This is our community, this is our nation, our contribution to the world, it's our job to preserve it, ensure it and nurture it - not someone else's.*" (cited by Macdonald, 2001, 176)

We might also actually add a third quote from DRAX (20 years later), cited by Theo Kindynis whose work on graffiti archaeology is conducted from the perspective of an academic with experience of the writing scene. This is the quote that he cites in a recent paper entitled Graffiti Archaeology (in which he refers to a lot of earlier tags discovered in certain corners of the London Underground):

> *"It's only a couple of names… but it's also memories, a story of identity, distant screams for recognition, frozen in time then fleetingly glanced before they are 'finally' consigned to history. Shit like this isn't everyone's cup of tea, but for those of us that give a fuck this is our archeology. This is OUR fucking history."* (cited in Kindynis, 2019, 25)

The aim of today's discussion is to explore some of this and other associated tensions in relation to INDIGO's focus on documentation, archiving and dissemination. To guide and spark this discussion, Geert and I came up with a series of potentially provocative statements that should match the somehow polarising title of the whole discussion session. These statements were chosen with the hope of bringing into focus points of disagreement, but hopefully also points of agreement and consensus between those that create graffiti and those that study it.

[…]

**Academia CHANGES Graffiti**

*Academic research, including documentation and archiving initiatives, changes graffiti. We can recognise that the 'academisation' of graffiti can lend it new values and widen the populations that value it. Does the long-term preservation (in situ or via digital records) undermine the ephemerality that traditionally underpinned the creation of graffiti? We might also consider whether the new audiences, that graffiti's academisation creates, are wanted by those who create graffiti. In other words, are these new audiences in line with the audiences that the creators are seeking? Many of their creations, although placed in public spaces use—as Alex Hale remarked in yesterday's key note—"languages which were not written for us"* (see Hale in this volume). *In turn, does academically orientated digital documentation and archiving influence the sorts of graffiti that are created, where they are created and how they are created? So, do graffiti documentation projects like INDIGO enhance, smooth, or alter certain characteristics of graffiti? What might be the consequences of graffiti's academic translation?*

[…]

**Samuel Merrill:** how do you feel about people studying your artwork from an academic perspective?

**MANUEL SKIRL:** Weird, weird.

*< Laughter >*

**MANUEL SKIRL:** No, I mean, you [academics] take this very, very seriously and also it's really somewhat charming and I blush a little bit. I think that, whatever we do, feeling it meaningful or not meaningful, could create some meaning, but on the other end, it's just logic or the way things go that when you do something that can be considered culture or part of a culture it's getting saved or preserved for the next generations. That somebody who is educated and feels art or images or language and image language must be preserved for the next generation. So, we understand history as it's going on. It just makes sense, you know, but on the other hand, and I can speak for myself, but also for many other people that I know, that it's not so much meaning in there other than just this colourful bird, for example.

**JANER ONE:** A lot of times. Yeah. Like 99% of the time.

**MANUEL SKIRL:** Some people put meaning or some message or something they want to transport for the audience or viewers. But the graffiti we know, and we are talking about is very strongly connected to hip hop in the first place and to this like way of doing it, that started in the United States and was very connected to gang culture and the visualisation of crime activity in certain areas. Then it was transported over to Europe and completely messed up actually from this context, the way to just ego and group identity and showing their activity.

**JANER ONE:** And also, what about this sentence: Academia changes graffiti? It depends on what do you mean by change? What about graffiti are you changing in your opinion?

**Geert Verhoeven:** Can I give you an example?

**MANUEL SKIRL:** Yeah.

**Geert Verhoeven:** If you know that we are going to photograph whatever appears at Donaukanal, are you going to paint more or other stuff when you know this or not?

**MANUEL SKIRL:** If you know it, yes. But you know, it's me and him that you're asking, and we are talking about a big group of people where a lot of them, I can be sure about that don't really care what you're doing. So, if they don't see it and if they don't consume it, or if they don't see there is a big audience consuming that, and they feel subconsciously or consciously their potential in this field as well, it won't change what they do and how they do it.

**JANER ONE:** Yeah. They do it anyways. They are tied to society. They will do it. They do it as a sort of a protest against society.

**Geert Verhoeven:** But it's not like, for instance, in one year, our database comes online. And then you can look for your own works. Would you, now knowing this, feel the urge to paint more so you would have more of your stuff appearing, or not?

**JANER ONE:** Well, maybe for the very last layer, because it's on top of everything, then you would see it forever. If it's the last layer, then you would see it very long. It is the first thing everyone would see and it's preserved there. If I know it's the very last picture taken, then that would make me do something really big, maybe, but other than that...

**MANUEL SKIRL:** Have you seen the picture already?

**JANER ONE:** I've only seen visualisations of models and stories and so on. What it maybe will look like.

**MANUEL SKIRL:** I feel like I'm not well prepared against you here.

**JANER ONE:** Don't worry. Sorry, what I wanted to say: this statement "academia changes graffiti" for me, it's about the way I understood this sentence first was like graffiti writers give the paintings different value than academia has. That makes sense to me. If you are looking through an academic lens, then you have a different set of values, right?

**SNUF:** I'd like to add something to that. I've just been here a couple of minutes, but I already can say, I'm pretty sure that you take more time looking at the graffiti than it took the guy painting.

*< Laughter >*

**Samuel Merrill:** we've been here two and a half days, so yeah, you're probably right.

*< Laughter >*

**SNUF:** So that might be like, okay, you kind of decide already. You interpret the kind of meaning that the guy painting might not even have intentionally put there. That doesn't necessarily have to be something bad, but…

**JANER ONE:** Yeah, in that sense, it changes graffiti.

[…]

**SERT:** I would like to say that a lot of academics are doing graffiti. I painted the floors with nurses. It's not like there are academics and on the other side, there is graffiti. It's people that are doing graffiti. People are free, but it's pretty much mixed up. It's not a strict line, I would say. There are also a lot of people studying art or studying graphic design who are doing graffiti. They know what they're doing in their job and they bring that to the graffiti sometimes. But also, the people I know who started graphic design paint classic graffiti, and they just paint the name, and there's no meaning mostly.

**Liljana Radošević**: What I wanted to say from where I stand as an art historian, as that person that goes around and gives meaning to everything that is meaningless. What I noticed for the past 20 years is that it's very hard to have just one point of view and analyse everything from that [point of view]. For me it made more sense to analyse it from two different perspectives. The first one is the culture. So, graffiti culture in general, or graffiti culture in a particular city. Because culture as such has changed, and the graffiti creators notice that. Nowadays, we have lots of graffiti writers or street artists finishing either high school, artistic high schools or universities. And that, even though they might be doing traditional graffiti and doing only letters, still changes their perception. And this changes the culture. In the nineties or late eighties, you still had graffiti writers who probably had maybe just a primary school education and were from different social status. And throughout the 1990s, it changed. So, culture itself is changing, but still, there are rules. So, if you look at it from this cultural point of view, you can say, yes, it should be ephemeral. Yes, it should be done without permission. Yes, we shouldn't be really intervening that much because we are not really part of the culture, but when you look at it from the personal point of view, from different artist's point of view, you realise that they're human beings who are developing, who are growing. They're finishing university. They're getting jobs, they're getting their families. These are all normal human processes through which they're changing their ideas of what they're doing, and their values. They're growing and growing in every possible way. So, when you look at it from that perspective, yes sometimes they want their art pieces to be preserved, and yes, they might want to make it a job. And yes, they might want to mix it up a little bit with street art, and then you don't really know if he or she's a graffiti writer or street artist. And then, when you compare it, it seems that the personal values are not really fitting the cultural values of graffiti. And then on top of it, you have us academics who are trying to squeeze all of these things into particular drawers making them more understandable. So, hopefully this made sense, but there are two different perspectives to this: the individual point of view, as a human being and the culture point of view as a graffiti culture.

**MANUEL SKIRL:** Can I add something there? I really don't think that that's something that makes graffiti or street art special because I'm also pretty sure that most of the people who created art or valuable historical objects or whatnot we see today in museums, not all of them knew what kind of impact they will have or what kind of value they were creating. I don't want to compare us to people who did hieroglyphs or so but if you see the parallels there, I think most of them just wanted to make their king or their pharaoh happy, but just didn't get any bread at the end of the day. And that value we have today for it is something completely else. And it's so enormous, right, and I think it's pretty much the

same today. And also, with the fact that graffiti might have been something for lower layers of society, young people, kids from really bad neighbourhoods and stuff like that. And today, it became something for the broad field. That's something that is maybe true if you see the transportation of graffiti from the United States over to Europe, especially in countries like Austria, we don't really have bad neighbourhoods, and we don't have ghetto behaviour or territorial behaviour and I think that's just what also happened with everything all around hip hop and all around youth cultures, because whoever has resources, money, or, the wish to be authentic is copying from criminals or dodgy people from one generation before. This is always the thing which we find authentic. And everybody wants to have a piece of this cake, I guess. So, I see kids now, running around like people who I would have considered drug dealers 10 years ago. And it's totally normal fashion today. No problem. And the same thing, I think, went with graffiti when we were small kids. I can just talk for myself, I was searching for something which is super cool, breaking some rules, going over some borders and has some artistic parts as well, and I found this is just right for myself.

**Liljana Radošević:** Yeah. I think this part, the last part you said, this is what keeps graffiti culture alive because every new generation wants to do exactly that. Just from their personal point of view, they want to change something. They want to do something.

**MANUEL SKIRL:** Be somebody.

**Liljana Radošević:** Yeah. And this is what keeps it going. This new influx of this fresh, positive energy keeps the graffiti culture going. And then you have the ones that kind of already rolled the wave, and then they want to go into another part of their lives. But, you know, it's still kind of coming in. It's still coming in.

**MANUEL SKIRL:** I think it's this classical thing again, talking for myself and for many, many people in Vienna that I know who are between like 25 and 35. Many of them put a lot of effort, love and time, incredible amounts of effort, love and time into this. And to try to get something out of it when this phase of life ends, when you discover the world and try to check out the boundaries and you just want to see what's left from it. And people find very different, interesting approaches in doing that or not doing that.

**Liljana Radošević:** Yeah. You still have the culture that survives, but then within the culture, you have the individual, as I said.

**MANUEL SKIRL:** You need to eat something as well.

**Liljana Radošević:** Yeah. You still have like two different streams, which you can't really always overlap.

**Samuel Merrill:** You mentioned authenticity there.

**MANUEL SKIRL:** You're still here.

**Samuel Merrill:** Yeah. You mentioned authenticity.

[…]

**Samuel Merrill**: Maybe this links into our second statement. I mean, what about when people get seriously attached to your work. Does that somehow diminish something about the work, your authenticity. Is it artificially preserved?

[…]

### Graffiti MUST be Recorded

*Projects like INDIGO assume that graffiti must or at least should be recorded for the future, partly because of graffiti's traditional ephemerality. They also reflect the new-found possibilities provided by digital technologies and media to carry out such recording at ever-increasing scales. At the same time, these technologies and media reformulate time, creating a kind of ever-expanding now with consequences for the turnover and transience of graffiti. Do the academics involved in such projects consider the possible unintended consequences of the imperative to record graffiti? Who should be responsible for recording graffiti? What do creators think about their work being documented, digitally archived, and preserved? There's obviously some recent evidence, including that presented by Rita Amor Garcia yesterday* (see Amor Garcia in this volume), *which suggests that graffiti creators might be changing their attitude with respect*




**Figure 1**. Graffito from 2009 from the Donaukanal. Photo by Massimiliano Carloni.

*to this. Are archaeologists, heritage practitioners and archivists new belligerents within the so-called 'war on graffiti', or are they potential allies? Do they help creators beat the buff, or are they the buff reformulated?*

[...]

**Samuel Merrill:** There is this assumption about the importance of ephemerality or whether ephemerality within the scene is just a consequence of the nature of reality, right? This is a kind of preservation in a sense. Do you see that as changing how long your works can last? And when you think about your works disappearing very quickly. If they stay long, that's good. If they don't, they go, that's fine. Is it like that? Are you kind of attached to them disappearing? Do you want them to disappear or not?

**JANER ONE:** For me personally, I try to learn as fast as possible to not give a damn about what happens after because the moment you let it get to you, you are an easy target for other people. And if you speak that out to people, they know it, and it's only trouble…

**Samuel Merrill:** It's going to go quickly.

**JANER ONE:** In my opinion, it was always the most clever way to not appear targeted by everything

**MANUEL SKIRL:** Yeah. If you do work in public space, I think you must go along with public opinion and public stuff happening there. So, it's not yours, right? It belongs to the nature of things happening there, and you shouldn't get too attached to it. But I think secretly, we are all a little bit attached to this. Of course, we want to have our stuff be visible or consumable for trespassers or people.

**SERT:** I mean, of course, if you paint something, you want it to last long. But if you paint it on a legal wall, it's part of the game, and will be gone someday. Maybe tomorrow, maybe the day after tomorrow, who knows.

**Samuel Merrill:** What about when people get seriously attached to your work. Does that somehow diminish something about the work, your authenticity?

**JANER ONE:** It depends on your own values. Different folks, different strokes, right? The graffiti community is very diverse. You can find your own group. I always knew what kind of people I'm looking for and never dealt with shady people. And there are definitely shady people, also in the graffiti scene.

**Samuel Merrill:** And these pieces that were shown yesterday on the tour. Potentially the oldest pieces that are still there on the Donaukanal from 2009, up high in certain places. Cause these are places that have been essentially within this environment embedded with value because they're older, right? They're still there from 2009. And the idea is that they're still, maybe because they're partly less accessible because they're higher up and hard to get. But I mean…

**Massimiliano Carloni:** For example, this one…

*< Displays the photo (Figure 1) on his smart phone >.*

**MANUEL SKIRL:** This is an area where you would need a ladder, a really high ladder, like five metres or more. These are, after they are done, harder to access, but also, in this case, it's a very, very respected person. Within the scene, nobody would cover it. Those people who would actually go to Donaukanal with a ladder to create something, they are all in the knowledge of "This is not something you should cover". And the things that are added to it, the "cris" letters, the little things, they are by some younger people without the necessary education to know that you shouldn't go over that and they also climbed the fence. You can see that this person climbed the fence.

**JANER ONE:** It's a very self-regulatory community, you know.

**Samuel Merrill:** What if that kind of respect was kind of artificially imposed on something much more recent somehow? Is everything worthy of preservation?

[…]

### ALL Graffiti are Archive-worthy

*Graffiti has been recorded in many ways by many different actors, from creators themselves to law enforcement agencies and to different extents throughout the past. But society's digitisation is now allowing that documentation to be carried out at increasing scales. Now, many graffiti digitisation projects take a maximalist approach. INDIGO aims to document graffiti, including that originating from so-called 'toys'—less experienced or skilled creators. Now, is this kind of Mr. Brainwash-esque approach sustainable, not least in terms of the environmental consequences of excessive data creation, but also in terms of their labour intensiveness? What can be gained from obsessively recording graffiti as moments of passing time? Does academic value lie in the accumulation of records? What do creators think of this approach? What should the criteria for inclusion in digital graffiti archives be? And in particular, how do creators feel about the documentation of the creations of those who may not have made their name yet. To riff George Orwell: all marks are equal, but are some marks more equal than others?*

**Samuel Merrill:** INDIGO is essentially recording a whole

sway of the channel and everything that's there. And I think there must be opinions, and I should stress, you [the creators] are doing a lot of the talking, which is great, but this is also for opinions from the other side of this so-called polarised debate, right? So, is there a sense that we should be looking to preserve all graffiti? It's clear that, like you really nicely described, there are certain pieces that are very well respected for various different reasons, individuals, or maybe because they are early pieces and those who are maybe unaware of that kind of respect, breaking those rules. You mentioned…

**MANUEL SKIRL:** Yeah. But also those people are important because if they wouldn't destroy the valuable pieces, there would be very good pieces all over the place. Nobody would touch them. And there would be no ongoing stuff anymore. I realised that after being super angry at those people, when you create big pieces and you carry hundreds of litres of paint to this place and you make something after a few days, people would add something to it or even destroy your thing. It really belongs to everybody.

**JANER ONE:** It's also understandable. Lots of work, the logistics. It's really heavy stuff. We have to carry a lot. It's not an easy job to paint *<laughs>*. It's really hard. It's really demanding on your body as well.

**Geert Verhoeven:** One of the problems we have is the following: So now we follow many of you on Instagram, right? Or we go along the channel and certainly Stefan, when he sees something new, we photograph it. He knows mostly everything by heart.

**JANER ONE:** *<quietly>* Yeah, Stefan is crazy.

**Geert Verhoeven:** And one of the things that we are missing right now are the small tags, the Antifa symbols and so on. The idea is really to photograph everything. But at this moment we are missing these small graffiti. So, we are looking for ways to get better at this. But do you see this as valuable to record? A small tag, an Antifa symbol or "Kurz is an idiot"?

**MANUEL SKIRL:** Ten years ago, I would've answered with no, but now with yes, definitely. I also started to appreciate graffiti, which is from non-hip-hop or non-graffiti-scene-people much, much more. Stuff that looks like good fun, or like emotions, people who just write some bullshit.

*< Laughter >*

**JANER ONE:** Yeah, like children painting.

**MANUEL SKIRL:** Stuff that would've been in the last row of the bus. I really appreciate this much more now because I think it just makes sense after a decade of looking at letters and typography and calligraphy. Your brain wants something else and something new.

**Geert Verhoeven:** Because one of the problems we have right now, when we look at all our photographs: it's all these nice pieces, right? But I always thought, okay, in graffiti you can find a lot of socio-political criticism. But this you don't see from your pieces. This you see in the small Antifa symbols and the small tags.

**MANUEL SKIRL:** There are also Antifa pieces, but the whole piece thing is more deeply connected with the hip hop culture and with what I called before, ego declaration or showing how much you and your group can do, where they can do it, how difficult and dangerous these actions are and showing everybody pretty clear that these were the same people by a combination of letters representing your actions.

**JANER ONE:** There are different motivations for people doing stuff like this. It's just a very powerful tool to be seen, or you're just reclaiming the space. You don't have to ask anyone. It's also sort of an ethical question in that regard because who in the first place says you can't do anything anywhere? Who was it? Why would someone take it away from you? So some people are like: "Okay, I'm just going to decide for myself that nobody decided it for me, I'm just going to do it." And for me, every graffiti is archive-worthy. I've always been that way. Because who am I to judge what someone else values? If someone thinks it's archive-worthy, then yes. Another thing: for academics, it's very important to archive everything because then you are maybe in the process of doing it, you find something out and then you

need to go back or need to connect thoughts.

**MANUEL SKIRL:** Maybe it starts mattering after some time. For some reason, you can't see now.

**Martin de la Iglesia:** I think the most important thing is that the criteria for inclusion must be clear. I'm perfectly fine when somebody takes photographs and says: Okay, these are the best pieces on Donaukanal or similar. But then it has to be clear what 'the best' means for this person.

**JANER ONE:** Yeah, what are the definitions?

**Martin de la Iglesia:** It has to be made explicit. So it could be that this person maybe dislikes the colour yellow. So he only takes photos of red pieces and whatever. But if I don't know that, then I get the wrong impression from these photographs. So it's okay to be selective, but then I, as an academic, have to know what the criteria for selection are. And only then I can arrive at conclusions.

**MANUEL SKIRL:** I think you can send 100 people to Donaukanal and have them take pictures of the 100 best things they see and you will get totally different things. There's also so many small things like tiles, little stickers and funny, urban knitting and stuff like that, you can find a lot of different things.

**Martin de la Iglesia:** It would be cool to send 100 people there and then take the things that most people took photos of.

**MANUEL SKIRL:** And that's the most proven art *<ironically>*. Or the biggest and most colourful ones.

**JANER ONE:** Yeah, I think aesthetics do have a science behind.

**MANUEL SKIRL:** That's okay because people have different tastes, so different graffiti I guess, also can add something. Even if you don't like everything or most of the things that are there on Donaukanal, you can still find something that you like if you're searching for it.

**Liljana Radoševi**ć: You mentioned that taking over the public space is one of the most interesting, most activating things for graffiti writers. And I think from what I've learned so far is that we are constantly being persuaded by the city governments that we can't use public spaces. The thing is, if we are paying taxes, we are supposed to be able to use our public space, but you can't really use it without permission for anything anymore. And, for example, in Belgrade, if you want to organise a protest, you actually need permission to organise protest, and then you get police escort for the protest. It kind of beats the purpose of the protest. So, I think the things that are happening, in our public space without permission are actually very important on this social level because they remind us that we should be able to use our public space, whether you like it or not, we should be able to negotiate with each other about certain things. And another point that I wanted to make about all graffiti is archive-worthy. Then we go back to the individual because in cultural studies it's usually said that the results you get are basically the added-up things of the personal background of the researcher. So basically you kind of start from your position in life as I don't know, art historian or archaeologist or sociologist, and then you add an extra Master of Arts and then you did things in your final work which will be an overall product of overall things that you collected throughout the time. So I think, when it comes to archiving graffiti, it's basically that. I love tags, for example, I've always taken photos of the tags and most of the researchers I have met over the years have kind of given up on researching graffiti. They never really love tags and they still don't like it and they never collected it.

**JANER ONE:** That's crazy to me!

**Liljana Radoševi**ć: Yeah. And without tags, you wouldn't have anything else.

**JANER ONE:** Yeah, because if you want to be interested in graffiti, you want to preserve or write something academic about it, you really can't ignore the tagging. Because everything stems from the tag. Even the big, powerful commercial paintings, they started with tagging.

**Liljana Radoševi**ć: No [spray] can control without tags.

**JANER ONE:** And it says all about the skills. If you want to find out if someone is good, you just give him a can and a skinny cap and let him do a tag. It's a very easy way to find out if someone is good.

**Liljana Radoševi**ć: And we go back to the point who is archiving what, and when, and in which way. We go back to the individual. Every graffiti writer and street artist, this individual that develops over the time. Researchers are also developing over time. And it's just not possible to archive everything all the time, unless you are a really big team constantly working 24/7 and at a certain point just some of the things don't get archived. We have to deal with that.

**MANUEL SKIRL:** That's completely impossible. For some stuff you would need to get permission from certain companies to enter their photo library. They don't even archive everything because like where metro or commuter trains or trams will get cleaned, they don't take pictures of everything. And they wouldn't let you have it either. There are abandoned buildings, tunnels, sewer systems where you just don't get to archive. And if the original creator hasn't archived it, then it's nowhere.

**JANER ONE:** If you know what kind of thing you want to look up, then you could install CCTV.

*< Laughter >*

**MANUEL SKIRL:** [Documenting] everything in public space is already ridiculous. It's always just a fraction.

**Liljana Radoševi**ć: Absolutely. You always have to make a choice. For example, recently, I had to make a choice because my phone was dying. I couldn't really photograph everything. So that was like a technical reason for me not archiving everything. I think it's almost impossible. And maybe this is the thing that we really shouldn't strive for, archiving everything.

**Samuel Merrill:** That statement isn't about archiving everything, but it's about acknowledging and accepting that everything might be archive-worthy. But I think there were a couple of points of that discussion, which I might just try and focus on a little bit because I think they actually lead us into this fourth statement. If I might try and artificially force us towards the decontextualisation statement. One was about the acceptance of the development or the flow of careers, both within the graffiti scene or within the academic scene within graffiti circles or academic circles. I recognise, for instance, that in this respect street art is the opposite way round, right? In some way, street art is a gateway drug for academics, right? People start and then over the years you maybe end up and you are starting to understand and read and appreciate.

**JANER ONE:** It's easier to consume.

**MANUEL SKIRL:** There are literal academics because graffiti writers would also be from every different social filter space, especially. And some of them just started as straight graffiti writers. And I think you have a fraction there, which would appreciate any graffiti or letter related thing much more over some, images that are consumable much easier, maybe also just because it's consumable much easier. And that gives you this feeling of being like a little bit more unique if you're after that also the same with music, right?

Decontextualistion MATTERS

*All documentation involves decontextualisation. John Berger (1980) reminds us that we need to be sensitive to the new context of interpretation added to private photographs when they become public. What might this mean in projects like at INDIGO? What does broadening public access do, especially when we might be talking about the older collections of creators themselves, which forms of documentation involve least decontextualisation or what strategies can lessen the impact of decontextualisation? When is decontextualisation the most problematic, perhaps when we find the tags of deceased writers on the interior design of fast-food joints. At the same time, with graffiti and street increasingly viewed online, as much in the street, are things like time-lapse photography, 3D scans, VR, augmented reality solutions as decontextualising as we might think.*

**Samuel Merrill:** That's one of the things that I'd like to push you along because okay, there's individuals, we always got

to break this down on an individual basis and there'll always be individuals who are both academics and writers and they're maybe harder to put into the boxes that we're trying to deal with. But I think it's that kind of cultural capital, that kind of "Oh yeah, I fucking understand tags. I'm really down with it. I understand what's going on here." But what do we feel? How do we feel about the point when everyone gets it? Does that diminish the value of it somehow? And this comes back to authenticity maybe. And maybe that gets to what we're talking about when we're talking about decontextualisation of taking everything out of where it was originally from. In a sense moving it away from its origins. Another thing was how you all individually kind of beautifully captured how all marks are worthy of archiving because they are actually not separate, right? They all work in this big ecosystem. The tag on the piece from 2009 is important because otherwise the whole thing breaks down, everything just gets stopped. And that somehow is maybe also part of the decontextualisation thing because when a lot of the recording or archiving techniques are being used, many of the projects we've been discussing are really about separating out pieces and understanding, you know, kind of watching the history of certain spaces and certain contributions. Earlier there was this question about what, are we talking about with 'decontextualisation'? So I wanna make sure that that's a bit clearer and mostly it relates to is something lost when something is taken away from the Donaukanal. A photograph is placed in a new position, a piece is maybe even physically moved. And that's that thing, but there's a little bit of a bridge somehow between that and the decoding translation practice going on in academia, which is people sitting down and trying to say: "Well, you can understand the beauty of tags", for instance. How does that make anyone in this room feel, these kinds of statements?

**MANUEL SKIRL:** I think it's just normal because we need to judge everything. We need to judge the value of everything and to keep the context with it. For me in graffiti, it matters a lot. I mean, just to make it very simple, along the position or the spot on the street of a piece or some artwork makes a lot of difference and not having this in the documentation, it already loses a lot of its value. For me personally, seeing some graffiti up at some roof or at some position where I can't really understand how it could have been put there. If it has some magic to it. That's only really possible if you see it with your own eyes on the street. And if you can turn around and have all this context. Also people who are doing big murals and artwork, and they relate to the area or they give some connection to the architectural features or just the use of the building itself. Stuff like that. So there's a lot of factors which can change the view, the sense or the value of a tag, graffiti, art-piece, whatever that can get lost when we just have a sheer photo of it.

**Geert Verhoeven:** If you think about our [INDIGO's] end product. What we envision to do at the end of the project is to really allow people to virtually walk along the Donaukanal so that they see in a virtual environment where you placed your tag or whatever. So you think that's valuable? More valuable than just showing them the photograph without context?

**JANER ONE:** I think you can do both. If you have the resources to do both, maybe it would be nice to have both because some people like to consume differently.

**MANUEL SKIRL:**I think no one knows what's normal in the future.

**JANER ONE:** On Instagram, you only see [Graffiti] without context, oftentimes.

**MANUEL SKIRL:** Maybe in two years, if you don't have 3D holographic stuff, nobody's going to watch it.

*< Laughter >*

**JANER ONE:** Maybe VR is mandatory. Yeah. Maybe.

**Geert Verhoeven:** When you don't take photographs of your stuff for Instagram, then you lose that context. Right?

**JANER ONE:** It depends. It depends on how good of a photographer you are as well. Because if you are a good photographer, you are mindful of the context and some pieces only are the way they look because of the wall. Oftentimes the spot determines how the piece flows.

**MANUEL SKIRL:** If you have a beautiful scenery. I can only, again talk for myself, but I'm sure that the other guys are doing that as well. You go to some abandoned building and you see some really nice rusty spots where you can already imagine what you are doing and even holding my phone there to see how big I'm going to paint. To have the perfect end result. And because the end result isn't paint on the wall, right? It's the photo on my phone. Because that's everything that's left for me.

**JANER ONE:** I think you can all agree that size matters. So when you put something there that is relatable, that you know how big it is in real life, like a person walking by your piece. This gives some context and it puts everything in perspective. And for example, for a rooftop, it wouldn't make sense to just take a picture of the rooftop. At first [one would photograph] maybe where you can see the height, get some sense. The second picture already shows it from farther, where you can take in the whole…

**MANUEL SKIRL:** Scenic shots. Yeah. They became much more important. Also since the resolution of photos got higher. If you see graffiti documentation from the nineties, you would only have the sheer piece.

**JANER ONE:** Yeah maybe even cut out with scissors.

**MANUEL SKIRL:** You were already happy when they had a decent resolution. And also how bright you can make pictures. The more it went back, the more scenic shots of graffiti with all the area and all the surroundings became fashion.

**Liljana Radošević:** I was taking photos during 1990s and my main reason for taking only one photo of the piece and just like trying to fit it all in without needing to take another shot was because it was expensive, and I didn't have money. When I was like nineteen I didn't have money to actually buy 10 films and develop the films and develop the photos and then document them in different ways. I knew I had only one shot and that was it.

**MANUEL SKIRL:** Now of course we take 100 pictures of something and then we sit at home alone on the couch and delete 99 of them.

**JANER ONE:** Yeah. That's like taking the perfect selfie *<laughs>*.

**MANUEL SKIRL:** I really appreciate having that.

**Samuel Merrill:** It's very interesting about the framing of your shots. I'm just wondering how often the square is becoming more and more the kind of canvas.

**JANER ONE:** Yeah. That's a big thing about social media and one of the biggest downsides.

**Chiara Ricci:** I agree about the risk of decontextualised graffiti, if you just take a picture, but I think that finally it is a risk you have, whenever you want to preserve something. I'm working in a conservation centre. So, if I preserve something from the past, it is not in that time and it's not in that site. Something you can do at your best is to provide tools to people, to understand it, to contextualise. We have an Egyptian museum in Torino, of course we are not Egypt. If I want to explain to a kid what a mummy is, I must give him or her some tools. And I think in a way it can be the same also with digital archives and graffiti. Of course, we have to take a little part of the reality that it's so complex and fascinating and provide as many tools as we can to contextualise. So I think it's a risk, but it's always a risk whenever you want to preserve something that is just a little part of the reality of the world. So if you think about our museums and connections, they are vulnerable**.** I think all of us can agree with that. And we are doing the same. We are just taking a little part. And what makes a good exhibition, a good collection in a museum or a bad one is how many tools you provide, maybe to the visitor to understand, and to interpret something like that.

**MANUEL SKIRL:** I think it's good when you have done a little fraction of it, that gives a good image of the variety from what it's representing.

**Chiara Ricci:** Now if I think of the past and the object from the past, they're just a fraction of their reality. And they came to us because someone made a choice. So whenever

you say all graffiti is archive-worthy. Yes, but someone will decide what to archive and what to not archive. It's the same what happened in the past.

**JANER ONE:** Yeah, the publisher always has the last word, right?

**MANUEL SKIRL:** It's always the person who is financing that thing who has the last word.

**Chiara Ricci:** But I don't think it's a bad thing in a total sense. I mean, it's over, history goes on and what we bring from the past to the future, it's part of our identity. So, in a way, I think it's a good point.

**JANER ONE:** Yeah. But decontextualisation definitely matters.

**Chiara Ricci:** It's a big, big risk, yeah. And I agree if you see something you don't know, also with paintings, you see Mona Lisa and you expect something super big. And then it's... I was super deceived when I saw Mona Lisa.

*< Laughter >*

**Jona Schlegel:** Are you considering actually changing the medium, with what you're recording, like going to do a video rather than photograph your work.

**JANER ONE:** Yeah, definitely, that's worth it. But it's way harder to take a very good video. So to make it look appealing, you are your biggest critic. With videos, it's easy to make a still and all the cameras still with a very interesting frame it's way easier. But, yeah, videos add more depth. They have more layers. There's more multisensory stimulation going on. Videos definitely help.

**MANUEL SKIRL:** Yeah, that's really nicely said JANER ONE but I still have to crush it. I think personally it makes sense to document or capture something in video when it moves. If it doesn't it is probably more the still image for me. If you're talking about moving objects, like trains or something, then yeah, definitely. If you're talking about process videos of somebody painting something. Definitely. But if it's a still object, I would prefer a photo.

**JANER ONE:** Yeah, that makes sense.

**SNUF:** For most graffiti there's also this one point where you're supposed to look at it. Most of the time it's straight up from the centre and front. But it doesn't make sense to look at it from straight down up from the wall where you don't see 95% of the piece.

**JANER ONE:** Yeah. Well, it's super flashy, but yeah, it's actually a still piece. It looks wacky, so yeah. Sometimes.

**MANUEL SKIRL:** Yeah.

**JANER ONE:** You're trying to make it amazing and it's bullshit though.

**Geert Verhoeven:** I wanted to pick up on what MANUEL SKIRL said because it really struck me that you said for you then the final photograph is the goal, right? So, but the coming home of smartphones and cameras, digital cameras, did you change the canvas? I mean, whole Donaukanal is your canvas where you paint, so to say, did you change your locations for your paint because of the way you can take photographs of it.

**MANUEL SKIRL:** Yes, definitely all the way. So, first I want to mention that I don't paint on Donaukanal anymore because I have techniques developed, which are not able to put on very rough walls. And I also need some time and I don't like the locations there anymore. I really like when my art, my piece, whatever, is in an environment where there is nothing else that can be connected to it. So no other tag, no other graffiti in the very best case. Not even a colour I don't like. So I'm really into the scenic photo and results. I've been doing this for 15 years now, being really just into the photo as an end result and that makes it maybe also much easier to let go from the actual piece in the real world because when you go to other countries or places that are hardly accessible, never going to see them anymore by yourself. And it's also, I think, very good to let go on it and just leave it for whoever looks at it and have your photos for yourself.

**JANER ONE:** I have also done some actions, purposefully where I knew I wouldn't take a camera with me just to have the moment for me, so also very humbly in a way.

**Geert Verhoeven:** So, is it correct that you say that you're doing it less out of an antisocial initiative, but more to make something arty, which you can photograph?

**MANUEL SKIRL:** This depends. I like both and it gives me more freedom to do something very ugly, very emotional. We would just emotionally mess something up or just have some fun. And then on the other side to give your very best into something very artistic and valuable for many people. The one thing gives me good vibes for the other thing. So, both are very important for me.

**Francisca Fernández Merino [Online]:** Would video also be a good option when the research is about graffiti audiences, to better represent the real-life experience?

**Samuel Merrill:** I think this is also a little bit what I was imagining in some cases as an audience of graffiti. You don't approach it from that perspective of the perfect shot. It's very rare, especially at Donaukanal, that you would pop out of the channel or walk along the edge and get the perfect shot. The question which we are getting at is if there is some value in videoing both from a research perspective or maybe to capture the moment of encounter as it will actually be in the real world for many of your artworks, right? Any thoughts on this?

**Liljana Radošević:** For me, that's like a photogrammetry system. You take as many photos as you can, meaning that each person takes it like a graffiti writer. Or a person who is archiving it, a person who is just walking by the channel and takes a shot and puts it on Instagram. The more photos you have, the more options you have to get, like the full image, the full impression of this particular piece.

**Samuel Merrill:** Okay. I agree with that, but I'm now thinking back to our tour yesterday and I want to push a bit on that because this was a tour designed for people interested in graffiti and street art from an academic or research perspective. And, of course, we moved through that space pretty consistently and people were adopting positions where they could see the whole piece for sure. But there was never this moment when I thought someone was backing so close to the edge of the channel, just to get the view.

**MANUEL SKIRL:** Yeah. Trust me. I did.

**Samuel Merrill:** That's what I'm interested in!

**MANUEL SKIRL:** With another person holding you to get the photo. And then you had this wide-angle lens on the new phone and you thought: all this water in my jeans**.**

**Samuel Merrill:** That's fascinating to me because that's a perspective of the image, the perfect image to be a personal keepsake or to go on social media. This might be almost impossible for the people who are visiting the Donaukanal, or at least they might not take the opportunity to hold onto my arm. I want to see this as the creator's story, but this is just a reflection.

**MANUEL SKIRL:** For some people it doesn't matter at all. Some people wouldn't take pictures, for some people it's really important. It's as different as the graffiti.

**JANER ONE:** Yeah, it's still subjective.

**Samuel Merrill:** We can't generalise about this stuff. Every single discussion point that we've had today was "Well, sometimes this, sometimes that". It's completely the same with everything in life. Isn't it?

**MANUEL SKIRL:** Balance.

Graffiti Need CATEGORISATION

*As yesterday's keynote reminded us, graffiti are 'unruly subjects' (see Hale in this volume). Humans like to sort things out. As such, maybe graffiti automatically invites this kind of categorisation, but does it need it? Should we be seeking to tame something like graffiti by categorising it. The graffiti and street art scenes make sense to those who directly engage with them and are made sense of by an array of sometimes competing terms. But with graffiti and street art's recontextualisation within the academic world, not least by archiving and documentation projects,*

*there's a need to translate these terms for wider consumption. Indeed. There have been several efforts about developing graffiti thesauri in different settings in order to characterise different types and elements of graffiti. But as Bowker and Star (1999) stress: all classification, processes and systems are deeply political. They reflect unequal power relations, and they can thus produce both advantage, but also suffering. What are the politics of metadata management with respect to graffiti? Is it even possible to categorise and structure something like graffiti, which has grown so organically without, or within formal stylistic restrictions. Can graffiti terms, styles and creators be put in boxes that neatly define them? How do creators feel about having their work and themselves being put in boxes?*

**Samuel Merrill:** If we can't generalise, can we categorise? Can we say, this is this, and this is that?

**JANER ONE:** You definitely can, but you have to be aware of the implications.

**MANUEL SKIRL:** I'm really sure that we need to judge or to be able to judge everything. That's why categorising is super important. And we all know there are these factors of good and bad graffiti, which are actually super idiotic but our brain rolls like this. If it has more colours, if it has more arrows, if its spot is more dangerous or harder to reach, or if you have been the first person to get this idea, if you did something special, if the quality and the readability of your letters is decent. These are all factors that give it a specific value. These days, of course, also social media: How much likes? How much followers? blah, blah, blah. All this together creates the value of your work. And why is that? Because people want to value everything. They want to know. Are you a good dancer? Are you a bad cowboy? Are you a good graffiti writer? And which position do you take in this scene? So they can value it because people are not self-confident and not believing enough in their own senses and in their own judgement. They need others to help them with it.

**JANER ONE:** We need to compare the whole time.

**MANUEL SKIRL:** Yes, it's very essential.

**JANER ONE:** But again in my opinion, you have to be aware of the implications. Be aware of what you leave out if you categorise something.

**Samuel Merrill:** That's coming through, the point, that actually nothing can be left out in a way. Because it's through those comparisons that we categorise. It's that classic kind of relation of "this is good because that is bad".

**MANUEL SKIRL:** No, this is good because it plays after the rules that it wins. So that's also what I needed to learn or what I wanted to learn when I started graffiti: How to be a cool graffiti writer. So you got to do it like this and you got to do it like that. And then you got to look who are the coolest guys and do what they did. Copy this proven concept and try to push it to the next level. Until I got bored of it and started to think about what I actually wanted to do. But most, I would say nearly all, of the people who are doing something artistic, are thinking with this concept.

**SERT:** The whole categorisation started in the early eighties or late seventies in New York. You do a tag, you do a throw-up, you do a piece and it's still like this today. I also worked many years in these categories. I make a tag with a marker or a can in two seconds, I make a throw-up in two minutes and do a piece in six hours. You work in all these categories, especially when it comes to styles. You can categorise, for example, "bubble style", "wild style". The scene-people get pretty bored of all the traditional styles. Like you mentioned, the shape has to be like this and every form of the letter must have the same thickness. But now there's a movement called anti-style and they don't paint like this. Their style looks anaesthetic, just to break the boundaries and to do something new. At first, I also didn't like it pretty much but over the years I think it also has its value. And even if I don't like the style personally, I don't think it looks that good, but who am I to judge if it has a value? It has the same value as mine, at least.

**JANER ONE:** It also doesn't say anything about if you are professional or not. You could have figured out the whole subway system and know every security checkpoint and still paint shit. That's the fun thing about it.

**MANUEL SKIRL:** I would still respect you.

*< Laughter >*

**JANER ONE:** Yeah, exactly. That's the thing. I have met writers who are so clever and really well prepared and still paint shit. And that's funny.

**MANUEL SKIRL:** I think also with this anti-style it's very normal. A new generation, taking something to the next level, which does not necessarily have to be better but just something else that brings new factors which are highly valued. And then it's getting in a direction we don't understand.

**JANER ONE:** What I have to admit is that anti-style is way better suited for sarcastic messages because the piece itself already is sarcastic. It's way better at letting the inner child out, in my opinion, because by following these very serious graffiti rules you're putting yourself into a drawer. You want to keep the same width, there are rules, aesthetic rules that work. They've proven to work. But this anti-style approach is giving you more freedom and it is way better for letting the inner child out. Letting the paint out and trying it.

**MANUEL SKIRL:** Yeah. I also like it a lot. I had some difficulties to get attached to what the newest generation in Vienna does, but now I see it really differently. And I see that these kids have a lot of fun.

**JANER ONE:** Yeah.

**MANUEL SKIRL:** I think it's very valuable when it makes you laugh. It doesn't matter why. It just brings you some good emotions. Also, I think popular music and popular art is always connected to how the most people feel and what the most people like. So, for example, popular rap from when I was twenty or so was super different from popular rap today. And I think that's not because these were the best rappers, but because the most people felt this way. Most people identified with that music. And if you look at the economy, when I was young, it was uprising and everything was possible. Reaching for the stars. And we also do our art like this. We really try to find something that we want to do and put it to the next level and be somebody with it. What I observe today with the new generation of graffiti writers is that they grow up really differently with less prosperity and also the art, the music, the tattooing and all the cultural streams next to each other represent this for me.

**JANER ONE:** The tattooing is a big factor actually.

**MANUEL SKIRL:** If you don't feel confident you don't feel it because you're not with this stream. And then you get old.

*< Laughter >*

**JANER ONE:** Yeah definitely. You get a vibe also from the tattooing. I think it was way more unlikely to see someone with a face tattoo. Some graffiti writers were really reckless, they also at some point grabbed a tattoo machine from Amazon, the most bullshit thing you could ever buy. But they started doing it on themselves and on their friends and they're having fun with it. And that's also a vibe. I would never do this myself, but I can appreciate people who do it.

**Samuel Merrill:** I think your reflection on the generational difference is quite interesting. I wasn't aware that the move to marking oneself within the scene is generational.

**JANER ONE:** Yeah. It's definitely something a lot of people who were graffiti writers turned into. A lot of them got into doing this, because it's also lettering, also always words in between and it's very familiar.

**MANUEL SKIRL:** Yeah. Hands down, it is just a really good way to make a living. There are much, much more people who would pay you for a tattoo than for a graffiti in their apartment or something like that.

[…]

**Jona Schlegel:** You were also talking about doing a tag, a throw-up, a piece and so on. If you put your piece on social media and write something like "this is a piece with this and that style". Would someone else say exactly the same? I'm so new to this culture and I think I'm not having the eye for it yet.

**MANUEL SKIRL:** So, there are different categories of graffiti. There's wild style, ignorant style or anti-style. Also, every single one of these have different names in different countries. So, what we call anti-style in Paris they say style enfant, or kids' style and it's super complicated. And then, there is also the question: what is this for you? And if this is a mixed creation out of those things. But again, we need somehow these words and these terms to describe something, to categorise it, but that does not necessarily mean that everything is something or is can, without doubt, be put into some of these categories. All graffiti artists, street artist or whatever are taking parts of every of those categories and areas and put together what they want from it.

**JANER ONE:** I think when you're start as an artist it's very important to understand different disciplines and categories. But as an artist, it can only hinder you to categorise stuff. So, it's definitely a different approach whether you're an artist or an academic. As an artist yourself, you don't want to exclude people from your work. Saying this is only for people who appreciate this is not helpful.

**Jona Schlegel:** So, this would not throw you off?

**JANER ONE:** No, there are books of graffiti writers who are very famous, and they also categorise because it definitely helps.

**MANUEL SKIRL:** Describing something to somebody who can't see it, right?

**JANER ONE:** Do it. Definitely do it.

**MANUEL SKIRL:** When I talk about artists with him [JANER ONE] and we are not having our phones right at hand we are describing with the terms we just called stupid. We said they boundary you, they take away your freedom of how to put something, but we still use them. We still know what we mean because it makes it easier to understand what you're talking about. Especially when you try to make something visual into words. Or if you talk about something super abstract and try to give the other person the image of what you're talking about. For that we need these words.

**JANER ONE:** Yeah. Language is really important to exchange information, but it has its limits. Art is not about words. Art is about experiencing.

**MANUEL SKIRL:** I stopped categorising my own stuff to put myself out of the danger of people telling me this is not that and this is not that.

**JANER ONE:** Exactly.

*< Laughter >*

**MANUEL SKIRL:** You get confronted with a lot of people, especially if you work in a public space, you get public opinion and people will tell me "This is not art. My seven year old daughter could do this" And I'm always like "Yeah, I never claimed anything else." I don't say this is art. I don't say this is street art. I don't say this is good. So I don't use any of those things for my own stuff. But for others, of course, I use it to make the person I'm communicating with understand what I'm talking about.

[...]

**Samuel Merrill:** Maybe subconsciously I was looking at my watch, but I don't know, but we are close to, if not past, the designated time and I'm also conscious of overdoing it. This sixth statement, I think we actually smashed that at various different points in the conversation. So I'm not going to force it…

### Digital Media Are ESSENTIAL

*Over recent decades, digital media, and in particular social media have reformulated the graffiti and street art scene. Corporate social media platforms, perhaps most notably Instagram, have provided creators with opportunities to simultaneously document, but also distribute their work globally. In this way, graffiti fame has become increasingly disassociated from physical works. The imperative for creators to continuously 'get up', maybe have been reduced even as the dynamics of these platforms and their reliance on economies of attention may have also driven the increased turnover of graffiti and street art. So what might be the implications of these technologies and me-*

*dia for creators' efforts in this respect, but also in terms of their efforts to remain anonymous. Are the graffiti-related benefits of social media only incidental to the profit-orientated priorities of these corporate platforms? And how does this undermine the anti-corporate traditions of graffiti cultures while reflecting also the privatisation of an increasingly precarious physical, but also digital public realm. How is graffiti-related data used and monetised by corporate social media platforms? What works are promoted by platform algorithms and how does this influence decisions related to insitu or by-record preservation, but also arguably the kind of works that are created in the first place. And what vulnerabilities might we think of more generally in terms of these technologies, in terms of things going obsolete—software, metadata schemes, ontologies, etc. At the same time, what potentials might digital technology and media offer those academic initiatives that partner with creators? What of digital crowdsourcing or crowd tagging strategies. Would the graffiti creators here be willing for instance, to tag their works on social media for INDIGO using specific hashtags? What might be the potential of linked open data initiatives and initiatives like Wikidata projects? Could creators imagine a future where they are comfortable becoming Wikidata?*

**Jona Schlegel:** I just wanna ask something on that digital part. So, if you would have the opportunity to have a 3D environment and your piece in this environment, would you then pick the perfect spots where an audience should see your piece? Would that be interesting for you?

**MANUEL SKIRL:** That's actually something that just occurred because there's a new function on the newest phones, which have some laser sensors. So you would be able to scan the whole thing. Some very good artists from Vienna use this technique to create posts on Instagram where it's possible to move around. And he would literally scan for hours, not just this piece, but also the wall right next to it, the floor with all the rotten leaves. He literally made a little digital diorama. This really popped out for me. I was really amazed how he did that and everybody's thinking about like really highly technical equipment. And whoever is ignoring that is going to lose some audience if they care or not, doesn't matter, but that that's going to happen for sure.

**Geert Verhoeven:** This was Jakob, right.

**MANUEL SKIRL:** Yes, exactly.

**SERT:** I go back to the question. I think all of us replaced a piece on Donaukanal. Of course we would choose the best spot, where the most people see it.

**JANER ONE:** Yeah. The spot also tells a lot about how the person thinks. When you walk upstairs and you do a tag. The first thing people see is the tag. If you do something there, no one can escape. You know what I mean? You can't turn left or right on the stairs. So you will see the piece. It says a lot about the person, which spots they paint.

**MANUEL SKIRL:** And also some people would tag on spots where nobody would do it because just the fact that nobody would do it makes them special.

**JANER:** Yeah.

**MANUEL SKIRL:** So you see everybody's doing the same. You try to make something different. And then there is stuff that actually doesn't make sense, but just makes sense because it doesn't make sense.

*< Laughter >*

**SERT:** Or, for example, on the opposite of flex another wall, just above the water. There's a spot where almost no one wants to paint. That's why I want to paint it. Because I know when I paint there it lasts longer.

**MANUEL SKIRL:** That's nature balancing itself out somehow.

**JANER:** And I also think that digital media is broad. When we think about digital media most think about social media, but there's a lot more depth to it. Some people, for example, tried a lot with VR. I think the possibilities here are endless. And yeah, I also agree with MANUEL SKIRL, whoever doesn't jump on that train will be lost in the future to some degree.

**MANUEL SKIRL:** Not lost!

*< Laughter >*

**JANER:** No, not lost, but you lose impact. It's definitely a new avenue that shouldn't be dismissed out of petty reasons.

**Samuel Merrill:** Now I'm starting to think we've got two more comments and then maybe we wrap-up after that and we take any other conversation…I think there'll be some beers somewhere, hopefully.

**Geert Verhoeven:** I want to ask if you see this as a kind of contradiction. So on the one hand you want to be famous on social media, have the likes and very impactful posts, but on the other hand, I suppose most of you guys still don't want to be known in general by your full name. So you want to be anonymously famous more or less.

**MANUEL SKIRL:** Yeah. You want to have the good part of being famous, but not the responsibility.

*< Laughter >*

**JANER:** Yeah. That's perfectly said. That's what's so awesome about Banksy.

**Samuel Merrill:** That's true for academics as well.

*< Laughter >*

**MANUEL SKIRL:** We all just want the same thing.

**Geert Verhoeven:** I would like to add another question, if I may. We use social media, like Facebook, Instagram of Meta, one of the biggest companies now in the world, not known for taking privacy very seriously. Do you consider this when you are uploading there?

**MANUEL SKIRL:** You should yeah.

**JANER:** Definitely, yeah. But we still do it, right? It's the same with a selfie, but it's way more troublesome than it is in all honesty. But yeah, since the NSA scandal and Edward Snowden and so on, everybody's aware of it, but at the same time, it's also a very integral part of our society. It's weird, but you get weird looks when you say you don't have social media.

**MANUEL SKIRL:** And also we often justify it for ourselves with "Who am I? I'm not so interesting for whoever", right? But together we are interesting because you can get metadata out of that. This already happens big time, right?

**SERT:** I want people to know my graffiti not to know my name or my face or whatever. It's about graffiti. Also my Instagram count is just like graffiti, no face, no name, whatever. Because it's not about that.

**JANER:** It's also definitely a cultural aspect. In the scene you get a lot of authenticity by staying away with your face…

**MANUEL SKIRL:** Staying anonymous.

**JANER:** Yeah, staying anonymous. It's definitely a factor. Trying to be mysterious when you are younger helps in that scene.

[…]

**MANUEL SKIRL:** I think I'm drifting away from the actual question all the time.

*< Laughter >*

**Samuel Merrill:** Well, you've been drifting constantly towards new questions, which is probably why we could stay for a very long time and hear a lot more fascinating insights on these things that we are outside in many respects. But to wrap this up, I find this, an extremely positive experience to actually get in the same room and talk about these things. And I think it's very, very easy and it happens very, very often that this kind of space and dialogue isn't sufficient in research projects. It is there to some degree, but it isn't expanded and doesn't continue. So, I thank you all for this conversation. It was very fun to moderate it. I think we can all mutually congratulate ourselves with a beer and a short round of applause if we want.

*< Applause >*

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# 'Imagine Being a Racist': goINDIGO 2022's «Ethics & Legality in Graffiti (Research)»

Discussion Round

Benjamin Wild, Geert J. Verhoeven, Norbert Pfeifer, Enrico Bonadio, DEADBEAT HERO, FUNKY, JANER ONE, MANUEL SKIRL, Massimiliano Carloni, Chiara Ricci, Christine Koblitz, Sven Niemann, Ljiljana Radošević, Jona Schlegel, Alexander Watzinger, Stefan Wogrin

**Introduction**

During the second discussion round of goINDIGO 2022, which took place on Friday, 13 May and was called *Ethics & legality in graffiti (research)*, three out of many invited graffiti creators joined a discussion on (potentially provocative) statements with symposium participants (joining in-person and online). The statements, compiled by Geert Verhoeven in consultation with Benjamin Wild and Norbert Pfeifer, were:

- objectivity OVER morals
- objectivity OVER consequences
- graffiti INCLUDES exploitation
- copyright DOES NOT matter
- Donaukanal graffiti IGNORES the origins

The three attending graffiti creators agreed to participate following their contact and invitation via Instagram. When introducing themselves, each conveyed their relationship to the Donaukanal and their different levels of experience and exposure within Vienna's wider graffiti scene. **DEADBEAT HERO** (active in Vienna since 2014) is a Texan artist mainly focusing on street art while "dabbling in graffiti". He owns an art studio and regularly interviews Viennese graffiti creators in his *Artcade* podcast. **FUNKY** (active intermittently since 2005) is a Bosnian, but Vienna-raised creator practising graffiti "with ups and downs and a lot of breaks like in life". He was close to the Donaukanal a decade ago, but his central activity zone is now more to the north of Vienna. **MANUEL SKIRL** (active since 2006) is a Vienna-based creator currently known for his organic structures formed by black and blue lines. The openness and inclusiveness of the Donaukanal scene offered him the chance to begin creating and, in time, to develop his personal style in "more artistic" directions.

Each of the three brought their own perspectives to the discussion of the selected statements, recorded in the following text. However, this text is not a verbatim or sequential account of that discussion. First, although retaining the 'feel' of the discussion has been prioritised, the text has been slightly edited for readability, and superfluous content got removed. Second, as is often the way with the most exploratory of dialogues, the main topic of conversation shifted quickly and regularly. Although the five statements were individually framed by Norbert Pfeifer (after which Enrico Bonadio took on the moderator role), the first four statements and their more detailed elaborations have been reduced to two sections to structure the text in a manner that might better serve the reader. This reordering of the transcription means that, in some places, the text does not always flow consecutively in the way it did during the discussion. These places are indicated by […], and they do not only mark hops forward but also hops backward in time.

Finally, it is essential to know that all authors—of which none was a minor—have read this text and confirmed in writing that they were okay with their statements. This agreement notwithstanding, one must understand that these statements were raised in a lively discussion and must also be understood and treated this way.

## Discussion Preamble

Already before the start of project INDIGO, it was evident that various legal issues would pop up. Is the project allowed to share photos of graffiti not created by team members? Who owns which kind of copyright when photographing graffiti? Is a 3D model of a graffito still subject to the same copyright rules? To what extent do the graffitists' rights differ when they create on the *Wienerwand* (where one can legally create graffiti) versus the more common permissionless creation of graffiti?

Compared to these questions, the range of anticipated ethical issues was initially not that broad. When asked in the project's proposal to specify ethical aspects, Geert Verhoeven wrote: "INDIGO will certainly record (and provide database access to) homophobic, racist, and sexist graffiti to avoid bias in its records". It became, however, clear during the first project weeks that not everybody unconditionally supported this statement. In addition, ethical questions of another nature arose: Do we exploit graffiti creators if we put their work online? Should INDIGO report inappropriate content, and what is considered problematic or improper? Can we publish pseudonyms without risking legal consequences for those carrying these pseudonyms?

This last question illustrates that many of the project's fundamental concerns have both an ethical and legal aspect. This ethical-legal intertwinement also transpired from a counselling session the INDIGO team had with the Pilot Research Ethics Committee of the Technical University of Vienna (TU Wien). Set up after initial discussions with Marjo Rauhala (the head of the Service Unit of Responsible Research Practises at the TU Wien), this meeting resulted in various constructive suggestions. Although these proposals help INDIGO follow a more responsible and ethically conscious research path, the aim of goINDIGO 2022's second discussion session was to further explore some of these legal-ethical conflicts together with those that create graffiti. Even though Marjo Rauhala could not attend this session for personal reasons, Enrico Bonadio—lawyer and author of many books on graffiti copyright—adequately covered the legal side.

## Objectivity OVER Morals | Consequences

[Please note that because of the overlap in the discussion, statements one and two are combined.]
*Inclusiveness is vital if one wants to document and digitally disseminate graffiti to facilitate its study. However, being a reflection of society, graffiti sometimes contain hateful or provocative messages. If those get inventoried by scholars and made freely accessible afterwards, could this be considered a promotion of subversive content? And if a project comprehensively documents graffiti to avoid bias, should those graffiti records be categorised and made queryable, so one can search for all swastikas or hate graffiti? And does exhaustivity in graffiti inventorying and dissemination not merely lead to a perfect law enforcement tool, which in turn might influence the exact phenomenon it is trying to document and study? In summary: should scholarly graffiti projects consider potential ethical issues, or must scientists only be guided by objectivity regardless of possible negative consequences, moral or other?*

[…]

**Geert Verhoeven:** In a project like INDIGO, or many of the projects presented here at the symposium, when we want to document whatever is going on in the scene, there are always homophobic, subversive graffiti. Is this something you consider problematic yourself? Is it something you think we should also just document in the same way we document a nice piece?

**FUNKY:** I think these homophobic graffiti or graffiti against, for example, people from Balkan, everything that's against humans, shouldn't be respected because I think this is not okay. It's okay to provoke a little bit with these political statements such as "refugees welcome". But not something like this homophobic stuff. I think when someone supports this, okay, I don't care. But I think this is not okay, and this shouldn't be a part of this scene because, in this world, we should not work against homosexuals. This is my opinion.

**Geert Verhoeven:** But the problem we have as scientists is that we want to document what is going on. And if you want to be objective, you don't express any value about this. You

just say yes, that's there. But then the other question is if we should add metadata tags to these graffiti as we do with all the other graffiti. This is "homophobic", this is "racist", whatever. Then people can also start searching for them.

**MANUEL SKIRL:** Yeah, but why not? If somebody wants to give lessons about hate graffiti and wants to search for material, why shouldn't it be good to search for something like this on a platform? I don't think it's good to ignore something and leave it out. Especially if you see it in the long term when people in the future want to know something about the graffiti that was done recently and want to learn something about it, also to be aware of our political situation or different opinions. I don't think we should give it too much of a platform. Unfortunately, it's freedom of speech, also when it's not your political opinion. But if you want to be objective and neutral, it's definitely a part of it. Graffiti has lots of emotions inside, and racism is also an emotion.

**DEADBEAT HERO:** I want to agree with it. I don't think that ignoring it would be right. So put it there like when you document history, don't take out all the bad stuff. You want people to know about what actually happened.

**MANUEL SKIRL:** Will people be able to contribute to the platform?

**Geert Verhoeven:** We are thinking about this. And also, if we could crowdsource, for instance, you could say: "Hey, this was made by this artist". We are just thinking about these things, but we also want to ensure anonymity. And so it's not something we can quickly implement.

**MANUEL SKIRL:** But that's not just with stuff that you don't want or don't want to be promoted, but in general. If you have a platform, a lot of other people will see their work there. They will also try to promote it by themselves. Yesterday, JANER ONE was here, and he said, "I'm more interested in the front page". Like he would upload many more [graffiti photos] if he saw that it was on the front of the page. And I think that's the same with people who are racist or who are into swastikas for whatever reason. They would also upload stuff like that if they can promote it, and then it's also critical to censor stuff.

**Benjamin Wild:** I think there are two different things we were talking about: freedom of speech and freedom of reach. Freedom of speech doesn't imply freedom of reach. Being able to say anything, that's totally fine, of course, but it should not always be possible to make it public to a very big audience, for example, through social media. We've seen it with Trump, for instance. He can say anything he wants, but Twitter is still blocking him. And I think there are good reasons for this.

**MANUEL SKIRL:** I think people are more provoked by you writing your opinion in block letters somewhere than if you just say it out loud, but yeah. I'm not educated in law or even freedom of speech. I don't know what is in there. In the United States, I'm pretty sure that all racist opinions are included in the freedom of speech.

**Enrico Bonadio:** Yeah. Hate speech is protected.

**MANUEL SKIRL:** But we are supposed to be a little more careful here.

**Enrico Bonadio:** Yeah, in America, there are preachers praising terrorists who cannot be touched because they protect freedom of speech very strongly. In Europe, there are more limitations.

**Christine Koblitz:** I still want to add something to the question of what you would add to the database. If you should add political graffiti that does not reflect your opinion or probably even hateful graffiti. We had the same discussion in our museum because in our collections, we had a lot of work from the Nazi times or a lot of material with the N-word in it. Now the question was: how do we deal with this, and how will we put it online? We're trying to provide a lot of information. Of course, we have to label things and discuss whether we show this or not. We also try to contextualise it and give them specific labels, so that you can find it. But if you post these labels on social media, you'll always have to be aware that these keywords will attract a certain crowd. They'll not read your posting, but they'll just add some hateful comments. This is also difficult for

us because, on the one hand, we want to have a discussion and provide information, but on the other hand, it's really annoying to monitor such a dialogue on social media. Sometimes it regulates itself but sometimes not. Also, when do we delete comments? As a private person, I can do that very soon, but as a public institution, probably not, because that's part of the discussion in museums where you should negotiate things. And also the way we see things evolve over time.

**Liljana Radošević:** I wanted to comment on that as well, because I think we all agree that all of the things should be documented because that's the context. And without the context, you can't really understand other things that are happening. Without the context, everything else that is happening is just a pale version of what it really is. I do keep an archive of the things that I really dislike. For example, I become a Hulk when I see skinheads. I can't really explain how liberal, open-minded, and proactive graffiti culture is in Belgrade without knowing that one-third of all graffiti belong to political graffiti and a second-third belongs to hooligans and football club supporters. And then you have the third part, which is graffiti and street art, but they're the most visible because they're the largest. And you know, they make Belgrade look much better. But if you look beyond it, you have all these political issues and all the stuff going on in the streets; there's continuous dialogue happening. And it's mainly between those extreme nationalist people and political parties and between those that are against those things and Antifa. So it's a very lively scene, but a scene that I'm not interested in. But still, I have to do something about it because, without it, I wouldn't be able to say that the things that I'm interested in are actually positive compared to all of the other things that are happening in the streets at the same time. So it's a very complex issue. Usually, I don't really write about them. Still, for me, it's important to acknowledge that they're there to understand them, to follow them, to see what is happening because otherwise, it's very hard to make your point when you try to explain something that is happening in the streets. For example, at the moment, we have one thing that is happening in Belgrade, everybody is trying to use photorealistic imagery to promote something. Nowadays, we have one brilliant and good project. It's part of the Partisan football club supporters. They did an excellent job in trying to change the bad image of the football club supporters. But then the other fraction of football club supporters realised that this photorealistic imagery works well. So now they're using photorealistic imagery for political agitation and use these extreme nationalist figures to do the same thing. At the same time, you have memorial graffiti of the young people who died that are also made in photorealistic imagery. If you go to Belgrade, you wouldn't be able to distinguish anything. And if you don't know the background, it's all nice and colourful. So, therefore, you have to do it. But the point is, as you [Christine Koblitz] said, what do you do with it? Do you actually publish it or not? And from my point of view, I don't publish it, but at the same time, public space is there to show you that something is happening with society. It's either a good thing happening or a bad thing happening. If we have a problem with extreme nationalists in the streets, it's better to know that the problem is there so that we can start working on it rather than covering it up and saying: "no, no, no, our society is perfect. We don't have a skinhead issue. We don't have hooligan issues. We don't have Nazi issues. We don't have refugee issues." So it's just a matter of context where you say "okay, here I want to publish it, and in some other cases, I don't want to publish it". I was babbling a lot and didn't solve any problem, but I think we have to have it all.

**Geert Verhoeven:** It interests me from you [graffiti] guys, maybe from you, FUNKY, the most. If you see some homophobic graffiti, would you first put your throw-up or whatever there to cover it up, or would this not influence where you start painting next time? So if you see some subversive graffiti with which you disagree, would you first start painting to cover that rather than anywhere else?

**Liljana Radošević:** At least in Belgrade, there was a different system. You had walls that were reused by the graffiti writers constantly. And then there were political comments in other parts of the city that they usually try not to intervene with each other. Nowadays, what happens is those extreme nationalists, for example, take over the walls that were traditionally reserved for graffiti and street art. Now they mark it with Serbian flags, and once they mark it, you can't use it because otherwise, you're probably going to

get your ass kicked or end up in the hospital. So now they're taking over the spaces that were completely open for dialogues. And about the homophobic stuff you mentioned: There is actually one artist in Belgrade that is in the LGBTQ community, he was active for almost ten years, and basically nobody touched his graffiti. Nobody. It was like a street art intervention. So, you still have homophobic comments, but nobody touched his stuff. So, it was kind of respectful or disrespectful in a very interesting way. I think every scene is different. Every city is different. Every neighbourhood is different. It's just tough to put everything in drawers and make it usable on the European level, for example, because it doesn't function the same way everywhere.

**Sven Niemann:** There's one artist from Italy, his name is CIBO, and he's specialised in going over Nazi graffiti because two of his friends were killed by Nazis a few years ago. He paints different kinds of food over Nazi graffiti. Then the Nazi comes across his piece, and he [CIBO] is adding another food. So, this is a very interesting artist. He's doing cupcakes, doughnuts, bananas, and so on.

**MANUEL SKIRL:** Yeah. It can also be a justification to work somewhere where you couldn't otherwise. I even know stories where people would put swastikas someplace just to go there the next day and paint over it.

*< Laughter >*

**Sven Niemann:** Yeah, we are in contact with the graffiti scene. If I see a swastika, I call a friend, and he just paints over it. I think it's very important to delete these symbols in the public space. I don't want to see any swastikas anymore.

**MANUEL SKIRL:** But can you imagine being a racist, seeing all the Antifa, left-wing stuff and being mad about it as well? I don't know about Bielefeld, but here in Vienna, there is much more progressive, liberal graffiti, which stays and remains readable longer than the other stuff. I feel sorry for those guys, to be honest.

**Enrico Bonadio:** It reminds me of Spain. There have been some graffiti with "Viva Franco", and some other artists added "Battiato", who's a famous Italian songwriter. So "Viva Franco Battiato", which I found fantastic. But those hate graffiti were in Vienna, right? The one shown in your [Norbert Pfeifer's] slides.

**Geert Verhoeven:** I don't think so. I think that Norbert just took them randomly. Just to have some examples, but we have this discussion because we would not like to become a hub for Nazis to look for imagery.

**MANUEL SKIRL:** That's very unlikely to happen, but still, it's an option.

**Liljana Radošević:** This is the thing; you just keep the context, but maybe just say that if somebody wants to find anything other than what is published, contact us. So serious researchers would actually consider that a good invitation: "oh, you have more, but you couldn't publish."

**Geert Verhoeven:** No, we publish everything.

**MANUEL SKIRL:** Yeah. I think it's just important that there is a representative amount and not much more of something than it is in comparison to the total amount.

**Geert Verhoeven:** Yeah. The idea is to present everything you document. Still, the question is: should we also make it searchable or maybe warn people that this is subversive content?

**MANUEL SKIRL:** Yeah, a warning would be cooler, maybe. Have this warning so people are aware and see you are aware. But then there is also stuff you don't even understand, like from hooligan groups or some nationalists that we don't know about, like from other countries. We also have a lot of people in Vienna from Serbia or Croatia who cross each other. I don't understand any of that. So, you would need some contacts for every language you don't understand for everything that you want to publish.

**Geert Verhoeven:** We had this discussion also with an ethical commission at the technical university, and there the remark came that we must define what is subversive.

**MANUEL SKIRL:** Exactly.

**Geert Verhoeven:** And this is our opinion; we might think that something is provocative, but who are we to state that? So, this is a complicated issue.

**MANUEL SKIRL:** Yeah. You need to judge many things there and declare them as something if you want to categorise them in boxes.

**DEADBEAT HERO:** In the end, it's your platform, so you can decide.

**MANUEL SKIRL:** <*laughs*> DEADBEAT HERO is just like: It's your problem.

< *Laughter* >

**Geert Verhoeven:** I think that concludes the discussion very well. <*laughs*>

**DEADBEAT HERO:** You can decide what to show. If people want to see it, they will see it, whether you publish it or not.

**Liljana Radošević:** Yeah. When I write about these things, I always say that I write about graffiti culture and street art, everything else I'm not interested in. They can say, "but you didn't include this, and you didn't include that". Yes, but this is my area of expertise; I deal with this. Everything else is not my expertise. I have documentation. You can borrow it. I can give it to anybody, but I'm writing only about this, full stop. This is my personal decision. Or maybe it could be an institutional decision. We do this, this and that, and everything else is not our domain of expertise. We don't want to analyse it, we don't want to contextualise it, or we don't want to put any ethical issues on it. It is what it is. This is the other part. This is my part. I'm dealing with this.

**Benjamin Wild:** I think that's making it a bit too easy. If Twitter and Facebook would just do that and publish everything, just giving everything a platform and letting everyone play on it doesn't work, I believe.

**Geert Verhoeven:** But we'll see with Twitter now that Musk got involved.

**Sven Niemann:** Today it's hard to distinguish graffiti because they're using the same techniques. So, the Antifa spray pieces that are quite professional, and so do some right-wing groups in Germany. I think it's not easy to distinguish them.

**Liljana Radošević:** But this is where you define graffiti culture. Graffiti culture originated in New York in the seventies...

**Sven Niemann:** They started as writers too. It's not easy to distinguish.

**MANUEL SKIRL:** It's not your choice what is part of it. Graffiti belongs to everybody who is doing it.

**Sven Niemann:** So it's not easy to distinguish political graffiti and graffiti from New York. I don't think it's possible.

**MANUEL SKIRL:** But when you do research or documentation about something, you must stop it somewhere, right? So you can say, for example, I don't put stickers, I don't put stencils. I don't use it as soon as it's indoors or something like that. And that can also be not using political stuff, even if it's an integral part of it. That makes it maybe much, much easier.

**Liljana Radošević**: Yes, exactly. Because the intention behind it also makes it different from the graffiti culture.

**MANUEL SKIRL**: But then you must also be careful to declare all the individual pictures. You need to understand every single artwork. Is it what I want to show? Or is it actually something that I don't want to show? Or is there some tiny little bit of political message in some corner?

**Sven Niemann:** And for RAZOR, a famous writer from Germany, for example. He did some political pieces too.

**MANUEL SKIRL:** Then it's a fading area.

**Sven Niemann:** Then you have to delete it from his artwork.

I think it's not possible to distinguish. My thesis is political graffiti anyway, so this is my problem.

*< Laughter >*

### Graffiti INCLUDES Exploitation | Copyright DOES NOT Matter

[Please note that because of the overlap in the discussion, statements three and four are combined.]
*Many fancy bars popping up along the Donaukanal happily feature a graffiti-covered wall as their backdrop. In that way, graffiti almost serve a kind of gentrification goal. In addition, graffiti-covered surfaces appear in commercials and movie clips. Can we consider this exploitation, and would creators want remuneration for this? In other words, do they feel that their copyrights are violated? Do they even know their rights in this matter?*

[…]

**Enrico Bonadio:** These statements are very interesting, but I don't agree with statement four [copyright DOES NOT matter], as you can imagine, because I've been researching this issue for many years. Well, as far as the statement "copyright does not matter" is concerned: it starts mattering. Judging from my ethnographic research, I found that an increasing number of both graffiti writers and street artists, more street artists than graffiti writers, are increasingly looking at copyright as a tool to react against appropriation, especially corporate appropriation. In America, you may be aware that there were several cases, most of which settled out of court, right? With a payment of an undisclosed sum for the artists or the writers. The companies that have appropriated the murals for commercial and promotional purposes are fashion companies, sunglasses, or car companies. Car manufacturers are very interested in graffiti because cars are driven in the streets. So, when it comes to advertising the car, the mural is quite appealing for a car company. Then we have McDonald's because their customer base is quite overlapping with graffiti lovers who are mostly youngsters. So corporate appropriation has triggered the interest of several artists and writers, I would say, not all, of course. It's quite a heterogeneous category. Some writers and artists are more interested now in at least considering the idea of complaining and, as a result, even taking action. To stop corporate appropriation, but also to prevent their murals and art from being associated with the messages they don't like. McDonald's, fashion companies, glamour companies. If we look at these legal cases, especially in America, but also a bit in Europe, we can see, in my opinion, how some artists have turned their attention to copyright as a tool to keep their message real, which is one of the mantras of graffiti writing. So they have used or tried to use copyright to reject associations with the corporate's messages. There are some complaints filed in America. If you read these complaints against fashion companies, McDonald's, etc., they say clearly: "we don't want to be associated with these kinds of messages. We don't want our art, lettering, graffiti writing, or more figurative street art to be associated with these messages. We don't like it, and that's why we take action".

Then a second legal interest arises to prevent the destruction or removal of some murals. You may have heard about Five Pointz in New York, right? That decision, that case, was revolutionary. Five Pointz was a mural hotspot in Queens in New York, which had become the Mecca of graffiti. They were painting legally. The property owner authorised, for many years, local and other painters, particularly one graffiti writer, Jonathan Cohen, whom I interviewed in Brooklyn. I interviewed him, and it was a great place, very famous. It attracted many graffiti writers and street artists from all over the world to paint on a rotating basis. Some murals were temporary, and the ones at the top were more permanent. So all the famous writers and street artists painted on the top part. So for more than 12 years, it was like this. But then, it was whitewashed entirely by the property owner without any prior notice. And that's not legal under US law. There is a piece of legislation in the US, the Visual Artist Rights Act (VARA), which protects artists' rights, including the right to object to the destruction of their artwork. They enforced that provision, and they won the case. It was a case for damages only because the murals had already been whitewashed. So they started legal action to ask for damages. And the judge awarded 6.7 million to 21 artists and writers because the property owner had illegally destroyed their legal graffiti and street artworks.

So it's the word upside down, right? Because usually, the graffiti writer is the vandal and the property owner is the victim. Here, it's the opposite. The property owner was the vandal, and the graffiti writers and the street artists were the victims. So it's upside down. That's why this decision is revolutionary for me. It may also mark a turning point in the public's attitude towards these forms of art. We have already questioned that.

**Norbert Pfeifer:** Okay, you talked about something like millions of Euros. When we talk about Donaukanal, I think we will not talk about millions. But of course, it still might turn to exploitation. It would be interesting to hear from the audience, from all of the audience, their experience with this aspect of exploitation. So I do not know who would dare to begin to speak.

**Enrico Bonadio:** We have an artist there. *<pointing at DEADBEAT HERO>* Writer or muralist?

**DEADBEAT HERO:** More murals. Yeah, I'm thinking about it because it's an interesting topic, especially with this A1 commercial [i.e. the commercial Norbert Pfeifer showed in the beginning, https://youtu.be/oLHtNJCI6zE]. I remember seeing this on television and realising how they kind of did this red swoosh along the wall, blocking some of the graffiti. But, yeah, I think if you are a public person, for example, and they're filming in an area, and they film you walking by as a normal person, you have to sign something to have your face shown in this environment. And with graffiti and street art, you should also have to give your permission for it to be used in this context. You should be asked, I think. So I do feel like that's an issue regarding advertising and using public art in this way. Of course, it's difficult if it's just a tag that you can't really read and you don't know who this artist is, but there are plenty of other places to film and ways to block this art.

**MANUEL SKIRL:** If there are people they could ask, like Stefan, who isn't here, unfortunately.

**DEADBEAT HERO:** Yeah, exactly.

**Norbert Pfeifer:** *<talking to Christine Koblitz from Wien Museum>* You also organised some graffiti and tags to be written within the museum, right? And, of course, there's also the question, was there an aspect of exploitation? So did the artist get something?

**Christine Koblitz:** *<asking MANUEL SKIRL>* Did you feel exploited by the museum?

**MANUEL SKIRL:** I think I should answer that whole question by myself because I personally have a completely different point of view, but that's something that I feel is just me. I don't think about those things. We got a lot of revenue [from the TAKEOVER exhibition—see Koblitz in this volume], and I think it was an excellent platform. I also remember we got some currency for it. So I didn't feel exploited, to be honest. And also, I really respect your [DEADBEAT HERO's] opinion; I think it's a really legit one, but for me personally, I try never to concentrate on scratching together what somebody potentially owes me. Especially if I work somewhere without permission, in public places, I always try to tame those emotions about getting exploited by car companies that film their commercials on the street. Yeah. Okay. Street art is on the street; cars are on the street. Makes sense. They try to reach young people. And when you give them this background for me personally, that's your own fault. If it's a commissioned work, if it's legal or even something you paid for, or if you invested something to have it there, such as a commercial billboard of a company, then it's something else. But 95% of places along the Donaukanal are technically illegal.

**Enrico Bonadio:** There were cases also in America, two cases in particular, where artists have taken action, even when the artwork has been created illegally.

**MANUEL SKIRL:** I'm not overlapping my personal opinion or morals with the law situation in the United States here. And I know that over there, a lot of stuff is happening, which is interesting and brings new ideas on how to see this more morally. But I personally made the experience that it's better to concentrate on creating something new than looking back on who owes you what when they use it. It just felt better. I just didn't want to spend my time having these

emotions.

**DEADBEAT HERO:** It's interesting that we, as artists, also try to put our artwork in the most publicly visible areas that we can, which kind of puts it in a position where it's always in the background of something.

**MANUEL SKIRL:** I always tell other people when they complain in front of me that they don't want anybody to see it, they should do it in their house or maybe in a book and just close it. But you want to be seen; you want to be recognised. And if a car company or a super cool fashion discounter is seeing your thing as the potentially best background on the whole Donaukanal, it's also some kind of honour. But I understand if people get mad, especially if they have financially hard times, kids, a family, or anything else, and then you see this on TV. I totally get why it makes you angry. Totally!

**DEADBEAT HERO:** It's interesting that there is this separation between compensation and recognition. Or not really recognition, but more just the courtesy of being asked that this can be in this commercial. Obviously, I'm not so much on the confrontation side, but it's nice to just be asked: Can we have this in a commercial? Is this fine for you? Sign it off, and then that's done.

**Enrico Bonadio:** May I ask you something? Do you think there is a contradiction between being a writer and taking legal actions by relying on copyright? Because graffiti writing is very much anti-establishment, right?

**MANUEL SKIRL:** Definitely.

**Enrico Bonadio:** Anti-government and against police brutality. Some commentators said it's a paradox. These guys fight the system. Especially for writing rather than street art, and then they ask a judge to be protected. You see contradictions in that, no?

**MANUEL SKIRL:** Yes, big time, of course.

**Enrico Bonadio:** But several of those I interviewed don't...
**MANUEL SKIRL:** Yeah, of course. There's also not just black and white. There's this big, big area of fading.

**Enrico Bonadio:** Yes, nuances.

**MANUEL SKIRL:** A lot of people are in between. I just found it ridiculous that somebody would tag ACAB [i.e., All Cops Are Bastards] everywhere and then call the police if they had any problems. You should make up your mind.

*< Laughter >*

**Enrico Bonadio:** So if McDonald steals a nice ACAB graffiti, you find it contradictory if the very same writer asks the…

**MANUEL SKIRL:** Asks the law, asks the government and the structure he's actually…maybe not when he's just against the police, but when you write "Fuck the law". McDonald's will copy that "Fuck the law", but…

**Enrico Bonadio:** That's free speech.

**MANUEL SKIRL:** Of course, it's free speech, but it's contradictory if you ask the law to help you get money if McDonald's prints it in their restaurant. I think that's pretty obvious, no? Maybe I'm alone here.

**Enrico Bonadio:** But there are different opinions in the sub-culture.

**MANUEL SKIRL:** Yeah, of course. Some people are lucky, some…

**Enrico Bonadio:** No, several highlighted exactly that. Others say: No, it's free speech. I want to be protected anyway. I can say whatever I want in my mural.

**MANUEL SKIRL:** I think people are getting very creative, especially when it's about getting money.

**Enrico Bonadio:** There is another contradiction that has been highlighted. They objected to my argument. "You are not part of the establishment. You take action against McDonald's because you don't want your mural to be

associated with the cheeseburger, but then you negotiate and settle a $ 40,000 settlement fee". Is this contradictory again?

**MANUEL SKIRL:** Yeah, I think so.

**Enrico Bonadio:** So you should not get any?

**MANUEL SKIRL:** If you write a declaration that you don't want to get connected to a specific product or certain company unless you get € 40,000, that's pretty… It's your right, of course. And also, I understand it, but…

**Enrico Bonadio:** They use your creation.

**MANUEL SKIRL:** I don't want you to use it because I don't want to be associated with it unless I get this amount of money? Again, I feel it, but it doesn't make sense. You want to be associated with it if you get paid enough, or you don't want to be associated with it.

**Enrico Bonadio:** So basically, another objection that has been made is if copyright enters and penetrates these subcultures, these artistic movements get corrupted. So copyright is capable of corrupting or making these subcultures not subversive anymore. I disagree. In my opinion, copyright is not just a capitalistic tool in the hands of greedy corporations. It is also that, of course, because you use copyright to make money, right? Because it's a monopoly and you can license it; it's a way to extract economic profits from your creation, and many do. Many famous street artists do. They become rich. They do merchandise. But it's not just that. Copyright also allows street artists and graffiti writers to keep control over their art. For example, I interviewed STIK in London. He does these stick figures. He made and agreement with charities, such as NHS, LGBTQ organisations, and homeless organisations, allowing them to use the stickman man for these social purposes. In return for no money, just covering the expenses. And he can do so because of copyright. So basically, he showed me the rule for using the stickman in our interview. If you want to use the stickman, you need to use yellow or white colour in the background. The lines should not be thicker than two or five centimetres. He's able to regulate the use of his creation by these charities. But he can do that because of copyright; the copyright architecture gives him the possibility.

**MANUEL SKIRL:** Yeah. But he also needs to enforce it. Every time somebody uses it, he needs to recognise it. I want to paint paintings. If this STIK wants to go to court daily, it's his thing. It's fascinating, but I don't know if this is a nice way to spend your day.

**Enrico Bonadio:** If a political party you don't like starts using your creation, you'll be annoyed, right?

**MANUEL SKIRL:** Yeah, of course.

**Enrico Bonadio:** So, the only way to react is to rely on copyright. Without copyright, that political party you hate might continue to do that.

**MANUEL SKIRL:** Yeah. I also think that's happened already.

**Enrico Bonadio:** There was a case in France decided at the beginning of 2021 where COMBO, a French artist, complained against Jean-Luc Mélenchon, the far-left candidate of the French presidential elections in 2017. Mélenchon used one of COMBO's murals in one of his videos without permission. COMBO started legal action against Mélenchon and his party for illegally using his mural and for violating the moral right of integrity. He lost the case also because the judge said: "Look, this was used by a political party, which is not very far from your own idea". So, it's not completely opposite to your beliefs. But apart from that, you can see that he took action because he didn't want his artwork to be used by any political party without his permission. No matter right or left. It was not a matter of much money. He didn't ask for money. It was more a matter of principle. "If you politicians use my mural in your promotional videos, in your political campaigns, you need to ask me for permission. You can't do that without permission".

**FUNKY:** Can I ask something?

**Enrico Bonadio:** Yes, sure.

**FUNKY:** Is it right when you give your murals or your graffiti pieces, or similar, on Instagram, Facebook or Google, users have the right to use it for themselves or for other organisations? Is this right?

**Enrico Bonadio:** No. You can't use them.

**FUNKY:** Because I had that a few times, and I couldn't believe this because this is my work. Someone is using it even for money.

**Enrico Bonadio:** Sometimes, for money, there is commercial exploitation, and you can stop that. You cannot prevent private users who use it, for example, for teaching purposes or research.

**FUNKY:** I think this is okay. For education, it's totally okay. But for example, someone is printing my stencil or my idea on a shirt. They are selling it. I saw it in shops like Primark or H&M.

**Enrico Bonadio:** Your own artwork?

**FUNKY:** Not mine, but others. I mean, this has not specifically something to do with graffiti. These are logos of Disney or other good cartoons sold by New Yorker or H&M. And this is something where I ask myself: "How could it be possible for a shop to have rights to these cartoons?" I don't know how to explain it.

**Geert Verhoeven:** Let's say, for instance, that when our project INDIGO ends, we would select the nicest pieces that were documented in the past few years, and we create a book out of this, and we would sell this on Amazon, for example. How would this work? Would we also have to give royalties to all the guys that created the works?

**Enrico Bonadio:** No, it is safe to ask for permission to be published in the book. I know it won't be easy because you need to trace them. And a book may contain many pictures. So when I worked on that photographic book you mentioned before [Bonadio, E. (2020). *Protecting Art in the Street: A Guide to Copyright in Street Art and Graffiti*. Dokument Press.]. It's a small one but contains lots of photographs. Photographs that have been given to me by artists and other people. It took me a while to get the authorisation of the artists and the photographer. Because here you have two copyrights. You have one copyright over the original mural and another independent copyright over the photograph, which belongs to a photographer. So, you need two copyrights. Two concepts.

**MANUEL SKIRL:** And when we talk about the copyright of every single tag on Donaukanal, you can easily take a picture with a dozen different artists.

**Enrico Bonadio:** It takes ages to clear the rights.

**MANUEL SKIRL:** It's impossible.

**Enrico Bonadio:** It took me a while. So, there is a rule in many copyright laws which says that if you do a diligent search to find out the copyright owner, but you cannot trace him or her, you can still use it. You can use it by saying "unknown artist". And in two or three pictures, I have written "unknown artist" because I took a picture in Havana. There was a mural with a copyright symbol. I took it and put "unknown artists", but I tried to make a reasonable and diligent search, but I couldn't find the artist.

**Liljana Radošević:** Now that we talked about books, I have one question about legal structures in different countries. I come from Serbia, from the organisation Street Art Belgrade, and in 2016, our first book was published. In this book, there were, of course, some artworks by artists from different places. I'm going to name just one. We had a little issue with a French artist, REMED, who did one beautiful mural in Belgrade. It was done for the Belgrade Summer Festival. So, he was invited by the festival, and the festival basically paid for the artwork. When the book was published, my colleagues tagged REMED and told him: "your artwork is in our book". And according to our Serbian law, everything in public space can be photographed, and you don't need to ask permission for it. So, of course, we, as human beings, recognise that if you have an artist, you should negotiate with him, but this wasn't really possible at the time. I think we also had a different mindset that we didn't think about it because no artist in Serbia and Belgrade

asked for these things because our legal system is different, our structure is different, and our community is so small that we all know each other. Basically, you don't need signed permission. You just call somebody and ask: "Hey, is it okay if we publish?". And he will say: "Yeah, sure, no problem."

**Enrico Bonadio:** Yeah, that's fine.
**Liljana Radošević:** So, we are used to that, but we didn't have a phone number.

**Enrico Bonadio:** An email is better than a call.

**Liljana Radošević:** Yeah, of course. But as I'm saying, our mindset is slightly different, and of course, there was no bad intention. The book we sell costs more to publish and print than the revenue we get from it. But the point is that I do understand REMED's point of view. He was very disappointed that we didn't contact him, but on the other hand, legally, we had no need to do it from the point of view of Serbian law. So Serbian law says that the mural belongs to the summer festival. Our colleague took the photograph. So, it was his photograph. The book is the way it is; it's not something that you can actually make money from. You don't need to ask for these things. Now we are preparing a new book, and we are trying to get in touch early with everybody present in the book. But I just wanted to say that you have these two legal systems. Okay, Serbia is a European country, but we are not in the EU. So our laws and our systems function differently than in the EU. Then you have this clash of two worlds where, without bad intentions, you can still do something that can make artists mad.

**Enrico Bonadio:** Probably in Serbia, you have the freedom of panorama exception. The freedom of panorama exception is an exception to copyright, where works placed in public spaces can be reproduced without permission. So you don't violate economic rights if you don't ask for permission. However, you still are required to acknowledge the ownership as long as you are aware of that.

**Liljana Radošević:** Yeah, of course, we added the name and date of production and that we have no authorship of the particular artwork.

**Enrico Bonadio:** But in the European Union, this is not harmonised. We don't have an EU law on freedom of panorama. So different countries adopt different solutions. The UK has the freedom of panorama just for sculptures and works of architecture. So in the UK, you can take pictures and publish pictures of sculptures and buildings, but not murals. I don't know why there is this discrimination. Probably it's because back in the days, decades ago, most artworks out there were sculptures, statues, or buildings, not paintings. But now, this discrimination doesn't make sense anymore because there are more paintings than sculptures out there.

**MANUEL SKIRL:** Is this law maybe just for recreating cityscapes or so? We have a lot of things, like souvenirs or other products, that people identify with a place where architecture and statues play a really big role. But I think they are also much more permanent than murals, no?

**Enrico Bonadio:** Yeah.

**MANUEL SKIRL:** Also, the most famous buildings and sculptures are the most well-known artworks in the world, actually.

**Enrico Bonadio:** Exactly. These laws were devised decades ago when the cityscape was different.

**MANUEL SKIRL:** And murals were only made for propaganda and stuff like that.

**Enrico Bonadio:** Yes, also.

**Geert Verhoeven:** I would like to ask the three graffiti writers here: if we would bring out a book in a year or two and use photographs of your work. Would you feel exploited or not?

**DEADBEAT HERO:** I would sue you <*ironically*>.

< *Laughter* >

**MANUEL SKIRL:** Personally, I just care if the photo is well done. And if it's from a stage where the artwork is still like

I wanted it to be. Long story short, I always appreciate it when people ask me for my photo because I have a good photograph most of the time before it got destroyed. No offence to anybody, but many, many people who are not in the scene tend to take photos from artwork that I am not happy with; and most of my fellow artists are also not happy with. For example, stuff is cut off, the photo is taken from a strange angle, and there's maybe a trash bin or some movable object in front of it where you think: Hey, you could have just pushed it away!

**Enrico Bonadio:** So you don't like those photos?

**MANUEL SKIRL:** I don't like those photos.

**Enrico Bonadio:** You would like to stop the use of those photos?

**MANUEL SKIRL:** No, I would just prefer the use of my photos instead of those photos. I don't want to stop anybody or tell anybody what to do. I would just prefer to see my photo there, speaking from my heart.

**Enrico Bonadio:** Yeah. But copyright can help you. That's the point.

**MANUEL SKIRL:** Yeah, of course. But I don't have the power for this. I want to use all my heart and blood to create artwork. That's fulfilling me much more. That's why I never went in this direction. I opened many of these publications. Some of them are great. Some of them are medium. Some of them are not really satisfying. But then I just close it and forget about it.

**Geert Verhoeven:** Let's say I have a photograph, and I see this is by MANUEL SKIRL, but I don't know who he or she is and whom I should contact.

**MANUEL SKIRL:** 99% of the people are really easy to find on social media, no? And if not, you can maybe find or talk to somebody who is close or from the same city. And if somebody understands that you have good intentions and you're not a police officer who is trying to investigate somebody, then you will always get a contact or at least somebody who tells you: talk to this person. Then you get permission, pretty unofficial, handshake quality, but still better than nothing.

**DEADBEAT HERO:** Yeah. Especially with quality artwork, you can find it 95% of the time through Instagram. Just type in the name. If you can't find the Instagram handle, just type in the hashtag "graffiti"' or "street art", and in whatever city or country you found the artwork, you can usually find it. I do that also every time I go to a new city. I type in "street art Malaysia", for example, and look at all the artists who are active there and the top-quality ones you will find easily.

**Geert Verhoeven:** So you would feel annoyed if I would use photographs of your work, and then we would have them published.

**DEADBEAT HERO:** Into a book?

**Geert Verhoeven:** Yeah.

**DEADBEAT HERO:** I would like a copy of the book

*< Laughter >*

**Enrico Bonadio:** For free.

**DEADBEAT HERO:** Yeah, exactly. I would just like to be recognised. I have a good little library of books with my artworks featured. And I just like to have that for me. For me, this is cool to have. And also, the point with the photos is good because that happens often. It's not a publication; many times, it's Instagram, or people tag me with my artwork, which is nice. But when somebody's already crossed it with some stuff, I don't feel inclined to share or acknowledge it too much.

**Sven Niemann:** I think we talked about the quality of pictures, but I think the time of release is also very important. Because some of the crews want to release it first because it loses value if it's not released first. In my hometown Bielefeld, there was some struggle between the spotter scene and the graffiti scene because everyone was taking photos of newly graffiti-covered trains and a friend

of mine released a photograph of a famous train before the crew could release it, and he got problems. So it's not only the quality of the picture but also the timing of the release.

**MANUEL SKIRL:** Yeah, it's the exclusivity. But I also think that's ridiculous. If you send a train into a station and are angry with people taking pictures. I don't know what these people are thinking.

**Sven Niemann:** Maybe one example, the book from MOSES and TAPS, I think most of you know it [MOSES, & TAPS (2020). Graffiti Avantgarde. Mainaschaff: Publikat]. There was a comment that said, I think, "copyright MOSES and TAPS" and that Norbert…

**MANUEL SKIRL:** Norbert Siegl took a picture of it and said, "thank you, next time, please also write *Graffiti Europa Org*" or something. You could tell that he wasn't even reading it. But there you see only the positive web reaching you. That's also good, I guess.

**Sven Niemann:** Yes, there's a lively discussion between spotters and the graffiti scene, which is very interesting. And maybe to add another point: we also analysed a lot of pieces from the eighties and the nineties in Germany, and a lot of sprayers used this copyright sign (©) and sprayed it next to their pieces already in the eighties. So there was an awareness of copyright in the scene itself. So it's very interesting. They're spraying this copyright sign and saying: "no, this is my piece".

**MANUEL SKIRL:** Don't you think it was more about the name?

**Sven Niemann:** Yeah, maybe the name too, but I also think next to the pieces, it said: "copyright" or "copyright by" and so on. I think this is very interesting too.

**MANUEL SKIRL:** But now that you say it, this really appeared very often. Also, next to the signature or the tag.

**Enrico Bonadio:** That was not uncommon in New York in the seventies, also Jean-Michel Basquiat and Al-Díaz. They invented "SAMO©", which means like "the same old shit", also with the copyright symbol. I interviewed Al-Díaz in Brooklyn. He told me that Jean-Michel Basquiat and himself chose to put the © to make a statement, right? It's our stuff. Of course, they didn't take legal action against anyone. But there was already, at that time, a specific sentiment of ownership. Al Diaz told me: "That's our tag. SAMO, it's ours, and we put a copyright symbol". And now Al-Díaz and the Basquiat foundation have litigated over a trademark SAMO. The Basquiat foundation filed the trademark application in the US on SAMO, and Al-Díaz opposed it. So they litigated over the exclusive use of the tags for reproducing them on shirts and other fashion products. Now it's okay; copyright has already even entered these subcultures. Also, back in the day, in New York in the seventies, you can see this corporate symbol, for example, by Tracy in its wild-style pieces.

**Chiara Ricci:** I can tell you about some issues from Torino in Italy. We had a project mostly about street art, and we had a digital archive. So we were not selling anything, just putting together documentation. And we tried to contact all the artists involved. I mean, we were using the pictures of their artworks, and with most of them, it was easy, and with some of them, it was difficult because there were sometimes two or more artists for a piece. And one of them replied to us, but the other one never replied. So we said: okay, what can we do? What should we do? We have one permission, but we missed the other. And then I realised we are within a festival. So we also had to contact the festival organisation. And then, sometimes these spaces were made into public spaces, but it was the outdoor wall of the public school. Then we have to contact the school. So at one point, we were overwhelmed by these legal parts. I mean, we decided to select just the simple cases because in other cases, we say, okay, no more, and we were not selling anything. So sometimes these are the problems. I can recognise the principle, and I agree, but then sometimes you crash on practical issues like that. And also, I don't know the best practice in this case. For example, we have a mural from a girl who is unfortunately dead, so what should you do in that case? Such an old mural is not part of the Italian protection law of cultural heritage, and as said, I don't have anyone to

talk to. So I don't know, for example, this was another issue. Finally, we didn't put this piece in the archive because we didn't know how to behave.

**Enrico Bonadio:** In that case, you need to contact the successor in title.

**Chiara Ricci:** Sometimes, finding the artist is just a little bit difficult.

**Enrico Bonadio:** Copyright lasts until 70 years after the death of the creator. Usually, it's passed on to children or a wife or husband. So you need to contact the family.

**Chiara Ricci:** Yeah. But it's not easy to find a family. So those are some cases we struggled with. I can understand the difference if you are a car-selling company or McDonald's. Still, in Torino, for example, we have street art tours. There is a girl who's part of the graffiti scene, and she used to make graffiti. She has a lot of friends within the graffiti scene, and she's doing graffiti tours. So, in that case, you suppose that she's keeping the original meaning of the artwork, but now those tours are becoming mainstream. So other little companies start organising tours. And you cannot be one hundred per cent sure that the original meaning is kept. I can interpret artwork in the street, in a public space and say, during my guided tour, something that was not the original thought of the artist. So that's difficult.

**DEADBEAT HERO:** That's smart what you did. Trying to contact all the artists is really good. And if you can't contact them, don't publish it. If somebody wants their artwork to be recognised, they're going to put their name there, be visible for people to be able to contact, but if it's not there and you can't contact them, then they probably don't want to be. So it's smart what you did.

**MANUEL SKIRL:** It depends. It can also be removed when it's a little bit older. Due to the weather or by other people.

**DEADBEAT HERO:** Yeah, it could be covered.

**MANUEL SKIRL:** I don't like my signature, so I put it super, super small and then maybe you couldn't even find it.

**DEADBEAT HERO:** And other pieces of yours had your signature, so one can say this is the same artist. It's just like any other creation, like music, for example. If you can't contact a musician to put their song in your video, then you're not going to put the song in the video. It's kind of common sense.

**MANUEL SKIRL:** Be safe.

**DEADBEAT HERO:** Yeah. Be safe because there are so many different personalities. And, of course, there will be other people who will have different opinions about that. And as far as the tour guide goes, I don't think it matters so much. I toured for a little bit. I was also the tour guy for a little wall to make some extra money on the side. And I can't even explain half of the stuff. So you can make up whatever you want. And these people will just be happy.

*< Laughter >*

**Chiara Ricci:** I suppose as an artist, you might not want that everyone can just do this?

**MANUEL SKIRL:** It's the same thing with any artwork.

**Chiara Ricci:** Sometimes, it's not just one meaning.

**DEADBEAT HERO:** A lot of artists that I spoke to on my podcast don't go into it with meaning. They produce it, and they don't want to explain it.

**Liljana Radošević:** Yeah. I have two comments. So in 50 years, many things have changed. We do try to talk about the origins. We do try to talk about this original culture that started in New York in the seventies, how they were functioning and what they were doing, and how it was possible or impossible for them to do their art. This has changed. There are some laws, and there are still some similarities, but in 2020, we experienced so many different social changes and different mindsets changes that we can't still be working from this premise of the seventies. So I think when we talk about copyright issues, I think this is a hot thing. This also plagues other art forms, not only graffiti and street art. And if it's like part of the general society, we

should reconsider these issues in graffiti street art because artists that grew up after 2000 have that mindset. And it's totally normal to consider these things from today's point of view. So this was my first comment. Basically, going back to temporality. Everything changes, evolves, and is different from 20 years ago. Even though we still have the same good things that connect us to this original culture from the 1970s.

And on the tour guide issues. So I'm an art historian, and I've been researching graffiti and street art since 2000. When I started doing street art tours, it was actually to support my research. It wasn't really to make money, but it was more like, I need to do these tours anyways. So while walking around the city, let's take other people and educate them a little bit. I think, for me, the main issue was the morality around it. For me, if I don't know something, I don't talk about it. And if people ask me: "oh, so what about this?" I just say, "I don't know". It's okay to say that you don't know something and that you can't be in the mind of every single person that does something in the street. But at the same time, I do understand that it's maybe not really nice for anybody just to go out and say, "Okay, I'm going give you a street art tour", and then walk around twenty clueless people and tell them some bullshit about the local scene and the local artist. I think there has to be this moral and ethical standard that you can't do a thing that you don't know anything about.

[…]

*This section was initially part of discussion session 1 [see Merril et al. in this volume]. Still, it fits better with these statements from discussion session 2.*

**Alexander Watzinger:** My first contact with the scene in Vienna was around the eighties, nineties, and it was a pure, almost outlaw scene. It was forbidden everywhere. But nowadays, some artists are getting a lot of money to cover buildings or things. Your personal opinion would interest me. How is this for you? Is this like, okay, they made it or is it more like, they are selling out? What is your opinion?

**JANER ONE:** It's a different perspective for everyone. You would get diverse opinions on this question. My personal opinion is: it's awesome! If you can do it, you can still do both, right? It doesn't mean that you can't still bond if you are getting money. That's something a lot of people don't keep in mind.

**Alexander Watzinger:** It doesn't destroy the act?

**JANER ONE:** A lot of people would say so. For me, no. I think it's also, how can I say, fair game. It is natural that other people, who don't want them to do [commissioned] stuff like this, cover it by just writing something over it. Very simplistic. But yeah, I think it's fair game. I think it's the other side of the coin that shouldn't be dismissed, in my opinion. Yeah. I think it's good.

[…]

Donaukanal Graffiti IGNORES the Origins

*It seems that graffiti created outside the Wienerwand (a collective of all legal graffiti walls in Vienna) are tolerated to a large extent, which removes much of the voluntary risk-taking and hide-and-run-from-the-police approach that characterised their modern American roots. Therefore, is it correct to say that Donaukanal graffiti lost their roots, their critical edge? If creating graffiti is no longer a high-risk pursuit that teases out the boundaries between legal and criminal behaviour, can it still be considered graffiti? Does this relative tolerance explain the number of new graffiti daily appearing around the Donaukanal?*

**Geert Verhoeven:** It started in the 1960s and 1970s as a highly illegal activity in Philadelphia and New York. And when I see graffiti creators on YouTube, for example, they are always masked and ready to flee from the police. And sometimes, when walking along the Donaukanal, people are there with beer and food. it's almost like a barbecue party. And I wonder if you don't really have to run from the cops, maybe then you just get a fine? But very often, it seems you don't get a fine. Does this change the way you create graffiti? Would you quicker start with a big piece because you know "Okay, I have a few hours"? And if the police come by, they might say you should go away, but then you still have an hour to finish the piece. Does this change the way you make graffiti? The way that cops are going about it here?

**MANUEL SKIRL:** I have a lot to say about this. First, I think

it's all about body language, especially in Austria. On the Donaukanal, there are a lot of places which are officially legal. You can search for those on the internet, but most of the walls would actually be also heritage-protected because some of the stuff is by Otto Wagner, a really famous architect. Most of the walls are technically illegal, but everybody in the scene or most people in the scene know that the police are not very highly educated about where these areas start and where they stop. And they are also not encouraged obviously to learn this and to enforce this. So they would only investigate if somebody calls them to check on you. That means it's up to the people or up to everybody's view to judge if what you are doing is right or not. And then we get to the beers, to the speakers, to a lot of things on the floor, which just makes what you are doing look like you are not prepared to run away from the police, right? So to create this image in an area where you actually should hurry up, that approach works much better along the Donaukanal during the day. People learn that when you stand there with two spray cans, and you paint very fast and look around super nervously, people will of course call the police. But if you stand at the same spot with brushes and music and your friends are sitting around barbecuing, people are like, "That's legit, of course". And especially in Austria where people wouldn't interfere or tell you what you do wrong. If they are not 100% sure about it, they would just walk by saying "Hi!". And that's it.

**Enrico Bonadio:** Even better to wear a yellow vest. Trying to pretend that you are cleaning.

**MANUEL SKIRL:** Exactly, something like this. Vienna is a city where you can do this everywhere. People wouldn't question what you're doing if your body language and whatever around you looks like you were working legitimately. I can tell this from many experiences.

**Geert Verhoeven:** So that's maybe also why many people, even from Vienna, think that a lot of it is legal.

**MANUEL SKIRL:** Of course. Yeah, of course.

**Christine Koblitz:** But this is a speciality of the Donaukanal.
**MANUEL SKIRL:** Yes. But we also figured out it could be the same elsewhere on a nice Sunday or Saturday afternoon. There are a few things in several districts. I would say it's a little bit easier because the people there are more like left-minded, progressive people, if I can say it like that. Also, Italy is an amazing place for this. People would even appreciate what you are doing, while in northern Germany, they would call the police on you and question whatever you're doing. In the south of Italy, you would get a plate of fantastic food. Yeah.

*< Laughter >*

There's a wide variety between how people and how the public are reacting to this. And I think wherever graffiti happens, the mentality, the vibes from a country, and the political situation all influence it.

**Liljana Radošević:** Yeah. But there are also areas, for example, if you're painting trains, this is also an area, even in Vienna, where you expect to run.

**MANUEL SKIRL:** Yeah. But also, 99% of the people who would find you and see you working there know exactly what is cool and what is not. So if we compare a train yard to a street, then the bypassers do not really know what you're doing or if you have permission from the shop owner or whatever, but the person who works in the train yard, such as mechanics, they know exactly that you're not supposed to spray paint on that train

**Sven Niemann:** Sometimes it's simple mathematics, so it is possible to measure the difference between street pieces and hall of fame pieces. With our knowledge graph, it was possible to compare the number of style elements. So I think in hall-of-fame pieces, the number is about 5.81 style elements such as outlines, fill-ins and so on. And in street pieces, it was, I think, 3.56. So it is possible to measure the difference in complexity. Of course, if you have the whole day to spray a piece, you have more time to make more complex things. It's simple mathematics, and you can measure it. Another common strategy is to have a legal name. In Paderborn, every artist has a legal name. So in Paderborn, they even use their proper name. So we have Volker and Norbert; of course, they have another illegal

name that no one knows. So this is a strategy.

**MANUEL SKIRL:** You're talking about Volker der Goldene Reiter?

**Sven Niemann:** Yeah. Good guy. He is a good guy, a good friend. He's supporting our project by reading graffiti, and we give him pizza and beer. So he's fine. But he wants my job <*laughs*> because you're not getting paid for painting graffiti all day. But I can't take his job because I can't spray.

< *Laughter* >

[…]

**DEADBEAT HERO:** Regarding the statement "graffiti ignores its origins", I also think of it in the aspect of skateboarding. So if the Donaukanal graffiti ignores the origins of graffiti, then I guess skate parks ignore the origins of skateboarding in a way. So it's not that it's ignoring it. It's just giving you a chance to do it in a setting with your friends and not have to worry about running from the police. It's more of a social thing, at least for me. If I have somebody coming from another country and we want to go paint something, it's easy, cheesy, have a beer, not thinking it's gonna stay, you know, a week after we painted it. It's not ignoring anything. It's just a, just a way for us to…

**MANUEL SKIRL:** It's developing a new field.

**DEADBEAT HERO:** Yeah.

**MANUEL SKIRL:** Taking something somewhere else and just adapting to the area. When painting in public spaces, talking for myself, I always adapt to the situation. I turn around and see, "Okay, how much time will I have here, or is it going to start to rain? Are people going to be mad?" That's all the factors that make the graffiti in the end. And I think it reads here [the statement] that graffiti is a person or something. But of course, the whole scene or the whole development of what is getting done by the scene is always adapting to the factors around it. So I don't think it's ignoring anything, but just…

**DEADBEAT HERO:** Yeah. Graffiti is always going to be there. If you want to do it illegally and run from the police, you can always do that.

**Geert Verhoeven:** But would you agree that the setting along the Donaukanal makes it less socio-political critical than maybe in other places in the city?

**MANUEL SKIRL:** No, maybe even more. I see the most political graffiti in Vienna at the Donaukanal because these people find a platform there to make their messages. They can take a lot of time. We don't have so much political graffiti on the street. I don't know why. Is it getting removed very fast, or are people not even doing it? But I would say it even encourages people to go there [the Donaukanal] and make very big "refugees welcome" or whatever. Also, when we had these terror attacks, they would black out big parts. So there's a lot of reaction to political happenings and political statements. Antifa wall, for example. And it's cool that it brings a little variety to the hip-hop stuff and the other stuff.

**MANUEL SKIRL:** I have to say sorry, but I must leave for my next date. It was really nice talking to you, and thanks for the coffee.

< *MANUEL SKIRL leaves* >

**Geert Verhoeven:** We can wrap it up here because there's now a break scheduled. I think these were some challenging issues, and no discussion is long enough to discuss all the possible points of view. And there are also many more interesting legal issues, like how one can tokenise creations, for example. So we might need another discussion session at the next conference.

# Facing a Chameleon—How Project INDIGO Discovers and Records New Graffiti

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**Abstract**
Graffiti are studied by, amongst many others, archaeologists, sociologists, (art) historians, linguists, ethnographers, architects, anthropologists, librarian scientists, geographers, criminologists, conservators, lawyers and architects. Although most of these professions rely on a digital representation of graffiti at a particular stage of their research, there has been strikingly little attention to how graffiti can effectively be monitored and digitally documented. And this is precisely one of the gaps that the heritage science project INDIGO is trying to fill. Through collaboration between geomatics, photography, data management and graffiti specialists, INDIGO aims to develop technical and logistical solutions that facilitate the systematic documentation, monitoring, and analysis of extensive graffiti-scapes. This paper focuses on the graffiti-discovering and data acquisition strategies INDIGO has been applying during its first project year. At the same time, the text explores new avenues for improving the existing approaches.

**Keywords**
anonymisation; change detection; computer vision; graffiti; localisation; monitoring; photogrammetry; photography; Vienna

## 1. Introduction

"Keep a look out for the Roman and later vandal! Most such marks should be individually photographed" (Museum of London Archaeology Service, 1994, p. 63). This 30-year-old archaeological advice for documenting ancient graffiti might seem a bit basic nowadays. Still, its consistent application to contemporary graffiti would be a big step forward in many cases. Despite the steady rise of academic interest in modern graffiti (Ross et al., 2017), the scholarly community has largely ignored the technicalities of inventorying this omnipresent urban chameleon skin. Most monitoring and recording of contemporary graffiti is typically done in a low-tech manner, usually solely through casual snapshot photographs. Often, such documentation records even miss primary data like a graffito's dimensions (Novak, 2014).

This attitude seems odd, knowing that a significant amount of our legacy to future generations relies on proper digital documentation. Whether one can assign something a 'legacy' emblem already in the present might be debatable. Still, if one considers contemporary graffiti to be cultural heritage or worth analysing (which, again, a growing number of the scientific community does), it is time to lift their inventorying above the casual picture-taking. This opinion was also voiced in the past by de la Iglesia (2015), Holler (2014) and Novak (2014, 2015). In addition, the authors of this paper argue that especially their ephemeral character makes documenting and monitoring graffiti worthwhile from an academic and heritage point of view.

Pushing the boundaries of the status quo in inventorying and understanding extensive graffiti-scapes is a major goal of project INDIGO (IN-ventory and Disseminate

G-raffiti along the d-O-naukanal). This two-year project, which launched in September 2021 through funding of the Heritage Science Austrian programme of the Austrian Academy of Sciences (ÖAW), aims to build the basis to systematically document, monitor, disseminate, and analyse a large part of the graffiti-scape along Vienna's central water channel *Donaukanal* (Eng. Danube Canal) in the next decade. INDIGO's goals and the project's research structure were detailed in Verhoeven *et al.* (2022), so this paper will rely on the more graphical overview presented in Figure 1. The 'inventorying' part of INDIGO is divided into two goals (i.e., 'document' and 'archive' all new graffiti) and covered by three different research pillars: the 'acquisition' of all relevant graffiti-related data, their 'processing' and long-term 'management'.

This paper almost exclusively focuses on data acquisition, with a minor coverage of data processing. Four subsequent articles in this volume cover the processing and management aspects in more detail:

- The contributions by Molada-Tebar & Verhoeven and Wild *et al.* focus on the colourimetric and geometric processing of the acquired photographs, respectively.
- Schlegel *et al.* (on the INDIGO thesaurus) and Richards *et al.* (on INDIGO's ontology and database) cover mainly the management pillar. However, their papers still have relevance for the processing part regarding how photographs will get tagged with metadata.

To tackle the long-term preservation challenges of the project's digital data, INDIGO has partnered with the CoreTrustSeal-certified repository ARCHE (A Resource Centre for the HumanitiEs; https://arche.acdh.oeaw.ac.at). These proceedings do not cover ARCHE, but Trognitz and Ďurčo (2018) do. The combination of all these papers indicates how INDIGO wants to provide answers to technical graffiti inventorying issues. In that sense, INDIGO's documentation tools and approaches aid in navigating "the ongoing methodological challenges associated with the study of graffiti and street art" (Ross et al., 2017, p. 415).

The remainder of this paper will first introduce the geographical setting of project INDIGO and cover

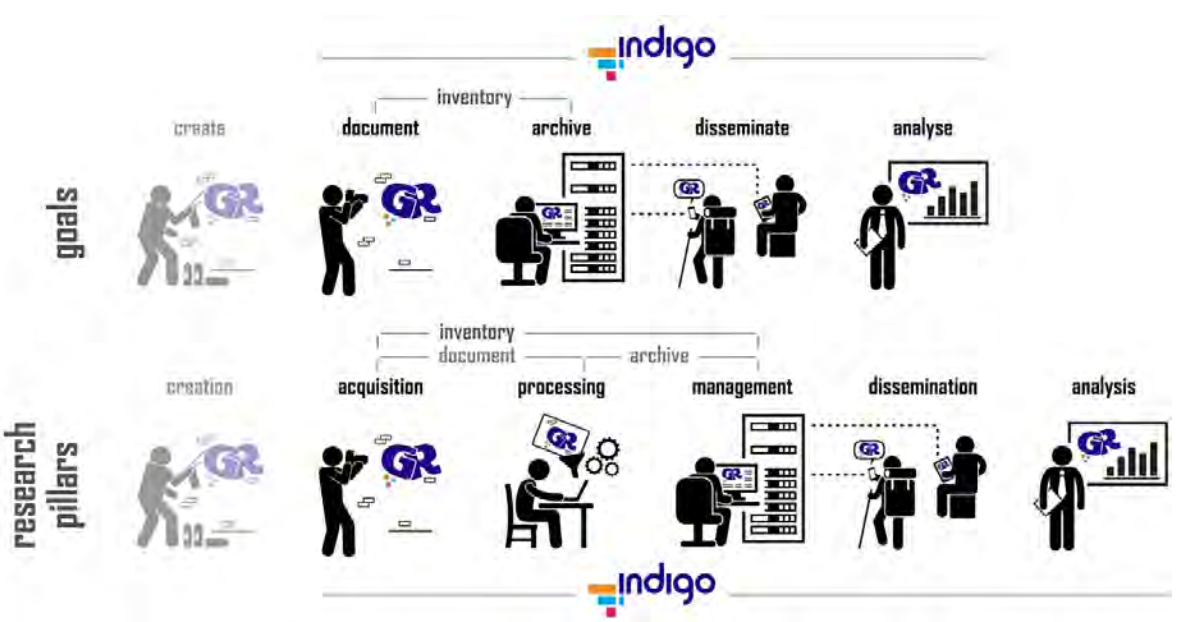



**Figure 1.** A graphical overview of INDIGO's goals and research pillars. Although everything starts with producing a graffito, creating graffiti falls outside the scope of project INDIGO.

the Donaukanal's initial total photographic coverage. Afterwards, the follow-up photography of new graffiti is detailed. Section 4 reveals how INDIGO discovers and monitors new graffiti. This section also details some pathways INDIGO currently explores to alleviate specific monitoring issues.

**2. Establishing a Foundation**

2.1. The Canvas

INDIGO wants to ensure the digital survival of a large part of Vienna's graffiti-scape and disclose new socio-political-cultural insights. Given its size, it would be impossible to consider the entire city of Vienna as the research area. That is why INDIGO focuses on one of Vienna's major touristic and graffiti hotspots: the *Donaukanal* or Danube Canal, a river channel branching from the Danube River in the northwestern part of Vienna. More specifically, the INDIGO project focuses on all public surfaces surrounding this central waterway from the *Friedensbrücke* (Eng. Peace Bridge) in the northwest until the *Verbindungsbahnbrücke* (Eng. Connecting Railway Bridge) in the southeast (see Figure 2).

Although this stretch of Donaukanal amounts to circa 3.3 km when measured in the middle of the waterway, it would be a poor way to quantify the length of all graffiti-covered surfaces researched by INDIGO. One must know that graffitists consider the Donaukanal their canvas. So, every surface on the left and right bank is subject to mark-making practices. [Despite the canvas analogy, please note that INDIGO Does not use adjectives like arty or related nouns such as art and artists when describing graffiti because they carry too much subjectivity]. However, graffiti are not only found left and right, but also above and below the walking surface (Figure 3). Along the channel, people can stroll or bike. The rising sandstone walls connected to this

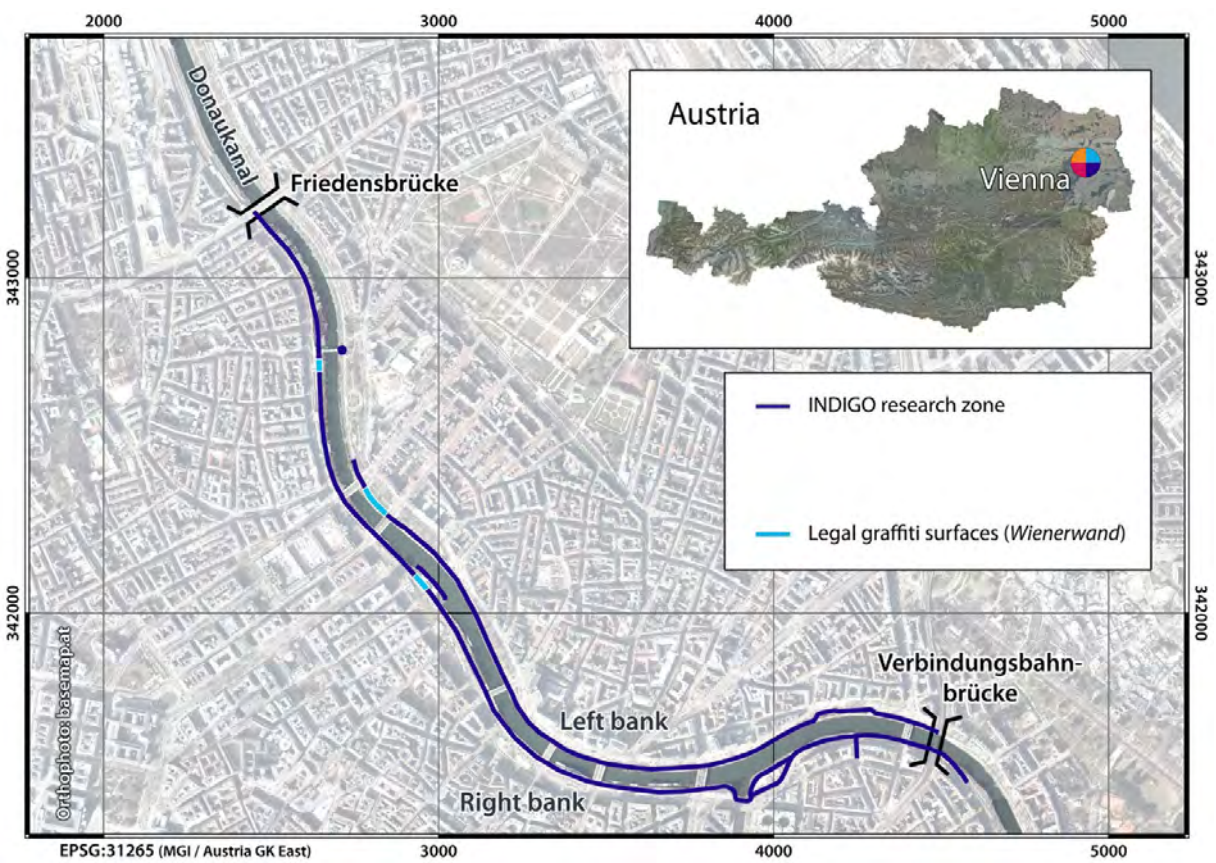



**Figure 2.** All urban surfaces covered by project INDIGO (and the limited number of legal graffiti surfaces in this area).

path are entirely graffiti-covered. However, a large part of the graffiti-scape is located just above the water level on the concrete embankments that contain a large stretch of the channel. When measuring the length of all graffitied surfaces (walls, bridge pillars, staircases) above the walking level, one ends up with 8.5 km. Adding the 4.4 km of graffiti-covered surfaces below the walking surface totals nearly 13 km of continuous urban surfaces that INDIGO monitors.

The INDIGO team is aware that this quantification can be criticised. First, a surface that is 1 km long but only 1 m high contains 50 % less graffiti than a surface only half as long but 3 m tall. However, because the height of these Donaukanal surfaces is so wildly varying, quantifying the total area of this graffiti-scape would be rather challenging. Second, in this assessment, one could disapprove of the split between the lower and upper stretches of urban surfaces. The reason for this division is that both parts necessitate different recording approaches. Compared to the rising walls beside the walking area, the channel's embankment must be photographed with another camera setup and from the opposite side of the channel. This different surveying approach was the justification for the presented quantification of the surfaces monitored and photographed by the INDIGO team.

Within this entire graffiti-scape, graffiti are only legal in three small areas which combined make up less than 300 m (see Figure 2). These three legal stretches are part of Vienna's *Wienerwand* (Eng. Viennese wall), a joint label given to the 22 legal graffiti zones in the city (see https://www.wienerwand.at). A relief plate at the beginning and one at the end delimits every *Wienerwand* zone. This plate shows a stylised pigeon (by Thomas Mock / KERAMIK) which symbolises graffiti creators: numerous in a city but often similarly ignored or unwanted (Figure 4).

2.2. Towards a Digital Backbone Via a Total Coverage Survey

INDIGO aims to document the majority of new graffiti created in this long, bendy and diverse research zone via thousands of photographs that digitally encode the stratified graffiti-scape. Highly processed versions of these photographs will end up in a spatial database that feeds

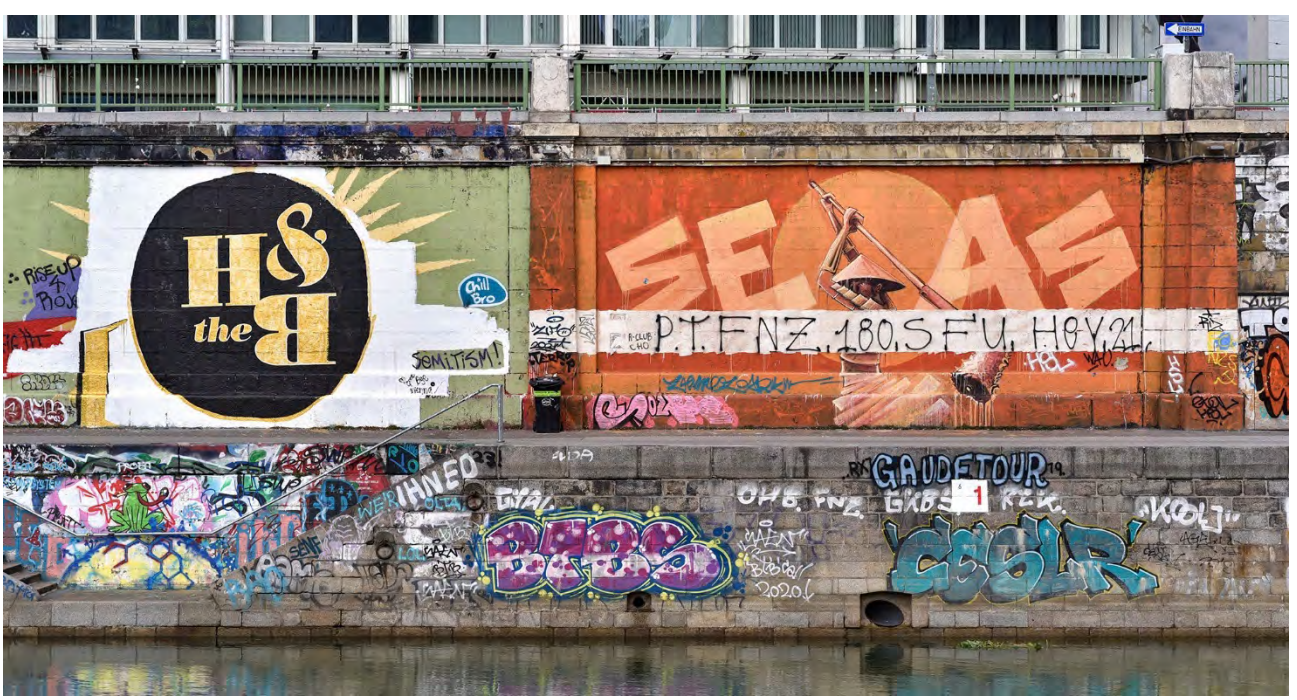



**Figure 3.** The surfaces that bear graffiti are located above and below the walking and biking area flanking the Donaukanal.



**Figure 4.** Four *Wienerwand* - limiting relief plates. They inevitably become part of the Donaukanal's graffiti-scape.

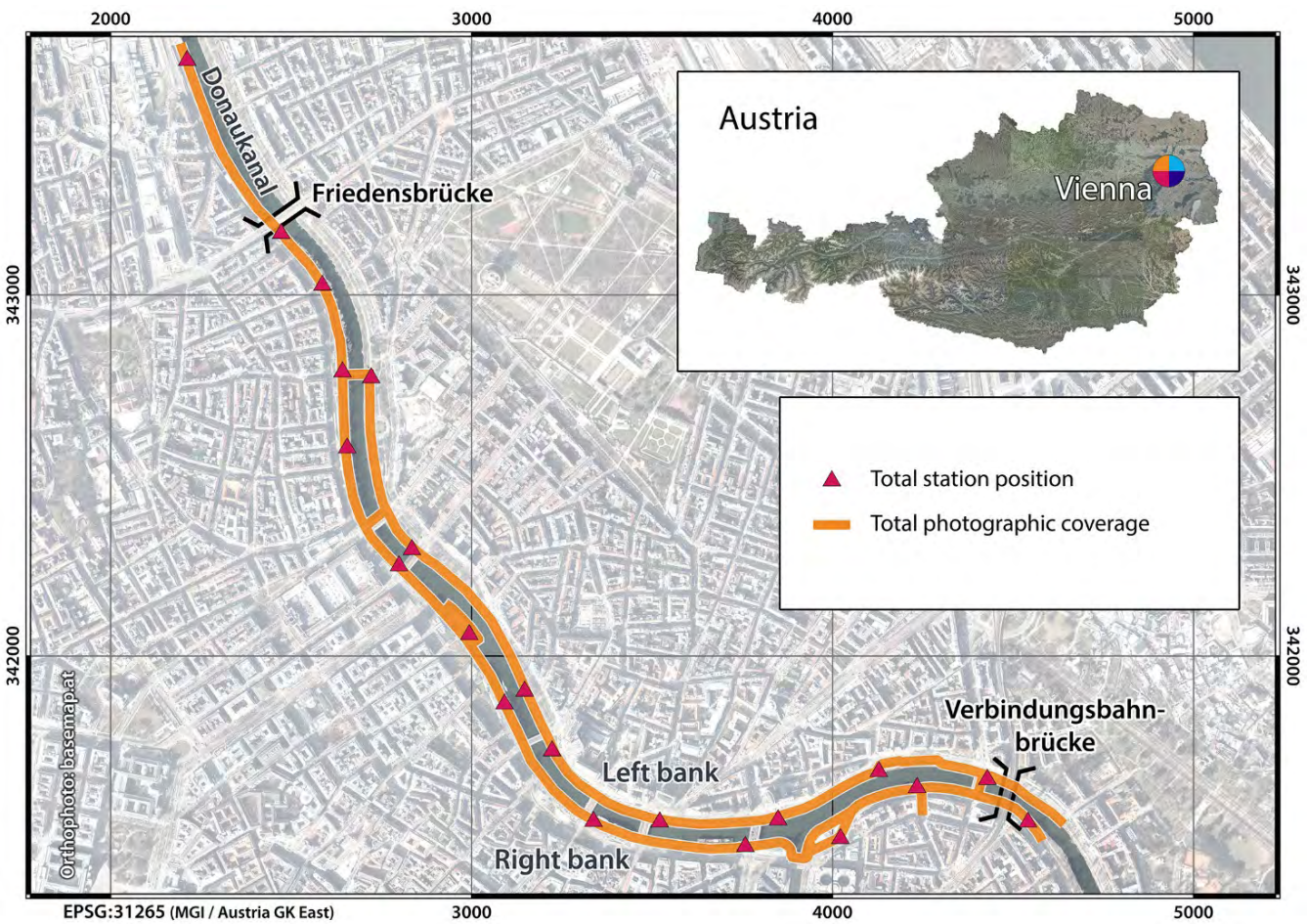



**Figure 5.** INDIGO's 2021 total coverage zone and the total station positions from where graffiti-scape points were measured.

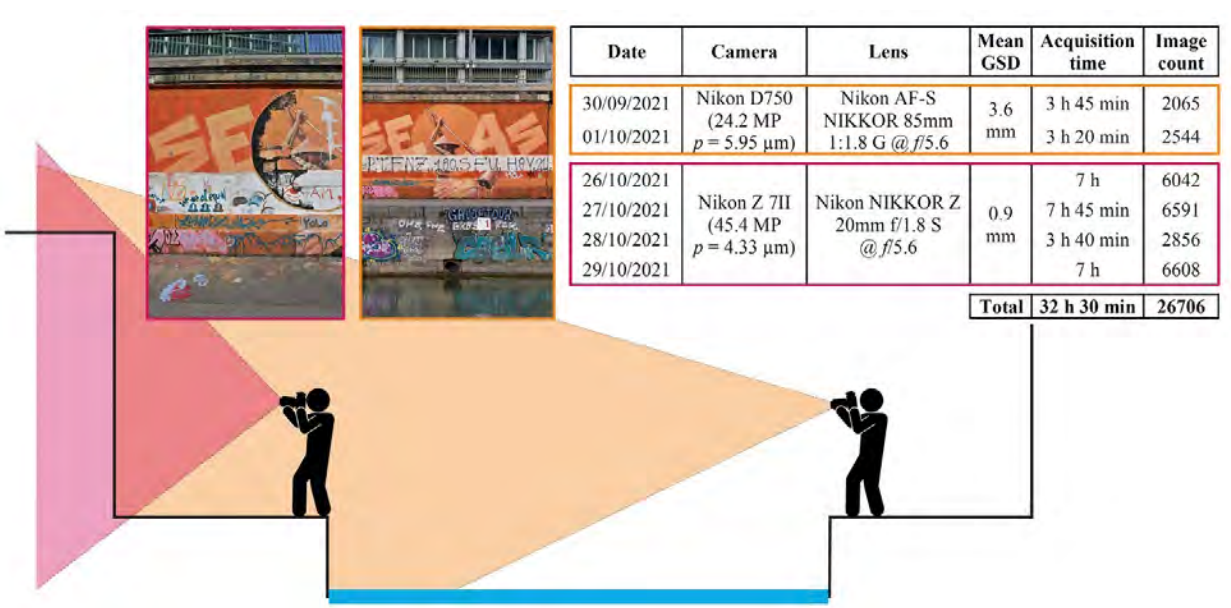
an online platform where users can freely and virtually visualise and query all graffiti records. To provide clean and relevant data for the spatial database and online platform, three-dimensional (3D) surface geometry of the Donaukanal, photographs of the graffiti, and auxiliary data must be acquired. The 3D digital surface is vital to remove the geometrical photo deformations (see the paper by Wild *et al*. later in this volume). It is also the backbone onto which graffiti photos will be mapped for the online display.

In October 2021, a zone slightly exceeding INDIGO's research area (Figure 5) was photographed for six days in a 'total coverage' image acquisition campaign. An illustration of the total coverage procedure and all relevant photographic data can be found in Figure 6 (note that the final extent of the research zone was only established after this total coverage survey). In the first two days, the channel's embankments were photographed at a time when the water level was very low. Photos from the left bank's wall were captured from the channel's right bank and vice versa (everything related to this acquisition is depicted in orange in Figure 6). During the last four days, all other surfaces were photographed (indicated with pink in Figure 6), generating 26.7k photographs altogether.

These photographs—and all the others taken within the framework of project INDIGO—should follow two basic guidelines established at the project's start to simplify data processing and yield uniform outputs:

- Photos should ideally be shot with the same camera-lens combination;
- Photos should feature a Ground Sampling Distance (GSD) of 1 mm or smaller. GSD is measured on the surface of the imaged object; it states the horizontal or vertical scene distance between two image pixels, which makes it one of the key factors determining the final spatial resolution of an image. Without considering all other contributing factors, it is possible to say that the spatial resolution of an image is roughly twice to three times the photo's GSD (Verhoeven, 2018).

So far, nearly all INDIGO's photographs feature a sub-1



| Date | Camera | Lens | Mean GSD | Acquisition time | Image count |
|---|---|---|---|---|---|
| 30/09/2021 | Nikon D750 (24.2 MP $p$ = 5.95 µm) | Nikon AF-S NIKKOR 85mm 1:1.8 G @ $f$/5.6 | 3.6 mm | 3 h 45 min | 2065 |
| 01/10/2021 | | | | 3 h 20 min | 2544 |
| 26/10/2021 | Nikon Z 7II (45.4 MP $p$ = 4.33 µm) | Nikon NIKKOR Z 20mm f/1.8 S @ $f$/5.6 | 0.9 mm | 7 h | 6042 |
| 27/10/2021 | | | | 7 h 45 min | 6591 |
| 28/10/2021 | | | | 3 h 40 min | 2856 |
| 29/10/2021 | | | | 7 h | 6608 |
| | | | Total | 32 h 30 min | 26706 |

**Figure 6.** The total coverage photographic survey took place during two and four consecutive days at the start and end of October 2021, respectively. Both survey moments also utilised a different camera setup and acquisition strategy. This illustration uses orange (for the first two days) and pink (for the last four days) to indicate all the relevant data, the photographer's position and a sample photo of both photographic campaigns. Note that the photo with the orange outline is cropped for layout purposes. Figure 3 shows the entire image.

mm GSD and a 45-megapixel full-frame mirrorless Nikon Z7 camera plus a Nikon NIKKOR Z 20mm f/1.8 S lens were used to capture them. A 24-megapixel full-frame Nikon D750 reflex camera was used only during the first two days of the total coverage survey due to a delay in shipment of the Nikon Z7 II. The combination of the larger distance *p* between the light sensing elements of the D750's imaging sensor (see the table in Figure 6) with the 40 m or longer object distance meant that the GSD of the first 4600 photographs exceeded 1 mm. Given the circumstances, this larger GSD is a non-ideal but reasonable compromise.

Using techniques from the photogrammetric and computer vision fields (more specifically, Structure from Motion or SfM), it was possible to determine the camera's position and angular rotation for all 26.7k acquired photos (see Figure 7). In addition to these so-called exterior camera orientations, the SfM algorithm also derives the camera's interior orientation parameters: a handful of variables that describe the camera's internal geometry (see Figure 7 for an example). However, there is one problem with the approach mentioned above: the output of an SfM algorithm is expressed in an arbitrary coordinate reference system, meaning that the estimated positions and rotations of the 26.7k camera stations are only correct in a relative sense; they are equivalent to their real-world values up to a global scaling, rotation and translation factor. The SfM output was embedded in a real-world coordinate reference system via a dense network of over 600 Graffiti-scape Points (GPs), measured during a multi-day total station surveying campaign (Figure 8). These GPs are object/scene points well-identifiable in many photos (even when potentially sprayed over) and whose long-term positional stability can be assumed (Figure 8, inset). Their coordinates were determined from one of the 21 total station locations that INDIGO established along the Donaukanal (see Figure 5). After indicating these 100s of GPs points in many thousands of photos, the SfM output could be rotated, scaled, and translated so that the exterior orientation of all camera stations got accurately expressed in the MGI/Austria GK East coordinate reference system (EPSG:31256). For more technical details on the acquisition and SfM processing of these data, please consult Verhoeven *et al.* (2022).

Having a large set of total coverage photos, plus the

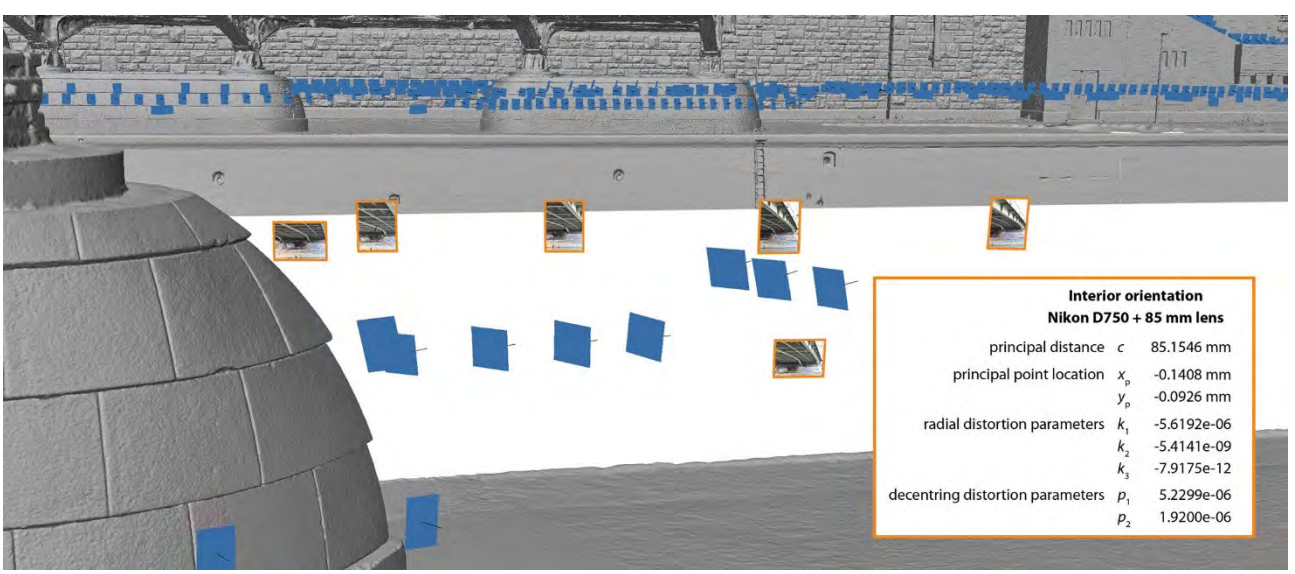



**Figure 7.** A portion of the polymesh digitally representing the solid surfaces along the Danaukanal. Note that the water surface cannot be extracted from the photographs. The blue rectangles visually represent the exterior orientations of the camera stations. At the camera stations featuring an orange outline, a photo was captured from the opposite bank with a Nikon D750 camera plus an 85 mm lens. Those photos are shown inside the orange strokes, while the lower right inset provides the parameters describing the interior orientation of this camera-lens combination.

associated absolute positions and rotations of the camera when it acquired these photographs, serves three essential purposes:

- First, all pieces of necessary data are available to generate a digital 3D model that encodes the geometry of all solid surfaces along the Donaukanal. This is achievable via Multi-View Stereo (MVS), another photogrammetric computer vision technique. When given a set of photos for which the image overlap is substantial and the GSD small enough, an MVS algorithm can produce a hole-free digital 3D surface representing fine geometrical features. Since this case meets both requirements, the well-known SfM-MVS software package Agisoft Metashape Professional could generate a continuous 3D surface in the form of a triangular polymesh, one of the prevalent representation schemes for such 3D models (Figure 7). Since INDIGO's envisioned online platform should offer virtual walks along the Donaukanal, this digital 3D surface model will form its geometric backbone.
- Second, these photos create a graffiti status quo. They constitute a complete record of the graffiti-scape at a particular moment, thus effectively establishing INDIGO's starting point for tracking change in the graffiti-scape.
- Third, those data enable the efficient processing of new graffiti photographs. Within INDIGO, all graffiti photos acquired after the total coverage survey are processed into two end-products: geometrically corrected orthophotos and textures for the 3D surface model. Although the contribution by Wild *et al.* in this volume provides more details on this, it now suffices to know that the generation of both products requires knowledge about the exterior orientation of the camera stations. With a technique known as incremental SfM, previously computed exterior orientations can be leveraged to significantly speed up the SfM-based processing of a new photo set.

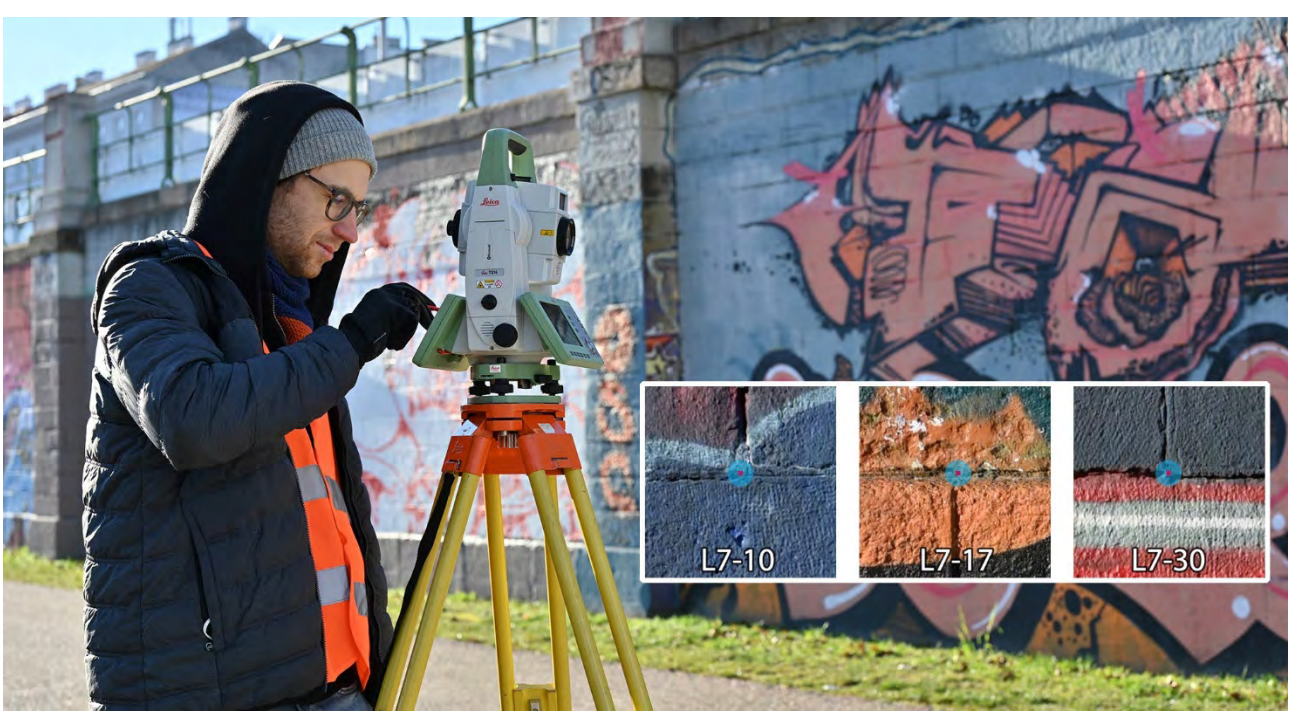



**Figure 8.** Operating the Leica Viva TS16 total station. The inset on the lower right displays three typical GPs.

However, the generation of 3D model textures and orthophotographs using incremental SfM and MVS only functions well if those new photographs are acquired according to specific rules. That is why the next section will focus on the photographic activities that followed the total coverage survey (the so-called 'follow-up surveys'). Afterwards, part four will provide more details on the graffiti monitoring strategy.

**3. Recording New Graffiti**

3.1. Follow-up Photography

3.1.1. Hardware

INDIGO relies on three photographers to photographically document new graffiti (the first three authors of this paper), although Stefan Wogrin does most work. These photographers have a pool of various hardware available (see also Figure 10):

- two identical imaging systems
- two ColorChecker Passport Photo 2 colour reference targets by X-Rite (now produced by Calibrite and hereafter referred to as ColorChecker)
- two Solmeta GMAX GNSS (Global Navigation Satellite System) receivers
- two Sekonic C-7000 SPECTROMASTER spectrometers
- two Samsung Galaxy Tab A7 Lite tablets.

All devices of the same type are labelled "A" and "B" to distinguish them. Device B is always set up identically to device A. For example, the tablets run the same apps, and all settings of both spectrometers match. How these devices are incorporated into the data acquisition workflow will be explained after some details on the imaging system.

INDIGO relies on two Nikon NIKKOR Z 20mm f/1.8 S lenses paired with a full-frame mirrorless Nikon Z7 II camera generating 45-megapixel photos. The Solmeta GNSS receiver is attached to the camera's hot shoe and directly writes geographical coordinates into the photo's Exif metadata. Both cameras feature the same settings. This not only enforces identical results (from a technical point of view) across imaging systems; it also ensures that the camera-related photo properties are appropriate for INDIGO's colourimetric and geometric processing pipelines. For instance, both cameras capture 14-bit lossless compressed RAW photos next to in-camera generated JPEGs. A relative lens aperture of *f*/5.6 provides a sufficient depth of field for all images while ensuring that the 20 mm lens operates at its maximum uniform resolving power. Vibration reduction is deactivated since it can seriously jeopardise SfM-MVS-based processing (Nocerino et al., 2022). However, even without vibration reduction, sharp photos are almost guaranteed because the cameras will never drop the shutter speed below 1/400 s. If this is about the happen, the camera's ISO value (a metric which expresses the sensitivity of the sensor to incoming light, as standardised by the International Organization for Standardization) is automatically cranked up from its class-leading base ISO of 64.

Both cameras also have back-button focusing activated. Out-of-the-box, the shutter release button of virtually any photo camera combines two tasks: focusing and capturing the picture. This means that a camera will automatically refocus for every photo it collects. Although such changes in focusing distance might be tiny (for example, when acquiring several photos of a graffito on a flat wall), variant focusing distances are best avoided in SfM-MVS-based processing pipelines (Luhmann et al., 2016). Since all photos of a specific graffito are processed together, there is a need to have solely one focusing distance. A possible solution is to use autofocus only for the first image and deactivate the autofocus for the remaining graffito photos. When documenting the following graffito, autofocus is switched on for the first image and deactivated from image two onwards etc. One could also keep the shutter-release button half-pressed after the first image (the first half-press engages the autofocus). Or capture all images via manual focus, whereby the photographer retains the manually determined focus setting for the first photo throughout the remaining image acquisition). However, all these approaches are cumbersome and prone to various mistakes.

Back-button focusing provides a neat solution for this issue since it transfers the auto-focusing part to a dedicated button on the camera's back (often an AF-ON button for advanced cameras—Figure 9A). Now, the photographer

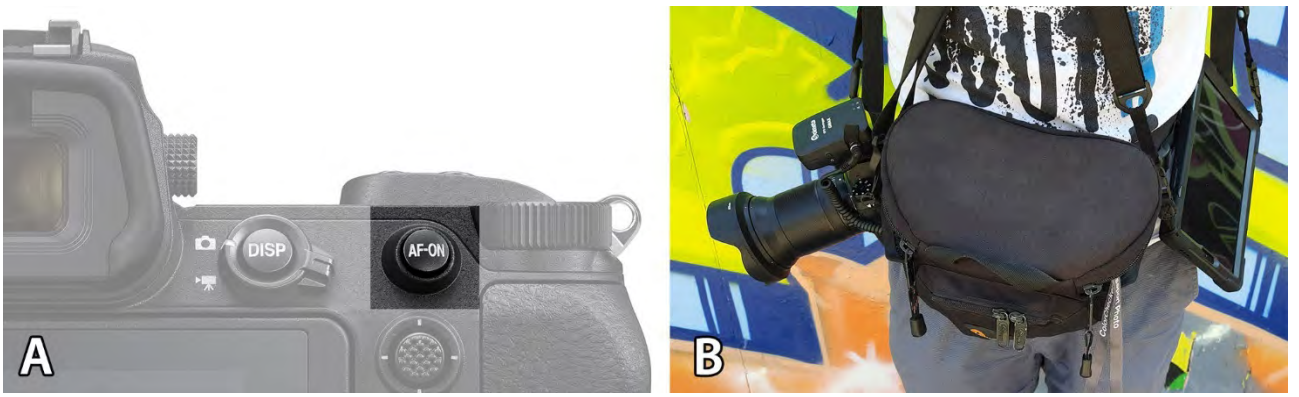



**Figure 9.** (A) The AF-ON button on the back of the Nikon Z7II. (B) shows one possible combination of carrying all hardware during a follow-up photography tour: the camera and tablet (in a protective case) feature a camera strap worn diagonally over the body, while a pouch carried in front holds the colour reference target and the spectrometer. The pouch protects these sensitive instruments without compromising easy access.

presses this AF-ON button once at the start of the photo series to focus correctly. All photos of that graffito are then captured via the shutter release button, which no longer commands the autofocus module. For the following graffito, the AF-ON button is pressed once more to obtain perfect focus, and image acquisition can start again. The depth of field generated by the *f*/5.6 aperture ensures that all parts of a graffito are depicted sharp, even if the camera-to-graffito distance varies a bit throughout the acquisition.

Camera (including lens and GNSS receiver), tablet, ColorChecker reference target and spectrometer must all be carried by the photographer. Although a duo executed some data acquisitions, the INDIGO team can choose between various camera straps, photo belts, backpacks, camera gear pouches and tablet cases to accommodate different strategies for operation by one individual (Figure 9B). Of this whole gear kit, one of the most delicate devices to handle is the ColorChecker. Since contact with sweat, dirt, water or even a finger will render the coloured patches of this target useless, the ColorChecker must always be stored, opened and closed with considerable caution.

3.1.2. Data Acquisition Workflow and Initial Processing

Figure 10 illustrates how these devices come together in the data acquisition 'follow-up' workflow. When starting a tour along the Donaukanal for follow-up photography, the photographer first checks the online map that displays locations with new graffiti (see part 4). The photographer then moves to the nearest new graffito and starts the data acquisition procedure.

First, a photo is acquired after focusing the camera on the ColorChecker reference target. The Colorchecker must be held in the same illumination as the graffito to be photographed. In other words, if the graffito is in the shade, so must be the colour reference target when it gets photographed. The same principle holds for the measurement with the spectrometer, which is acquired afterwards and contains the illumination's entire spectral power distribution. Both pieces of data are used in the colourimetric processing package COOLPI (see Molada-Tebar & Verhoeven in this volume) to achieve accurate colours for the graffito photographs that follow (see later). Usually, the spectrometer file is used, with the ColorChecker image as a backup in case the former would not be there (instrument or measurement forgotten, data corrupt etc.).

In addition, the ColorChecker photo serves two other purposes. It allows dividing all the images from one follow-up photo tour into graffito-specific subseries. Imagine that a follow-up tour yields 1000 photos, of which 25 are of a ColorChecker. INDIGO uses a MATLAB-based script that automatically detects these ColorChecker images (based on the short focusing distance) to subdivide the entire photo set into 25 subseries, each containing all photographs for a given graffito. Third, the ColorChecker photo is essential

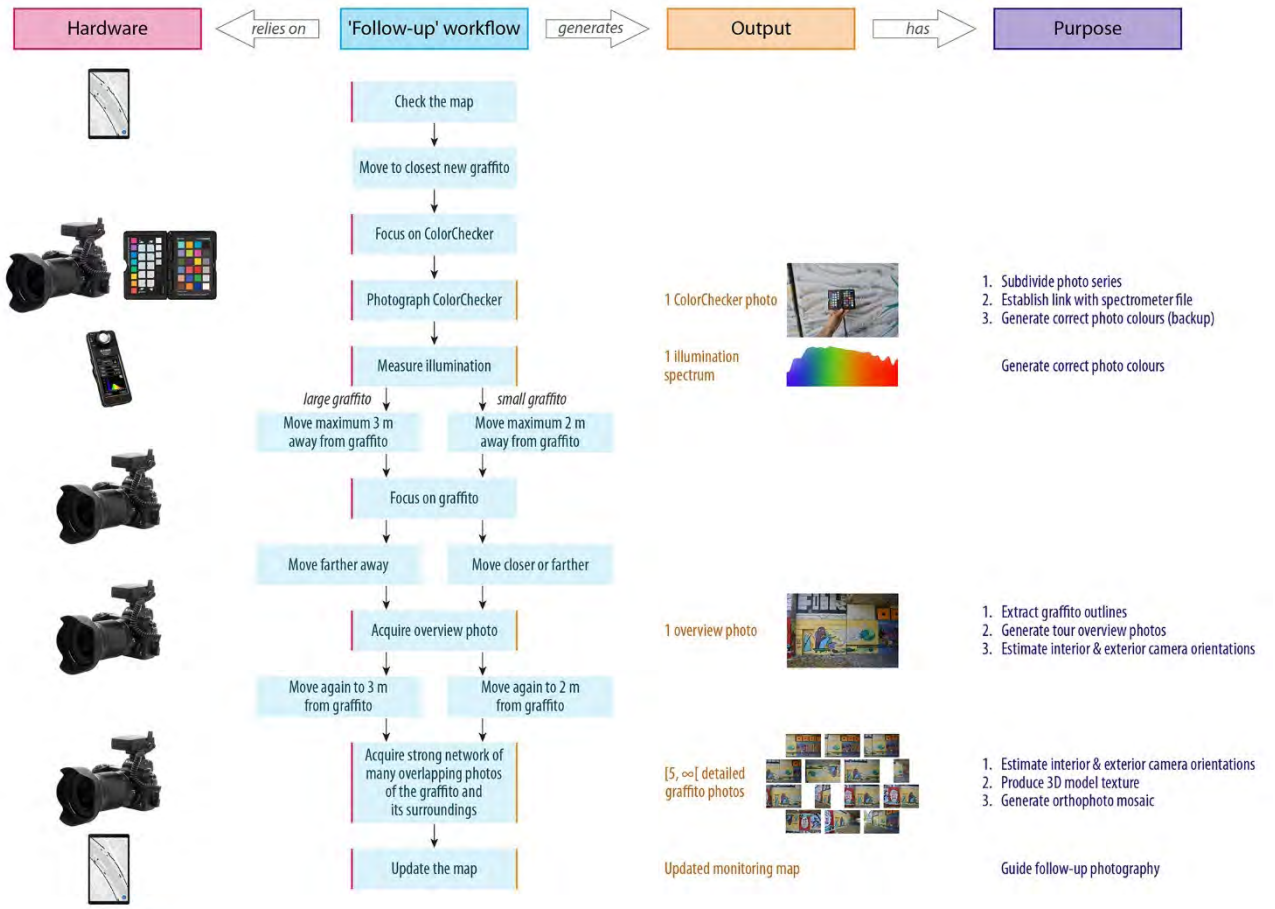



**Figure 10.** Follow-up photography workflow for a new graffito. The illustration indicates the hardware needed and the purpose(s) of the generated outputs.

to solve potential problems in assigning the spectrometer files. The Sekonic C-7000 SPECTROMASTER does not store something trivial like the date and time of data acquisition. Personal communication with Sekonic clarified that one should not expect this feature in a future firmware update either. Without date and time, one must rely on other means to unambiguously assign a given spectrometer file to a graffito. One could photograph the spectrometer's screen or write down the file number, but this slows down the entire acquisition process and is not error-proof either.

Currently, INDIGO solves it via additional checks in the MATLAB script mentioned previously. Besides counting the ColorChecker images, the script also checks the count of spectrometer files. If both numbers are identical, the script assumes that the fifth spectrometer file belongs to the graffito photos acquired directly after ColorChecker photo five. To solve cases with file count mismatch, the script compares the accurate Correlated Colour Temperature or CCT from the spectrometer file with a CCT value calculated from the ColorChecker photo. If the ColorChecker photo and spectrometer measurement were acquired properly, both values should be relatively close, thereby establishing a link between the respective datasets.

After the spectrometer measurement, it is time to photograph the graffito. This process must account for several prerequisites: the photographs should be

appropriate for SfM-MVS processing, photos should feature enough spatial detail, and the whole acquisition should not take longer than necessary. First, the photographer stands approximately 3 m from the graffito and looks through the viewfinder. Suppose the graffito extends beyond the camera-lens field of view (i.e., what is seen through the viewfinder). In that case, the lens can be back-button-focused on the graffito. This choice is represented by the left part of the blue workflow steps in Figure 10. If the graffito is identical to, or smaller than, the field of view at 3 m, the photographer moves 1 m closer to the graffito and then focuses the lens using the back-button focusing technique (i.e., the right side of the workflow steps in Figure 10).

At this point, the lens' focus should remain invariant for the entire photo acquisition of this graffito. For longer photo acquisitions (like the total coverage tours), the lens' focusing ring would now be immobilised with cellophane tape (Verhoeven et al., 2022). Since this is impractical for the many graffito-specific acquisitions that occur in one follow-up tour (because it would mean taping the lens for every graffito and then removing the tape again for the next one), not touching the back-button focus nor the lens focusing ring works equally well. With the focusing distance fixed, an overview photo is acquired from either farther or closer than the focusing distance. This photo is important for three reasons. First, its camera-to-graffito object distance is quite a bit smaller or longer than the photos that will subsequently be acquired from either 3 m or 2 m. This variation in image scale is vital for a good interior and exterior camera orientation estimation during the SfM step (Nocerino et al., 2014). Second, INDIGO wants to create a digital vector file that represents a graffito's border. It is anticipated that segmenting a graffito from its surrounding graffiti-scape is best done on such an overview photo. Third, a downscaled version of these overview images is ideal for generating photo tours via MapHub (https://maphub.net/projectINDIGO/Photo-tours).

Once the overview image is captured, the photographer moves back to the virtual 3 m or 2 m mark and collects a set of largely overlapping photos while walking parallel with the surface that bears the graffito. Ideally, this image set forms a geometrically strong camera network, achievable by including portrait- and landscape-rotated images collected with the optical axis perpendicular and inclined to the graffito surface (Luhmann et al., 2016). After some finetuning in the first project months, most graffiti recorded by INDIGO are now covered by roughly eight to twenty photographs (sometimes only around five photos for a small graffito). Although more photos are always beneficial to counteract interior orientation instability effects (Fraser, 2013), the INDIGO photographers have to balance costs versus benefits in each case. In addition, the results from our orthophoto pipeline (see Wild et al. in this volume or Wild et al. (2022)) testify to the SfM-MVS appropriateness of the hitherto collected image sets.

Together with the overview photo, this collection of images constitutes the entire photo set that forms the input for the graffito-specific SfM-MVS-based geometric processing pipeline. Once all images are oriented, the overview picture gets deactivated to prevent its much larger or much smaller GSD from impacting the uniformity of the 3D surface model, its corresponding texture and orthophoto mosaic. Overall, the outlined approach enables the production of orthophotos with the agreed-on 1 mm raster cell size because photos feature a GSD of 0.7 mm when shot at the 3 m mark. At 2 m, the GSD drops to a much smaller-than-usual 0.4 mm GSD, enabling the production of more detailed orthophotos if needed. The authors find it important to have this possibility for small graffiti, as they might feature smaller relevant details than their bigger counterparts. To get a feeling for the GSD needed to spatially resolve specific graffito details, Figure 11 depicts a sprayed whale eye as imaged with the same camera-lens combination from different object distances.

As a final step in the workflow, the monitoring app gets updated on the tablet (see section 4.1), and the photographer moves to the next spot with a new graffito. At that point, the entire procedure is repeated.

### 3.2. Recording Improvements

Since the start of the follow-up photograph at the beginning of November 2021, the data acquisition workflow has witnessed several significant and minor changes. Initially, there was no spectrometer available; the 3 m or 2 m

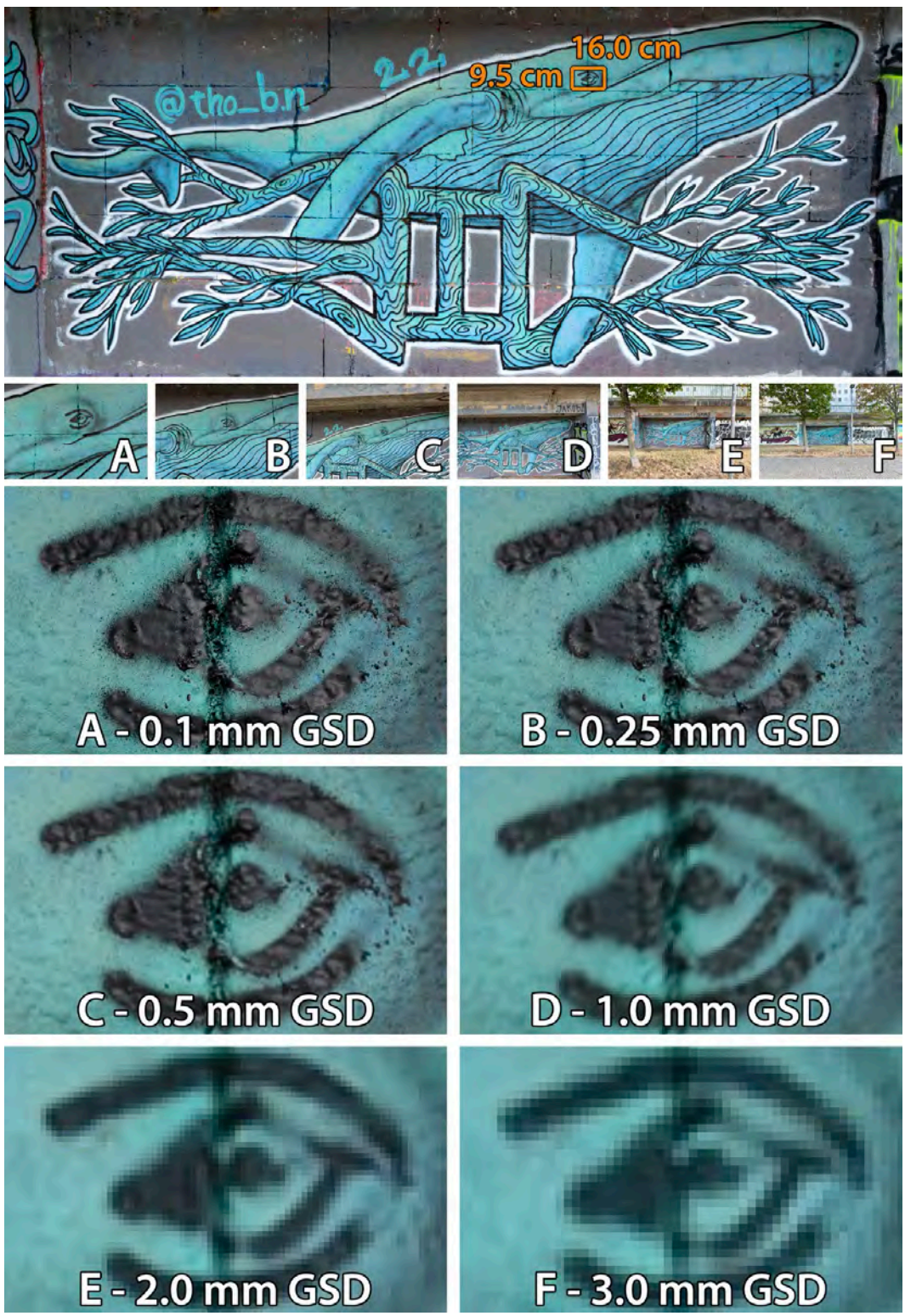



**Figure 11.** One graffito (top inset) is photographed with a Nikon D750 and a 20 mm lens from 0.34 m (A), 0.84 m (B), 1.68 m (C), 3.36 m (D), 6.72 m (E) and 10.08 m (F). This leads to highly varying GSDs and perceivable spatial details in the photos.

object distances were less rigorously followed, and the overview photo was sometimes acquired after the dense photo network. One could argue that the latter would save a bit of time, but collecting an overview image at the end made it easier to forget. Even now, minor mistakes occur. Photographing two or more hours in a strict regime while juggling various hardware makes it easy to lose focus. Working on days with extreme temperatures or when in a rush does not help either. Besides thin gloves on frigid days, there is little potential improvement for these matters.

Nevertheless, INDIGO still sees room for serious advancement in acquiring accurate coordinates for the camera stations. At this moment, a Solmeta Geotagger GMAX is mounted on the camera. This unit uses the American GPS and Chinese Beidou satellite constellation to compute the camera's location with a precision of about 2.5 m (at one standard deviation). In ideal scenarios, this precision can be reached because the unit uses the correction signals broadcasted by the satellite-based augmentation systems WAAS (Wide Area Augmentation System; for the USA), EGNOS (European Geostationary Navigation Overlay Service; for Europe) and MSAS (MTSAT Satellite Augmentation System; for Japan) (GPS-Camera, 2016). The estimated geographical latitude, longitude, and altitude values are—together with camera heading or yaw angle (see below)—written into the Exif metadata of the RAW and JPEG files. These values are leveraged in the incremental SfM workflow for computational speed improvements (see Wild *et al.* (2022)). In addition, the GNSS receiver logs its position every second; this yields a long text file with NMEA 0183 strings (a communication standard set by the National Marine Electronics Association) that can be transformed into a vector track for displaying the photographer's entire path of that follow-up tour.

However, the Solmeta device has two major disadvantages. First, the logging works unreliably and sometimes stops for unknown reasons. Second, the device does not make it straightforward to retrieve the camera's complete and accurate exterior orientation. A camera's complete exterior orientation is specified by its position and angular direction in space. The former is defined via the three coordinates ($X_O$, $Y_O$, $Z_O$) of the projection centre *O*, while the direction is described by the rotation angles roll, pitch, and yaw around the *X*, *Y*, and *Z* axes of the scene's coordinate reference system (Kraus, 2007). The Solmeta writes four of the six parameters in the image metadata. Still, the essential pitch and roll camera angles can only be found in the NMEA log files since even the latest Exif specification 2.32 did not foresee metadata tags for them (Camera & Imaging Products Association, 2010-2019). Although the authors have experience with the automated processing of such NMEA log files, previous research on a similar Solmeta GNSS receiver revealed that those rotation angles are not very accurate and often suffer from significant outliers (Verhoeven et al., 2013; Wieser et al., 2014). To have the incremental SfM optimally leverage such *a priori* information about the exterior orientation, it helps if the latter closely approximates the correct values.

Based on previous experience (Doneus et al., 2016), the INDIGO team has developed a device to record the camera's




**Figure 12.** The new RTK-enabled GNSS logging device (left and middle) with the interface controlling its settings (right).

exterior orientation (Figure 12). Built from commercially available but cost-effective components in a 3D-printed housing, this device also connects to the hot shoe on top of the camera. It receives a Real-Time Kinematic (RTK) GNSS correction from the Austrian EPOSA service (*Echtzeit-POSitionierung-Austria*, Eng. real-time positioning Austria), for which the settings get wirelessly controlled from the tablet or any smartphone (Figure 12). Although a thorough assessment of this device and its integration with INDIGO's geometric photo processing workflow will be reported in a future paper, first tests have indicated the potential to obtain centimetre-accurate coordinates and sufficiently correct rotation angles for each camera station. In addition, there should be no issues with logging the camera path.

Finally, the INDIGO team is also checking the feasibility of carrying one or two more lenses besides the 20 mm lens. In the whole Donaukanal graffiti-scape, three types of locations prove hard to photograph properly. Some bridges have pillars so close to the water (Figure 13A) that it is challenging to photograph the water-facing parts with the field of view generated by the 20 mm lens (Figure 13D1–D4). Moreover, the photographer is forced to operate at the edge of the walking surface, creating a rather dangerous situation.

Similarly challenging photographic documentations take place in the small sections with staircases that are part of the channel's concrete embankment (Figure 13B and C). New graffiti frequently appear on the vertical surface between these staircases, so INDIGO should record them. It would be more convenient and safer to photograph both surface types from the other side of the channel with a much longer lens (Figure 13E). Or, one could stay on the same side and use a much shorter focal length lens. Although INDIGO has conducted tests with the rather unique but excellent Samyang XP 10mm F/3.5 wide-angle lens (Figure 13F1–F2), either solution is suboptimal as one needs to carry extra glass. In addition, changing lenses lengthens the acquisition time and always risks getting dirt on the imaging sensor.

These are also two reasons why the Nikon NIKKOR Z 50mm f/1.8 S lens is seldom taken along. This 50 mm lens was bought for the follow-up photography of new graffiti just above the water level on the concrete embankment walls (being the third problematic surface—Figure 13B). Although 50 mm is too short to deliver the sought-after 1 mm photo GSD when photographing from the channel's opposite side, the lens's size and mass made it seem a good trade-off between 'what is needed' and 'what can be easily carried along'. Because of obvious logistical challenges, these walls are marked much less frequent than the walls above the walking surface. So rather than taking the extra 50 mm lens along during the usual follow-up tours, INDIGO plans to cover these walls exhaustively during a second total coverage survey in October 2022. Given the minor change in this part of the graffiti-scape, this should suffice to record the bulk of new graffiti.

Rather than using the previously described setup (a Nikon D750 camera plus 85 mm lens), the second total coverage survey will cover the lower walls with the Nikon Z7II plus a Nikon NIKKOR Z MC 105mm f/2.8 VR S lens (also used for Figure 13E). Although the longer focal length (and corresponding smaller field of view) of this lens will result in more photographs and a prolonged total coverage survey of these directly-above-water surfaces, the final GSD will drop from the initial 3.6 mm in 2021 to 2.1 mm in 2022. Only a 220 mm lens would yield the ideal 1 mm GSD. However, acquiring images along many kilometres with such long-focus lenses is not straightforward. Note that INDIGO's project proposal mentions four total coverage tours; however, their scheduling assumed a specific monitoring tactic. The next session will provide more details on INDIGO's current and future monitoring strategies.

## 4. Monitoring New Graffiti

### 4.1. New Graffiti Discoveries

INDIGO's current monitoring approach centres around two apps for the tablet or smartphone: ESRI's ArcGIS Field Maps and Instagram by Meta Platforms. ArcGIS Field Maps is an application that relies on ESRI's main Geographic(al) Information System (GIS) ArcGIS to offer users a convenient way of collecting and editing geospatial data in the field. The app runs on INDIGO's tablets which support 4G LTE (fourth generation Long Term Evolution), so data can be stored and retrieved from the cloud 24/7. In this way, all data in the app are instantaneously available to the three photographers, wherever and whenever they have internet access.

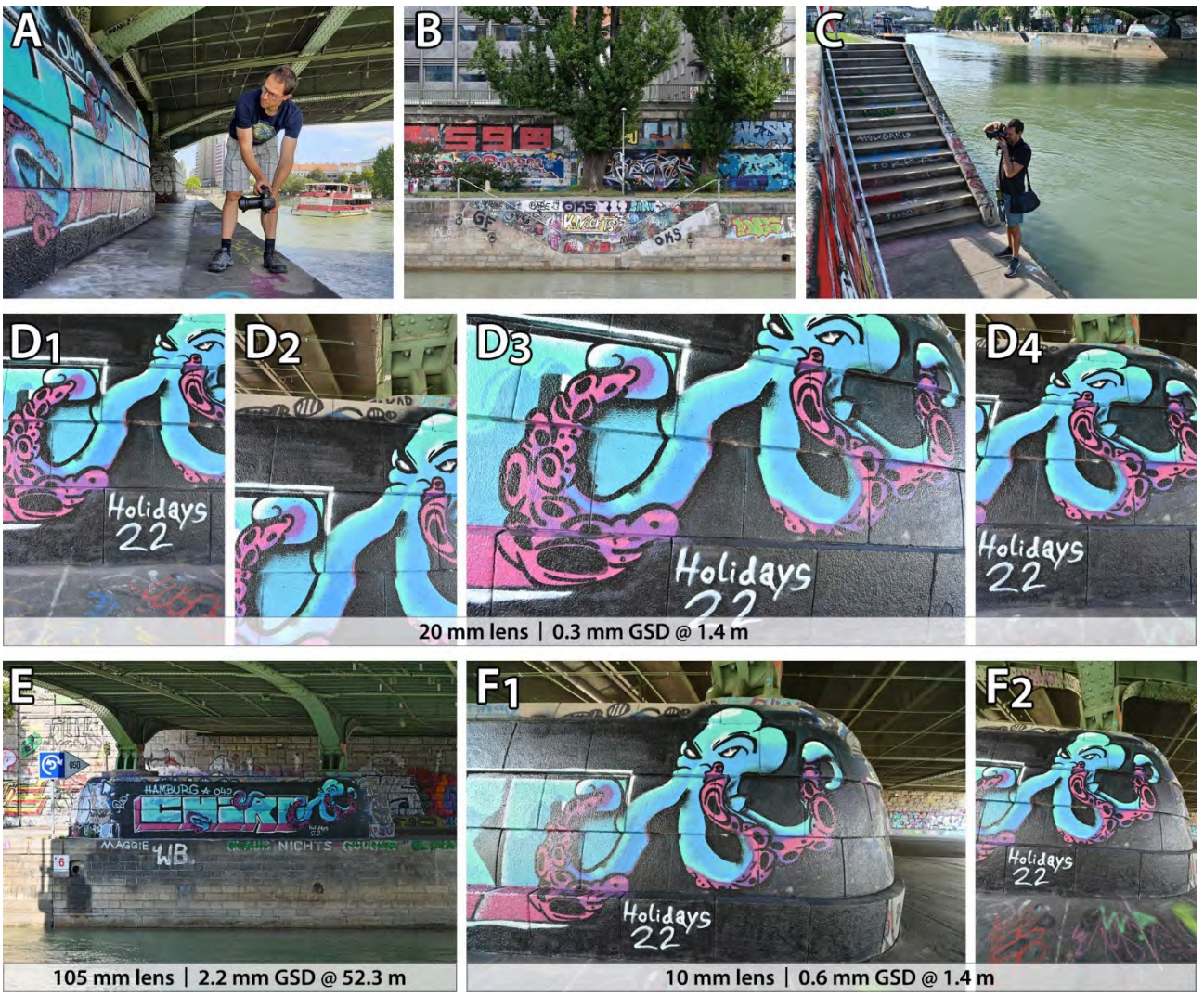



**Figure 13.** Three surfaces that are difficult to photograph appropriately. A) water-facing parts of some bridge pillars with only 1.5 m of manoeuvring space until the embankment edge; B) embankment surfaces just above the waterline and (together with C) narrow staircases embedded in these embankments. The current solution is photographing cases A and C with a 20 mm lens. Insets D1 to D4 show some results of the bridge pillar in A. Note that the camera is usually held vertically in a low position (like A and resulting in D1) and then lifted to yield D2. The considerable image overlap is necessary for SfM purposes. A horizontal or landscape camera rotation (D3) would necessitate at least three images to incorporate some parts of the unchanged surroundings (like the floor or the green metal parts of the bridge pillars). A photo covering a small portion of the ground and metal bridge parts (like D4) is uncommon; one needs to hold the camera above the water, thus creating an unstable and dangerous acquisition position. The lower row presents two possible solutions to this problem. Acquiring a photo with a longer focal length lens (E) takes away the risk and will always yield a lot of surrounding elements, which are necessary for the incremental SfM algorithm (see Wild et al. in this volume). Still, this solution delivers a GSD about twice the threshold set by INDIGO. In addition, one also must cross the channel to photograph. Using an extreme wide-angle lens avoids this time cost. F1 and F2 show that a 10 mm lens can capture the element of interest plus surrounding structures with both a horizontal (F1) and vertical (F2) camera rotation (for reference, compare F1 with D3 and F2 with D4). With this solution, the photographer needs fewer photos or can move slightly closer to the pillar element, making acquisition safer. Although the GSD is twice that of the 20 mm lens, it is still far below the 1 mm threshold.

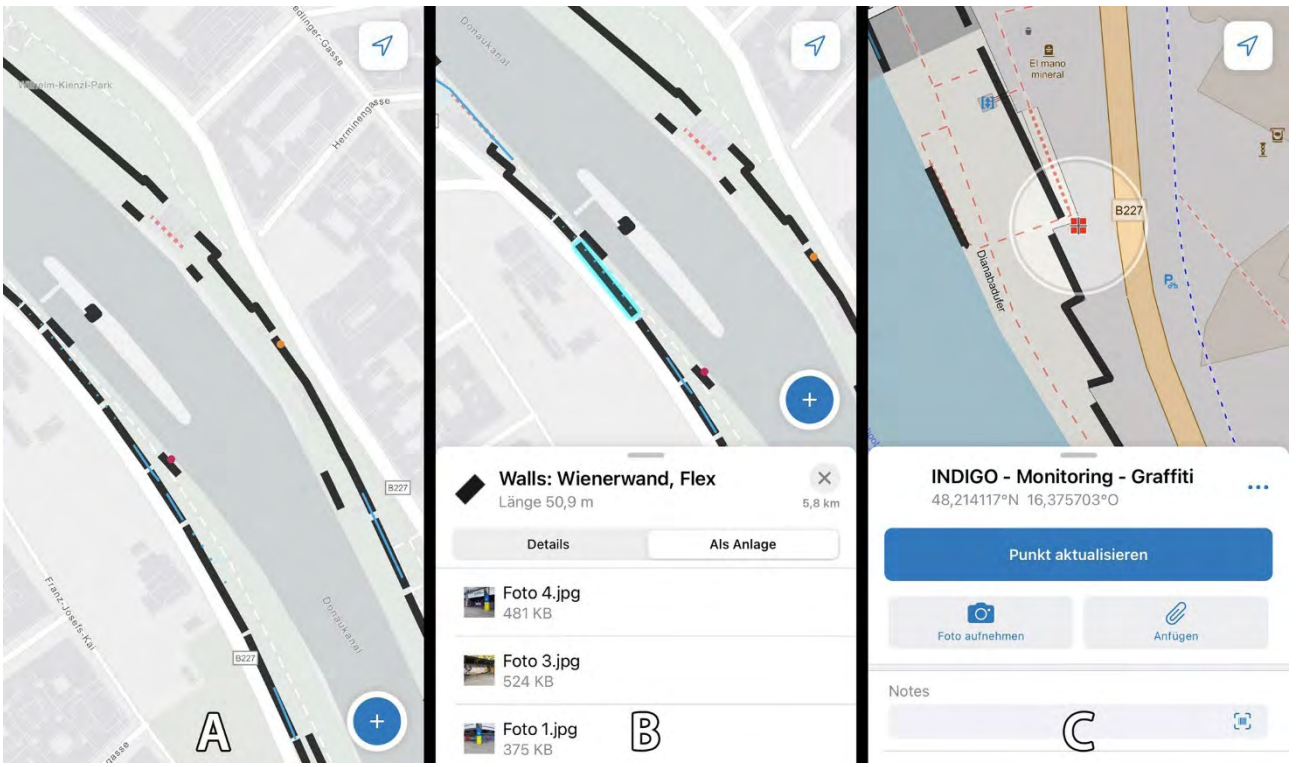



**Figure 14.** Screenshots from the ESRI's ArcGIS Field Maps used by INDIGO to monitor new graffiti. (A) shows the usual dark pink and orange dots. The lighter red dots symbolise areas without graffiti (like a bar or restaurant). Thin blue lines denote the sections for the monthly photo tours. (B) shows overview photographs linked to each of the black rectangles representing a section of INDIGO's research zone. (C) displays the creation of a new graffito point.

The app contains the INDIGO base map, which uses black rectangles to represent all surfaces that can potentially bear graffiti (Figure 14A). Every black rectangle is considered a specific section of the research zone. Each section is tagged with various overview photographs (acquired with the tablet) that depict the zone's graffiti status quo (Figure 14B). The map also reveals differently coloured dots (Figure 14A). These dots represent newly created graffiti. The information to place these dots comes predominantly from the social networking platform Instagram. The INDIGO photographers daily check for new videos and photos shared by graffiti creators active along the Donaukanal. In addition, INDIGO uses Instagram to promote its graffiti reporting hashtag #indigodonaukanal; the project's website also features an online form to report new creations. However, only since the summer of 2022 have a couple of graffitists been using this hashtag, while the online form remains unused after one year. Finally, new graffiti are also attested when biking or walking along the Donaukanal. In the case of walking, this can happen during INDIGO's follow-up photography tours or for purposes unrelated to INDIGO. Even though one can always check the latest overview photo of that zone, in practise, this approach usually relies purely on visual memory.

ArcGIS Field Maps makes adding a new graffito dot to the base map straightforward. These dots can also be complemented by photos (usually one from Instagram) or notes (Figure 14C) to aid the photographer during the subsequent follow-up photography. However, dots can be dark pink or orange in colour (Figure 14A). Each of them indicates a new graffito to record. A dark pink dot means that the graffito is recent and has not been recorded by

INDIGO. In contrast, an orange dot indicates a documented graffito, but one for which—if time and weather allow—new documentation would be beneficial. This situation can occur when the graffito initially contained a sunlit and shaded portion or when one of the many moveable urban objects, like a container, was partly blocking it. If the photographer is happy with the documentation, the dot's status will update and disappear from the map. The entire monitoring workflow ends with acquiring a new overview photo (usually a panorama) of that zone with the tablet.

4.2. Monitoring Issues

Although relatively effective, the current monitoring strategy has a few drawbacks. First, the app is not open source. INDIGO tries to be an open-data project, and software developed within INDIGO is open-source by default. However, INDIGO is not dogmatic in its use of existing tools and chooses the software best suited for a given job. If competition between a viable closed- and open-source software package would exist for a particular task, the latter gets prioritised. However, the INDIGO photographers could not find a reliable and easy-to-set-up alternative for ESRI's solution.

Second, the current monitoring strategy relies heavily on the graffiti community and one's memory. INDIGO's graffiti reporting tag and online form are much less used than hoped. This lack of engagement, combined with the fact that not all graffitists are active on Instagram, leads to a severe underrepresentation of new graffiti in the monitoring app. Luckily, INDIGO's main photographer (Stefan Wogrin) can memorise large parts of the Donaukanal graffiti-scape, allowing him to spot many new and unreported creations during his follow-up photography tours. This impressive feat notwithstanding, only more sizable new graffiti get photographed because it is impossible to remember every new sticker or small tag. In a certain way, INDIGO's records get thus increasingly biased in favour of the more sizeable works, like pieces and characters.

To counteract this issue, a new category of monthly follow-up segments was defined and denoted by thin blue lines in the app (see Figure 14A). These segments are exhaustively photographed every month to gather much of the tinier writing. However, focusing on these zones only partially tackles the bias. Much can still happen in one month, and less noticeable creations might still occur in parts of the research area not covered by these monthly sessions.

However, there is currently not even a partial fix for the remaining two issues. The monitoring and recording approaches rely on much manual work, making them slow: from the app input to acquiring an overview panoramic photo whenever a new graffito gets documented. Due to its unfavourable cost-benefit ratio, creating a follow-up overview panorama gets even often omitted. Not only does it considerably slow down an already tedious documentation process, but the primary person to acquire these photos already knows the overall graffiti status quo inside out. Nevertheless, these overview panoramas would still be of enormous help for the other photographers or if one would like to spot minor changes.

Finally, getting the location of new graffiti from cropped Instagram photos also leads to location errors. It is not uncommon to find a dot below the wrong bridge or on the wrong side of the channel.

4.3. Monitoring Improvements

To solve the crudeness in locating new graffiti, avoid much manual work, and notice smaller creations, INDIGO is developing a monitoring approach based on automatically detecting small changes between multitemporal photographs. So far, the idea has proven more straightforward than its execution.

The envisioned workflow goes like this. Two GoPro HERO10 Black action cameras are mounted on a camera bar. The bar sits on a typical action camera handgrip, allowing the dual-camera construction to be handheld (see the shadow in the lower part of Figure 17A). Because the camera lenses point approximately in opposite directions, it is possible to photograph nearly every sandstone surface above the path one is biking on, as well as the concrete surfaces below the walking/biking path on the other bank (albeit with less spatial detail). This setup also ensures that the left and right bridge surfaces flanking the biking path are imaged (Figure 15). Repeating this acquisition on either side of the channel results in a long dual sequence of photos that depict the upper surfaces twice: once highly detailed, and a second

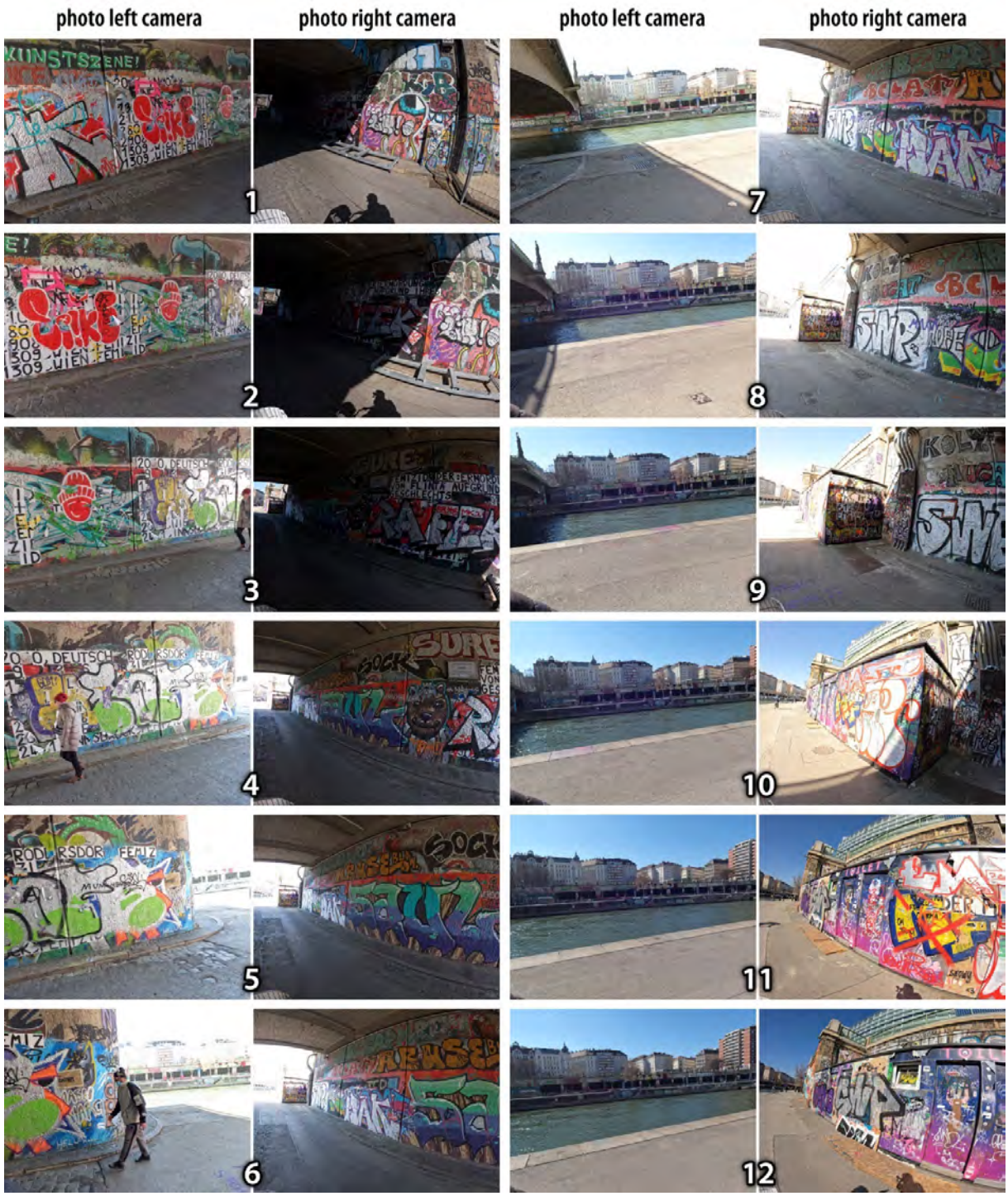



**Figure 15.** A sequence of twelve left-right photographs acquired from the Donaukanal's left bank. The left GoPro points at the opposite bank, thereby also imaging the surfaces directly above the water. The right camera takes pictures of the walls above the walking/biking path from approximately 4.5 m away. As only every second photo is shown for illustration purposes, the actual overlap of the photos depicting the nearest walls is circa 80 % and not 60 %, as presented here.

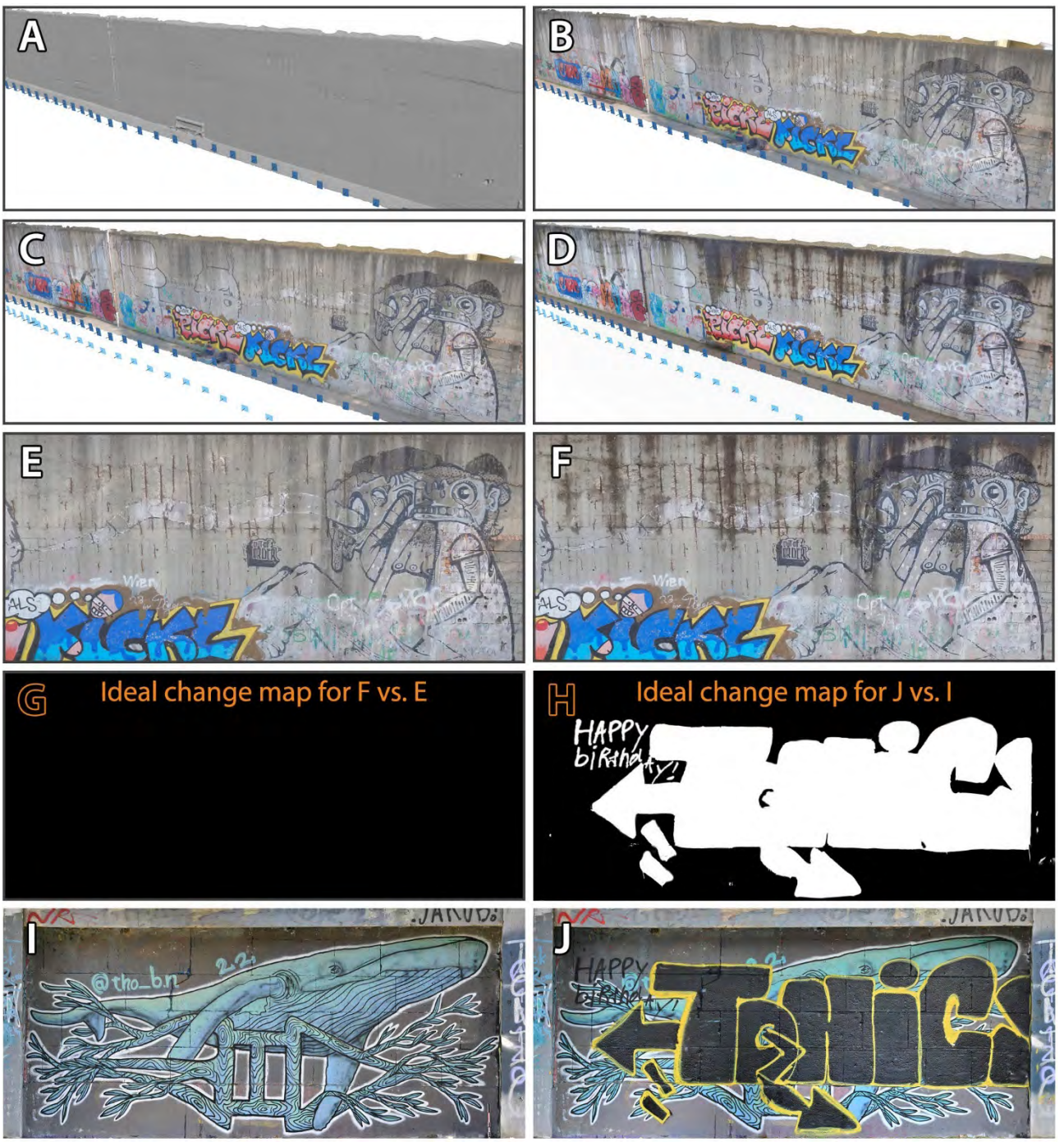



**Figure 16.** The sequence of insets A to D explain how two photo events could result in two pixel-perfect aligned textures (E and F), from which one could extract a change map. In this case, the change map (G) should be blank because all changes that occurred are unrelated to the graffiti. This is not the case for the scene changes between insets J and I. Here, inset H depicts the ideal change map. The ideal change maps G and H were manually created in Adobe Photoshop 2022.

time with a large GSD. However, the latter images are only used for the concrete surfaces just above the water, since these can otherwise not be photographed. Despite the GoPro's 2.7 mm wide-angle lens and capability to save two photos per second, the biking speed should not exceed 15 km/h to achieve an 80 % longitudinal image overlap at a 4.5 m camera-to-wall distance.

Using the previously mentioned SfM approach, the exact exterior orientation of each camera station is retrievable. Imagine a GoPro photo series acquired during a one-hour biking tour on Monday morning and correctly processed with SfM by Tuesday afternoon. At that point, one can compute a meshed 3D surface of these images using an MVS algorithm (Figure 16A). Once the mesh is ready, it can be textured with the photographs (Figure 16B). After a rainy night, a new GoPro photo series is collected on Wednesday morning. Because an incremental SfM approach can leverage the network of oriented Monday photos (i.e., the dark blue rectangles in Figure 16C), the position and rotation of the newest camera stations (symbolised by the light blue rectangles in Figure 16C) are estimated by Wednesday evening. At that stage, the mesh computed on Monday gets textured with the Wednesday photographs (Figure 16D) so that two textures exist, partly displayed in Figures 16E and F. Ideally, these texture images are pixel-perfect aligned so one can look for differences between any two pixels at any location. In its most simple way, this last step could subtract the Monday texture from the Wednesday texture to yield a so-called change map or change image. Since this change map depicts any relevant difference that occurred in the graffiti-scape between Monday and Wednesday, it would be a perfect guide for the follow-up photography tour on Thursday.

The hard part of this whole workflow is, however, the change detection step. So far, none of the tested algorithms has proved capable of robustly computing change maps in a reasonable amount of time. The challenges to this problem predominantly lie in the large pixel counts of the images and the potential for dissimilar photos of unchanged graffiti scenes. Let us consider the last issue. Photographing an invariant graffiti scene once in cloudy conditions and once in harsh sunlight will result in two photos that look different. Not only might the colours look distinct, but the sunlight will generate strong shadows that are absent in the other photograph. Although a human quickly understands that the graffiti-scape itself did not change, designing an algorithm robust to these graffiti-irrelevant photo differences has proved hard. The same problem occurs after a rain shower. The ideal change map (Figure 16G) between Figure 16E and F is blank because the only scene variation between both photo events relates to rainwater running down the concrete (see Figure 16D and F). These challenges notwithstanding, INDIGO will continue to invest time in this change detection approach—mainly focusing on more uncomplicated cases like Figure 16H—because it could prove helpful for many heritage monitoring projects.

Finally, this GoPro-based monitoring approach must deal with one more challenge: by-passers unavoidably appearing in photographs. Given that all INDIGO data become publicly available at the end of the project, it is of the utmost importance to anonymise every person or other relevant personal data (like number plates) in these photos. And again, detection robustness and speed of execution are critical. Luckily, INDIGO could already successfully test software by the Austrian company Celantur (https://www.celantur.com). Celantur specialises in the anonymisation of still images and videos. The software blurs faces and can anonymise entire bodies, also when people are partly obscured (Figure 17A–B) or depicted as tiny figures in highly overexposed parts of the photo (see Figure 17C). In addition, Celantur's software features annotated output with confidence values and can deliver binary photo masks. These masks can be applied at any stage of INDIGO's entire image processing workflow, ensuring that the original photos stay unaltered. A later paper will provide a more comprehensive assessment of the Celantur anonymisation solution.

**5. Conclusion**

In their 2015 paper on the Urban Cartographies Research Project in Belo Horizonte (Brasil), Marra and Aroztegui Massera wrote: "Traditional academic fieldwork and artistic projects alike have trouble capturing a chameleonic city's characteristics, as well as the continuous growth of urban images and representations. The main difficulties

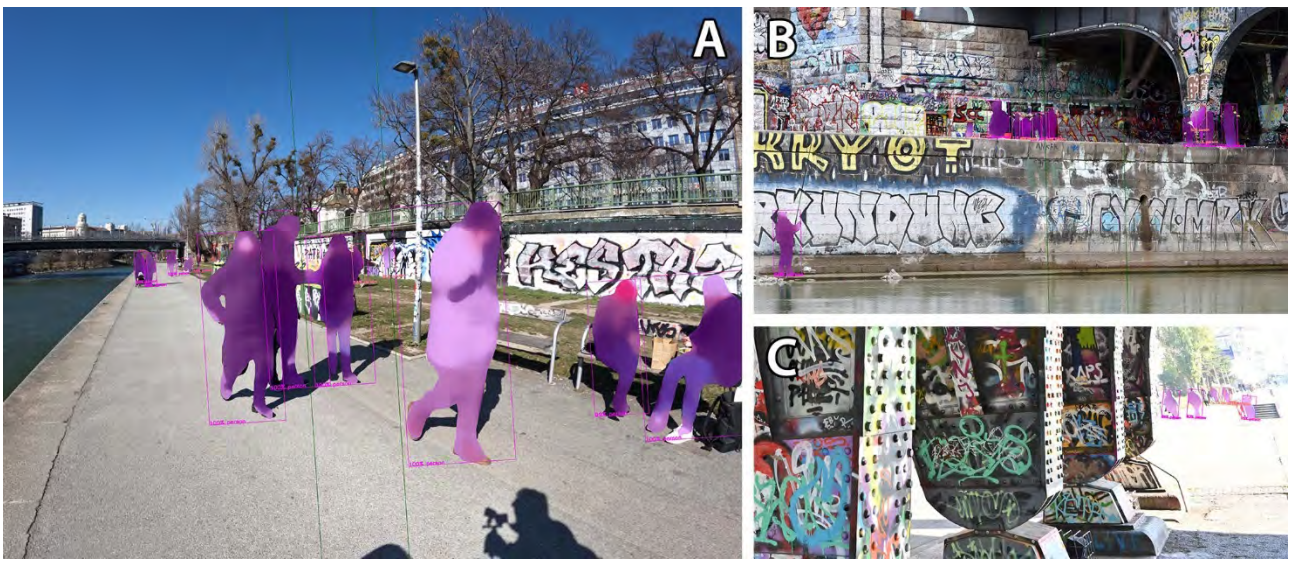



**Figure 17.** The binary masks (applied in purple) generated by Celantur's anonymisation software. Entire bodies can be masked, irrespective of people's distance to the camera (close in A or very far in C). Partial occlusions (A and B), busy graffiti backgrounds (B) and overexposure (C) do not seem to impact the software's performance.

occur when dealing with the temporal dimension of observation, the issues that emerge when working directly with passersby, and the current technological nature of recording artifacts" (Marra & Aroztegui Massera, 2015, p. 118). Tackling these recording challenges—which the academic graffiti community has largely ignored—is one of project INDIGO's primary goals. This paper has presented the team's technical solutions established during the first project year. In addition, the text highlighted some of INDIGO's remaining obstacles to monitoring and recording the spatio-temporal variations in the chameleon skin of an urban landscape effectively and accurately.

**Conflict of Interests**

The authors declare no conflict of interest.

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# Towards Colour-Accurate Documentation of Anonymous Expressions

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**Abstract**
Colour is a powerful communication element in most forms of cultural heritage. This importance of colour notwithstanding, the documentation of cultural heritage typically captures the geometrical aspects and seldom the spectral dimensions of an artefact. This is partly because the science of colour (called colorimetry) is non-trivial. In addition, capturing accurate colour data with digital cameras remains challenging due to the operating principle of standard imaging sensors and the need for a stable and well-characterised illumination source. Despite these limitations, the heritage science project INDIGO made it one of its central aims to generate colour-accurate photos from graffiti captured with standard digital cameras in varying outdoor illumination conditions. This paper first discusses the importance of colour accuracy in graffiti documentation. Afterwards, the text details (in a non-mathematical manner) essential colorimetric and camera principles that underlie the generation of colour images from raw image sensor data. This in-depth coverage supports clarifying the main hurdles to accurate photo colours. Finally, the paper introduces the open-source COOLPI software resulting from this research. We are confident that COOLPI will benefit any other heritage documentation project, or any application where digital cameras play a fundamental role in acquiring correct colour values.

**Keywords**
camera characterisation; CIE colour spaces; colorimetry; colour transformation; COOLPI; graffiti; image processing; Python; RAW photo

**Acronyms**

| | |
|---|---|
| ADC | Analogue-to-Digital Converter |
| AW | Adopted White |
| CAT | Chromatic Adaptation Transform |
| CCM | Camera Characterisation Matrix |
| CCT | Correlated Colour Temperature |
| CFA | Colour Filter Array |
| CIE | International Commission on Illumination |
| CMF | Colour-Matching Function |
| CMYK | Cyan-Magenta-Yellow-blacK/Key |
| CRS | Coordinate Reference System |
| CS | Coordinate System |
| DN | Digital/Data Number |
| EV | Exposure Value |
| Exif | Exchangeable image file format |
| FoV | Field of View |
| HVS | Human Vision/Visual System |
| JP(E)G | Joint Photographic Experts Group |
| OSM | Output Space Matrix |
| RGB | Red-Green-Blue |
| SPD | Spectral Power Distribution |
| TIFF | Tag(ged) Image File Format |

**1. Introduction**

1.1. Colour and Cultural Heritage

Even though colour is not a physical attribute of an object but a perceived human physiological sensation, colour should be a significant focus point in cultural heritage documentation (Molada-Tebar, Marqués-Mateu, & Lerma, 2019b). As a descriptive attribute, colour is indispensable for proper object recognition and cataloguing, but also for tasks like damage detection or restoration, to name but a few (Boochs et al., 2014). However, colour is so much more; it is an effective communication tool that evokes emotions and can profoundly affect viewers (Chen et al., 2020; Hanada, 2018). That is why colour is crucial in creating and studying graffiti. Graffitists often aim to communicate social, cultural or political ideas so that they remain engraved in the minds of passers-by. In this sense, graffiti can be considered a powerful form of visual communication free from conventional restrictions (Velikonja, 2020). To reach the intended impact of their visual message, graffiti creators often rely on a varied, vivid and striking colour palette (Feitosa-Santana et al., 2020).

Colour is thus one of the absolute distinguishing features of a graffito, often even more than its geometrical aspects. Given this significance, one of graffiti project INDIGO's primary research aims is to obtain digital colour values for each part of a graffito. These values should be as close to reality as possible (i.e. colorimetric) to digitally preserve the spectral characteristics of the work and the essence of the message that the creators intend to convey. However, obtaining colour-accurate data remains a significant challenge in heritage documentation (Korytkowski & Olejnik-Krugly, 2017). Using colorimetric instruments directly on cultural assets might be forbidden or can be cost-ineffective. For example, it would take very long to acquire sufficient samples with a portable spectrophotometer from all the differently coloured regions of a painting, like a mural. That is why INDIGO relies on digital photographs. Given the large number of samples in a digital photo (i.e. each of the many million image pixels has at least a red, green and blue spectral value), photographs might be considered a good and fast approach to obtaining dense colour data over a large spatial extent. In addition, photographing is a cost-effective, non-contact and physically non-invasive method. When many overlapping photos are available, it also becomes possible to extract realistic and accurate 3D models that digitally encode the surface geometry (Verhoeven et al., 2022) or support various analytical tasks like change detection (Palomar-Vazquez et al., 2017). This explains why many traditional heritage documentation endeavours and some less-conventional projects on contemporary graffiti recording, like INDIGO and others (Rodriguez-Navarro et al., 2020), consider photographs the primary source to obtain spatial and spectral data about the study object(s).

However, whereas the acquisition and processing workflows for photo-based 3D surface modelling have achieved a certain maturity and consensus, this is not true for photo-based colour extraction. It turns out that generating colour-accurate photos is still relatively complex, as it requires a thorough understanding of colorimetry (i.e. the science of colour), a camera's hardware plus processing pipeline, and the illumination source used while photographing. In addition, various colorimetric limitations related to surface reflectance and digital cameras must be considered (Kirchner et al., 2021). In summary: one cannot rely on a standard digital photo camera for rigorous and objective colour determination without a robust photo acquisition and colour management procedure (Molada-Tebar et al., 2018). The topic of this paper is to provide the necessary background for understanding this problem and to offer an approach for retrieving colorimetric data from digital photos of graffiti.

1.2. Colour Within Project INDIGO

Project INDIGO aims to build the basis to systematically document and digitally disseminate almost 13 km of uninterrupted graffiti along the *Donaukanal* (Eng. Danube Canal), the central waterway of Vienna, Austria (Verhoeven et al., 2022). The project hopes to digitally preserve this unique form of volatile cultural heritage and open new analytical pathways for such large graffiti-scapes. To that end, the photo-based documentation aims to include the geometrical (i.e. shape and dimensions), spectral (i.e. colour), geographical (i.e. location), temporal (i.e. time of creation and lifespan) and contentual (i.e. subject matter and meaning) aspects of every graffito.

Striving for colour-accurate graffiti photographs was prompted since colour is essential in graffiti's visual appearance and study. INDIGO wants to ensure that the result of a red spray can is digitally archived as red pixels and not as orange ones. Colour-accurate photo records not only keep the intended visual impact of the graffiti creator but can also open new windows for analysis: what are the dominant colours in this graffiti-scape? Can we link certain brands of spray cans to specific colour values? Do certain creators consistently use the same colour palette? In addition, project INDIGO wants to create an online platform where everybody can query and visualise graffiti records. A part of this platform should provide an extensive 3D surface model of the entire research zone. This 3D model will include overlapping, multi-temporal textures (i.e. a texture patch for every new graffito). Enforcing colour accuracy for every texture patch should help minimise tonal differences across these textures' seams, thereby contributing to a smooth viewing experience.

Finally, all of INDIGO's data will become freely available at the project's end. Since it is not unimaginable that machine learning engineers will use this vast photo collection to automate the classification of graffiti by creator or style, consistency of the digital records is vital.

### 1.3. Colour and Graffiti: an Example

Before diving into the realm of light, colour and cameras, it is beneficial to start with an example to get some basic feeling for the parameters that influence the final colour in a photograph. On top of several camera-dependent factors, one must keep many camera-agnostic variables in check to generate




**Figure 1.** Digitally photographing a graffito (upper row) generates a RAW image (central row), of which the exposure parameters largely influence the pixel values. However, even an adequately exposed RAW image can result in different colours (lower row) depending upon the RAW development settings used inside the camera or by the computer software.

image pixels with approximately correct colour values. Two of those are the exposure values and the development settings—used internally by the camera or externally by dedicated computer software—to convert the raw sensor data into the final pleasing JPG/JPEG or TIFF image. Figure 1 illustrates both. A graffito (Figure 1 top row) created on a wall below Vienna's Rossauer Bridge is photographed with a Nikon Z7ii and a Nikon NIKKOR Z 20mm f/1.8 S lens. The ambient incident light levels were measured with a Sekonic L-358 FLASH MASTER light meter, yielding the following exposure values: ISO 100, *f*/5.6 and 1/13s. These values were dialled into the camera to generate the RAW image in the middle of the central row. The lens aperture and sensor sensitivity were kept invariant at *f*/5.6 and ISO 100 for the photos on its left and right. However, an underexposure of two photographic stops or Exposure Values (EVs) was achieved via a shutter speed of 1/50 s, while a shutter speed of 1/3 s yielded the 2 EVs overexposed photo on the right. Because the values of the photographs are unprocessed or raw (thus constituting a RAW image), two things can be noticed:

- The image looks very green since a camera's imaging sensor is most responsive in the green spectrum. This apparent colour imbalance must be considered when rendering the final JPG or TIFF file.
- The photos look very dark, even the correctly exposed and overexposed ones. The pixel values of a RAW image are ideally varying in a perfectly linear fashion with the incoming light. Like the human visual system, more collected light means higher values. However, computer monitors apply a non-linear tonal transformation when displaying images. This transformation is 'undone' when rendering the final JPG or TIFF file from the RAW image. Since they do not consider this non-linear transformation by the monitor, RAW camera images look very dark.

To understand how these exposures would yield different colours in the final photo, the lowest portion of the RAW images depicts a processed version into a neutrally rendered JPG image. However, the last parts of the entire rendering process also largely influence the resulting colours (Karaimer & Brown, 2019). The lowest row of Figure 1 depicts three different renderings of the properly exposed RAW image. Most cameras and RAW conversion software feature rendering settings like "flat", "standard", and "vibrant". Each setting applies one or more algorithms to 'lift' the shadows or 'suppress' the highlights, to sharpen details and boost or restrain colour vibrancy. All these sub-settings—which solely aim at turning the raw, unprocessed data into a pleasing photo with a specific style—influence the finally rendered pixel values, thus increasing the potential of ending up with inaccurate colours (Ramanath et al., 2005).

In addition, RAW-to-JPG operations are complex, diverse, typically manufacturer-specific and thus proprietary (Chakrabarti et al., 2009), making it hard to understand all rendering operations fully. If they are executed within the camera (i.e. when the camera is set to deliver a pleasing, fully-rendered output image), the process can usually only be controlled via a few basic settings like sharpness, vibrancy and shadow recovery. These, plus many other factors, prevent digital photos from being accurate colorimetric records. If rigorous colour determination based on image pixels is the aim, a colour-aware procedure with control over each parameter is essential (in addition to auxiliary data). Our paper presents the workflow and software to achieve this within project INDIGO. Since such a description necessitates much particular terminology, we decided to let clarity rule over textual conciseness. This makes it possible to provide the reader with a rather in-depth but non-mathematical overview of all critical colour imaging principles and their supporting colorimetric ideas.

The rest of the article is structured as follows. First, we introduce the basics of creating, measuring and communicating colour (Section 2). Second, the basics of creating pixels with a digital imaging sensor are tackled (Section 3). Based on these colorimetry and camera principles, Sections 4 and 5 explain why standard photographs are not colorimetric and which data acquisition and processing steps INDIGO has put in place—in the form of a free and open-source software package COOLPI—to largely alleviate that shortcoming. Finally, Section 6 provides some workflow reflections and covers the imaging situations COOLPI will not be able to handle. All our work is guided by colorimetric standards, particularly those published by the *Commission Internationale de l'Éclairage* (CIE; Eng. International Commission on Illumination).

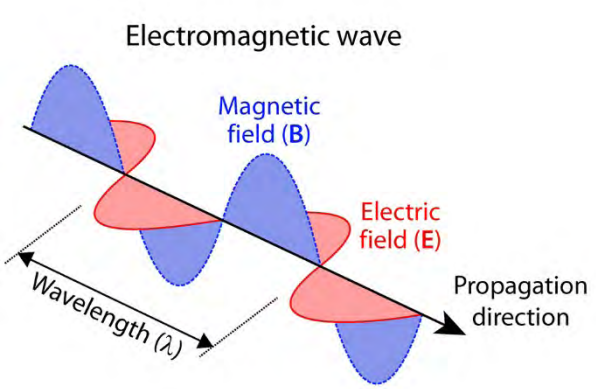
Although written in British English, this text uses the non-British variant "colorimetric" because "colour" and "colorimetric" are official CIE terminology (CIE, 2018).

**2. Understanding Colour**

Photographing an object works because the light created by at least one source reaches that object; the object then reflects a part of that light towards the camera. However, many hard- and software parts are needed inside the camera to turn the captured signal into a photo that closely resembles the object we witnessed with our eyes. This entire photo acquisition pipeline leverages many colorimetric concepts. The following five sub-sections—based mainly on Verhoeven (2016)—provide a basic introduction to the concepts essential to understanding the proposed image processing workflow.

2.1. Light

Electricity and magnetism are intimately related. Moving a magnet around an electric wire creates an electric current. Still, a moving electric field will also produce a magnetic field. Since both fields create each other, they oscillate together and create a so-called electromagnetic wave (see Figure 2 on the left). Being a wave-like phenomenon, electromagnetic radiation can be distinguished by the length of its waves, called the wavelength ($\lambda$). Electromagnetic radiation with a wavelength between 400 nm (400 x $10^{-9}$ m) to 700 nm (700 x $10^{-9}$ m) is called visible light or simply light (although colorimetric applications often use 380 nm as cut-on and 780 nm as cut-off wavelength). Light is thus only a very narrow spectral band out of all possible electromagnetic radiation (see Figure 2 on the right and Figure 3) and the only wavelengths to which human eyes respond with a visual sensation. To both sides of the visible band resides radiation that does not produce a visual sensation: gamma rays, X-rays and ultraviolet radiation with shorter-than-visible wavelengths, while the long-wavelength region encompasses infrared radiation, microwaves and radiowaves (Figure 3). The part of the electromagnetic spectrum that includes the complete ultraviolet to infrared bandwidth, comprising radiation with wavelengths between 10 nm (0.01 µm) to 1 mm (1000 µm), is called the optical electromagnetic spectrum (Ohno, 2010) (see the classification in Figure 2).




**Optical electromagnetic radiation**

| Division | Subdivision | Abbreviation | Cut-on (nm) | Cut-off (nm) |
|---|---|---|---|---|
| *UltraViolet (UV)* | Vacuum UV | VUV / UV-D* | 10 | 200 |
| | Far UV | FUV / UV-C* | 200 | 280 |
| | Middle-UV | MUV / UV-B | 280 | 315 |
| | Near-UV | NUV / UV-A | 315 | 400 |
| *Visible (Vis)* | Blue | B | 400 | 500 |
| | Green | G | 500 | 600 |
| | Red | R | 600 | 700 |
| *InfraRed (IR)* | Near-IR | NIR | 700 | 1 100 |
| | Short Wavelength IR | SWIR | 1 100 | 3 000 |
| | Mid Wavelength IR | MWIR | 3 000 | 6 000 |
| | Long Wavelength IR | LWIR | 6 000 | 15 000 |
| | Far/Extreme-IR | FIR | 15 000 | 1 000 000 |

**Figure 2.** On the left an electromagnetic wave consisting of electric and magnetic oscillating fields. The oscillating electric field vectors are indicated in red, while the blue lines represent the magnetic field vectors. On the right are the divisions of optical electromagnetic radiation.

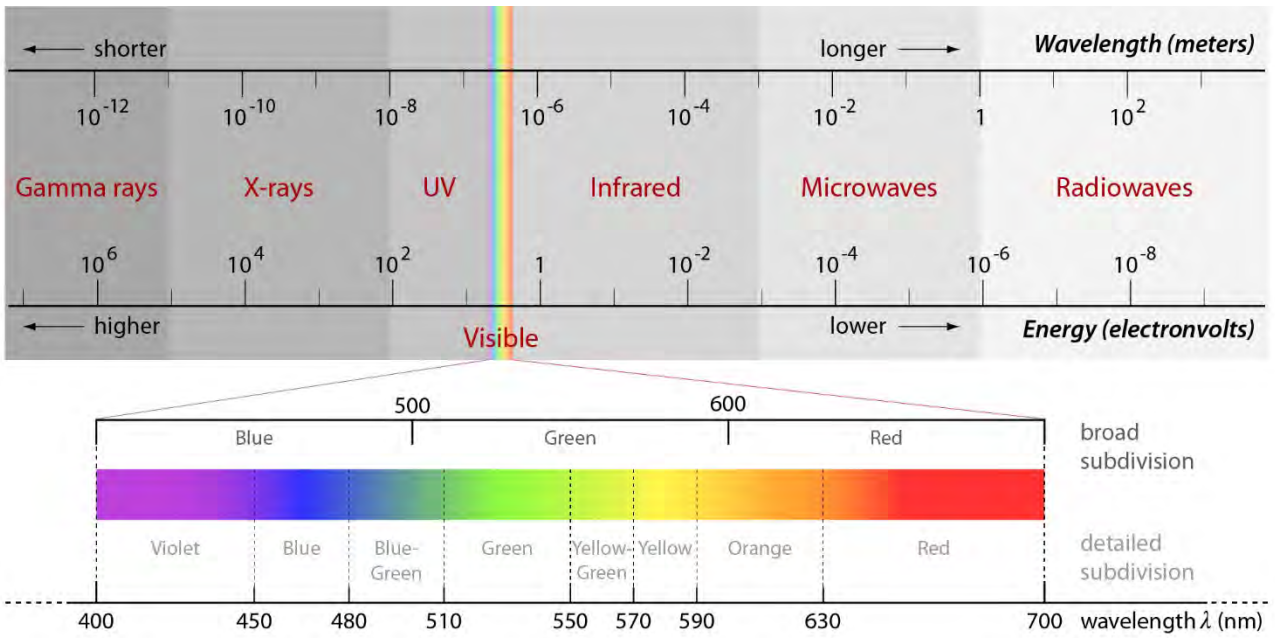



**Figure 3.** The complete electromagnetic spectrum with the spectral subdivisions of the visible waveband. The spectral hue names are after Hunt (2004).

In the visible wavelength range, each wavelength of light correlates with a sensory impression of a particular colour (or, more technically correct, 'hue'). Even though colour is thus not a physical property of electromagnetic radiation, the light spectrum may be roughly divided according to it, as indicated in Figure 3. The latter shows that the light spectrum contains all hues visible in a rainbow: varying from red on the long-wavelength side over orange, yellow, green and blue to violet on the short-wavelength side (sometimes the hue indigo is defined between blue and violet). For the sake of simplicity, the visible spectrum is usually considered to consist of only three bands: Blue (400 nm – 500 nm), Green (500 nm – 600 nm) and Red (600 nm – 700 nm). Although a coarse approximation, many image-related devices, such as digital cameras and monitors, base their physical working principles on this subdivision.

In addition to the wave properties mentioned above, electromagnetic radiant energy exhibits particle-like behaviour. These indivisible particles are called photons, discrete energy packets with energy levels that differ according to the wavelength. Due to this quantisation, a visible photon with a wavelength of 650 nm will always have 1.9 eV of energy, while photons with quantum energies of 3.6 eV characterise 345 nm ultraviolet radiation. These numbers show that shorter wavelengths have higher radiative energies (see Figure 3). This also explains why highly energetic ultraviolet radiation causes sunburns.

None of the wave-like and particle-like descriptions of electromagnetic radiation is complete by itself. Still, each offers a valid description of some aspects of electromagnetic radiation's behaviour. However, one could as well forget about this wave-particle duality if in need of absolute physical accuracy. Essentially, there are no waves and particles, just quantised fields with discrete excitations. That is also why quantum field theory is the theoretical framework behind the standard model of particle physics (Mandl & Shaw, 2010). However, to understand how light contributes to the creation of colour, this naïve interpretation of light as 'waves' and a stream of 'particles' is satisfying enough.

2.2. Creating Colour

Human colour perception results from the visible electromagnetic radiation received by the eye's photoreceptors and how the brain subsequently interprets these signals (B. B. Lee, 2004). In brief, colour 'happens' inside the human head, and this combined eye-brain processing is known as the Human Vision/Visual System (HVS). Although the general principles of the HVS are known and basically identical amongst all humans, smaller aspects can differ. For instance, some people might be more or less sensitive to Red light. This leads to varying forms of colour deficiencies in male and female populations but also explains why two human observers might perceive colour in more or less different ways. In addition, the emotions that colour evokes are subjective, dependent on the observer's experience and culturally determined (Jonauskaite et al., 2019).

These differences notwithstanding, there is always an interaction between three elements required to generate or see colour: a light source, an object and an observer. At the origin of this imaging chain lies the interaction of light with the scene or object. This interaction determines which portion and quantity of light the HVS (or digital imaging sensor) will detect and process. Figure 4 details this: visible electromagnetic radiation falls onto an object; depending on its physical and chemical properties, the object reflects, absorbs and transmits a fraction of all the incident light. Finally, a digital camera or a human observer picks up the diffusely reflected portion. This signal emanating from the object is called the spectral stimulus signal, the spectral stimulus or simply stimulus. The stimulus is thus always a function of the light source and the object's spectral reflectance. If one of those two components is altered, so will the stimulus. For example, healthy grass is green because it mainly reflects incident solar light between 500 nm and 600 nm, a range perceived by the HVS as green. If grass gets solely illuminated by a light source devoid of wavelengths between 500 nm and 600 nm (e.g. a blue disco light), this part of the spectrum cannot be reflected, making it impossible for the HVS or a digital camera to render grass green.

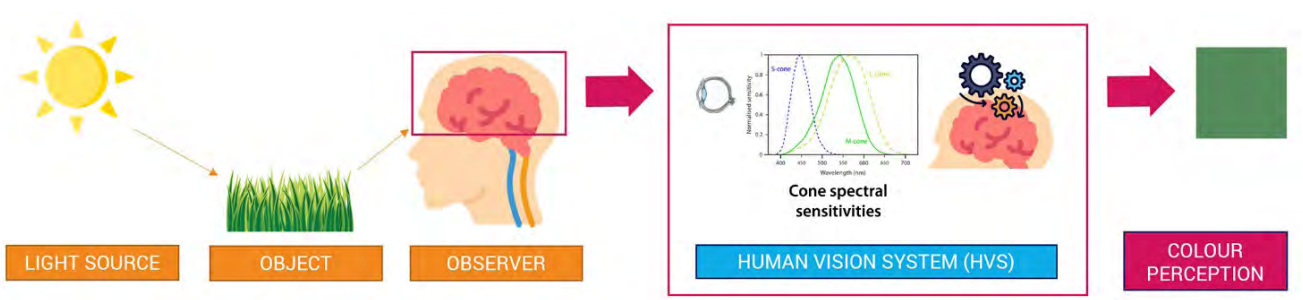



**Figure 4.** Three elements are needed to perceive colour: a light source, an object and an observer (HVS).

The spectral stimulus which arrives at a digital camera gets integrated over millions of small photodetectors, all of which feature one of three spectral response curves (approximately situated in the Red, Green and Blue parts of the spectrum—see Figure 5A). A human observer integrates the stimulus over the five to six million cones in the retina at the back of the eye (Wandell, 1995). Similar to the camera's imaging sensor, the centre of the retina is densely packed with three cone variants with a specific response to visible wavelengths: cones sensitive to Short, Middle and Long wavelengths (S, M and L), named according to the part of the visible spectrum to which they are most sensitive (Stockman & Sharpe, 2000). Figure 5B depicts the linear normalised spectral sensitivity curves of the S-, M- and L-cones. These curves are known as the cone fundamentals.

Since a digital photo camera and the HVS sample the incoming signal in three different spectral regions, they are so-called trichromatic devices. Their respective spectral response/responsivity curves (also known as their spectral sensitivities) determine the likelihood that a photon of a specific wavelength will contribute to the imaging process

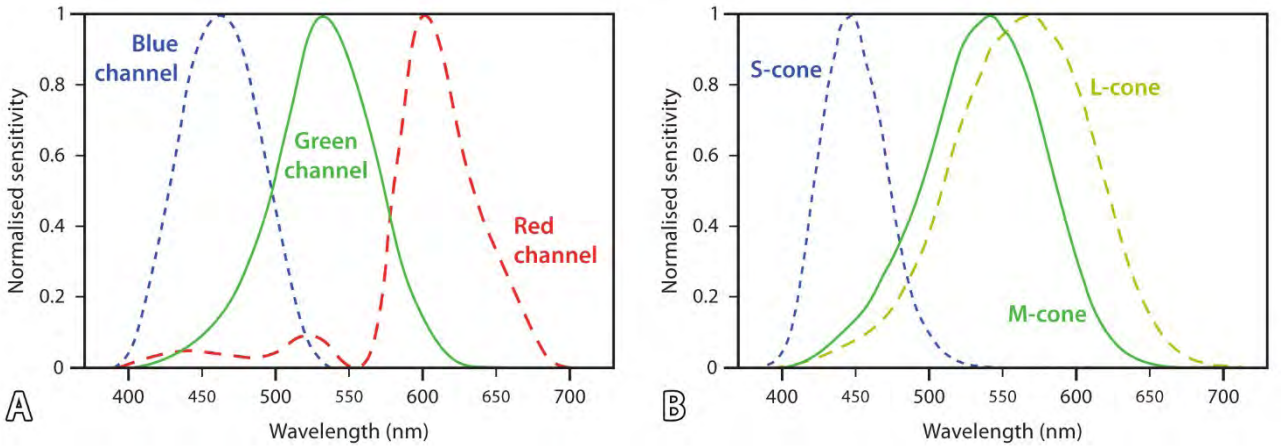



**Figure 5.** The normalised spectral response curves of a Nikon D200 (A) and the cones in the retina of a human eye (B). The latter curves are also called cone fundamentals, and the graph uses the 10° data from Stockman and Sharpe (2000).

(Cornsweet, 1970). They can thus be interpreted as probability functions. In short: when photons of a stimulus arrive at the eye or digital camera, they get weighted by the three sensitivity functions. Each of the three resulting photon collections is added up to produce a signal, and the three signals are proportional to the area under the three curves.

The raw trichromatic signals generated by the camera are then processed inside or outside the camera (see Sections 3 and 4) to yield Red-Green-Blue (RGB) colour values that—when combined—ideally depict the colour as perceived in the real world by a human observer. Inside the HVS, the brain's post-retinal structures process the trichromatic retinal signals to yield a colour perception. Although both processing chains are vastly different, the relative proportion of the photons absorbed by the three cones/spectral response curves determines which colour gets perceived in both cases. For completeness, it is interesting to know that the brain encodes the retinal signals into three opponent signals: two chrominance signals and one achromatic channel representing luminance information (Valberg, 2005). Later in this paper, we will see why splitting colour into its chromaticity and luminance components is helpful.

2.3. Standard Observers and Colour-Matching Functions

Because it was impossible in the early 20th century to directly measure the response functions of the S-, M- and L-cones inside the human eye, visual colour-matching

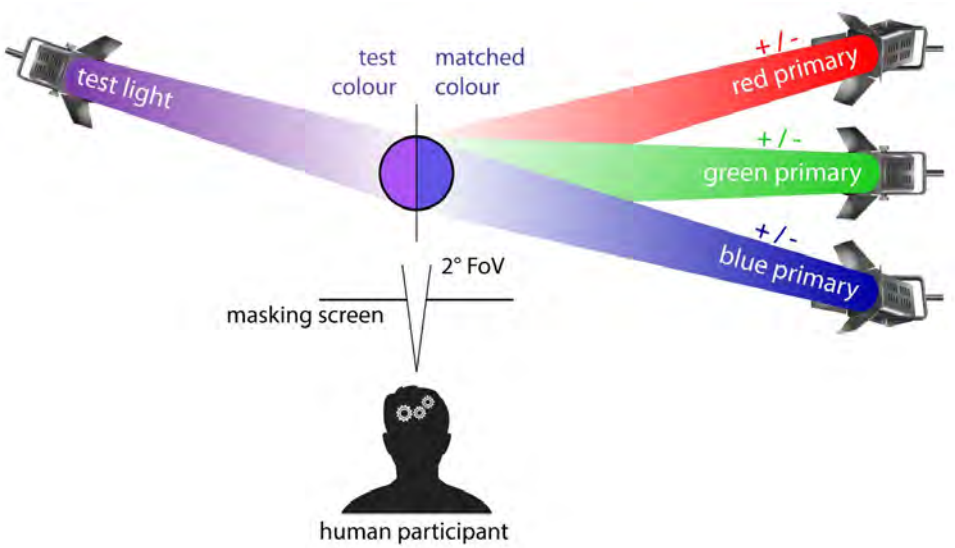



**Figure 6.** The setup of a colour-matching experiment.

experiments were conducted to derive a so-called CIE standard observer (H.-C. Lee, 2005). This CIE standard observer is a mathematical representation of the average colour vision of humans in the 380 nm to 780 nm range. Characterised by three curves called the Colour-Matching Functions or CMFs, the standard observer is a central pillar of present-day digital imaging and colour science.

As a matter of fact, two CIE Standard Observers exist: one initially determined in 1931 and another defined in 1964. Both were established with the help of healthy and young human participants asked to look at a white screen through a small aperture. Different test colours from the visible spectrum were projected onto that screen, thereby filling half of the screen (see Figure 6). At the same time, these participants could work with one Red, Green and Blue monochromatic light (i.e. a light source producing one wavelength and technically called a primary). The participants adjusted the amounts of these three lights/primaries on the other half of the screen until the additive mix of these three lights matched the projected test colour (see Figure 6).

This colour-matching process was repeated until most colours across the visible spectrum were covered. For some test colours, no match could be obtained by additively mixing the three lights. The only way to make a match was to remove one of the lights and add it to the test colour. When this happened, the primary was given a negative value. In 1931, the CIE published the three curves that resulted from averaging two such colour-matching experiments: one by David Wright (1928-29) and one by John Guild (1931). These curves became known as the CIE 1931 2° standard observer. The "2°" in the name comes from the fact that the participants had to look through a hole that allowed them to have a 2° Field of View (FoV) during the colour-matching experiment (see Figure 6). This 2° FoV was used because it was believed all cones were located in a small area of the retina called the fovea. Scientists later found out that the cones covered a larger area, spreading beyond the fovea.

That is why the CIE used the colour-matching experiments by Stiles, Burch and Speranskaya (Speranskaya, 1959; Stiles & Burch, 1959) to propose a second, 10° standard observer in 1964. Besides a larger FoV and more observers (49 versus the initial 17), the wavelengths of the Red, Green and Blue primaries also differed for these new tests: [645.16, 526.32, 444.44] nm versus [700.0, 546.1, 435.8] nm for the first experiments in the 1920s. So today, two standard observers exist: the CIE 1931 2 degrees observer and the CIE 1964 10 degrees observer (Figure 7A). Their CMFs are technically denoted CIE 1931 2° RGB CMFs $\bar{r}(\lambda), \bar{g}(\lambda), \bar{b}(\lambda)$ and CIE 1964 10° RGB CMFs $\bar{r}_{10}(\lambda), \bar{g}_{10}(\lambda), \bar{b}_{10}(\lambda)$, respectively (Ohno, 2000). Slight adaptations to these CMFs have been proposed in the past two decades (CIE, 2006, 2015), but many engineers and scientists still favour the original ones.

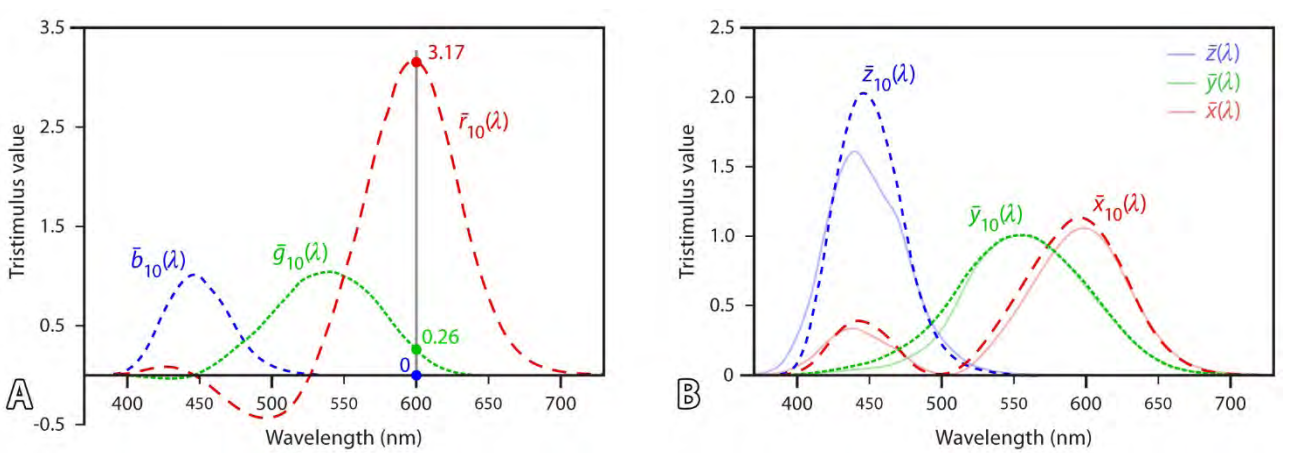



**Figure 7.** A) The CIE 1964 10° RGB CMFs; the tristimulus values for an orange hue of 600 nm are indicated. B) The CIE 1931 2° XYZ CMFs (modified by Judd (1951)) and CIE 1964 10° XYZ CMFs with primaries *X*, *Y* and *Z*. All datasets from Colour and Vision Research Laboratory (2021).

Both sets of RGB CMFs allow determining the relative quantity of the corresponding standardised primaries (i.e. the specific Red, Green, and Blue lights) needed to match a monochromatic test light of a particular wavelength. As an example, Figure 7 displays the 10° RGB CMFs and indicates that a combination of 3.17 parts of a 645.16 nm light, 0.26 parts of a 526.32 nm light and 0 parts of a 444.44 nm light source will produce a perfect match for the colour sensation of a 600 nm monochromatic test light. As such, most perceivable colours can be described by a known set of *RGB* primaries and three numbers corresponding to the amount of each primary needed to create that specific colour. These numbers are called the tristimulus values for that colour, and colour televisions, computer monitors, scanners and digital photo cameras exploit this trichromatic additive colour-mixing phenomenon.

However, Figure 7 also shows these RGB CMFs to have negative lobes. This results from the previously mentioned negative primary. The observer of the colour-matching experiment had to remove one primary from the mixture and add it to the monochromatic test light to achieve a match with the remaining two primaries (Wandell, 1995). Even though this behaviour is due to the similar spectral responses of the L- and M-cones (see Figure 5B), these CMFs are inconvenient for colorimetric applications because they create a physically non-achievable solution for RGB devices. For example, a digital camera should be negatively sensitive to particular wavelengths, meaning it should emit them.

The CIE performed a linear mathematical transformation of the initially calculated RGB CMFs to avoid negative values at all wavelengths. This yielded a new set of imaginary *XYZ* primaries and corresponding XYZ CMFs: CIE 1931 2° XYZ CMFs $\bar{x}(\lambda), \bar{y}(\lambda), \bar{z}(\lambda)$ and CIE 1964 10° XYZ CMFs $\bar{x}_{10}(\lambda), \bar{y}_{10}(\lambda), \bar{z}_{10}(\lambda)$, for a 2° and a 10° FoV (CIE, 2018). Figure 7B shows that both CMFs are slightly different, as the CIE 1964 10° XYZ CMFs also involve regions of the retina that are less densely packed with cones (Malacara, 2011). Note that the *X*, *Y*, and *Z* primaries are physically unattainable; they are purely mathematical constructs made up from the real CIE *R*, *G*, and *B* primaries using a matrix transformation. Even though no single natural person is probably exactly like any of the CIE standard observers (Nimeroff et al., 1961), and notwithstanding the drawback that the CIE XYZ CMFs use imaginary primaries because no physical matching lights can obtain these functions (Hung, 2006), these CMFs are still essential in all aspects of colorimetry and a vital element for understanding colour perception.

Finally, it is necessary to understand that the 10° cone fundamentals depicted in Figure 5B are an exact linear transform of the 10° XYZ CMFs (which also counts for the 2° curves). Via multiplication with a 3x3 matrix containing nine elements, one can quickly get one set of curves from the other and vice versa (Berns, 2019). The CMFs and cone fundamentals are thus duals of one another (Horn, 1984). The following section will explore how these CIE XYZ CMFs allow calculating the fundamental *XYZ* tristimulus values for any perceivable colour.

2.4. Expressing Colour: Colour Models and Spaces

In the digital world, colour is represented using global colour models and more specific colour spaces. Colour is often mathematically defined as a three-dimensional (3D) property. However, a point in a 3D space can be determined using many different Coordinate Systems (CSs). In cartography, a CS is determined by its dimensionality (i.e. the number of coordinate axes) and the attributes of these axes: their name, abbreviation, units, direction and order (Iliffe & Lott, 2008). As an example: a 3D Cartesian XYZ system using the meter. If any of these attributes changes, the CS changes.

The same goes more or less for colour (Verhoeven, 2016). Many CSs for colour exist, typically built upon three or four coordinate axes with a specific name, direction and order. Two well-known examples are the RGB and CYMK colour models. Whereas the RGB colour model is used in digital cameras and monitors to describe colour values with an *RGB* triplet, a 4D system like CMYK is used in printing to describe colour via specified amounts of a Cyan, Magenta, Yellow and blacK/Key primary. However, a specific *RGB* triplet such as *R*:130 – *G*:110 – *B*:255 does not define a particular colour but only indicates the ratio of the three components used. Although 255 is the maximum value for each *R*, *G* and *B* channel in an 8-bit image, a colour model does not specify how 'vibrantly blue' this maximum should

be. In other words: a colour model is a mathematical system without describing how these values should be interpreted in terms of real-world, quantified colours. Colour models such as RGB, CMYK, HSV (Hue, Saturation, Value), and HSL (Hue, Saturation, Lightness) are, therefore, said to be relative.

To accomplish an unambiguous description of colours, one needs colour spaces. And again, cartography functions as a handy comparison. Cartographers use the term Coordinate Reference System (CRS) when a CS is fixed to a specific object. For example, a 3D Cartesian XYZ coordinate system with units in meters related to the Earth by fixing the CS' scale, orientation and the position of its origin. Similarly, the CIE XYZ colour space is associated with the operating principles of the HVS, and all other colour spaces are related to the XYZ colour space. Once coordinates are given in any colour space, one knows unambiguously which colour these coordinates represent. To map from relative *RGB* values to absolute CIE *XYZ* values, RGB colour model-based colour spaces are defined by three primaries, a specific CIE illuminant and a gamma value.

Defining a specific primary for each axis is similar to choosing the three monochromatic lights in the colour-matching experiments. From a conceptual point of view, establishing a primary determines the greenest green, the bluest blue and the reddest red, represented by the highest value on the *R*, *G*, and *B* axes. Since these primaries can be freely defined, each colour model has almost unlimited colour spaces. In other words: a particular colour space is just one possible, absolutely defined instance of the more general colour model.

The best-known RGB colour spaces for digital photographs are sRGB, Adobe RGB (1998) and ProPhoto RGB (also known as ROMM RGB), all with three unique primaries. Figure 8 provides the data for these three colour spaces and compares all three in the CIE *xy* chromaticity diagram. The chromaticity coordinates (*x*, *y*) are defined by:

$$x = \frac{X}{X+Y+Z}, y = \frac{Y}{X+Y+Z} \qquad (1)$$

so that a colour's chromaticity can be described irrespective of its luminance (Hunt, 2004). The three points that form a colour space triangle correspond to the chromaticity coordinates of that colour space's primaries (Figure 8 also gives these values). The area in the triangle is known as the colour gamut and encompasses all the colour values one can create by mixing those three primaries. From Figure 8, one can infer that the sRGB space has a relatively limited gamut (which corresponds to those of most monitors). In contrast, Adobe RGB (1998) and ProPhoto RGB have much wider gamuts, even though all three are based on the RGB colour model. In other words, the ProPhoto RGB colour space can represent more colours than the Adobe RGB (1998) space, which can store a broader range of colours than the sRGB colour space. Since the horseshoe-shaped chromaticity diagram represents all chromaticities visible to a standard human observer, the gamut of human vision is clearly not a triangle. The outer curved diagram boundary is known as the spectral (or monochromatic) locus, because monochromatic lights can generate these chromaticities. The diagram includes the wavelengths of those monochromatic lights for completeness.

Combining three primaries with a particular CIE illuminant and gamma value (concepts detailed in Sections 2.5 and 4.6, respectively) thus effectively maps *RGB* values to the CIE XYZ reference colour space. As mentioned, *X*, *Y*, and *Z* primaries are purely mathematical entities, but they allow us to uniquely create and describe all possible colours that an average human perceives. The values mentioned above (*R*:130 – *G*:110 – *B*:255) expressed in the sRGB colour space correspond to *X*: 32.8 – *Y*: 23.1 – *Z*: 97.3, describing a purple-ish tone (see Figure 8 on the right). A more blue-ish tone results when the same *RGB* values are expressed in the ProPhoto colour space. As one would expect, its objective description in CIE 1931 2° XZY values changes to *X*: 29.8 – *Y*: 24.2 – *Z*:82.5. However, it is the reverse conversion which makes the XYZ colour space so powerful: given a colour expressed in terms of CIE *XYZ* tristimulus values, its corresponding value in any possible colour space like sRGB or Adobe RGB (1998) can be computed. And because the CIE XYZ colour space is device independent, it functions as connection space between input and output devices. In other words, devices like scanners and digital cameras have

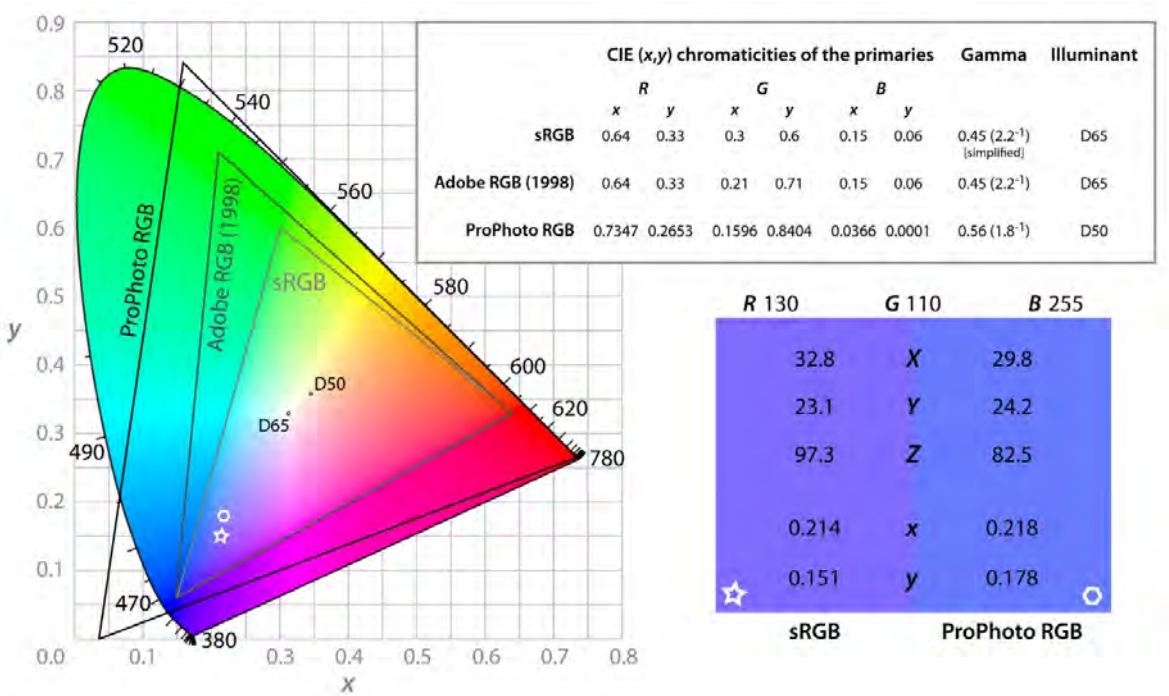



**Figure 8.** On the left, the primaries and bounds of three RGB colour spaces are drawn on top of the *xy* chromaticity horseshoe diagram that represents the limits of human colour vision. The top right inset provides all colour space-specific data. The bottom right illustrates how identical *RGB* values (130, 110, 255) result in different colours (and CIE 1931 *XYZ* or 1931 *xy* values) when expressed in the sRGB or ProPhotoRGB colour space. Both colours are indicated in the chromaticity diagram.

to find a way to map their device-specific *RGB* values to corresponding *XYZ* values. As we will see in Section 5, this is one of the most critical steps in producing adequately accurate colour values with a digital camera.

However, not just the values generated by a digital camera must, at a certain point, be expressed in *XYZ* coordinates. The XYZ colour space is omnipresent in colorimetry, and everything—from illumination sources to stimuli—can be described in terms of *XYZ* coordinates. This is the topic of the following two sections.

2.5. Characterising Illumination

Any light source can be expressed by its Spectral Power Distribution (SPD): a series of numbers quantifying the amount of each visible wavelength (between 400 nm and 700 nm) included in the light source. Blue disco light emits mainly wavelengths between 400 nm and 500 nm and has almost no output from 500 nm to 700 nm. On the other hand, a camera flashlight contains all visible wavelengths in varying proportions. Plotting these numbers yields a graph like the ones in Figure 9A. Both SPDs were measured by the INDIGO staff with a Sekonic C-7000 SPECTROMASTER portable handheld spectrometer. The graph shows two different illuminations of a graffito just before photographing it. These curves always combine direct solar radiation and diffuse skylight. The former might be zero on very cloudy days or when a graffito is in the shadow.

The SPD of any light source can thus be measured with a spectrometer. However, in colorimetric applications, one usually does not work with just any light source but with so-called CIE standard illuminants: quantified and standardised illumination sources. The CIE has described several standard illuminants (International Organization for Standardization, 2022) based on physically obtainable

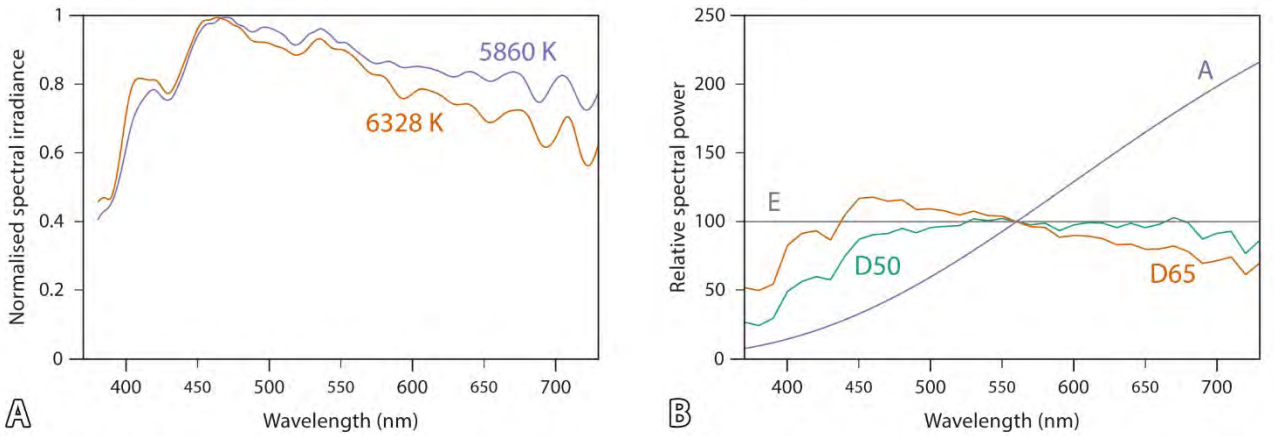



**Figure 9.** Inset A depicts two spectral power distributions of the outdoor illumination just before photographing a graffito. Inset B represents the SPDs of the CIE D50, D65, A and E standard illuminants. The SPDs of the latter four come from the ISO/CIE 11664-2:2022 standard (International Organization for Standardization, 2022).

light sources or their statistical representations (see Figure 9B). Of those, the CIE D65 is the most widespread. The "D" part of the name indicates that D65 is a Daylight illuminant, part of a family that is representative of the various phases of daylight (Judd et al., 1964). Its SPD (see Figure 9B) aims to roughly correspond to the average western European midday light (comprising both direct sunlight and diffuse skylight). The "65" part refers to this illuminant's correlated colour temperature of approximately 6500 degrees kelvin (CIE, 2018).

Summarising metrics like the Correlated Colour Temperature (CCT) exist since it is not always possible nor practical to consider the illumination's entire SPD. The CCT characterises the illumination's dominant colour with a temperature reading on the kelvin scale. The kelvin value (symbolised by K) refers to the temperature at which a theoretical object (called a blackbody) must be heated so that its SPD generates the same colour experience as the SPD of the illuminant. A blackbody is a theoretical object that absorbs all incident electromagnetic radiation; it is black. Any electromagnetic radiation originating from a blackbody is emitted solely as a function of its temperature, as described by Planck's law (Walker, 2004). Figure 10 depicts the temperature-dependent output of a blackbody, and although iron is not a blackbody, it pays off to visualise heated iron to understand the curves in Figure 10 better. When heated to 700 K (i.e. 700 K – 273.15 = 426.85 degrees Celsius or 427 °C), the piece of iron is characterised by a deep red glow. The iron shall radiate brighter, reddish-orange light when raising the temperature to about 1000 K (727 °C). Increasing the temperature to its boiling point at 3134 K (2861 °C) yields a brilliant orange-yellowish light. In other words: the SPD of the emitted light is only a function of the iron's absolute surface temperature, hence the term Colour Temperature (CT). Since a blackbody is an idealised object and illumination sources are not ideal blackbody radiators, the entire SPD of these sources cannot be described solely as a function of temperature. However, their colour or, more accurately, their chromaticity can. This gave birth to Correlated CT or CCT: the kelvin temperature at which a blackbody SPD yields the same chromaticity experience as the illumination source under consideration (Borbély et al., 2001).

Being a one-dimensional metric, CCT is a convenient but limited way to characterise and summarise many illumination sources. Although an in-depth discussion of its (dis)advantages is beyond the scope of this paper, one of the problems with CCT is that different SPDs can

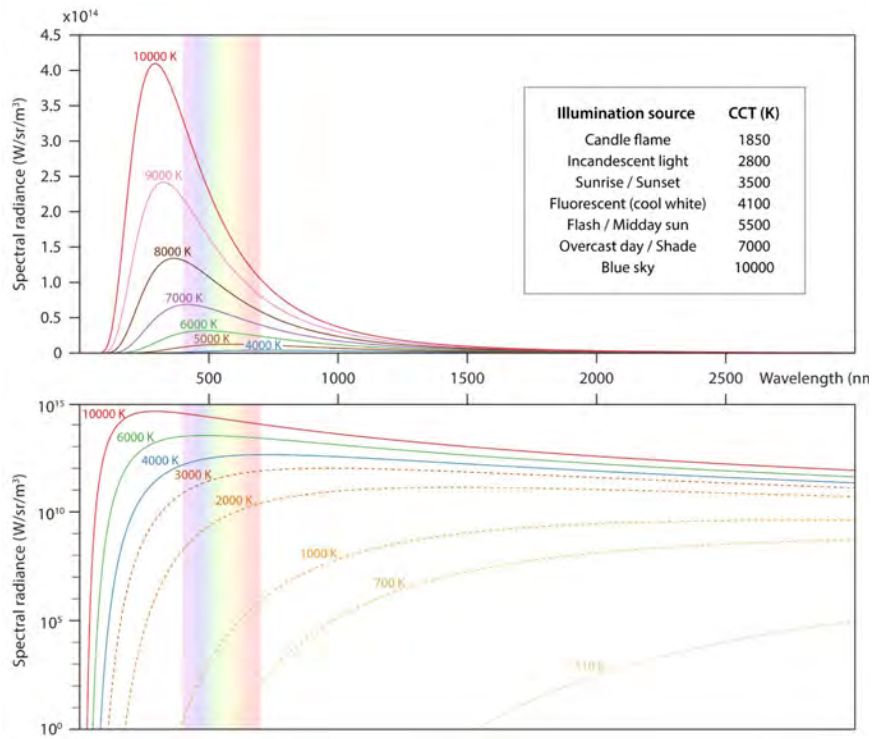
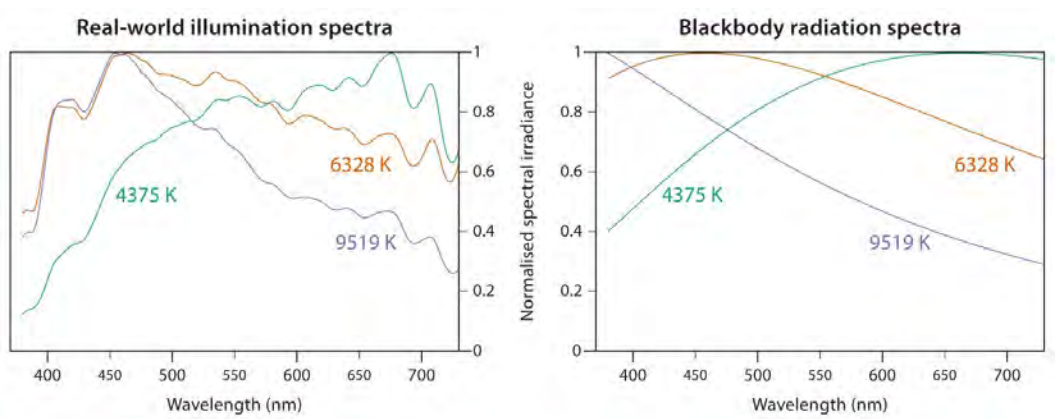



**Figure 10.** The blackbody radiation output for different kelvin temperatures (K). The lower graph is a semi-log plot with the spectral radiance displayed on a logarithmic scale to better visualise the radiation emission at lower temperatures. In this way, it is possible to show that a blackbody with the temperature of an average human body at 37 °C (or 310 K) does not emit any visible light. Only around 700 K (or 427 °C) gets visible red light emitted. Dashed lines in the lower, semi-log plot indicate blackbody radiation at temperatures not depicted in the upper plot. Blackbody radiance curves of a specific temperature share the same colour in both plots. The inset provides the CCT values of common illumination sources.

result in an identical CCT value. Figure 11 illustrates this. The left side displays three real-world daylight SPDs and their CCTs. These SPDs—measured with a Sekonic C-7000 SPECTROMASTER spectrometer—are normalised to their maximum value to ease comparison. Although the Sun is close to an ideal blackbody, these real-world daylight SPDs are pretty different from the SPDs of a blackbody heated at those temperatures (Figure 11, right side), mainly because solar illumination is altered by various absorptions via atmospheric gasses.




| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.9711 | 1.0000 | 0.6706 | 0.3676 | 0.3785 | 4375 K | 0.9960 | 1.0000 | 0.7305 | 0.3653 | 0.3668 |
| 0.9533 | 1.0000 | 1.0661 | 0.3157 | 0.3312 | 6328 K | 0.9692 | 1.0000 | 1.0949 | 0.3163 | 0.3264 |
| 0.9380 | 1.0000 | 1.4105 | 0.2801 | 0.2986 | 9519 K | 0.9719 | 1.0000 | 1.4565 | 0.2835 | 0.2917 |
| *X* | *Y* | *Z* | *x* | *y* | | *X* | *Y* | *Z* | *x* | *y* |

**Figure 11.** The SPDs and CCTs of three outdoor illumination scenarios are displayed on the left, while the right side depicts the blackbody spectra at the same kelvin temperatures. The tables below both plots provide the CIE 1931 2° *XYZ* and *xy* coordinates of each SPD.

Instead of CCT, illumination SPDs are also characterised by their *XYZ* values (see Figure 11). To obtain these *XYZ* values, the illumination's SPD is multiplied by the CMFs of a CIE standard observer. Then, all the visible wavelength values are summed for each of the three CMFs to obtain the CIE *XYZ* tristimulus values for that incoming stimulus (this multiplication and summation combination is known as integration; see also Figure 13, but without the reflectance.). The resulting *XYZ* coordinates are said to represent the white point of the SPD. In other words, expressing the colour of an illumination source as an *XYZ* coordinate triplet tells us how much of the imaginary *X*, *Y* and *Z* primary is needed to produce that colour.

Despite being purely mathematical, the CIE XYZ colour space features a few unique properties. For instance, the *Y* value represents the luminance data generated by the HVS, which is approximately the physical counterpart of the perceptual quantity brightness (CIE, 2018). That is why the white point's *XYZ* coordinates are usually divided by *Y*, so *Y* always equals 1. Because the *Y* value represents the luminance of a colour, the resulting *X* and *Z* coordinates characterise the SPD's white point without considering its luminance. Having two coordinates (*X*, *Z*) instead of one (like CCT) offers advantages. For instance: CCT as a principle relies on glowing hot objects. However, there is nothing that glows green or magenta. So if an SPD of a given illumination source would be perceived as a bit greener than the blackbody radiation at that temperature, this can be expressed by the *XZ* white point coordinates but not by the CCT. Table 1 provides some white point coordinates of standard CIE illuminants. Via equation (1), these white points can also be expressed as chromaticity coordinates (*x*, *y*).

**Four CIE standard illuminants**

| Illuminant | White point CIE 1931 (*x*, *y*) | White point CIE 1931 (*X*, Z), *Y* = 1 | CCT (K) | Represents |
|---|---|---|---|---|
| A | 0.4476, 0.4074 | 1.0985, 0.3558 | 2855.5 | tungsten filament lamp |
| D50 | 0.3457, 0.3585 | 0.9642, 0.8250 | 5001 | average daylight around 5000 K |
| D65 | 0.3127, 0.3291 | 0.9504, 1.0886 | 6503 | average daylight around 6500 K |
| E | 0.3333, 0.3333 | 1, 1 | 5455 | equi-energy radiator |

**Table 1.** Some summarising data on four CIE standard illuminants. The CCT values for A, D50 and D65 are from the ISO/CIE 11664-2:2022 standard (International Organization for Standardization, 2022). The white points were computed with the CIE 1931 2° XYZ CMFs, and the standard illuminants' SPD tabulated in the same ISO standard.

Finally, it is essential to know that the 2° and 10° XYZ CMFs (see Figure 7B) have arbitrary units because they were normalised to yield identical *XYZ* values for a spectrally flat stimulus (i.e. an equi-energy stimulus). That is why the equi-energy CIE illuminant E has [1, 1, 1] as *XYZ* white point (see Table 1). Illuminant E is, therefore, called the reference white of the CIE XYZ colour space. It was already mentioned above and indicated in Figure 8 that any RGB colour space has a reference or native white (like D65 for sRGB). In each case, the SPD of this illumination results in a maximum identical value for each axis (i.e. [1, 1, 1]), thus representing white. For example, the stimulus in Figure 19C equals the reference white SPD for a Nikon D700.

2.6. Measuring Colour

Colorimetry, or the science of colour measurement, intends to express colours quantitively based on colorimetric standards (Hunt & Pointer, 2011). Since 1931, the CIE has provided several systems for that purpose, like the CIE XYZ colour space mentioned before. Since the text already explained the concepts of SPD, standard illuminant and their characterisation via CIE *XYZ* coordinates, it becomes now straightforward to explain colour measurement.

To express any object's colour as *XYZ* coordinate triplet, one needs three elements again (see Figure 12): the light source or illuminant, the object or sample and an observing instrument. The whole principle is identical to the one explained in Figure 4, with the constraints that the

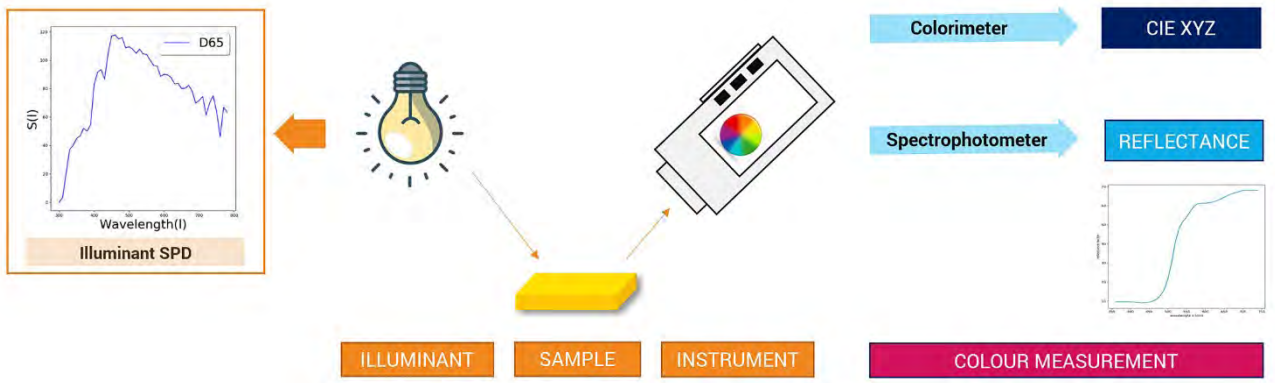



**Figure 12.** Colour measurement: an interplay between illuminant, sample and instrument.

light source is usually a CIE standard illuminant and the instrument a CIE standard observer. Once the light of the (standard) illuminant hits the object, a fraction of the entire SPD gets reflected—which, as said before, depends on the object's physical and chemical structure. Like the output of a light source, the spectral reflectance of an object can be measured and graphed. This graph is called the spectral reflectance curve; it quantifies which wavelengths get reflected and by how much (see Figure 12 on the right or Figure 13 in the middle).

Finally, a colorimeter will produce *XYZ* tristimulus values. Colorimeters have internal filters and processing algorithms, so they can mimic the CIE 1931 2° or CIE 1964 10° XYZ CMFs and integrate the stimulus over them. Colorimeters are great devices, but they are not as accurate as spectrophotometers. In addition, the operating principles of colorimeters and spectrophotometers are dissimilar (Berger-Schunn, 1994). A colorimeter solely observes the incoming stimulus and provides the *XYZ* coordinates to characterise the colour of that stimulus. As such, they are often used to characterise computer monitors. In contrast, a spectrophotometer has a standard light source integrated, usually a simulation of the D65 illuminant (even though they may include additional standard illuminants). This light source illuminates the sample, which partly reflects a portion back into the spectrophotometer. Since the instrument knows the exact SPD of its integrated light source, it can compute the object's reflectance from the stimulus it receives. In that way, spectrophotometers can be placed on any part of an object to accurately measure that sample's spectral reflectance. This spectral reflectance curve can be considered a unique spectral fingerprint of that object part. At that stage, the instrument has all the pieces to generate the *XYZ* values of the sample: it knows the SPD of the illuminant and the sample's spectral reflectance. Both can now be multiplied into a stimulus; the latter gets integrated over a CIE standard observer to yield 2° or 10° CIE *XYZ* tristimulus values (see Figure 13) (CIE, 2018; Hunt & Pointer, 2011).

Figure 12 depicts these two different pathways: either a colorimeter computes CIE *XYZ* values directly, or the latter are obtained mathematically after first calculating the exact spectral reflectance of the sample. The problem with a colorimeter is that the illuminant can remain entirely unknown. And since the stimulus is a function of the illuminant, a sample will feature different *XYZ* values according to the light source. That is why *XYZ* values for colour reference targets (like the well-known ColorChecker series by X-Rite, now produced by Calibrite) are always defined for a particular illuminant. And that is why well-defined standard illuminants are essential. If a non-standard illuminant were used to express the *XYZ* values of an object, these values would be worthless without considering the entire illumination SPD. Agreeing on some standardised illuminants makes communication of colour values thus more straightforward. Moreover, using a spectrophotometer to directly measure the object's spectral reflectance, the *XYZ* colour values can be computed

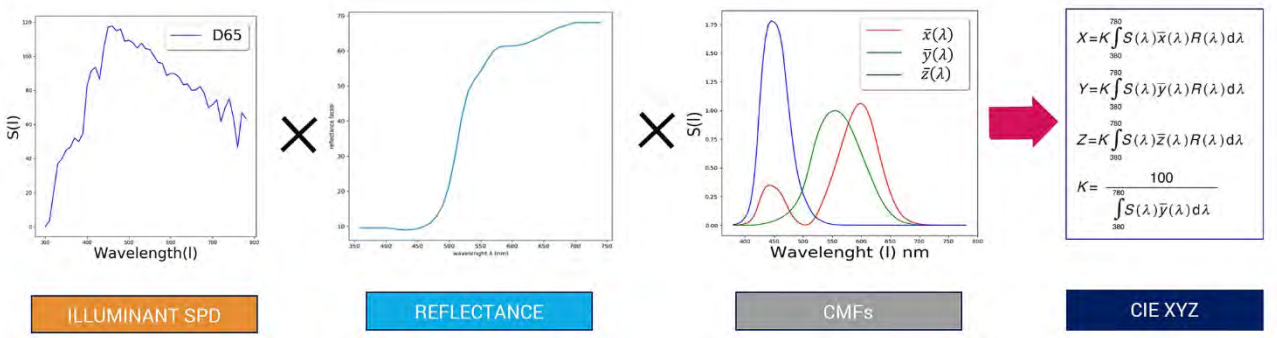



**Figure 13.** Scheme for the computation of CIE *XYZ* values from reflectance data.

for any known SPD. That is why spectrophotometers are recommended, even though they are more expensive than colorimeters.

At this point, it is essential to address if one can rely on a conventional digital camera for colour measurement, thus effectively simulating a colorimeter or spectrophotometer. Using the reasoning established before, one can state that every pixel of a digital graffito photo results from an illumination's SPD interacting with the graffito's reflectance at a specific point, thus yielding a spectral stimulus which gets integrated over the camera's spectral sensitivity curves. In this chain, it is only straightforward to measure or estimate the SPD of the illuminant with a spectrometer (see the left graph of Figure 13). So how can one get accurate colour data from the raw pixel values registered by the camera? Sections 3 and 4 will cover this topic.

## 3. The Birth and Storage of Image Pixels

### 3.1. Image Sensors: A Collection of Photosites

Analogue signals are continuous and exist in the tangible world as functions of space and time. Digital signals are found inside computers and are merely a collection of discrete states. Once an analogue signal is digitised, perfect clones become possible. The digital product is, however, always an approximation of the analogue reality because this numerical translation is accomplished by the processes of sampling and quantisation (both explained below). The analogue signal digitally captured by photography or any other form of optical imaging is the continuously varying electromagnetic radiation reflected or emitted by the scene. In the case of traditional photography, a digital image is generated by converting the visible portion of radiant energy into an electrical output signal which is then digitised.

All cameras comprise optical elements such as lenses and filters that gather electromagnetic radiation and focus it onto their imaging sensor. For applications like conventional photography, these imaging sensors consist of a two-dimensional array of individual photon-sensing sites or photosites (Figure 14). The photodetector is the key component of such a photosite, as it collects light during the exposure time. Nearly all imaging sensors have one photodetector per photosite, although Foveon's X3 image sensor features three detectors per site (Lyon & Hubel, 2002). Depending on the sensor design, the individual photosites may contain more or less circuitry, and the photon-receiving surface area of the photodetector may be smaller or larger. Throughout the years, academia and industry have proposed diverse photosite arrangements and photodetector designs to achieve specific performances (e.g. increase the image's spatial resolution or optimise the spectral sensitivity of the imaging sensor).

Most photo cameras feature an imaging sensor in which one photodetector contributes one effective pixel to the image. For instance, a 24-megapixel digital camera has an imaging sensor built-up of at least 24 million photosites/photodetectors distributed in rows and columns (for example, 6000 columns by 4000 rows). 'At least' is essential here since additional photosites handle tasks like dark

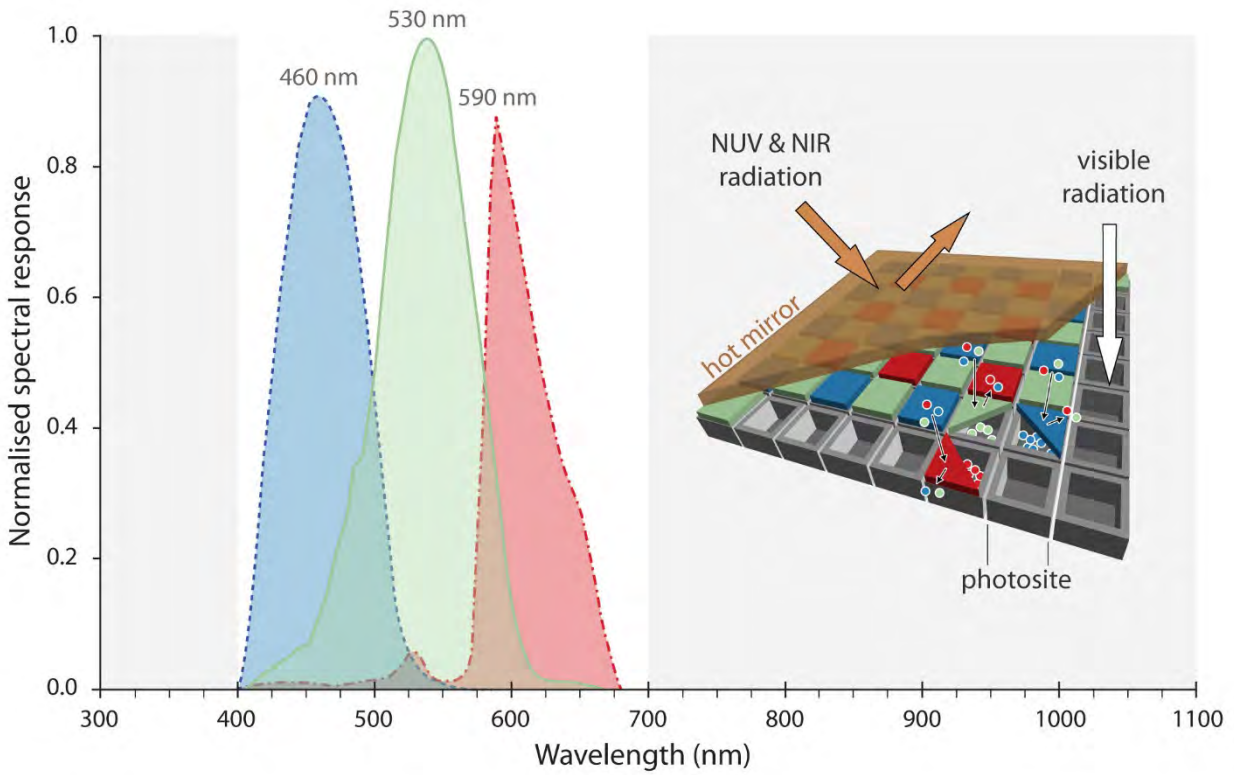



**Figure 14.** The relative spectral response curves (also known as the spectral sensitivity functions), sensor element layout and working principle of a typical off-the-shelf digital photo camera with a Bayer-filtered imaging sensor. NUV and NIR mean Near-UltraViolet and Near-InfraRed, respectively.

signal correction (see Section 4.1) and white balancing (see Section 4.2).

3.2. Sampling: Collecting Photons

The fundamental building blocks of any digital image are called pixels (Billingsley, 1965) or pels (Schreiber, 1967), coined terms for picture elements. To create these pixels, an imaging sensor inside a conventional photo or video camera collects incoming photons over the area of every photosite. However, not all photons are collected, only from the incident visible electromagnetic radiation (i.e. light). To achieve this, the imaging sensor features a filter on top (the so-called hot mirror; Figure 14) that blocks non-visible electromagnetic radiation. Without this filter, the sensor would also detect near-ultraviolet and near-infrared radiation, making it impossible to render the scene colours as humans perceive them.

As Figure 14 depicts, none of the photosites captures the entire visible spectrum. A mosaic of thin, coloured filters ensures that every photosite only gathers one particular part of the incident light. This Colour Filter Array (CFA) comes in various designs, but digital cameras mainly use a so-called Bayer pattern which features twice as many green filters as blue or red ones (Bayer, 1975). So per photosite, photons are solely gathered in one of the three 100-nm-wide spectral bands, being the Blue waveband (with wavelengths from 400 nm to 500 nm), the Green (500 nm to 600 nm) and Red (600 nm to 700 nm) spectrum (Figure 14).

This process lasts as long as the exposure lasts (e.g. 2 s or 1/250 s). All the absorbed photons generate an electrical charge in every photodetector. After the exposure, every single detector's charge—which is linearly proportional to

the amount of incoming radiation—is read out. It represents a sample of the visible electromagnetic energy originating from the imaged scene (see Figure 15). In other words, photographic pixels are created by sampling the scene in the spatial, spectral and temporal dimensions. A digital photograph is thus never a very accurate reproduction (in absolute terms) since its pixels represent averages in space, spectral range, and time.

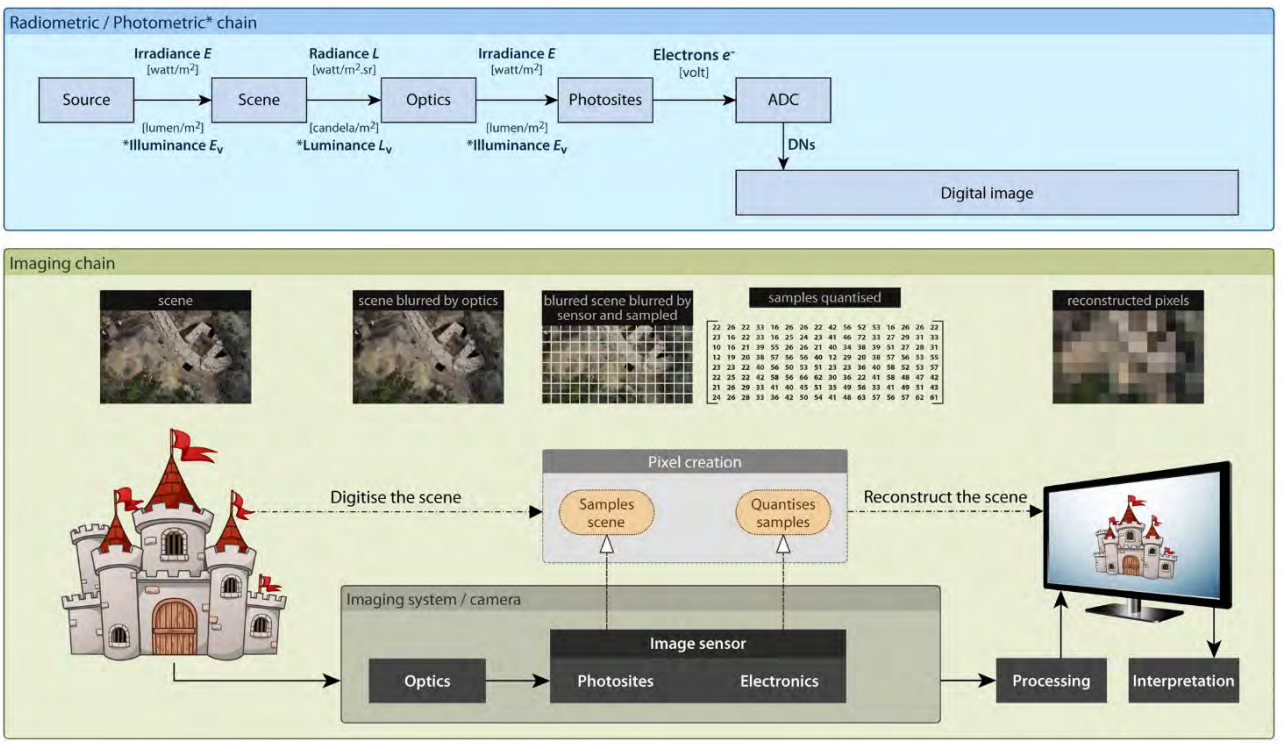



**Figure 15.** The complete imaging chain: a digital camera digitises an analogous real-world scene which gets reconstructed on a monitor. The lower part of the illustration depicts the overall pipeline (from left to right), including the pixel creation stage. On top, the imaging chain is broken down into its radiometric and photometric components. The latter quantities and units apply when imaging visible electromagnetic radiation.

### 3.3. Quantisation: Handing Out Digital Numbers

These sample values (i.e. the generated charges) have to be mapped onto a discrete set of numbers by a process called quantisation. In their most raw form, image pixels are thus created by quantising every photosite-specific sample to a discrete Digital/Data Number (DN) by the Analogue-to-Digital Converter (ADC). The total range of tones or quantisation values an ADC can create is called the tonal range. The ADC's bit depth determines the image's tonal range: quantisation with *N* bits rounds all possible charges to these $2^N$ values. For example, a conventional 12-bit ADC can discriminate $2^{12}$ or 4096 tones; every pixel gets one of those 4096 possible discrete DNs, 0 for the lowest and 4095 for the highest possible charge.

Raw photo pixels are thus sampled and quantised versions of a continuous analogue spectral signal (Verhoeven, 2018). These samples are determined by a pair of pixel coordinates (*r* and *c*, indicating row and column) and one specific value (the DN). An array of these pixels is called a digital image,

mathematically represented as an $M \times N$ matrix of numbers, $M$ and $N$ indicating the image dimensions in pixels. However, at this stage, every pixel only has one value, one DN. Section 4 will cover all the processing steps that are needed to turn these raw DNs into a colour photograph where every pixel contains one digital number for the Red, one for the Green and one for the Blue spectral band (which explains why photographs in their final, processed form are often called RGB images). So, the processed photos a camera generates from the initially captured raw pixels can be represented by $O$ matrices of $M \times N$ elements, $O$ being the number of spectral bands. $O$ is three for an RGB image and one for a greyscale image.

3.4. RAW Versus JPEG and TIFF

The last paragraph mentioned two types of photographs: photos containing raw pixel values and fully processed RGB output photos. This dichotomy or 'choice' is also reflected in many digital cameras, which can usually produce and store both image types:

1. An image which holds per pixel the single DN captured via its corresponding photosite. This image is typically referred to as the RAW photo or RAW file. RAW is not an acronym. It only signifies raw or minimally processed image sensor data with pixel values that are linearly related to the incoming radiation in the Red, Green or Blue visible spectral band. RAW can thus be considered the only scientifically justifiable file format (Verhoeven, 2010). However, the RAW format is not all roses. Even though most dedicated digital cameras support saving RAW files, they all have a manufacturer-specific structure and extension, like *.NEF for Nikon, *.RAF for Fuji, *CRW or *.CR2 for Canon and *.GPR for GoPro. Adobe also launched its open-source Digital NeGative (or *.DNG) format in 2004, attempting to standardise the RAW file format. However, most manufacturers refrain from implementing it. In addition, RAW data need many processing steps to end up with the second image type: a normal-looking photo.
2. A highly-processed viewable image with pixels nonlinearly related to the captured stimulus. This image is usually expressed in the sRGB colour space and saved as a JPG/JPEG-compressed image or TIFF file. When talking about a photo, this viewable type of image is meant. Even though some dedicated cameras (and smartphones) might not offer the option to save the RAW image, the latter always forms the basis to yield a pleasing output photo.

In addition to the pixel values or DNs that encode the real-world scene, both image types contain Exif (Exchangeable image file format) metadata. These metadata describe image acquisition parameters (such as the serial number and model of the camera, the aperture, focal length, shutter speed, possible flash compensation, and the date plus time of photo acquisition) in mandatory, recommended and optional tags stored in a separate segment of the file (Camera & Imaging Products Association, 2010-2019). Suppose the camera is GNSS (Global Navigation Satellite System)-enabled. In that case, tags can also hold the latitude, longitude and altitude of the camera's geographical location. All these Exif-defined tags are created by the camera and stored simultaneously with the DNs in the image file, making it possible to analyse them afterwards.

**4. 'Developing' or Rendering Raw Digital Numbers**

Many processing or 'digital development' or 'rendering' steps are involved in producing a normal-looking output photo from a RAW image. These steps either happen inside the digital camera or are executed afterwards via dedicated RAW conversion computer software. Despite the variety of RAW processing pipelines detailed in the scientific literature, there is agreement on the central processing stages (Karaimer & Brown, 2016, 2019; Ramanath et al., 2005; Sumner, 2014). Within the scope of project INDIGO, we have developed the software package COOLPI. COOLPI, or the COlour Operations Library for Processing Images, is open-source and freely available on GitHub: https://github.com/GraffitiProjectINDIGO/coolpi. The software can also be installed directly from the Python Package Index repository or PyPi (https://pypi.org/project/coolpi) using pip (by running "pip install coolpi" on the system shell).

COOLPI relies on rawpy (https://pypi.org/project/rawpy), a Python wrapper for the LibRaw library (https://www.libraw.org), to facilitate many of the well-known RAW processing steps, but with adaptations at several stages to prioritise colour accuracy (see also Molada-Tebar et al. (2018)).

Generally, one can distinguish six main steps to convert a RAW image file into a viewable RGB photo expressed in a colour space like sRGB. Some implementations might change the sequence of these steps, but the order in which they are detailed below is relatively standard. Figure 16 summarises all these steps and related terminology. It can, therefore, function as a visual guide for the rest of this paper.

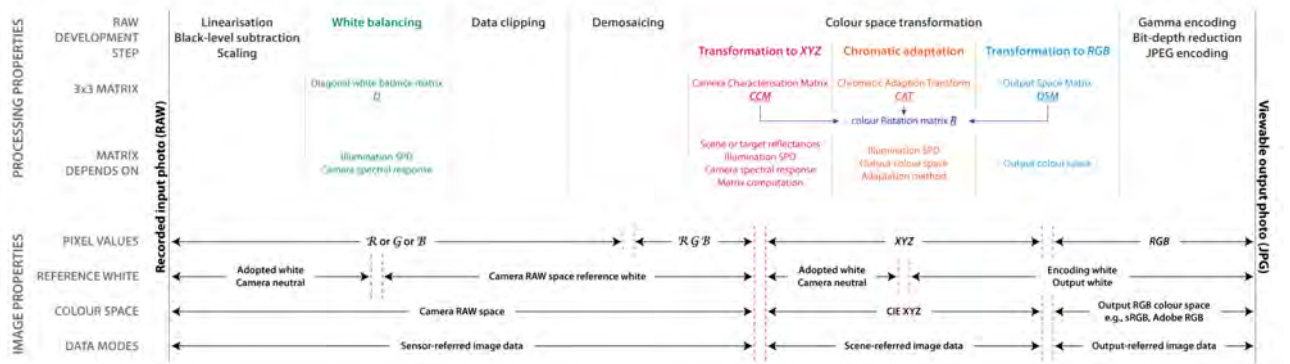



**Figure 16.** The figure outlines the entire RAW development chain covered in this paper. All matrix operations directly influencing the final colour are indicated in a chromatic tone. The factors on which those matrix operations depend, and the colour space or white point transformations they effectuate, are also indicated.

4.1. Linearisation, Black-level Subtraction and Scaling

Although the sensor's response to the incoming illumination is mainly linear (Chakrabarti et al., 2009), some cameras introduce a non-linear operation to compress the data. For example, many Sony cameras of the NEX and ILCE series feature a 14-bit ADC, but these 14-bit data get compressed to store them as 11-bit data, thereby reducing the file size considerably. Since all subsequent RAW development steps expect linear data, it is necessary to correct any non-linearity from the start (Ramanath et al., 2005). This linearisation step is straightforward: the linearisation curve embedded in the metadata of the RAW file gets applied to the stored data (from now on indicated as $\mathcal{R}$, $\mathcal{G}$ and $\mathcal{B}$), thereby decompressing the RAW data back to its original bit-depth. For example, Figure 17 shows how the Nikon D70's linearisation curve maps the initially stored but compressed data with a limit value of 683 back to the 12-bit maximum value of 4095. In other words: the original RAW data in the D70 image are compressed by the camera into 9.4 bits (i.e. $\log_2 683$). Via the linearisation curve, the compressed data are 'unpacked' to 12 bits (i.e. DNs from 0 to 4095). The Nikon D5600 linearisation curve shown in Figure 17 indicates that the 14-bit RAW data (i.e. DNs from 0 to 16383) are compressed into 12 bits. Figure 18 visualises the effect of this curve. Figure 18A shows the non-linear version of the RAW file. Halfway through the image's width, B depicts the linearised version.

A black-level correction to compensate for dark current accompanies this step. Dark current is a signal generated even when the sensor is not illuminated. In other words: pixels which should be perfectly black still have some value. This value increases with exposure time and is temperature dependent. The warmer an image sensor, the more dark current gets produced. To render black as truly black, the lowest value in the RAW file (or some default value) is considered pure black and gets subtracted from every image pixel (Figure 18C).

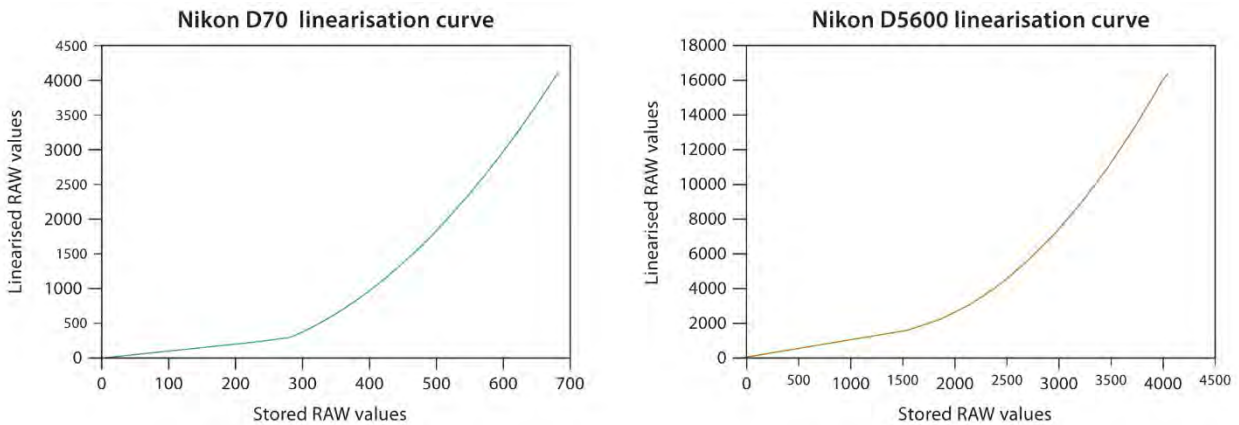



**Figure 17.** The linearisation curves of the Nikon D70 and Nikon D5600. These curves reside in the Exif metadata of the RAW files.

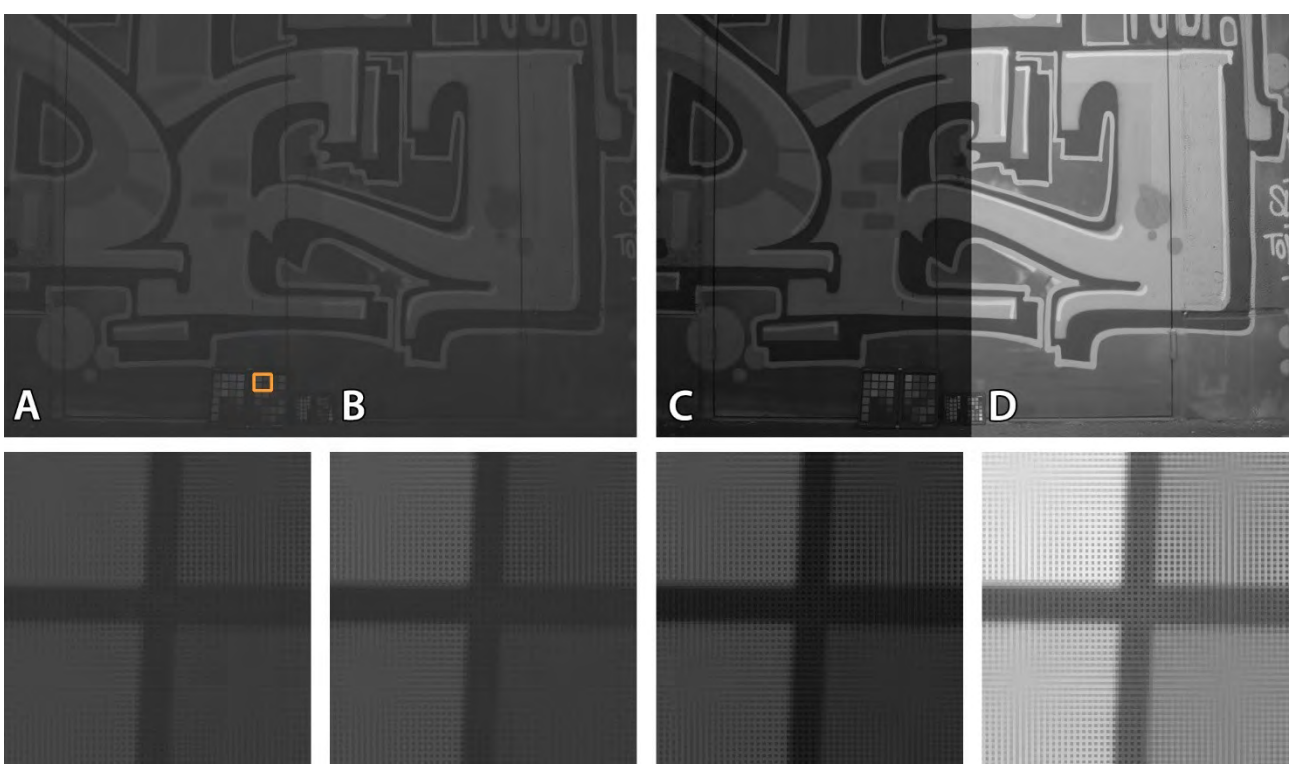



**Figure 18.** A Nikon D5600 RAW file in its initial processing stages. A) indicates the non-linearised image, while B) shows the linearised version (which is slightly brighter). C) displays the linearised, black-subtracted version, while D) shows the RAW image scaled to the [0.0, 1.0] interval. The CFA patterning is apparent from the zoomed-in parts in the bottom row. All images have been subjected to a 1/2.2 gamma encoding, as they would otherwise be too dark for display.

Some RAW converters then scale the input data (usually 12- or 14-bit) to 16-bit integer values. For a 14-bit file (which can hold $2^{14}$ or 16,384 different integer values), the most straightforward scaling approach is multiplying all DNs with four so that every pixel features a value between 0 and 65,535 (i.e. $2^{16}$-1). Other RAW converters (and COOLPI) rescale the raw $\mathcal{R}$, $\mathcal{G}$ and $\mathcal{B}$ DNs to the [0.0, 1.0] floating-point interval (Figure 18D). There are also more adaptive scaling approaches possible. These could ensure that details in the brightest portions of the image (the so-called highlights) never get clipped. The 'Exposure' or 'Exposure compensation' sliders found in RAW converters like Adobe Camera Raw (https://helpx.adobe.com/camera-raw/using/supported-cameras.html) or RawTherapee (https://www.rawtherapee.com) enable interactive scaling to account for over- or underexposure. Although COOLPI does not offer such interactive scaling, the authors are experimenting with automatic image-specific scaling to unify the exposure of all photographs from one particular graffito because exposure values cannot be spot on every time. Finally, some RAW converters also feature sliders that non-linearly scale the DNs, typically to brighten the shadows or compress the highlights in the image. If a colour-accurate rendering of the scene is wanted, one should stay clear of such operations.

The bottom row of Figure 18 illustrates that, at this stage, the image looks like a patterned greyscale image. The greyscale nature relates to the fact that there is still only one DN per pixel (either $\mathcal{R}$, $\mathcal{G}$ or $\mathcal{B}$); the patterning originates from the CFA. It is easy to discern because most objects reflect differently in the Red, Green and Blue spectral ranges. Neighbouring photosites capture thus very different DNs, even under uniform illumination.

4.2. White Balancing

White balancing is the most crucial RAW development step to guarantee that the output photo represents colours faithfully. In short, white balancing ensures that white looks white and grey looks grey in the output image. A perfectly white pixel should have identical *RGB* values, like *R*: 255 – *G*: 255 – *B*: 255 for an 8-bit output image. However, this does not only hold for white pixels. Any spectrally neutral or achromatic object (i.e. reflecting any wavelength of light with identical magnitude) that varies from black over grey to white should feature equal RGB values in the final output image. So, when a light source with a flat SPD over the visible spectrum (like illuminant E) gets diffusely reflected from a light grey and spectrally neutral card, one expects the camera to digitise the resulting equi-energy stimulus with identical $\mathcal{R}$, $\mathcal{G}$ and $\mathcal{B}$ pixel values. Figure 19A shows this not to be the case since the spectral response curves of the camera's sensor have different widths and heights. This usually results in a high $\mathcal{G}$ value and lower $\mathcal{B}$ and $\mathcal{R}$ values. The camera counteracts this by normalising the $\mathcal{R}$ and $\mathcal{B}$ values to the $\mathcal{G}$ DN via multiplication with a scaling factor or so-called multiplier value, thus ensuring identical $\mathcal{R}$, $\mathcal{G}$ and $\mathcal{B}$ values for all pixels of the achromatic card (see Figure 19A).

However, the illumination source also influences these multipliers. Suppose illuminant A shines on the same spectrally neutral card. The subsequent stimulus will now be most substantial in the Red spectrum, which results in high $\mathcal{R}$ DNs (sometimes even higher than the $\mathcal{G}$ ones) and low $\mathcal{B}$ values (see Figure 19B). In this case, the camera has to slightly reduce the $\mathcal{R}$ pixel values (with a multiplier smaller than 1) and boost the $\mathcal{B}$ DNs to ensure the achromatic card looks light grey and not orange-red.

To determine these multipliers accurately, the camera must estimate (or be told) the scene illumination when acquiring the photo. Since the camera cannot consider an entire SPD, the illumination's dominant colour is characterised by the Correlated Colour Temperature (CCT), a concept introduced in Section 2.5. Human eyes constantly adjust to such CCT changes and can tell a wall is white, irrespective of the illumination conditions (Hung, 2006; Livingstone, 2002). Digital sensors and film are unable to do so. In the analogue era, one had to change the type of film or use appropriate corrective filters to avoid colour casts. In digital photography, the camera needs to know the predominant colour of the illumination to calculate the correct multipliers (E. Y. Lam & Fung, 2009). That is why the camera automatically estimates the illumination's CCT when acquiring a photo; or the photographer manually determines this number, often via the camera's white balance presets like "cloudy", "fluorescent", "shade", or "direct sunlight" (see Figure 10 for common values). With an established CCT, the camera computes the illumination's white point, from which the correct multipliers get derived. Finally, those multipliers

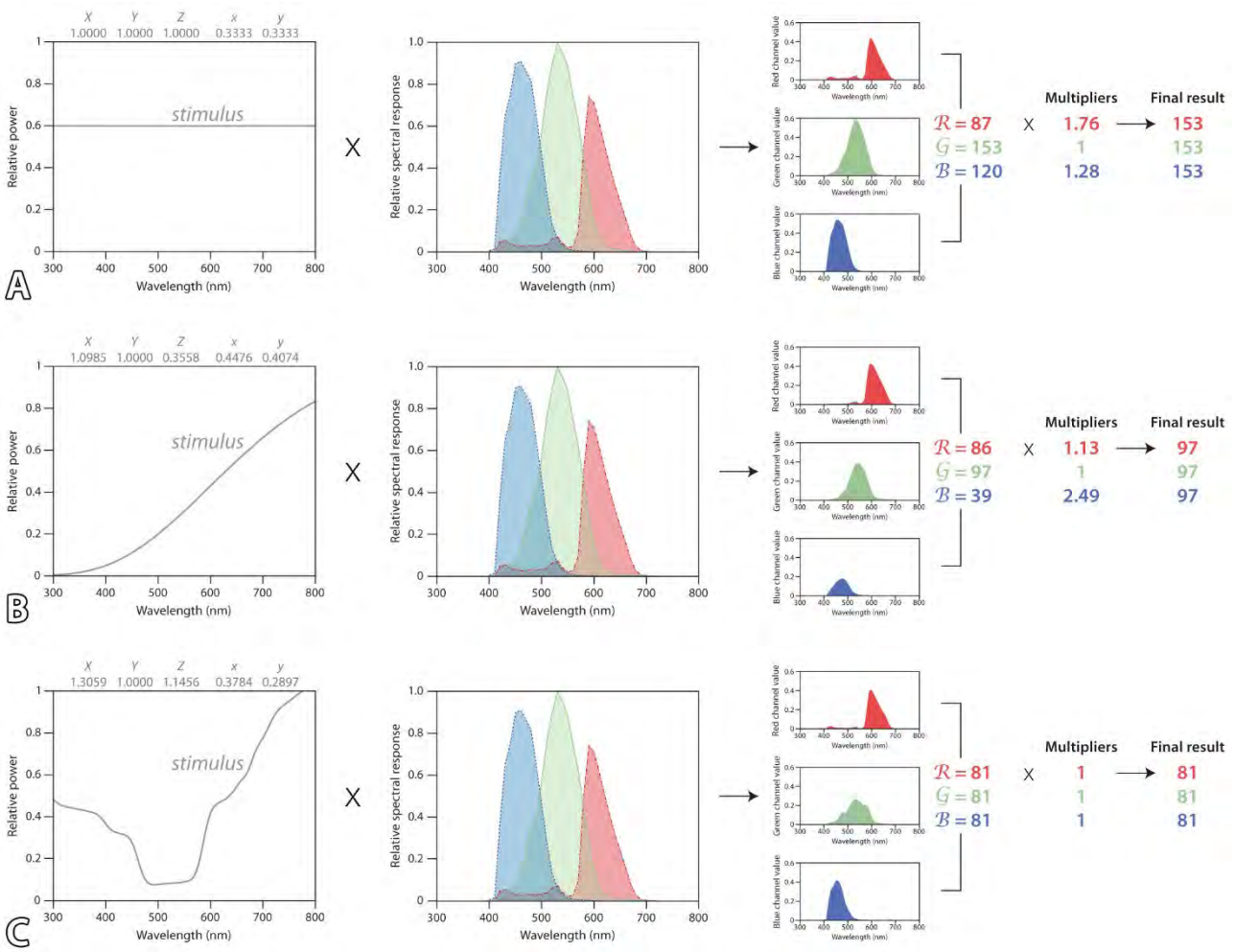



**Figure 19.** A) depicts how the interaction of a spectrally flat stimulus with the spectral responsivity curves of a digital camera yields unequal $\mathcal{R}$, $\mathcal{G}$ and $\mathcal{B}$ values. The multipliers can be computed knowing that the stimulus is supposed to generate three equal values. Row B depicts a similar situation with standard illuminant A diffusely reflected off a spectrally neutral reference card. This stimulus mainly contains red light, so the multipliers are adjusted accordingly. Row C displays an experimentally defined stimulus, resulting in maximum RAW values [1, 1, 1] for the Nikon D700. The illumination's SPD (which looks like the stimulus since the illumination got diffusely reflected from a spectrally neutral card) can be summarised via its *XYZ* tristimulus values [1,3059, 1, 1.1456] or (*x*, *y*) chromaticity values (0.3784, 0.2897). These values constitute the reference white of the Nikon D700 RAW space. Data on the D700's spectral response curves come from the camspec database (https://www.gujinwei.org/research/camspec/camspec_database.txt) published by Jiang et al. (2013).

get saved in the Exif image metadata. Figure 19 mentions the white point values above the stimuli. Irrespective of its determining procedure, the estimated scene illumination white point is known as the adopted white (International Organization for Standardization, 2012) or camera neutral (Adobe, 2021).

When developing the RAW file (either by the camera or—as in the case of INDIGO with COOLPI—afterwards on a computer) into a JPG or TIFF, these multipliers are used to recalculate the linearised, black-subtracted and scaled raw pixel values of all channels to make sure that the scene's spectrally neutral zones—and by extension also all the other

colours in the digital image—appear without major colour casts in the final output image, irrespective of illumination condition. Technically, a diagonal matrix $\underline{D}$ with the channel multipliers takes care of this (see Figure 20).

Figure 16 indicates that white balancing chromatically adapts the camera's adopted white to the so-called camera RAW space reference white (Rowlands, 2020b). As mentioned in Section 2.5, the reference white of the camera RAW space equals the SPD or chromaticity coordinates of the illumination that generates identical $\mathcal{R}$, $\mathcal{G}$ and $\mathcal{B}$ values when diffusely reflected off a spectrally neutral target. In other words, only this illumination will yield the equal RAW values one expects for a spectrally neutral target. Row C of Figure 19 shows the reference white SPD and chromaticity coordinates for a Nikon D700 camera. When locating these chromaticity coordinates in the diagram of Figure 8, it is clear that this camera's reference white is more of a reddish, almost magenta colour rather than a neutral one. In the colour space transformation step (Section 4.5), this RAW space reference white will be chromatically adapted to the output colour space's D50 or D65 reference white (called the encoding white).

Although digital cameras are usually reasonably good at estimating the CCT value/the white point for outdoor illumination conditions, more reliable values can be computed from a photographed spectrally neutral card (a so-called white balance card) or the illumination's SPD (see Figure 20, and also Section 6.2 for a comparison). That is why the INDIGO staff uses a Sekonic C-7000 SPECTROMASTER portable handheld spectrometer to measure the graffito's spectral illumination directly before starting the photographic documentation. The latter begins with a photo from an X-Rite ColorChecker Passport Photo 2 reference target. Since this target features a few spectrally neutral patches, one can use their RAW DNs to extract the channel multipliers directly. Thus, this initial photo serves as a backup solution to the spectrometer data (see Verhoeven, Wogrin et al. in this volume for more details about the data acquisition pipeline).
The image is still greyscale at this point (see Figure 20), but

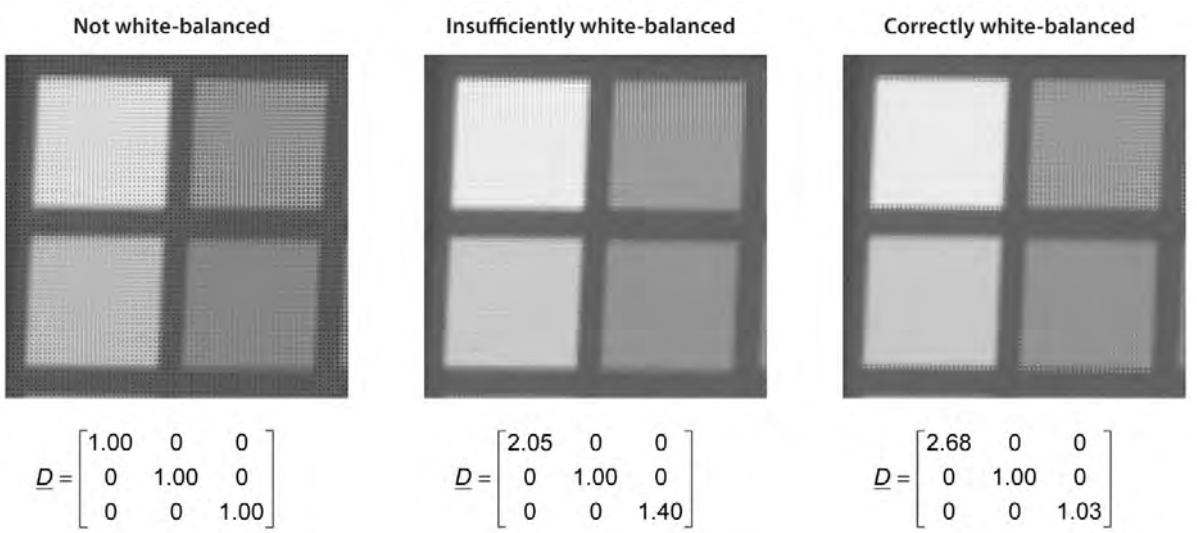



**Figure 20.** Three crops of the Datacolor Spyder Checkr reference chart, visible beside the smaller X-Rite ColorChecker Passport Photo 2 below a graffito in Figures 18 and 21. Both reference targets contain spectrally neutral patches (the outer left ones in the crop). On the left is a crop of a RAW image that is not white-balanced, which is conceptually identical to multiplying it with a white balance matrix $\underline{D}$ containing only 1's on its diagonal. The middle crop represents a white-balanced RAW image using the multipliers determined by the camera's automatic illumination estimation and stored in the image's Exif metadata. These multipliers are not sufficiently accurate; the neutral patches still display some CFA patterning, indicating that their pixels feature dissimilar $\mathcal{R}$, $\mathcal{G}$ and $\mathcal{B}$ values. The image on the right eliminates this because it is adequately white-balanced by multiplying every $\mathcal{R}$ DN by 2.68 and every $\mathcal{B}$ DN by 1.03. These numbers were determined from the RAW pixel values of the lower neutral patch.

spectrally neutral objects (like dedicated white balance cards or neutral patches of a colour reference chart) no longer display CFA-related patterning. In other words, their linear $\mathcal{R}$, $\mathcal{G}$ and $\mathcal{B}$ values will all be very similar (ignoring image noise and illumination differences). However, the mosaic pattern is still apparent for chromatic objects (like the two patches on the right of the chart crop in Figure 20) since they have different reflectances in the visible spectrum's Red, Green and Blue parts.

4.3. Data Clipping

White balancing commonly leaves the $\mathcal{G}$ DNs generated by the green-filtered photosites alone. After scaling to either a [0.0, 1.0] floating-point range or a [0, 65535] integer range, no $\mathcal{G}$ DN will surpass either 1.0 or 65,535. However, that is not the case for the $\mathcal{B}$ and $\mathcal{R}$ DNs. Since they have all been multiplied with a constant factor in the white balancing step, the $\mathcal{R}$ and $\mathcal{B}$ values of highlight pixels could easily go beyond those floating-point and integer maxima. If left untreated, this will result in highlights with odd colours.

Imagine a 12-bit RAW image of a graffito with a white outline. The entire graffito lies in the shadow, apart from a tiny sunlit part of the outline. With a camera exposure suitable for the shaded region, the pixels of the white outline will feature high $\mathcal{G}$ DNs like 3800 (see Table 2). The photosites that sample the white sunlit part will overflow with photons, yielding saturated pixels with the highest possible 12-bit DN: 4095. Since digital cameras are usually less sensitive in the Red and Blue spectral range, the $\mathcal{R}$ and $\mathcal{B}$ DNs that make up the white outline are substantially lower; even the sunlit pixels are not saturated (see Table 2). After rescaling to the [0.0, 1.0] range, the $\mathcal{G}$ DNs of the outline in the shadow are close to 1. Still, those of the saturated white pixels will be 1 (again, the maximum possible value). At this stage, the $\mathcal{R}$ and $\mathcal{B}$ DNs are still far below their maximum value because the same constant value was used to scale all DNs linearly. However, white balancing changes this picture.

Even though white-balanced pixels of the white outline feature identical high values (i.e. 0.93), a problem occurs with the $\mathcal{R}$ and $\mathcal{B}$ DNs of the pixels representing the sunlit white outline. Using a $\mathcal{R}$ multiplier of 1.4 and a $\mathcal{B}$ multiplier of 1.6, both DNs surpass 1.0 with a value of 1.21. At the same time, the maximum $\mathcal{G}$ DNs remain 1.0 because they stay unaltered during white balancing. Because the $\mathcal{G}$ DNs are too low with respect to the $\mathcal{B}$ and $\mathcal{R}$ ones, and because green and magenta are complementary colours, such green-deficient pixels look pinkish or magentish. A processing step that clips all channels to the lowest value of the maximum $\mathcal{R}$, $\mathcal{G}$ and $\mathcal{B}$ DNs (i.e. 1.0 here) prevents such false highlights colours. Some advanced RAW converters typically offer the user a 'highlight recovery' slider, which estimates the underrepresented highlight component(s) rather than clipping it (note that this approach also includes a highlight compression to bring all DNs back in the [0.0, 1.0] range). And yes, RAW converters must take similar precautions to avoid false colours in the shadow areas, which could occur with white balance multipliers smaller than 1.0.

| | DN range | Majority of the white outline | | | Sunlit white outline | | |
|---|---|---|---|---|---|---|---|
| | | $\mathcal{R}$ | $\mathcal{G}$ | $\mathcal{B}$ | $\mathcal{R}$ | $\mathcal{G}$ | $\mathcal{B}$ |
| 12-bit RAW | [0, 4095] | 2714 | 3800 | 2375 | 3529 | 4095 | 3088 |
| Black-subtracted, scaled RAW | [0, 1] | 0.66 | 0.93 | 0.58 | 0.86 | 1.00 | 0.75 |
| | [0, 65535] | 43444 | 60815 | 38015 | 56472 | 65535 | 49415 |
| Black-subtracted, scaled, white-balanced RAW | [0, 1] | 0.93 | 0.93 | 0.93 | 1.21 | 1.00 | 1.21 |
| | [0, 65535] | 60821 | 60815 | 60824 | 79061 | 65535 | 79064 |

**Table 2.** Clipping in the $\mathcal{R}$ and $\mathcal{B}$ channels is often necessary so their maximum values do not surpass those of the $\mathcal{G}$ DNs after scaling and white balancing.

4.4. Demosaicing

Even though the linearisation, black-level subtraction, scaling and white balancing have changed the initial $\mathcal{R}$, $\mathcal{G}$, and $\mathcal{B}$ DNs, the RAW file is still a single-channel image in which each pixel has only one value, representing either the collected Red, Green or Blue incoming light (Figure 21A). To

end up with an image where every pixel features an $\mathcal{RGB}$ triplet, the remaining two values are interpolated from the surrounding pixels in a process called CFA interpolation, de-Bayering or demosaic(k)ing. An immense range of demosaicing algorithms has been developed to tackle this interpolation process and the various artefacts it can introduce. Most commercial RAW converters only offer one undisclosed algorithm. At the same time, free and open-source software like RawTherapee and COOLPI provide various demosaicing options. The demosaiced result is an $\mathcal{RGB}$ image, a three-channel or three-band image featuring a 'channel' or 'band' for all the $\mathcal{R}$ values, one for all the $\mathcal{G}$ and one with all the $\mathcal{B}$ values (see Figure 21B).

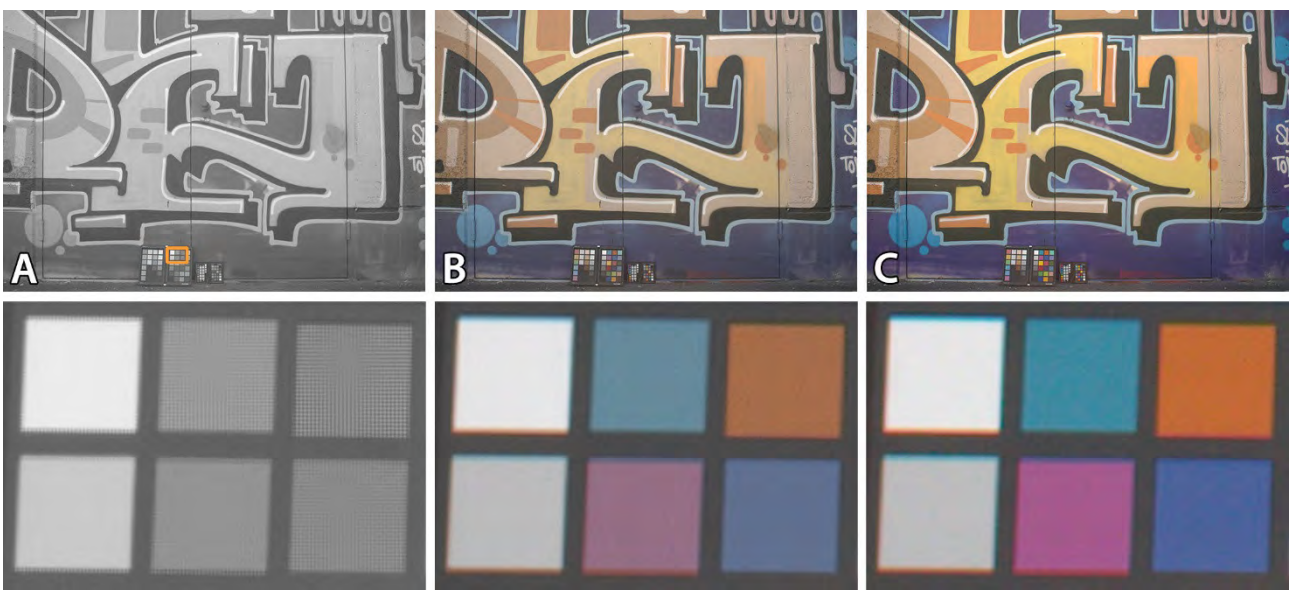



**Figure 21.** A mosaiced image (A) is a one-band, greyscale image that still shows CFA patterning in chromatic areas. After demosaicing (here with the algorithm by Malvar et al. (2004)), a three-band colour image is obtained for the first time in the RAW development process. The image colours seem realistic but desaturated. The insets of column C result from transforming B via a colour rotation matrix $\underline{R}$ into the linear sRGB output colour space, followed by a gamma encoding. Although nonlinear gamma encoding occurs only at the end of the RAW development chain (i.e. Figure 21C), it was also applied to Figures 21A and B because they would otherwise appear too dark and be useless as illustrations.

COOLPI, and many other RAW converters, also provide the option to create minimally/half-size/2x2 demosaiced images. The result is not obtained via an actual demosaicing algorithm because no values are interpolated. However, this approach bins each quartet of 2x2 pixels ($\mathcal{R}$, $\mathcal{G}$, $\mathcal{G}$, $\mathcal{B}$) into a single $\mathcal{RGB}$ pixel. The $\mathcal{B}$ and $\mathcal{R}$ values are taken as-is, while the $\mathcal{G}$ DN is the average of the two $\mathcal{G}$ values. The result is an image with only a quarter of the megapixels of a fully demosaiced RAW image.

At this point, we can also explain Figure 1 better. The middle row shows RAW colour images with a strong green colour cast. These demosaiced images were not white-balanced so that they could visualise the dominance of the green spectral sensitivity curve. The images are also very dark because they lack gamma encoding. The lack of this non-linear encoding is expected at this stage of the RAW processing pipeline as it only happens at the very end (see Section 4.6). However, since this makes it hard to visualise what is happening, a 1/2.2 gamma encoding was applied to Figures 18, 20, 21A and 21B for visualisation purposes.

### 4.5. Colour Space Transformation

Although the RAW processing pipeline finally yielded a colour image, the pixels' $\mathcal{RGB}$ values are still expressed in the camera-specific RAW space. To ensure that imaging

hard- and software know how to interpret these numbers, pixel values must be converted into a standard RGB output colour space like sRGB or Adobe RGB (1998). This step is likely the most complex, and together with white balancing, critical in pursuing accurate photo colours. Without going into detail yet, the RAW converter uses multiplications with one or more matrices to express the black-subtracted, scaled, white-balanced, clipped, and demosaiced pixel values into a standard colour space. Various approaches exist to obtain these matrices (Rowlands, 2020a), all with varying accuracy and applicability.

One possible approach is to use the matrices that research labs or imaging companies have derived. For instance, the Paris-based company DXOMARK (https://www.dxomark.com) scientifically assesses cameras and lenses. Amongst a plethora of quantitative data, their website provides the matrices for most digital cameras to convert the white-balanced RAW $\mathcal{RGB}$ data to sRGB for the D50 and A illuminants. Figure 22 depicts both illuminant-specific matrices for a Nikon Z7ii camera. Imagine a scene photographed using D50 illumination. One would merely need to multiply the matrix of Figure 22 by the white-balanced, demosaiced $\mathcal{RGB}$ values obtained after step 4.4 to end up with perfect colours. To ensure that neutral tones in the white-balanced image (for example, [0.3, 0.3, 0.3]) get mapped to neutral tones in the final sRGB image, the sum of all row coefficients always equals [1, 1, 1] for these matrices.

CIE-D50

| | | $R_{sRGB}$ | $G_{sRGB}$ | $B_{sRGB}$ |
|---|---|---|---|---|
| Color matrix as defined in ISO standard 17321 | $R_{raw}$ | 1.81 | -0.72 | -0.09 |
| | $G_{raw}$ | -0.14 | 1.44 | -0.31 |
| | $B_{raw}$ | 0.03 | -0.46 | 1.43 |

CIE-A

| | | $R_{sRGB}$ | $G_{sRGB}$ | $B_{sRGB}$ |
|---|---|---|---|---|
| Color matrix as defined in ISO standard 17321 | $R_{raw}$ | 1.8 | -0.72 | -0.09 |
| | $G_{raw}$ | -0.18 | 1.39 | -0.22 |
| | $B_{raw}$ | 0.03 | -0.65 | 1.61 |

**Figure 22.** These matrices from https://www.dxomark.com/Cameras/Nikon/Z7II---Measurements transform white-balanced, demosaiced Nikon Z7ii RAW image data to the sRGB colour space. A 3x3 matrix is provided for two illumination conditions: the standard illuminants D50 and A. Some authors call such matrices colour rotation matrices *R* (Rowlands, 2020a).

However, illumination never has the same SPD as the theoretical D50 illuminant (although natural daylight could come close). To deal with these and other complexities, the colour transformation step usually comprises three steps instead of just one matrix. First, white-balanced and demosaiced $\mathcal{RGB}$ values are transformed into the CIE XYZ colour space. Afterwards, another matrix transforms the *XYZ* values into the linear form of a specific *RGB* output colour space like sRGB or Adobe RGB (1998). Between both transformations, a chromatic adaptation accounts for the fact that these output colour spaces are determined for an illuminant which likely differs from the illumination used while photographing. Because of its importance and complexity, Section 5 further details this step.

### 4.6. Gamma Encoding, Bit-depth Reduction and JPEG Encoding

At this stage, the entire RAW conversion process has been linear. However, because the first generations of computer monitors displayed pixel values in a non-linear fashion, colour spaces like sRGB and Adobe RGB (1998) also have a gamma value defined to cancel out this non-linear behaviour. This value is fixed for every colour space but often around 1/2.2 (see Figure 8). Multiplying every pixel with this gamma value is the only non-linear tonal transformation in the entire RAW development pipeline.

RAW converters often combine this colour space-related gamma encoding with tonal mapping. The latter can produce photos with more contrast and punchier colours than real life (see Figure 1 at the lower right), as most people prefer that (Parulski & Spaulding, 2003). To keep colour accurate, COOLPI does not apply such tonal mapping. If tone mapping would really be needed—for instance, to fit the high contrast ratio of a digital photo into the often lower contrast ratio supported by monitors or photo paper—it should ideally occur in the colour space transformation step (Torger, 2018). Finally, this step includes a bit-depth

reduction and JPEG encoding since most photographs are saved as 8-bit JPG files.

A possible seventh step—occurring before the bit depth reduction—to achieve the final rendered photo is via additional (global or local) pixel editing. Operations like sharpening, correcting lens distortion or chromatic aberration, denoising and fixing red eyes all aim to remove imperfections and make the image more pleasing. Although many RAW converters combine the conversion steps 1 to 6 with such editing capabilities (e.g. Adobe's Lightroom, Phase One's Capture One, RawTherapee), pure RAW converters like dcraw (Coffin, 2008) and LibRaw (LibRaw LLC, 2021)—and right now also COOLPI—do not offer this functionality. The absence of such image processing capabilities in COOLPI explains why the lower right blue patch in Figure 21C still contains image noise, while the neutral patches' boundaries still suffer from 'fringes' of colour due to chromatic aberration of the lens.

**5. The Complex Marriage Between Digital Cameras and Colour**

5.1. Luther and Ives

In an ideal world, a camera's sensor spectral response curves would mimic the cone spectral sensitivity curves of the human eye (or be a linear transformation thereof, like the 2° or 10° CMFs) (Sharma, 2003). Only in that way would a camera reproduce accurate colours congruent with the colour experience of a human observer. This is the Luther–Ives condition (Ives, 1915; Luther, 1927). However, Figure 23 illustrates that a camera's spectral response curves might seriously deviate from the human cone responses or any existing set of positive CMFs (Parulski & Spaulding, 2003). Figure 23 displays the Samsung Galaxy S8 smartphone camera's spectral response curves and their area-normalised version. The second plot means that the area under each sensitivity curve is identical, so they would produce equal $\mathcal{RGB}$ values if equi-energy illuminant E were the stimulus. This plot looks quite different from CIE 1931 2° CMFs (right part of Figure 23), which are by default area-normalised.

What does this difference mean? Imagine a given spectral stimulus. This smartphone would digitise this stimulus into raw $\mathcal{RGB}$ values. At the same time, the human eye and a colorimeter would generate *LMS* and *XYZ* tristimulus values. But because the smartphone's digital camera does not satisfy the Luther–Ives condition, it is impossible to linearly transform the camera's raw $\mathcal{RGB}$ DNs to exactly end up with these ideal *LMS* or *XYZ* coordinates. However, this is not solely so for smartphone cameras. It is safe to state that no standard digital photo camera meets the Luther–Ives

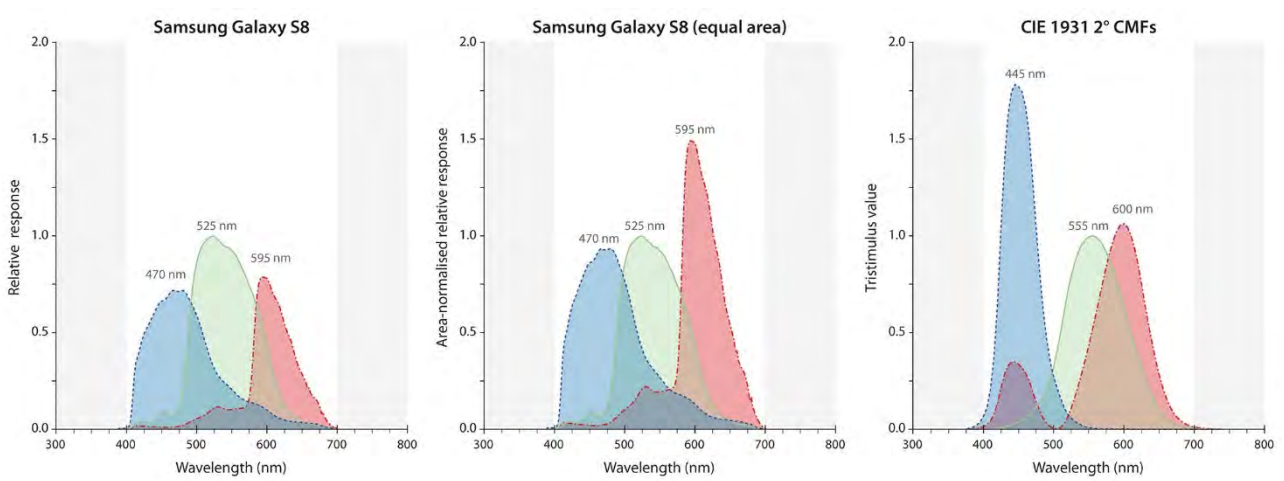



**Figure 23.** The relative spectral sensitivity curves of a Samsung Galaxy S8 smartphone camera on the left (data from Burggraaff et al. (2019)) with its area-normalised version displayed in the middle. This plot can be compared to the CIE 1931 2° CMFs on the right (CMF data from Colour and Vision Research Laboratory (2021)). The onset of the invisible near-ultraviolet and near-infrared regions is always indicated in grey.

condition (see also Holm (2006) and Jiang et al. (2013)). In other words: digital cameras are far from perfect colour-capturing instruments because colour accuracy is only one out of several, often mutually exclusive image criteria (such as image noise, light gathering efficiency, resolving power, and manufacturing costs) that are taken into account when designing an imaging sensor (Berns, 2001; Imai et al., 2001).

5.2. Camera-Specific Transformations

Although a camera's sensor spectral response curves would ideally mimic the cone spectral sensitivity curves of the human eye or any of the CMFs, Figure 23 shows these curves are different in shape and seem slightly shifted with respect to one another. One must thus find a way to minimise the differences between the two sets of curves or develop a good transformation from the $\mathcal{RGB}$ values into *XYZ* values. A long look-up table with all corresponding values (e.g. $\mathcal{RGB}$ values [768, 3200, 2304] correspond to *XYZ* values [5, 78, 19]) would be possible but impractical. However, with linear algebra, one can find a 3x3 matrix to do that.

Suppose a perfect 3x3 matrix to transform the camera's initial $\mathcal{RGB}$ values to *XYZ* values would exist. Even then, that transformation would be camera-dependent as the imaging sensors used by different camera brands and models feature minor to more considerable variations in spectral responsivity (see Figure 24). In other words: after demosaicing, all RAW $\mathcal{RGB}$ pixel values are expressed using the RGB colour model, but because different camera sensors will generate different $\mathcal{RGB}$ values when they simultaneously observe the same scene using the same lens under the same lighting conditions, the camera RAW space is device-dependent (Punnappurath & Brown, 2020). And to add a final touch of complexity: this 3x3 transformation is also illumination- and (often) scene-dependent because they both determine the unlimited amount of spectral stimuli a camera can sample. The following three sections cover how one can solve all this complexity.

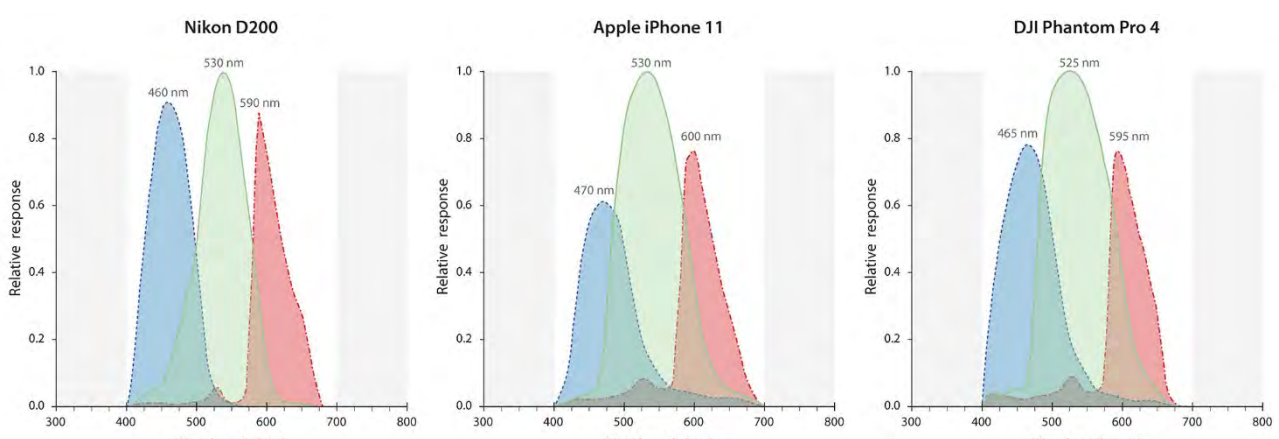



**Figure 24.** The three spectral responsivity curves of the imaging sensor inside a Nikon D200 semi-professional digital camera, an Apple iPhone 11 mobile phone and the DJI Phantom 4 Pro quadcopter camera. The spectral data for the last two imaging sensors came from Tominaga et al. (2021) and Burggraaff et al. (2019), respectively. The onset of the invisible near-ultraviolet and near-infrared regions is indicated in grey. Note that these response curves are the combined result of the transmittance by the camera lens, hot mirror and CFA elements, plus the quantum efficiency of the silicon sensor.

5.3. Colour Space Transformation: Three Matrices…

Like a coordinate transformation changes coordinates from one coordinate reference system to another (Iliffe & Lott, 2008), colour transformations map colour data from one colour space to another. As explained above, a camera-, scene- and illumination-dependent linear 3x3 matrix can transform the white-balanced and demosaiced $\mathcal{RGB}$ pixel values from the device-dependent RAW space to the device-independent CIE XZY space. Nevertheless, this matrix is only one part of the entire colour space transformation

step mentioned in Section 4.5. Even though that section summarised all processing by one colour rotation matrix *R*, the entire colour space transformation step (and thus matrix *R*) is often split into three 3x3 matrices. In this way, each sub-step is easier to standardise and control (consider Figure 16 for a visual representation of these steps):

1. **Transformation to *XYZ* | $\mathcal{RGB}_{\text{RAWReferenceWhite}}$ to $XYZ_{\text{AdoptedWhite}}$**: the first step transforms the linearised, black-subtracted, scaled, white-balanced, clipped and demosaiced linear $\mathcal{RGB}$ data into *XYZ* values. This is the linear 3x3 matrix mentioned in Section 5.2. In the academic literature, this matrix typically goes by the name Colour Correction Matrix, Colour Conversion Matrix, Camera Characterisation Matrix or Compromise Colour Matrix (all four using the acronym CCM). The *CCM* consists of nine elements (see Equation 2); these depend on the scene illumination, the imaging hardware (i.e. the camera's spectral response plus the lens' spectral transmission) and the scene values used to estimate it (typically 24 patches of a ColorChecker reference chart; see Section 5.5).

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{\text{AdoptedWhite}} = \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} \mathcal{R} \\ \mathcal{G} \\ \mathcal{B} \end{bmatrix}_{\text{ReferenceWhite}} \quad (2)$$

2. **Chromatic adaptation | $XYZ_{\text{AdoptedWhite}}$ to $XYZ_{\text{OutputWhite}}$**: although outdoor illumination can, to a certain extent, approximate the D50 or D65 SPD, it usually differs quite a bit. However, output colour spaces like sRGB, Adobe RGB (1995) or ProPhoto RGB include a standard illuminant in their definition. This standard illuminant is the space's reference white, defining how cool or warm a perfect 'white' pixel looks in that colour space (see Figure 8). Specifying colours to a new reference white is technically called chromatic adaptation. Thus, a so-called Chromatic Adaptation Transform (CAT) is needed; another 3x3 matrix *CAT* to transform the capture's illumination-related *XYZ* values into new *XYZ* values, expressed with respect to the white reference of the output colour space (typically $XYZ_{D50}$ or $XYZ_{D65}$). Converting pixel values between white points is usually—and thus also by COOLPI—performed with a Bradford CAT (K. M. Lam, 1985).
3. **Transformation to *RGB* | $XYZ_{\text{OutputWhite}}$ to $RGB_{\text{linear}}$**: finally, the $XYZ_{D50}$ or $XYZ_{D65}$ coordinates are transformed into a common output colour space like sRGB or Adobe RGB (1998). COOLPI uses the former by default. Although these colour spaces are not linear, this third 3x3 Output Space Matrix *OSM* converts to a linear version of the colour space. Afterwards, a separate colour space-specific (see Figure 8) gamma encoding follows to end up with the final *RGB* coordinates that are no longer linearly related to the initial $\mathcal{RGB}$ data.

5.4. …But Many Possible Combinations

Every *OSM* to compute linear *RGB* values is standardised and known. For instance, they are freely available on Bruce Lindbloom's webpage (http://www.brucelindbloom.com/index.html?Eqn_RGB_XYZ_Matrix.html). The same website (http://www.brucelindbloom.com/index.html?Eqn_ChromAdapt.html) also provides common Bradford *CAT*s. The main difficulty thus lies in finding the nine unknown elements of the first matrix. Although Section 5.5 details how to determine the *CCM*, the subsequent paragraphs first address a few variations on the workflow sketched in Section 5.3.

- The colour transformation step consists of three 3x3 matrices. Combined with the channel multipliers stored in the diagonal matrix *D*, that makes four matrices (each indicated with a specific colour in Figure 16). However, the scientific literature covers various ways to unite these components (for an overview, see Rowlands (2020a)). In addition, some matrices have slightly different functions despite bearing the same name across the literature. For example, the *CCM* spectrally characterises the digital camera by taking values expressed in the camera-dependent RAW space and transforming them into the device-independent CIE XYZ colour space. Some authors and this paper (see next section) compute

this matrix based on white-balanced $\mathcal{RGB}$ data. In contrast, others derive it from the $\mathcal{RGB}$ values before white balancing. In both cases, the procedure is called camera characterisation, and *CCM* is the resulting matrix. A *CCM* might thus include channel multipliers (indicated with ① in Figure 25), but the one discussed here does not (② in Figure 25). This approach is for a particular reason. Decoupling white balancing from the $\mathcal{RGB}$-to-*XYZ* matrix operation allows for easy finetuning of the channel multipliers afterwards in RAW conversion software like COOLPI (using the illumination's CCT or neutral patches in the image; see Section 4.2 and Figure 20). In addition, some authors suggest that scaling the $\mathcal{R}$, $\mathcal{G}$, and $\mathcal{B}$ DNs before demosaicing might yield a better quality output image (Rowlands, 2020a). Finally, it also makes sense intuitively. By multiplying every $\mathcal{B}$ and $\mathcal{R}$ value with a multiplier, white balancing essentially normalises the spectral sensitivity curves by area (cf. the central graph of Figure 23). Because the CIE XYZ CMFs are area-normalised by definition, both sets of curves thus become instinctively comparable.

- Sometimes, the *CCM* and a kind of *CAT* are combined. Adobe calls this combination the Forward matrix *F*, and it will transform white-balanced and demosaiced $\mathcal{RGB}$ data directly into *XYZ* data for a D50 illuminant (Adobe, 2021). A standard *OSM* from Lindbloom's webpage (together with a *CAT* if the output space's reference white differs from D50) takes these data into the final linear version of the output colour space. Adobe also makes it easy for users. Upon converting any proprietary RAW file to Adobe's open-source DNG file format with their free Digital Negative Converter (https://helpx.adobe.com/uk/camera-raw/using/adobe-dng-converter.html), two forward matrices for that particular camera get written into the DNG metadata: for the standard illuminants A and D65. Adobe has determined both matrices for most digital cameras. An enormous but precious effort as manufacturers typically do not disclose any characterisation information about their cameras. Providing a matrix *F* for two highly different illuminants enables DNG-aware software to interpolate the final forward matrix for the CCT of the actual scene illumination.
- Combining all three matrices yields the colour rotation matrix *R* provided via the DXOMARK webpage (see Section 4.5) or stored in the metadata of certain Olympus and Sony RAW files. As Adobe, DXOMARK provides two matrices—for illuminants A and D50 (see Figure 22)—to interpolate a CCT-specific matrix from. The camera-embedded matrices typically cover a handful of specified CCT ranges. The CCT estimated by the camera or determined in the RAW development software is again used to select (or interpolate) the most suitable matrix *R* from all pre-computed ones.

### 5.5. Getting to Know Nine Unknowns: Camera Characterisation

Determining the nine unknowns of the *CCM* is a procedure known as camera (spectral) characterisation. Since we have to transform the white-balanced and demosaiced raw data into the CIE XYZ space, having three sets of raw $\mathcal{RGB}$ values generated by a camera under illumination with a known SPD suffices. For example, one could illuminate a graffito with an artificial light mimicking a D50 illuminant and photograph the graffito. After white-balancing and demosaicing the RAW image, the $\mathcal{RGB}$ values of three pixels—each from a graffito patch with a different colour—are written down. Measuring those three actual graffito patches with a spectrophotometer yields the $XYZ_{D50}$ counterparts of these pixel DNs. Using Equation (2), nine equations arise from the two sets of nine values (three sets of three values). Because the *X*, *Y*, *Z*, and the $\mathcal{R}$, $\mathcal{G}$, $\mathcal{B}$ values are known, these nine equations enable computing all unknown elements of the colour correction matrix *CCM*.

However, the resulting matrix would only be effective for that specific camera (plus lens), lighting, and graffito. In other words, altering any of those three would necessitate the creation of a new *CCM*. Since the constant need for new *in-situ* colour measurements would make this procedure practically unfeasible, solutions were developed to simplify the spectral characterisation of cameras. The following

paragraphs detail the chart-based characterisation method since it is ubiquitous and currently the only method COOLPI offers. To aid understanding, the upper part of Figure 25 can function as a visual guideline.

Companies like X-rite (now Calibrite) and Datacolor are known for their photographic colour reference targets. One of the most known and widely used charts is the 24-patch ColorChecker chart. The chart comes in different sizes, ranging from the A4-sized ColorChecker Classic (https://calibrite.com/us/product/colorchecker-classic) to a credit card-sized ColorChecker Classic Mini (https://calibrite.com/us/product/colorchecker-classic-mini). Besides six achromatic patches, every ColorChecker target features 18 patches that should represent everyday colours found in foliage, the sky and human skin (see Figure 25). Although one could measure the spectral reflectance curves of each patch to derive its *XYZ* values for a particular illuminant, $XYZ_{D50}$ or $L^*a^*b^*_{D50}$ values can be found online on sites like BabelColor (https://babelcolor.com/colorchecker-2.htm) or sometimes on a sheet enclosed with the target (note that CIE $L^*a^*b^*$ values can be retrieved via a transformation of the *XYZ* values). Instead of measuring three differently coloured parts of an object (like a graffito) every time it gets photographed, it is much more convenient to include the ColorChecker target in the photo and use the D50 *XYZ* values of its 24 patches to compute the *CCM*.

Because 24 patches yield 72 values on the $\mathcal{RGB}$ and *XYZ* sides (i.e. 24 * 3), the *CCM* can be calculated more robustly by solving these 72 equations. Moreover, the matrix becomes

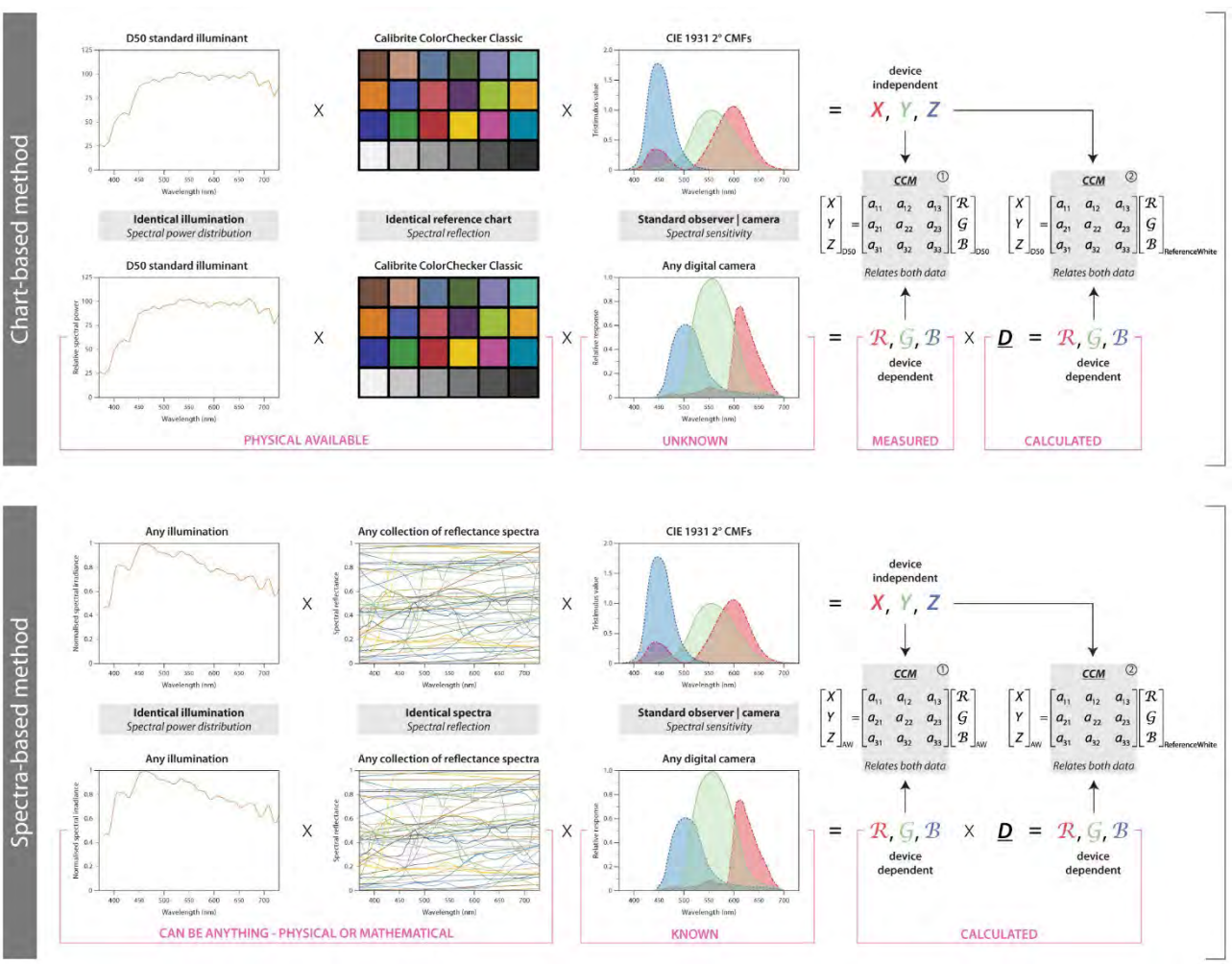



**Figure 25.** The chart-based versus the spectra-based approach for camera characterisation. In the spectra-based approach, AW means Adopted White. For the chart-based approach, the AW is usually D50 or D65.

applicable for a broader range of photographic scenes as more colours are involved in its computation. For instance, imagine a scene with many blue paints and a reference chart without a blue patch to build the *CCM*. In that case, colour accuracy might suffer for the blue tones. On the other hand, one could extend the number of patches to include typical spray paint colours, thus making the *CCM* more accurate for photographing graffiti. These potential positive effects of the chart-based approach notwithstanding, a few critical observations must be made.

1. Too often, the values of such reference targets are used irrespective of the photographic illumination conditions. Remember that colour values are generated by integrating a stimulus over a set of XYZ CMFs, and this stimulus is a function of object reflectance and illumination. Although the reflectance of the 24 patches should remain invariant for a couple of years when treating the chart appropriately, illumination conditions continuously vary. The patches' published *XYZ* or $L^*a^*b^*$ values are thus only correct for a physically not-obtainable D50 illuminant, and they become progressively erroneous (i.e. unusable) with increasingly different illumination conditions. One should ideally compute the patches' *XYZ* values using a relevant illumination SPD.
2. There are different ways to solve the mathematically overdetermined system of 72 equations to obtain the nine elements of the *CCM* (Holm, 2006; Molada-Tebar et al., 2018; Molada-Tebar, Marqués-Mateu, & Lerma, 2019a; Molada-Tebar, Riutort-Mayol, et al., 2019; Westland et al., 2012). One can use the Normal Equation to minimise the sum of the squared differences between the sets of *XYZ* and $\mathcal{RGB}$ values:

$$\underline{CCM} = \left[ \left( \mathcal{RGB}^T * \mathcal{RGB} \right)^{-1} * \mathcal{RGB}^T * XYZ \right]^T \quad (3)$$

with *T* meaning the transpose. Or, one can compute a more perceptually relevant solution for *CCM* with an optimisation algorithm that minimises colour differences using $\Delta E_{00}$ or CIEDE2000, a colour difference metric based on the working principles of the HVS (CIE, 2018). Although summing the rows of matrix *CCM* should ideally result in the illuminant's white point, that is not the case for the previous solutions. That is why Finlayson and Drew (1997) introduced a White-Preserving Normal Equation, resulting in a neutral *CCM* in which the sum of all row elements equals the illumination's white point expressed as *XYZ*. In other words: any pixel with the maximum possible $\mathcal{RGB}$ values [1, 1, 1] in the white-balanced demosaiced RAW image will get *XYZ* coordinates that match those of the illuminant's white point. Figure 16 reflects this by indicating that the *CCM* maps the RAW space reference white back to the adopted white.
3. Since cameras violate the Luther-Ives condition, there is no perfect linear mapping between the camera's raw $\mathcal{RGB}$ DNs to *XYZ* coordinates. Any 3x3 Colour Correction Matrix *CCM* is thus always a compromise, thus explaining why some authors call it the Compromise Colour Matrix (Kasson, 2015). A *CCM* might work well, but there will always be situations where it yields noticeable errors for specific colours. However, non-linear corrections are needed to deal with these outliers and transform the camera space better. Such adjustments are present in camera profiles that can be created according to guidelines of the International Color Consortium (ICC) or via the DCP (DNG Camera Profile) standard that Adobe promulgates (Adobe, 2021; International Organization for Standardization, 2010). ICC and DCP camera profiles have the potential for excellent colour transformation because they contain large lookup tables with colour values to interpolate. However, a 3x3 matrix approach keeps the data linearity intact, which can be necessary for certain subsequent image processing operations. In addition, ICC and DCP profiles are larger, more complex and thus slower than a *CCM*. That is why COOLPI does not include these table-based profiles, thus rendering them also beyond this paper's scope.
4. The choice of target strongly influences the *CCM* (Cao et al., 2008), so it might often be better to leverage thousands of reflectance spectra for camera characterisation (see the lower part of Figure 25). For this approach to work, one needs to know the spectral sensitivity curves of the camera. The most reliable way to determine them is via RAW photographs of a series of narrowband spectra (e.g. from 650 nm to

655 nm, 655 nm to 660 nm). Ideally, a monochromator generates these small wavebands and steps through all wavelengths of interest (Darrodi et al., 2015; Jiang et al., 2013; Verhoeven et al., 2009). Although one can also apply narrowband interference filters instead of a monochromator (Hubel et al., 1994; Mauer, 2009), both procedures are time-consuming and necessitate expensive laboratory-grade equipment. That is why academia also focuses on mathematical spectral sensitivity recovery methods that use numerical optimisation to estimate the response curves from one (or a small set of) RAW photos that record broadband spectra (Finlayson et al., 2016; Walowit et al., 2017). With the response curves, camera raw $\mathcal{RGB}$ values can be computed for unlimited stimuli. Any possible SPD (even from physically unrealisable illumination) can be multiplied with an extensive collection of reflectance spectra to generate these stimuli (see Figure 25). Since the camera gets characterised via thousands of reflectance spectra instead of the ColorChecker's 24 artificial ones, the resulting *CCM* is more accurate and robust (although tests by Jim Kasson (2022) revealed that the differences might not be as dramatic as is often thought). In a way, the spectra-based *CCM* is no longer scene- or chart-dependent but only specific to the camera and illumination. Knowing a camera's spectral sensitivity curves also optimises white balancing, as one finds optimal channel multipliers upon multiplying the illumination SPD with the camera response curves.

**6. Musings and Discussion**

6.1. What COOLPI Can, Cannot yet, and Will Never Be Able to Do

INDIGO photographers first take a picture of a ColorChecker Passport Photo 2 target (containing, amongst other charts, the 24 ColorChecker patches) before photographing each new graffito. After that, they measure the graffito's spectral illumination. Multiplying that illumination's SPD with the known spectral reflectance of the ColorChecker patches yields 24 illumination-specific *XYZ* triplets. Combining those with the white-balanced, demosaiced pixel values of the ColorChecker RAW photo should yield an accurate *CCM* for the graffito photographs acquired directly after the spectrometer measurement. In addition, this workflow supports two ways to correctly determine the white balance multipliers: indirectly via the illumination's CCT (see 6.2) or directly from one of the target's spectrally neutral grey patches. In the latter case, the multipliers typically are extracted from the second, third or fourth bottom row grey patch starting from the left (see Figure 25).

Instead of a situation-specific *CCM*, the INDIGO team also experiments with workflows that use a fixed D65-based *CCM*, developed under very controlled lighting conditions in a colour cabin. Finally, project INDIGO plans to determine the spectral sensitivity functions of its cameras because it can bring colour accuracy to the next level. However, any of these approaches necessitate a specific data processing workflow. A dedicated RAW development tool like COOLPI is, therefore, essential because it facilitates and automates the testing and application of these different colour-prioritising RAW development workflows (or any better variant the team might develop).

By making COOLPI open-source (https://github.com/GraffitiProjectINDIGO/coolpi) and bundled with lengthy documentation, the authors hope that many other heritage documentation projects can now pay more attention to accurate colour in their digital records. Although proprietary RAW developing software can be easy-to-use, powerful and yield acceptable colour accuracy, their processing is done 'behind closed doors' and according to a rigid scheme. The free Python toolbox COOLPI allows for very flexible and explicit, well-documented processing pipelines, the latter being a fundamental principle of reproducible science.

However, it is crucial to be aware of issues COOLPI currently cannot solve or might never be able to. For instance, many objects—but certainly spray paints—have an anisotropic reflectance, meaning they look different depending on the angle of observation or illumination. In order to fully describe this angular reflectance behaviour, one needs the Bidirectional Reflectance Distribution Function (BRDF) of every object (Schaepman-Strub et al., 2006). However, it is hard to obtain an object's BRDF and even harder to account for it, so COOLPI cannot deal with BRDF-related colour differences or other non-linear imaging factors such as specular reflection, glare, and flare.

COOLPI can also not solve the problem of metamerism.

Because there are only three types of human cones with rather broad spectral sensitivities, stimuli with different SPDs can produce identical cone responses, thus representing the same colour. Such spectra are called metamers. The perceivable colour match is a metameric match, and the effect is known as metamerism (Hung, 2006; König & Herzog, 1999). Because a camera has three broad spectral response curves, it is also a metameric imager (Sharma, 2003). However, since the spectral responses of the standard observer and a digital camera do not match (i.e. cameras do not satisfy the Luther-Ives condition; see Section 5.1), these metameric matches differ (Fairchild et al., 2001). If the camera sensor generates identical raw values for two stimuli a human discriminates, that information is permanently lost.

Finally, COOLPI will likely never remove lens-related effects like chromatic aberrations or distortion (see Section 4.6). On the other hand, COOLPI's following version could support image denoising and flat fielding, the latter being a procedure to account for sensor dust, nonuniformities in the image sensor and optical vignetting (Berry & Burnell, 2005). Although COOLPI's current version 0.1.18 does not consider the camera's spectral response curves, they should be supported in the RAW image processing as soon as project INDIGO has determined them for the cameras. Finally, the INDIGO team is also trying to optimise the crucial white balancing step and account for uneven illumination. Both topics are highly relevant because knowledge about the illumination conditions during photo acquisition drives many RAW processing steps (see also Figure 16). The following two sections will delve slightly deeper into these topics.

### 6.2. The Importance of Illumination Estimation

On a summer day with relatively few clouds, the illumination's CCT can stay relatively stable for several hours around noon (see Figure 26). The same can be said for the 'strength' of the illumination, denoted illuminance and expressed in lux. As long as the outdoor illuminance stays invariant, camera exposure should not change. However, Figure 26 illustrates that after 16:00 (at least in Vienna at the end of August), the sun increasingly produces warmer light (i.e. the CCT decreases) while the diffuse skylight becomes bluer, quantifiable though its CCT increase. A decreased illuminance indicates that longer shutter speeds or higher ISO values will be needed compared to the illumination conditions around noon.

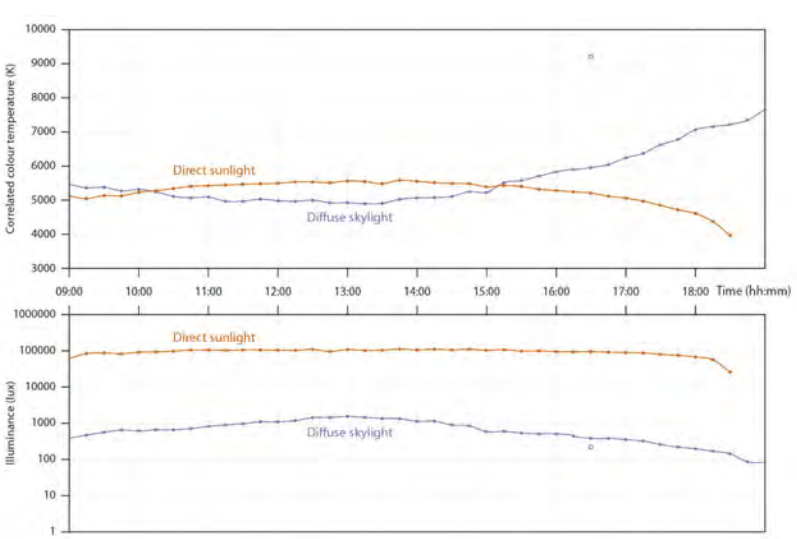



**Figure 26.** The evolution of the CCT and the illuminance of two outdoor illumination conditions during one sunny, almost cloudless summer day (30-08-2022) in Vienna, Austria. Measurements were performed every 30 minutes with a Sekonic C-7000 SPECTROMASTER portable handheld spectrometer. Diffuse skylight readings occurred in an inner courtyard to avoid any influence of direct sunlight. The Sun's low position prevented direct sunlight measurements after 18:30. The CCT and illuminance graphs of the diffuse skylight indicate an outlier measurement at 16:30. Given the relatively stable illumination conditions, it is considered a measurement artefact. The lower lux value means that the spectrometer's field of view was likely partly blocked by its operator. A data gap at 16:30 was avoided by interpolating a new value from the 16:15 and 16:45 readings.

With the illumination's SPD and CCT measured by the spectrometer, there are various possibilities to get the correct channel multipliers. One can first compute the corresponding (*x*, *y*) chromaticity and then the CIE *XYZ* coordinates for the estimated CCT, or directly obtain the *XYZ* values from the SPD. Multiplying these *XYZ* values with the inverse of the *CCM* (determined without white balancing) yields correct multipliers. However, this approach relies on the correctness of the *CCM*. An easier and maybe more accurate solution is to rely on the colour engineers of the camera manufacturer. Because they know the spectral response of their cameras, ideal CCT-specific multipliers are computed and stored inside each camera, as Figure 28 illustrates for the Nikon Z7ii. One can create such a plot by reading the channel multipliers from a series of RAW images that had their CCT value incrementally changed in the white balance section. Once these multipliers are known, they can be treated as a large look-up table. A third and optimal approach is to integrate the SPD over the spectral sensitivity curves of the camera and normalise the result to the green channel. Finally, one can also read the raw $\mathcal{R}$, $\mathcal{G}$, and $\mathcal{B}$ values of a spectrally neutral object (like a white balance card) that shares the same illumination as the graffito (as Section 4.2 detailed).

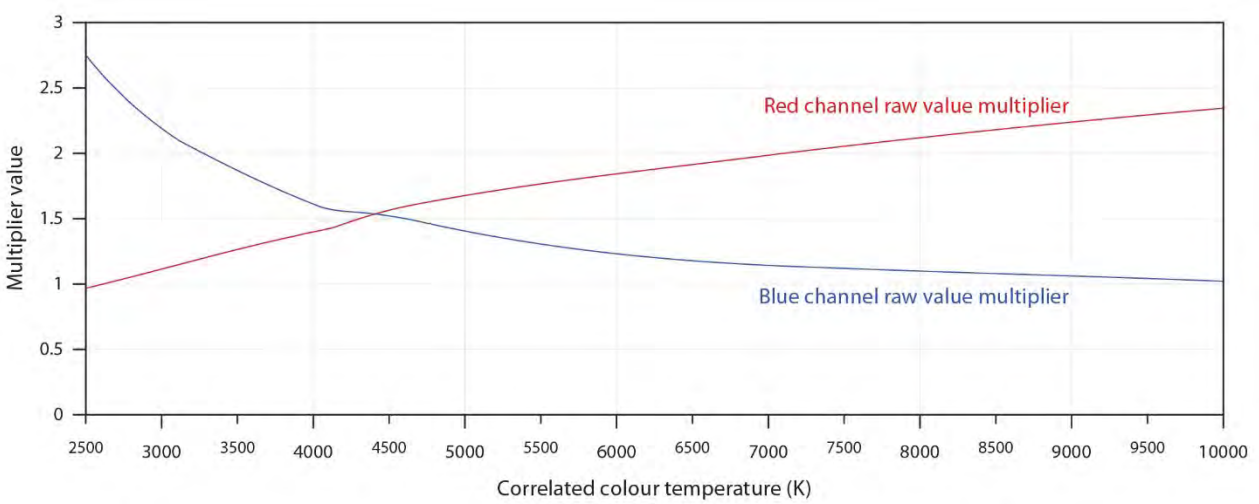



**Figure 27.** The CCT-specific $\mathcal{R}$ and $\mathcal{B}$ multipliers stored inside a Nikon Z7ii. Since this camera accepts any custom CCT value between 2500 K and 10000 K with a 10 K increment, this graph depicts the 751 channel-specific multipliers. The rate of change in these multiplier values slows down after 6500 K. All values were extracted from the RAW images' Exif metadata via Phil Harvey's free ExifTool (https://exiftool.org).

However, imaging a white balance card or measuring the illumination SPD with a spectrometer just before photographing a graffito might not be all that useful if illumination conditions change quickly. Figure 28 graphs the evolution of the CCT during 90 seconds while the sun is breaking through the clouds. In the first 80 seconds, the CCT drops 700 K, after which it stabilises (see Figure 28, middle row for the detailed view). If photography were to occur during that time, the white balance of the first photos would be very different from the last photographs of that graffito. One could measure the illumination before and after acquiring photographs and interpolate between them to end up with photo-specific CCT values. However, if the CCT change is not gradual throughout image acquisition (for instance, it is stable during a part of the acquisition), this method does not work either. Continuously logging the illumination is also not practical. Not only would it necessitate a spectrometer that can constantly measure and log the data, but one must also ensure that the sampled illumination conditions are always identical to those of the graffito. The only practical solution to deal with illumination changes throughout photo acquisition thus seems to be a software approach, but COOLPI does not contain anything to that end (yet). Or could we rely on the camera to estimate the illumination's CCT?

The lower row of Figure 28 reveals that the illumination estimation by the Nikon Z7ii was very underwhelming. The camera photographed the graffito every second when the sun broke through the clouds; afterwards, its auto-estimated CCT values were retrieved from the Exif metadata. Compared to the reliable spectrometer measurements, the Nikon is, on average, 1500 K wrong, and the CCT trend is not even close to being the opposite of the illuminance curve. As the spectrometer data indicate, one expects the CCT to drop if the proportion of direct solar radiation increases in otherwise cloudy conditions. In summary: for photo colours to be accurate, one needs to rely on a spectrometer measurement or include a white balance card image and hope the illumination's CCT does not change drastically throughout photo acquisition.

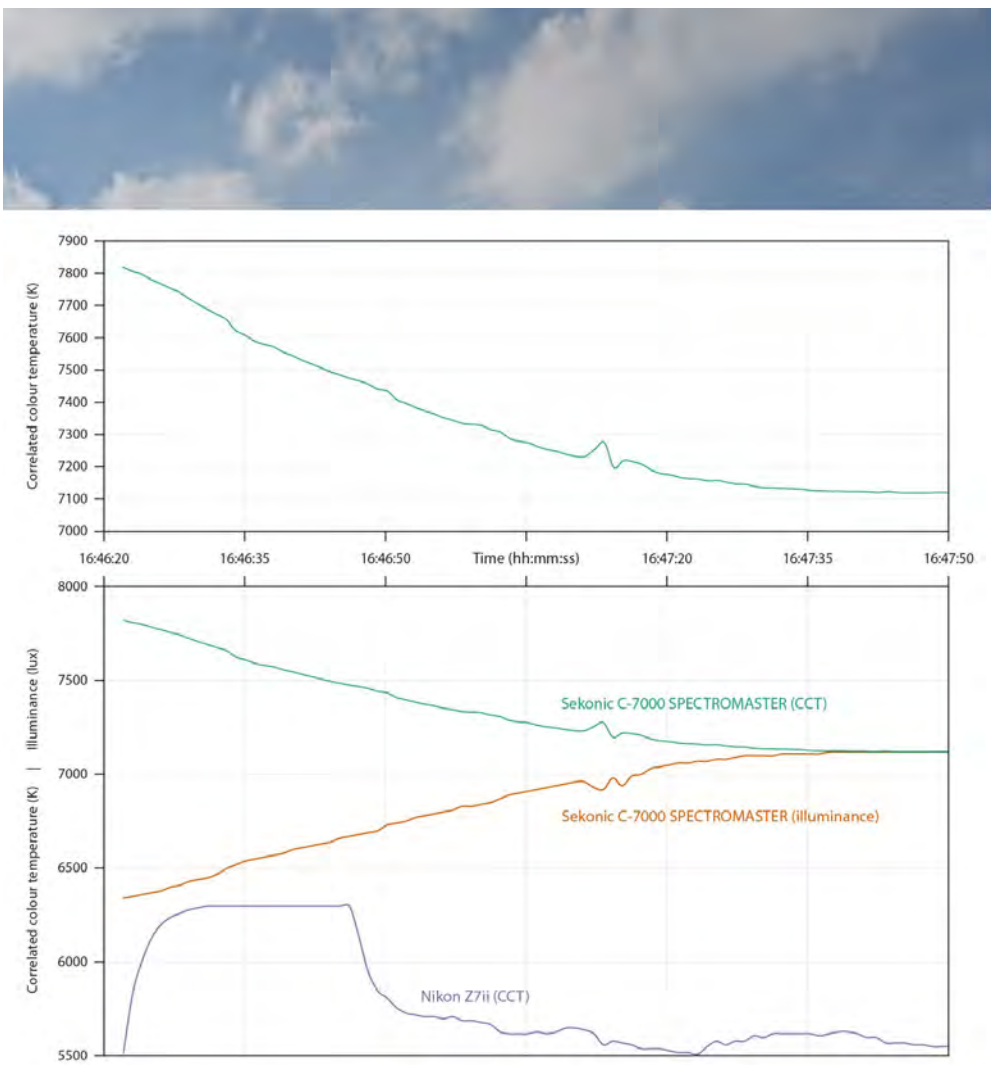



**Figure 28.** The evolution of the illumination's CCT while the sun breaks through the clouds. The upper part is a photo of the sky conditions. The middle row (i.e. upper graph) depicts in detail the one-second measurements acquired with a Sekonic C-7000 SPECTROMASTER on 05-09-2023 in Vienna (Austria). The spectrometer was mounted on a tripod and pointed in the opposite direction of a graffito. The spectrometer also recorded the illuminance (in lux), which steadily increased while the sun revealed itself more (see the lower graph). By coincidence, the lux values were in the same range as the CCT numbers, which is why both are together on the vertical axis. The CCT estimated by a Nikon Z7ii pointed at the graffito is too low and fails to mimic the real CCT trend.

6.3. One Graffito, Different Illuminations

White balancing can work well if an entire graffito receives one type of illumination. However, problems arise if the subject contains a shaded portion beside one that receives direct solar illumination (see Figure 29). COOLPI can currently not deal with such situations, as one would need to manually or automatically determine the differently illuminated parts and process them separately. However, the authors anticipate such functionality, which is why the INDIGO photographers have been acquiring dual spectrometer readings and ColorChecker Passport Photo 2 images in such situations since the project's start. One can assume that it is not too hard to deal with different illumination conditions like those depicted in Figure 28. However, shadows produced by tree branches lack such evident divisions between the differently illuminated zones. And if those tree branches move in the wind, one can assume it becomes tough to consider these photo-specific shadow patterns.



**Figure 29.** Different illumination conditions often apply for a more sizeable graffito. In this case, the graffito is located below a bridge which throws part of the creation into the shade.

## 7. Conclusion

Colour can bring much joy to the world and enlighten one's mood. However, colour is also a tricky phenomenon, and the science of colour is profoundly mathematical. This paper provided an overview of the main concepts needed to understand if and how digital photo cameras can accurately digitise colour. Hopefully, it has become clear that one needs to control and understand every step of the RAW photo processing workflow to ensure a more or less accurate colour recording of heritage objects. To manage that process, the academic graffiti project INDIGO has developed the free and open-source Python toolbox COOLPI. We hope that COOLPI, and the research currently undertaken within the scope of project INDIGO to expand this toolbox, will benefit future actions in graffiti documentation and extend to other scientific fields where recording accurate colour values plays a fundamental role.

## Conflict of Interests

The authors declare no conflict of interest.

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# Urban Creativity Meets Engineering. Automated Graffiti Mapping along Vienna's Donaukanal

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**Abstract.** Graffiti are polarising. Some consider them vandalism, others part of our cultural heritage. If we consider graffiti to be part of our cultural heritage, we should also treat them as such. However, long-term and detailed graffiti documentation initiatives are sparse, so many of the existing archives with graffiti records are biased and incomplete. In addition, graffiti records usually suffer from decontextualisation, that is the lack of environmental information (be it spatially, temporally, but also smell and weather conditions). This means that graffiti documentation might not reflect the intended setting or meaning by the creator. INDIGO, a graffiti-centred academic project, largely overcomes the issue of decontextualisation by designing and implementing photogrammetric engineering approaches that support the ongoing documentation of an extensive graffiti-scape. The latter is situated along the Donaukanal, Vienna's central waterway and one of the most prominent graffiti hotspots worldwide. One innovation developed in the framework of INDIGO is a freely available Metashape add-on called AUTOGRAF. AUTOGRAF employs photogrammetric computer vision techniques to automatically create ortophotographs from all photographed graffiti. Orthophotographs or orthophotomaps are distortion-free images, combining photographs' visual qualities with characteristics of maps. They allow embedding the graffiti in their native, albeit virtual, 3D environment and can thus largely overcome decontextualisation.
In this contribution, we showcase the significant advantages of orthophotomaps over conventional photographs and introduce the AUTOGRAF-based workflow that allows the automated derivation of graffiti orthophotos. INDIGO will use this tailor-made tool to enable graffiti analysis in unprecedented detail by mapping and displaying graffiti in their original setting along the Donaukanal.

**Keywords**
AUTOGRAF; graffiti; orthophoto; photogrammetry; street art; structure from motion

## 1. Introduction

Even though ubiquitous, they are ephemeral, often disappearing within hours or days: graffiti. They accompany us through our everyday (urban) life. While some enjoy their omnipresence, others get annoyed or even feel provoked by the mere existence of painted (or smeared?) or scratched infrastructure. Beautiful or not? Artistic or not? Legitimate or not? Graffiti are polarising. This polarisation may be one reason for the increased attention received by graffiti, reflected in numerous magazines and newspapers featuring graffiti content (e.g., Peteranderl (2020) in Der Spiegel, Lohberger (2019) in Die Presse, Vandermerghel (2022) in

The Guardian, Gonzalez (2020) in The New York Times, and Saenz Gordon (2021) in The Red Bulletin). Since over a decade, graffiti have been increasingly entering mainstream media, and graffiti hotspots are often the most vibrant parts of cities. Today, guided graffiti tours are almost as common and popular as tours through established art museums.

Nevertheless, graffiti have not yet received the scientific attention they deserve (Masilamani, 2008; Ross et al., 2017). While 'ancient' graffiti (i.e. prehistoric cave paintings) are documented, preserved and analysed elaborately, the documentation and analysis of 'contemporary' graffiti often remain superficial and general. Ironically, this lack of scientific rigour is likely (partly) associated with the high frequency at which graffiti appear and vanish daily. The sheer amount of study objects and the ephemerality to which they are subjected complicate a continuous in-depth graffiti analysis.




**Figure 1.** Example of graffiti records at the Donaukanal that are spatially pretty well contextualised. The images were downloaded from spraycity.at. The date in brackets denotes the year the graffito was first photographed. A1 and A2 show graffiti depicting fish-like creatures, a popular motive along the Donaukanal which habitats a surprisingly large fish population. B1 and B2 illustrate graffiti that affirm (B1) or manipulate (B2) the message of the graffito beneath. B1 references Carlo Giuliani, an Italian demonstrator whom a policeman shot during an anti-globalisation protest in 2001 in Genoa, Italy (McDonnell, 2007). It was sprayed on a circled A, a common symbol for Anarchism. B2 depicts a graffito devoted to the Viennese football club Austria Wien (abbreviation: FAK). The initial text above (highlighted in red) was "TOD UND HASS DEM FAK" (Eng: "Death and hate to the FAK") but was later manipulated to "KOKS UND HASCH DEM FAK" (Eng. "Coke and hash to the FAK").

There are initiatives dedicated to graffiti documentation. Projects like Global Street Art (http://globalstreetart.com), INGRID (https://www.uni-paderborn.de/forschungsprojekte/ingrid) and Spraycity (https://spraycity.at) provide well-curated and extensive graffiti databases. Graffiti photographs are the backbone of their documentation, often accompanied by metadata such as the creator's name, graffiti style or thematic content. Those metadata records are essential to analyse graffiti. However, they often miss one crucial aspect: the larger spatial context. For many graffiti, the content can only be understood in the environment they are placed in. 'Contextualised' graffiti is also discussed in various articles and essays (Bengtsen, 2014, 2019; Blanché, 2015; Ferrell & Weide, 2010; Riggle, 2010), highlighting the necessity to keep the spatial context in mind when documenting graffiti. Many works play with or manipulate the neighbouring environment, such as other graffiti, infrastructure or nature (Figure A1, A2). This location-specificity is also connected to temporality. The spatiotemporal context is relevant for graffiti referencing earlier works they are (partly or wholly) covering (Figure B1, B2). Sometimes those manipulations are identifiable, but in many cases, the reference remains hidden from the viewer due to the destruction of the work beneath. It can only be reconstructed by continuous (photo)documentation. However, even intensive photographic coverage sometimes does not suffice. The result of such documentation is usually a chronologically or thematically sorted collection of images, ideally spatially referenced by some coordinates, usually visualised as a dot on a map. This spatial simplification combined with the amount of collected photos often makes it hard to get the bigger picture. The works are presented as isolated entities and implicit but substantial parts of the work vanish, causing decontextualisation even in well-curated graffiti databases.

### 1.1. Project INDIGO and Vienna's Donaukanal

The academic graffiti-focused project INDIGO tackles, besides many other challenges, the issue of spatiotemporal decontextualisation by setting new standards in how graffiti are documented and disseminated (Verhoeven et al., 2022). INDIGO focuses its documentation efforts on one of the most prominent graffiti hotspots worldwide: the Viennese Donaukanal (Eng. Danube Canal). The Donaukanal is Vienna's central waterway and has a total length of 17 km. The 3.3 km long part of the Donaukanal on which INDIGO focuses features a combined stretch of approximately 13 km of graffiti-covered surfaces (Verhoeven et al., 2022), making it one of the longest uninterrupted graffiti zones globally. Not only is the mere spatial extent of Donaukanal's graffiti zone remarkable, but the pace at which new graffiti are created is exceptional. As the surfaces of Donaukanal are almost entirely graffiti-covered, creating a new graffito usually implicates the partial or complete destruction of one or several graffiti beneath (Figure 2). If not documented, the covered graffiti are lost forever, and with them, a socially relevant and fascinating part of our cultural heritage.

### 1.2. Textured 3D Geometry and 2D Orthophotographs

Of course, no documentation can ever replace the experience of viewing a graffito and appreciating it with all senses. However, modern techniques allow the accurate and digital construction of the real-world environment. 3D models enable us to place objects in their natural environment and thus provide the possibility to view and analyse them in their native, albeit digital, spatiotemporal context. Today, digital twins of (parts of) cities have become very popular because of the opportunities they provide and their relatively cheap and easy production (Dembski et al., 2020). Techniques such as laser scanning and image-based modelling are considered standard products in the digital construction of environments and are widely accessible (Brenner, 2005). INDIGO seizes these tools to allow researchers, graffiti creators, tourists and other interested users to gain an unprecedented realistic impression of the graffiti-scape along the Donaukanal.

These plans notwithstanding, the digital creation of an extensive and time-varying spatial 3D environment in which each graffito is queryable remains technically and logistically challenging. Large amounts of data must be acquired, stored, processed, interpreted and finally interactively disseminated. This volume covers many steps of this process. While the paper by Verhoeven et al. mainly focuses on photo acquisition, and the article by Molada-Tebar & Verhoeven presents the colour processing of the graffiti photographs, this contribution details the correct geolocation and geometrical correction of all photographs. These

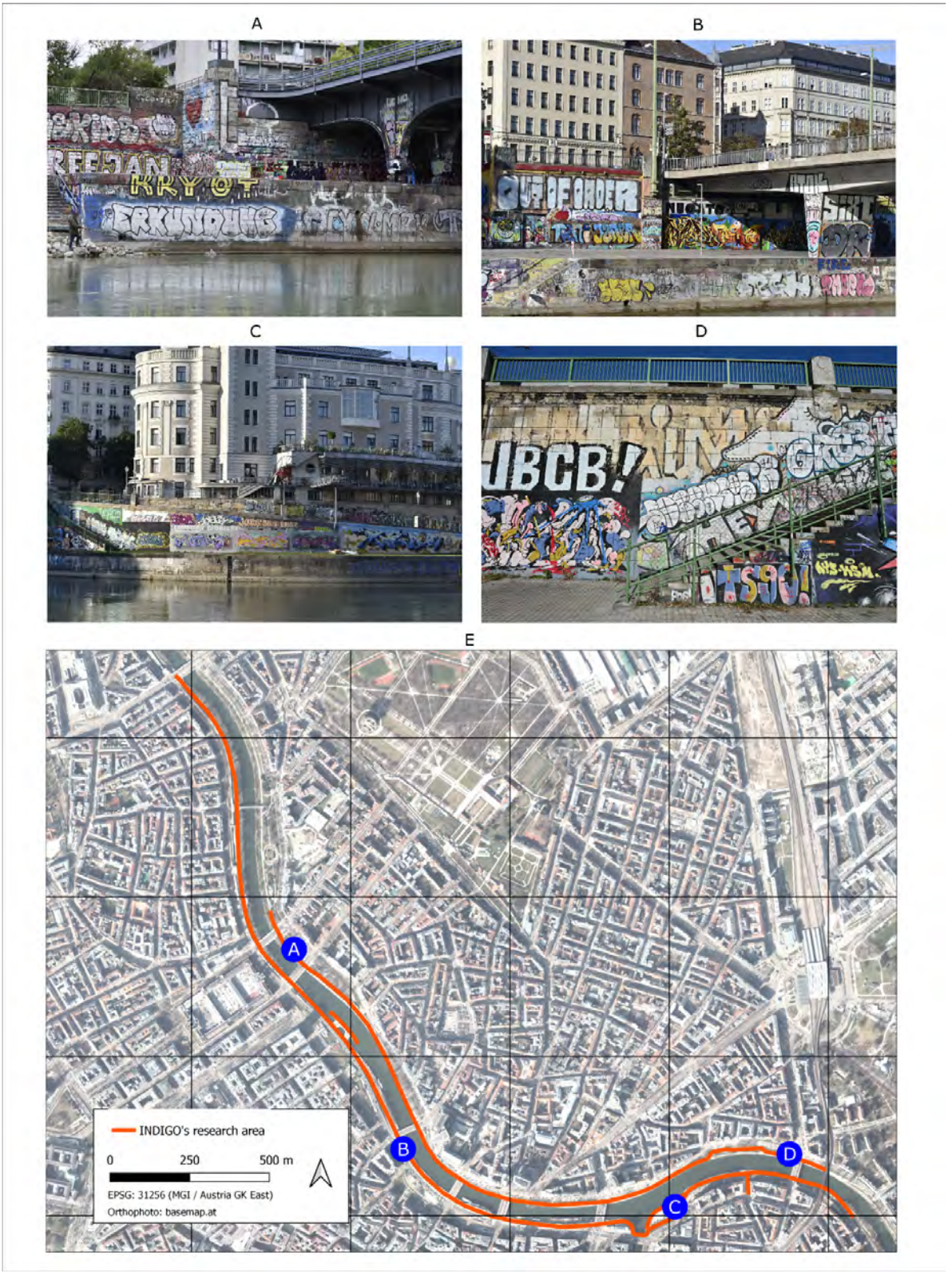



**Figure 2.** A-D: Example images of the graffiti-covered surfaces at the Donaukanal. E: Orthophoto of the Donaukanal with INDIGO's whole research area (dark orange) and the approximate locations of the graffiti depicted in A-D.

procedures are important because they will deliver the two main products for the envisioned online 3D platform.

The aim is to create an extensive, digital 3D model with colour-accurate textures of the Donaukanal's graffiti-scape. These textures, and the digital 3D geometry onto which they are applied, are both generated from the numerous graffiti photographs. However, the extraction of 3D geometry and texture mapping only works if the exact camera position is known. This paper will explain the process for obtaining this information and focus on an additional product that can be created once the camera position is known: an orthophoto. Section 2 details this concept, so it now suffices to know that an orthophoto represents a photo with map-like characteristics: it has a fixed scale, is devoid of geometrical distortions and enables the accurate measurement of a graffito's dimensions and proportions.

The combination of the 3D model with graffito-specific orthophotographs is INDIGO's answer to the decontextualisation issues mentioned above. The textured 3D model of INDIGO's envisioned online platform will allow users to view every graffito in its correct urban setting, both spatially and temporally. Suppose one also wants to study a graffito's dimensional, stylistic or semantic aspects. In that case, a highly detailed 2D orthophotograph can be viewed alongside the 3D model. Because the 3D textures and 2D orthophotographs will be queryable via an underlying database, the platform can support both intra- and inter-graffito visualisations and analyses, thus providing as much context as is currently technically feasible. Although urban smells and noises would make the contextualisation even more exhaustive, including these sensations is not planned.

The remaining part of the article will 1) focus on the geomatical techniques that support the accurate geolocation of every photograph, and 2) shed some more light on the orthophoto concept. However, we start with some examples to explain why orthophotos are indispensable products for documenting and disseminating graffiti.

**2. Mapping Graffiti with Orthophotos**

Orthophotos are no new invention, but they have helped humans understand and navigate the environment for many decades. We most frequently encounter them in aerial form, acquired from cameras mounted on satellites, aeroplanes or drones. These spaceborne or aerial orthophotos can be used like maps, but instead of abstracted shapes, they depict the natural situation. A significant difference between a conventional photo and an orthophoto is that the latter has a uniform scale allowing the measurement of correct proportions and dimensions of the depicted object. Orthophotos are thus also often referred to as orthophotomaps, enabling the accurate measurement of distances within a photo (Figure 3).




**Figure 3.** Example of a graffito orthophotomap with a uniform scale. Within this orthophoto, we can measure distances, angles and areas. The perimeter of this graffito is 36.82 m, and its area equals 51.2 $m^2$, making it one of the largest graffiti along the Donaukanal as of November 2021

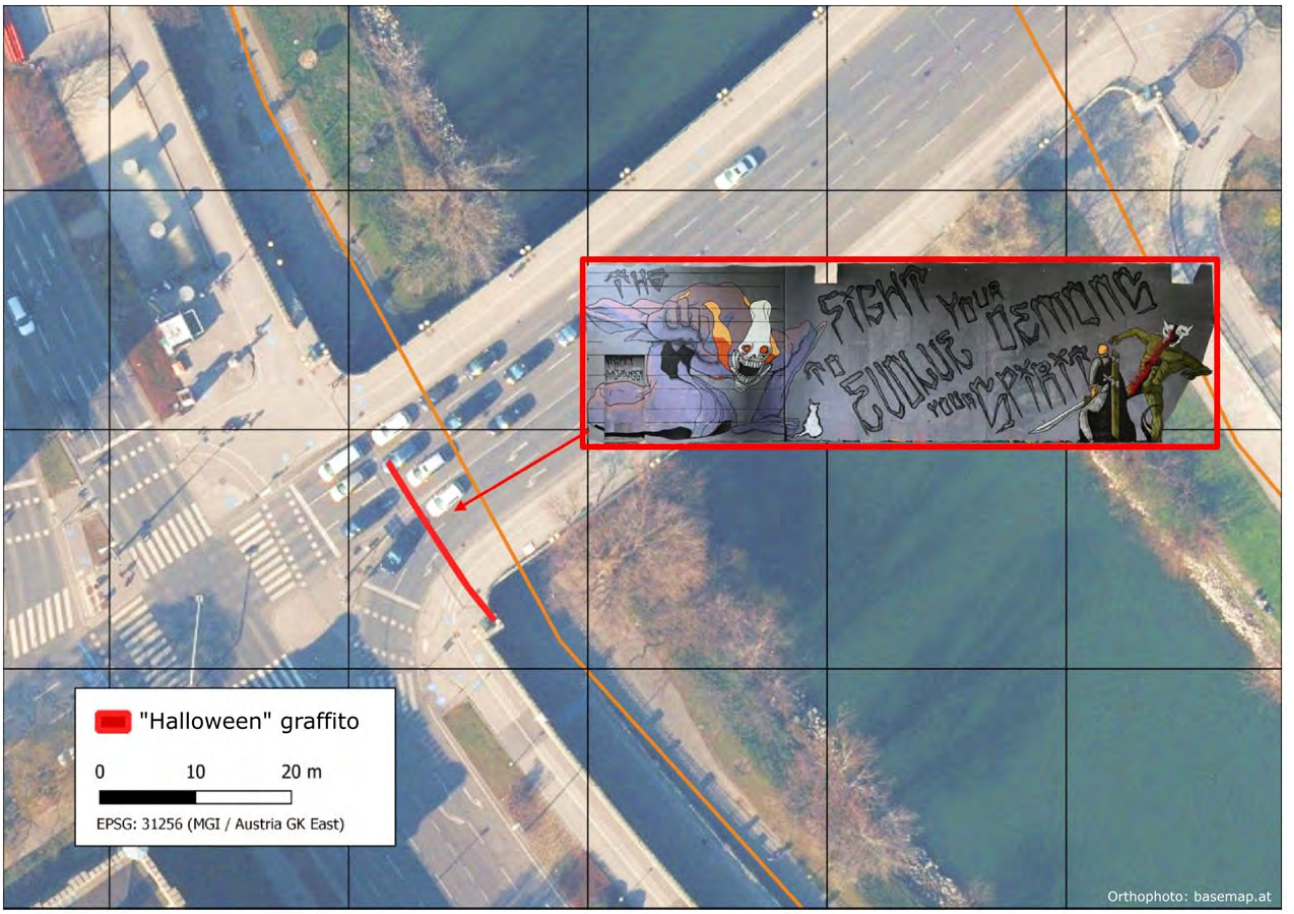



**Figure 4.** Aerial orthophoto of a small part of the Donaukanal showing the outline of the graffito (below the bridge) from Figure 3.

However, more information is hidden in orthophotos: they are usually georeferenced. Georeferencing implies that the absolute location of an object depicted in the image is known. For every pixel in the photo, a real-world coordinate can be assigned. With this information, one could go to the Donaukanal (virtually or physically) and see if the cat in the 'Halloween' graffito is still visible or has been oversprayed (Figure 4). Thus, orthophotos not only allow measuring within a photograph, they also connect the photo to the real world.

Single orthophotos can also be merged in a so-called orthophotomosaic, a very large composite orthophoto consisting of multiple individual ones that are seamlessly stitched together. Such mosaics support the study of extensive surfaces, while still providing much spatial detail (INDIGO' s orthophotos should depict, on average, details of about 2 mm). This technique supports even the distortionless depiction of extremely elongated graffiti. The next chapter will explain technical fundamentals concerning orthophotos and showcase how orthophotos are generated by introducing the orthophoto recipe.

2.1. The Orthophoto Recipe

Although sometimes hardly visible, every photo we take suffers from image distortions which are primarily caused by three factors:

- **Perspective distortions** occur when the object is not a single plane that is parallel to the focal plane of the camera (dashed red line, Figure 5).




**Figure 5.** Photograph taken around Halloween in November 2021. The photograph exhibits typical distortions occurring in conventional photos. The perspective distortion is highlighted with two converging dashed red lines. The orange rectangle shows an example of topographic displacement caused by a door in the wall. The lens distortion is made visible with the red dashed line. While the wall bottom is a straight line in the real world, its image is slightly curved.

- **Topographic distortions** are caused by the topographic relief of the photographed object (i.e., the graffito-carrying surface). Since an orthophotograph mimics the observation of a surface with a viewing direction orthogonal to the graffiti plane, it does not make clear if elements are intruding or extruding. In Figure 5 (see orange rectangle) the right and lower part of the intruding door frame are, however, visible in the photo. Another good example is an aerial orthophoto of a city with a large tower. The top and foot of the tower should be in the same position when viewed orthogonally from above, but the side of the building will likely be visible in the aerial image due to the central perspective of the camera. That is why elements lying below or above a horizontal reference surface (like the tower in the aerial image or the door which lies deeper than the overall vertical reference surface) are said to be topographically misplaced. The further such elements are located from the reference surface, the larger their topographic displacement or distortion will be.
- **Lens distortions** are caused by unavoidable imperfections in the mechanical realisation of the camera's lens system. They are usually manifested to the viewer by the inward or outward bowing of straight lines when lenses with very small or rather large focal lengths are used. Compared to the distortion types above, lens distortions usually play a subordinate role. However, they are still visible (e.g. in Figure 5), so they should be accounted for.

Together, these distortions cause the object in a photo to appear warped, sometimes occluded and without a uniform scale. Figure 5 demonstrates the issues with a conventional

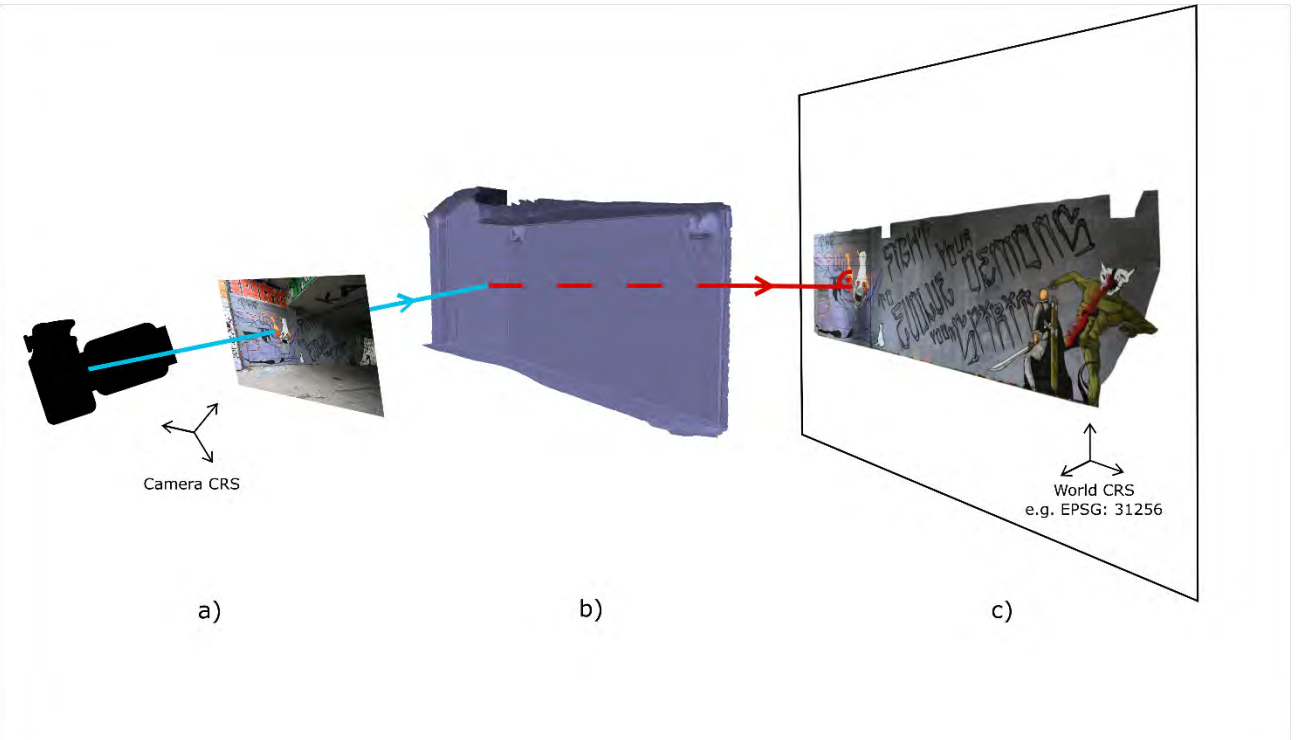



**Figure 6.** Schematic depiction of the orthorectification process with all 'ingredients' to the orthophoto recipe (Wild et al., 2022).

graffito photograph. One could dampen the effects of perspective distortion by changing the acquisition angle and position. However, changing the shooting direction can never account for all distortions and is often impossible due to photographic constraints at the scene. In the case of INDIGO, many graffiti are close to the water or on bridge pillars. These can only be photographed obliquely, causing significant perspective distortions.

We can remove all three types of distortion and simultaneously scale the photo by applying the orthophoto recipe (Figure 6). The technical term for this process is orthorectification, and its 'ingredients' are:

a. The interior and exterior orientation parameters of the camera used; the camera's interior orientation mathematically describes the internal camera geometry, including lens distortion parameters. The exterior orientation describes the position and angular rotation of the camera when acquiring the photo.
b. A digital 3D model of the graffiti-covered surface (i.e. the wall, bridge pillar, staircase).
c. A projection plane (i.e. the reference surface mentioned before) serves as the canvas for the final orthophoto.

Knowing the camera's orientation is necessary to compute the direction vector (green ray in Figure 6), which is intersected with the 3D model of the scene (which takes care of the topographical distortions). The pixel values are then orthogonally projected (red ray) onto the projection plane to also remove the tilt distortion. In this manner, the photograph can be orthorectified pixel per pixel. Because we know the exact geospatial position of the camera (given by the exterior orientation), the final orthophotograph is also correctly georeferenced.

### 2.2. Automating the Graffiti Orthorectification

While the orthorectification principle is relatively simple, the difficulty lies in retrieving all the required data. Besides being reliable, this step needs to be highly automated con-

sidering the large number of graffiti photos project INDIGO generates each week. Fully automated orthorectification without human intervention is the innovation we present in this section.

INDIGO's bespoke orthorectification tool AUTOGRAF (AUTomatic Orthorectification of GRAFiti photos) takes several photos of one graffito as input, derives all necessary orthorectification parameters and outputs the georeferenced orthophoto. Since every graffito is covered by multiple photos, the final product can be considered an orthophotomosaic. AUTOGRAF is developed as an add-on to the commercial software Metashape Professional by Agisoft LLC (Agisoft LLC, 2022), which already provides many functionalities necessary for orthorectification. Explaining the tool and its capabilities in detail would go beyond the scope of this contribution. Instead, we give a brief and straightforward overview of how the INDIGO tool automatically generates accurately georeferenced orthophotomosaics from thousands of photos that capture the hundreds of graffiti monthly appearing on the urban surfaces along the Donaukanal. For more details on AUTOGRAF, the reader is referred to Wild *et al*. (2022). At https://github.com/GraffitiProjectINDIGO/AUTOGRAF, the tool can be downloaded freely.

The INDIGO orthorectification happens in three steps (Figure 7): 1) initial quality checks of the inputted graffiti images, 2) the automated retrieval of the (interior and exterior) orientation of the cameras at the moment of the respective

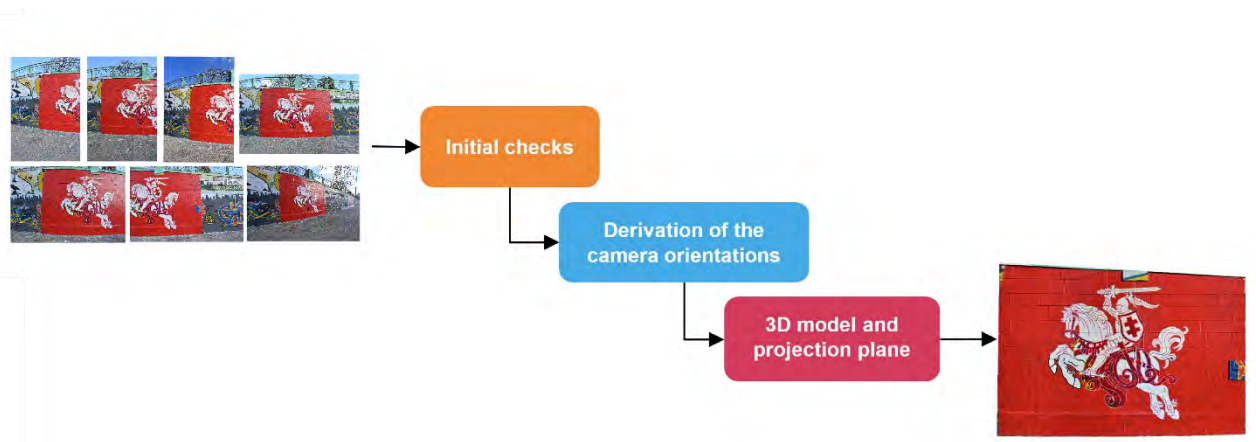



**Figure 7.** Simplified flowchart of INDIGO's automated orthorectification pipeline.

image acquisition, and 3) the derivation of the 3D surface model and the projection plane. These three steps are followed by the orthophoto computation.

After AUTOGRAF receives photos of one graffito, the initial checks validate their consistency and quality. Blurry images or images erroneously assigned to a certain graffito are automatically identified and discarded in further processing. This prior image filtering not only improves the reliability of the workflow but also reduces the processing times, which is a crucial advantage considering the thousands of images INDIGO acquires every month.

For all photos that pass the initial checks (usually around ten per graffito), the camera orientations are computed by identifying common feature points between image pairs, a technique commonly referred to as image matching. These feature points 'tie' the images together, which subsequently allows an algorithm like structure from motion (Ullman, 1979) to retrieve their interior and relative exterior orientations. To recover the exterior orientation parameters, including the camera's exact location and 3D tilt at image acquisition, tie points are then sought between this network of approximately ten graffito-specific images and an existing network of circa 27 000 oriented photos that cover INDIGO's entire research area. The INDIGO team acquired

these images in the autumn of 2021 (see Verhoeven et al. in this volume), and their exterior orientations were retrieved and expressed in the Austrian coordinate reference system MGI / Austria GK East (EPSG:31256). With this 'total-coverage photo network', it is possible to continuously and incrementally add new images while simultaneously retrieving their interior and exterior camera orientations (Figure 8). In this way, INDIGO's entire photo network grows with about ten images when a new graffito gets geometrically processed. Figure 8 also shows that all the image tie points can be visualised as a 3D point cloud.

Once all photographs of the graffito are oriented, the 3D surface model can be extracted by so-called dense multi-view stereo matching (Seitz et al., 2006), which results in a much denser point cloud. By connecting these points into

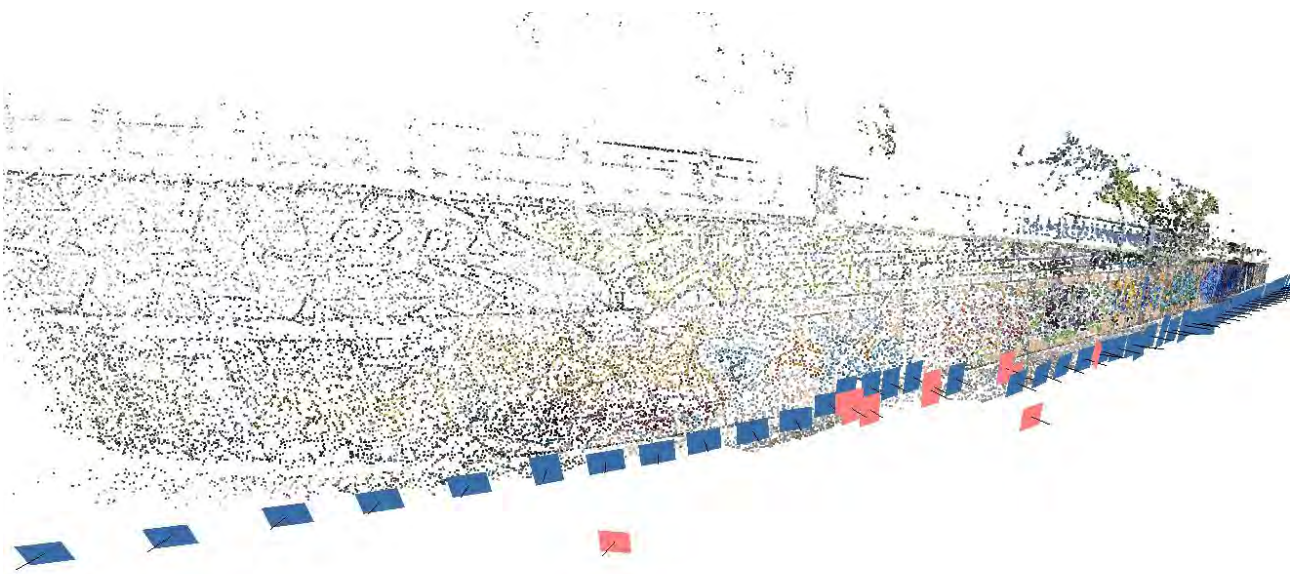


**Figure 8.** Depiction of a tie point cloud, including the oriented cameras symbolised as blue and pink rectangles. Blue rectangles denote already oriented images (i.e. the existing network of oriented images at that stage). Pink rectangles denote the incrementally added photos of a new graffito.

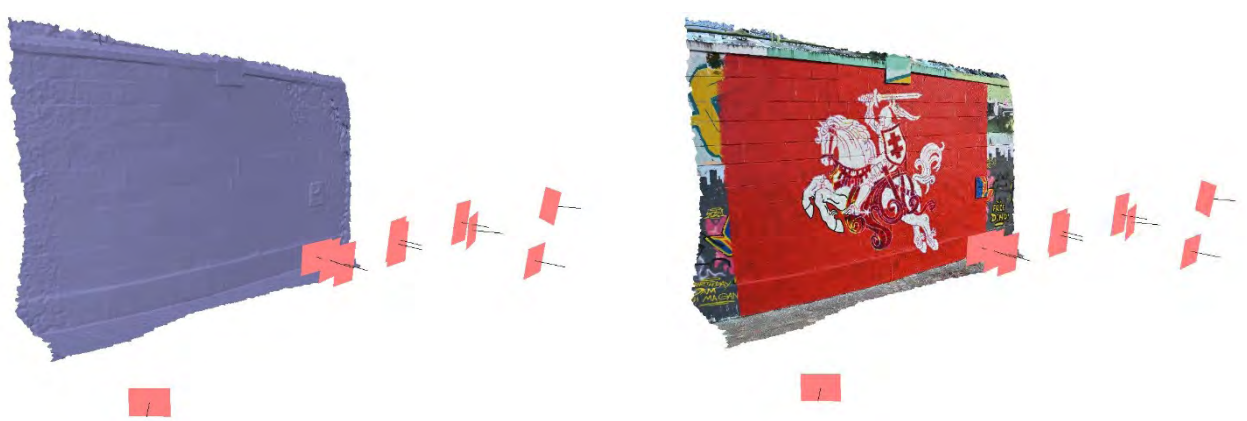


**Figure 9.** 3D meshed surface model (non-textured: left; textured: right) of an exemplary graffito scene. Red rectangles symbolise the locations and tilts of the camera sensor for the various photographs.

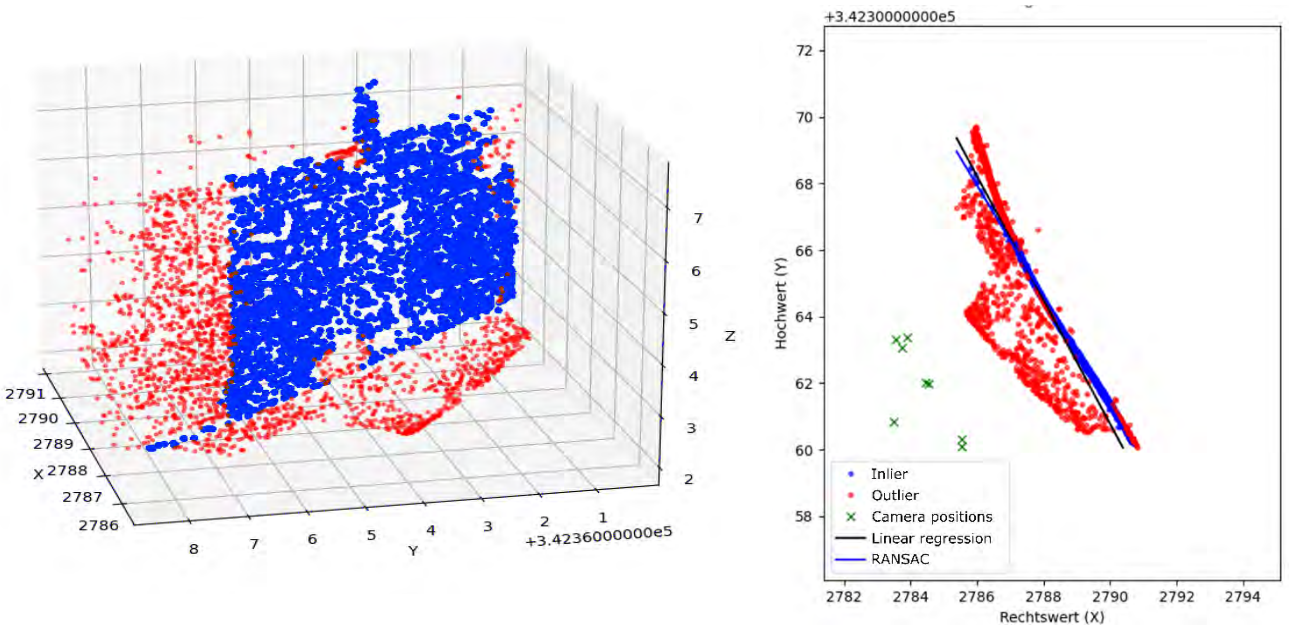



**Figure 10.** RANSAC-classified tie point cloud. Blue dots denote points belonging to the graffiti-covered surface. Red dots denote outliers not part of this surface.

triangles, a continuous so-called triangular meshed 3D surface is derived (Figure 9 on the left). Finally, the images can also be projected onto this 3D meshed surface to generate a photographic texture for it (Figure 9 on the right).

Although the 3D meshed surface and its texture are products that will go into the online 3D platform, no orthophotomosaic has been computed at this stage. To that end, we first need to define the reference surface or projection plane. This projection plane is computed by fitting a plane into the tie point cloud. As this 3D point cloud also contains points that do not belong to the graffito-covered surface (e.g., trees or facades in the background), the point cloud is filtered (Figure 10) using the outlier detection algorithm RANSAC (RANdom SAmple Consensus; Fischler & Bolles, 1981). The result is a plane approximating the surface onto which the graffito was created. This method fails only for graffiti generated on highly complex surfaces (e.g., bridge pillars or staircases), which means that manual intervention is necessary if proper orthophotomosaics are needed from these surfaces.

This automated process results in a detailed orthophoto of the graffito (on average a raster cell of circa 0.9 mm, effectuating a spatial resolution of about 2 mm), thus supporting detailed mapping and dimensional or contentual analyses. Because the orthoimage also includes accurate geolocation info, it can be correctly positioned in the usual 2D maps (see Figure 11) but also in a digital 3D environment.

### 2.3 The 100-Graffiti Experiment

AUTOGRAF was applied to 100 randomly selected Donaukanal graffiti created between November and December 2021. The graffiti were documented with 826 photographs, which were separated into individual folders and fed into the software. This experiment was conducted on a PC with the following relevant specifications:




**Figure 11.** Orthophoto example (left) with the corresponding location of the graffito along the Donaukanal (right, orange line).

- CPU: Intel Core i9-12900KF, 3.2 GHz, 16-core processor
- GPU: NVIDIA GeForce RTX 3060, 12 GB DDR6 VRAM, 3584 CUDA cores
- HDD: Seagate FireCuda 530 2TB M.2 SSD, 7300 MB/s read, 6900 MB/s write

RAM: 64 GB DDR4-4400, 2200 MHz Overall, the tests yielded very promising results. Only five graffiti could not or only very poorly be orthorectified. In return, 95% of the graffiti were accurately georeferenced and satisfyingly orthorectified. Displaying the graffiti orthophotomosaics on a 2D map emphasises the reliability of the developed workflow and shows how equally the spraying activity is distributed along the Donaukanal (Figure 12)

Besides the tool's reliability, its computational demand is of vital interest considering the large amounts of photographs that will be processed during the INDIGO project. Overall, it took 10 hours and 33 minutes to process the 826 images and turn them into graffiti orthophotomaps. The average processing time per graffito was 6 minutes and 20 seconds, indicating that at least AUTOGRAF will be able to keep up with the enormous speed at which graffiti are created and documented at the Donaukanal.

**3. Outlook and Conclusion**

In this contribution, we explained the orthophoto concept, highlighted its importance in digitally preserving and analysing graffiti, and introduced a freely available tool that supports the automated derivation of orthophotos from thousands of graffiti photos in the context of project INDIGO. The introduced tool does not only remove image distortions from the graffiti photographs, but also puts the digital graffiti record in the right geographical spot. With these data, one can reconstruct the different layers of a graffiti-covered wall and see what was beside, above or below a given graffito. Knowing a graffito's location also supports questions like 'Where are the graffiti hotspots?', and by linking this geographical orthophoto information with additional metadata even more complete analysis of the graffiti-scape can be conducted. The question of 'Where are hotspots of…' can, for example, be specified with keywords like 'political graffiti' or 'graffiti of artist XY'.

One of INDIGO's central aims is a 3D + 2D platform allowing neat visualisation of graffiti in their native environment. This platform is still being developed, and many technical hurdles like efficient data streaming of enormous datasets are still to be solved. However, our proposed methodology sets the basis to overcome a major obstacle in today's graffiti documentation and analysis, thereby directly tackling

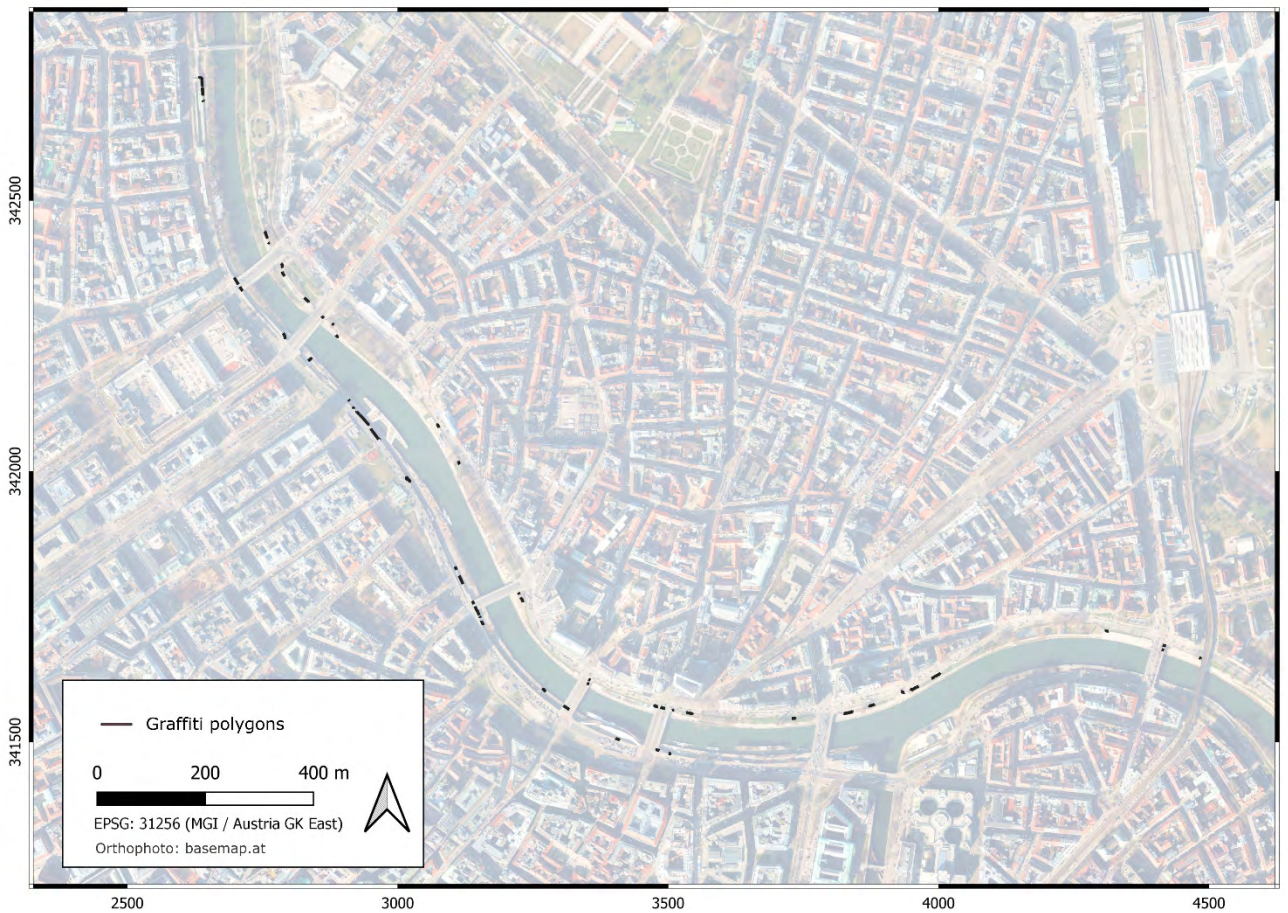



**Figure 12.** The outlines of the 95 successfully orthorectified graffiti photo sets. The base map was made transparent to improve visibility.

the issue of graffiti decontextualisation. All this will hopefully contribute to novel ways of experiencing and scientifically analysing graffiti-scapes, in turn boosting the understanding and heritagisation of these colourful and diverse mark-making practices.

**Conflict of Interests**

The authors declare no conflict of interests.

**Acknowledgements**

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# Joseph Kyselak (1798–1831), the First Tagger and Local Patron of the Wiener Donaukanal Graffiti

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**Abstract**

Joseph Kyselak (1798–1831) achieved fame during his lifetime on account of a strange habit: he left his name in huge black letters in many, perhaps hundreds of places. Since 2006, art historian Gabriele Goffriller and director Chico Klein have been collecting facts and figures on Joseph Kyselak. When we began, there were countless articles and stories about him, even novels and a play, but very few facts. After 16 years of research—what do we know about his aims? Is there a concept? Can Kyselak be seen as the first graffiti tagger in the world? In this paper, we want to give a short overview on the exquisite and endangered heritage of the local patron of graffiti.

**Keywords**

Austria; Biedermeier; Habsburg monarchy; literature; Wanderlust

## 1. Kyselak's Journey and Book

In the summer of 1825, on the 12th of August, a young assistant officer named Joseph Kyselak left his hometown Vienna.

Accompanied by his white dog, he started his journey on foot. This journey led him to the most beautiful spots of the territories of today's Austria, Slovenia, Italy and Bavaria. For nearly four months, he hiked the Alps, visiting historic sites and places, and climbing various ruins. Kyselak collected enough impressions of nature, landscapes and people to write a book about his adventures.

He completed the first part of his journey by stagecoach; then he hiked from Styria to Carinthia and Slovenia, north to Salzburg, south again and then high up in the Tyrolean mountains. The way back home was mainly a journey on the rivers. Kyselak's writings on nature and landscapes, of people and countless visits to historic sites were published four years later, in 1829.

We know little about what happened to his book "Skizzen einer Fußreise..." - "Sketches from a journey by foot…", we don't know how many books were sold. Only two years after its publication (Kyselak, 1829a, 1829b), in 1831, Kyselak died at only 32 years of age. The Cholera pandemic that spread throughout Europe claimed Kyselak as one of its victims. Although this book is important as part of the development of the Austrian Romantic Epoch's travel literature, Kyselak didn't gain notoriety for it, not even for his ambitious destinations in the mountains.

But he became famous for one strange habit—for inscribing his name wherever he could. According to contemporary witnesses, there were hundreds and hundreds of his 'tags'—and some of them still exist.

## 2. Since 2006: The Kyselak–Project

In a research project on Kyselak, which began sixteen years ago with director Chico Klein, we archived Kyselak's inscriptions that have been preserved over the last two centuries. We had to separate the stories and the notoriety,

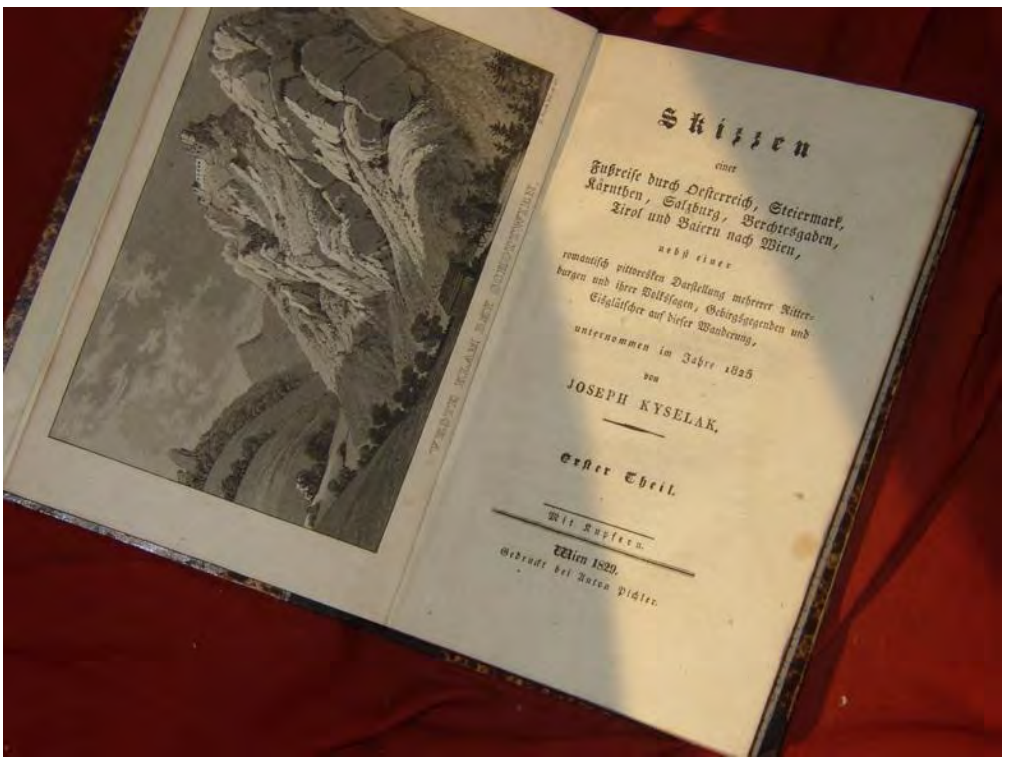



**Figure 1.** Frontispiece of Kyselak's only book 'Skizzen einer Fußreise durch Österreich...' from 1829



**Figure 2.** Documenting one of Kyselak's signatures in Lower Austria, Foto ©kyselakprojekt

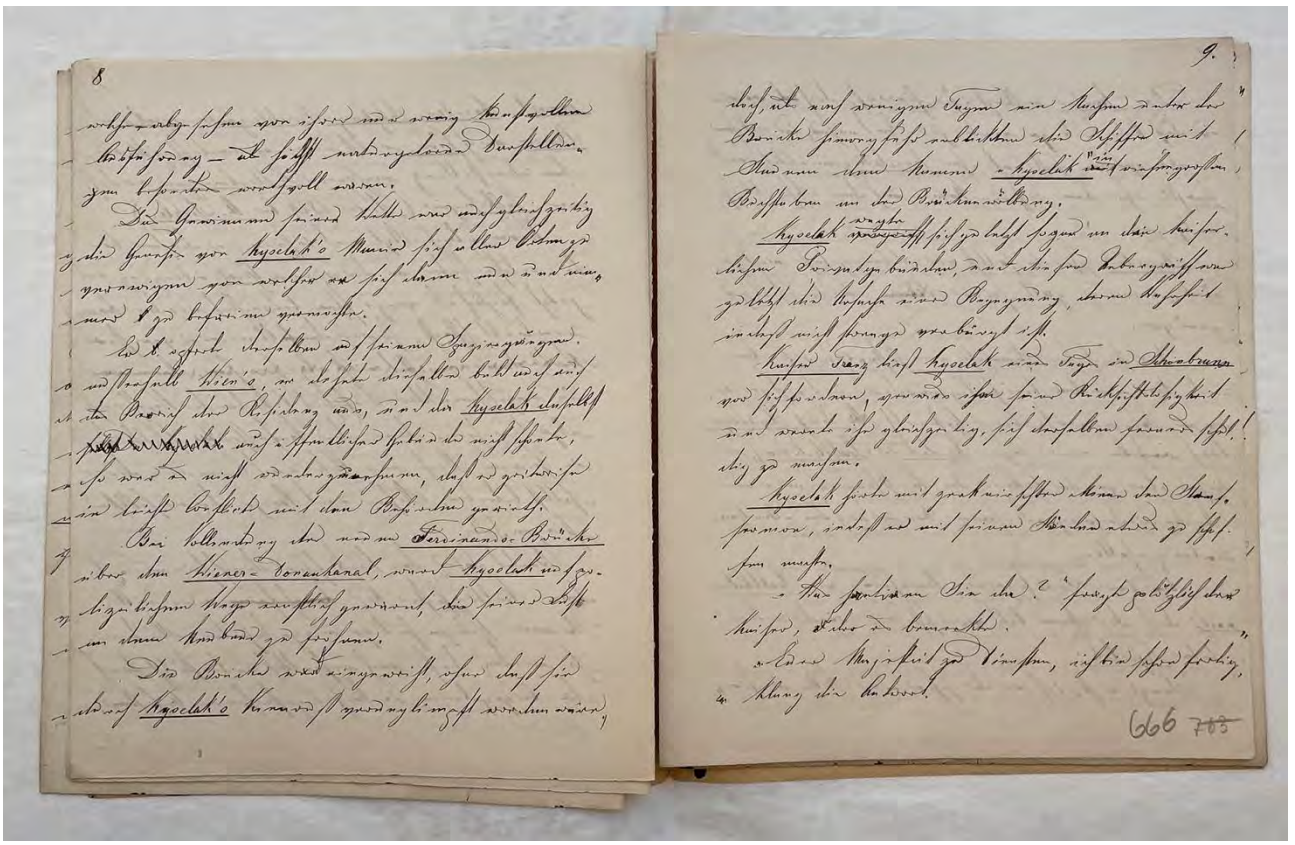


**Figure 3**. Anonymous manuscript on Kyselak - at the Donaukanal, Vienna, Haus, Hof- und Staatsarchiv. ®kyselakprojekt

which followed Kyselak's name through his lifetime, from facts and common sense. We've edited Kyselak's book and made a TV documentary about him.

We've found about twenty still existing inscriptions and nearly about as many visual citations from artists of his time. And, of course, we have noted hundreds of articles in journals and books — the findings in historic newspapers and books are increasing, thanks to digitisation and the internet.

Kyselak was an urban myth during his lifetime, and he constantly fascinated a broad public. Related to their interest in his ...let's call it "Œuvre", almost everybody who was writing about him tried to find out what he intended with his 'tagging'. While tagging wasn't known by then, today it is defined as: "A writer's signature with a marker or spray paint, considered the most basic form of graffiti. Testimonial of the presence of a writer in a determined spot, usually executed quickly with connected letters. A tag is a writer's personal logo" (Caputo, 2010).

One of the countless stories that have been told about Kyselak, a particularly imaginative one, is about a new bridge built at the Danube Canal in 1819. Kyselak, already very well-known at the time, would have been warned by the police that he was not allowed to pursue his passion. The bridge was inaugurated without disturbance, but only a few



**Figure 4.** Eduard Gurk, Ruine Gutenstein, Wien Museum

days later, boatmen observed the famous signature at the bottom of the bridge arch.[1]

Compared to modern graffiti, our knowledge of Kyselak is quite contradictory. Unlike most modern writers and taggers, that see themselves as artists and prefer to work anonymously or use an alias, we have no idea why Kyselak wrote and presented his name. We don't understand his message; his intention remains enigmatic.

But after some months of research, what we did have was

1 - Bei Vollendung der neuen Ferdinands-Brücke über den Wiener Donaukanal wurde Kyselak auf polizeilichem Wege ernstlich gewarnt, seiner Lust an dem Neubaue zu fröhnen. Die Brücke ward eingeweiht, ohne dass sie durch Kyselak's Nimbuß verunglimpft worden wäre, doch, als nach wenigen Tagen ein Nachen unter der Brücke hinwegfuhr, erblickten die Schiffer mit Staunen den Namen „Kyselak" in riesengroßen Buchstaben an der Brückenwölbung"; When a new bridge over the Donaukanal was finished, Kyselak would have been warned by the police not to indulge in his hobby. The opening ceremony took place without any sign from Kyselak, but a few days later, boatsmen discovered his huge signature under the bridge." S.n. (s.d.)., The bridge was inaugurated in the presence of the imperial highnesses on the 19th of June 1819.

quite valuable information about who Kyselak was. There is a little portrait of him, picturing him signing a wall on the ruins of Castle Gutenstein. His friend, the painter and graphic artist Eduard Gurk captured his figure, so to say '*in flagranti*'. Kyselak, apart from what he is actually doing, is of immaculate appearance, wearing a silk top hat, elegant grey trousers and a blue frock coat. He was a young assistant finance officer from a well-documented officer's family and worked as a true servant for his majesty Emperor Franz II/I (Goffriller, 2009; Lorenz, 2015).[2] When he was writing on walls, stones or bridges, Kyselak didn't use a pseudonym, a *nome de guerre*, or an alias. 'Kyselak' was his real name.

**3. Tags in Kyselak's Time**

When asking whether we should consider Kyselak the first tagger, I want to point out what I discovered about the habit of tagging in Kyselak's time. We know that graffiti is significantly older than Kyselak, and we can be pretty sure that graffiti tagging appeared at the same time as human beings began to write. Names have been presented on walls simultaneously with our literality, and our scripturality.[3]

Famous examples of early taggers are travellers like Lord Byron and Johann Wolfgang von Goethe. Even Leopold Mozart, presenting his famous children to a German audience in the summer of 1763, didn't hesitate to show his pleasant anticipation by scratching a short notice into one of the windows of his accommodation in Frankfurt.[4]

Not only travellers left their marks in the wild. An Italian research project has documented thousands of painted inscriptions in red ochre made by shepherds and goatherds on the mountain cliffs, especially in the Valley of Fiemme (Trentino province). The writings, dating from 1650 until about 1950, use alphabetic signs and numbers and are significant evidence of the shepherds' acquired ability to read and write (Bazzanella & Kezich, 2020).

**4. Tags and Literature**

Kyselak himself notes, when visiting a famous cave, that the walls of the cave are covered with names…in 1825! This cave became famous two centuries before Kyselak's visit, when Emperor Maximilian I ended up being stuck in this cave while hunting. climbed to the cave and ended up being stuck there. Maximilian, thought to be doomed to die, was finally saved chivalrously. The dangerous sheer slope here is one of two illustrations of Kyselak's book, a lithography that shows the bold rock face with the cave slightly left of the centre.[5] What did Kyselak find there?

"I measured the cave, maybe 25 steps in width, on both sides covered with hundreds of names from visitors, who had enjoyed themselves there. Even my friends' names from my hometown were to be found. I welcomed them as if these loved ones were standing right before me. You' Friendship Book' given by nature, whom grateful empathy would love to donate much more, keep safe your contributors! No false obligingness, friendly hypocrisy and flattering symbols, where often the unknown donor calculates nothing but his payment, and the presentee only sees the pleasant form and shallow fashion of the giver's mind. But here, at this visit, hearts brim over with love! Everybody gave his tribute, as nature and culture taught him, putting aside any bragging against successive generations."

In the mountains, it is fashionable, even more so today, to leave a token as proof of presence. Perhaps just for safety reasons, or maybe to mark the happy arrival to a summit, maybe out of exuberant 'Wanderlust'. But looking at tags

2 - Kyselak began to work as an assistant at the Kaiserlicher Hof, from 1818 until 1823, then was transferred to another department.

3 - Reisner (1971), especially on the 'I-was-here-syndrome'; Kraack (1997), especially for Austria: Observations on conquering the landscape by signing were done by Kos (1992). A broad view on the history of tagging is presented in Birzin et al. (2022).

4 - CC-BY-SA: Historisches Museum Frankfurt, Foto: Uwe Dettmar; Retrieved June 20, 2022, from OS - Object - 144527 | Historisches Museum Frankfurt (historisches-museum-frankfurt.de).

5 - Kaiser-Max-Grotte bei Zirl, Tirol. Kyselak notes that students, mostly from Munich, frequently travelled to Innsbruck for climbing, see Goffriller (2014), Kyselak (1829b, p. 128), Goffriller (2009, p. 328).

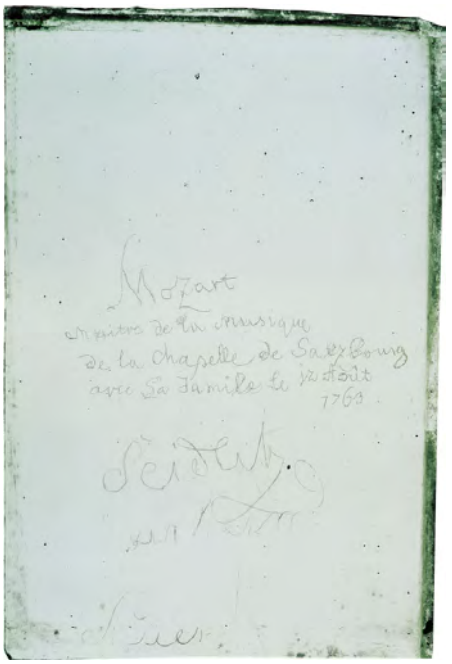



**Figure 5.** „Mozartfenster“: Windowglass from Frankfurt, Bendergasse 3, Historisches Museum Frankfurt



**Figure 6.** Shepherds' writing in the Val di Fiemme.

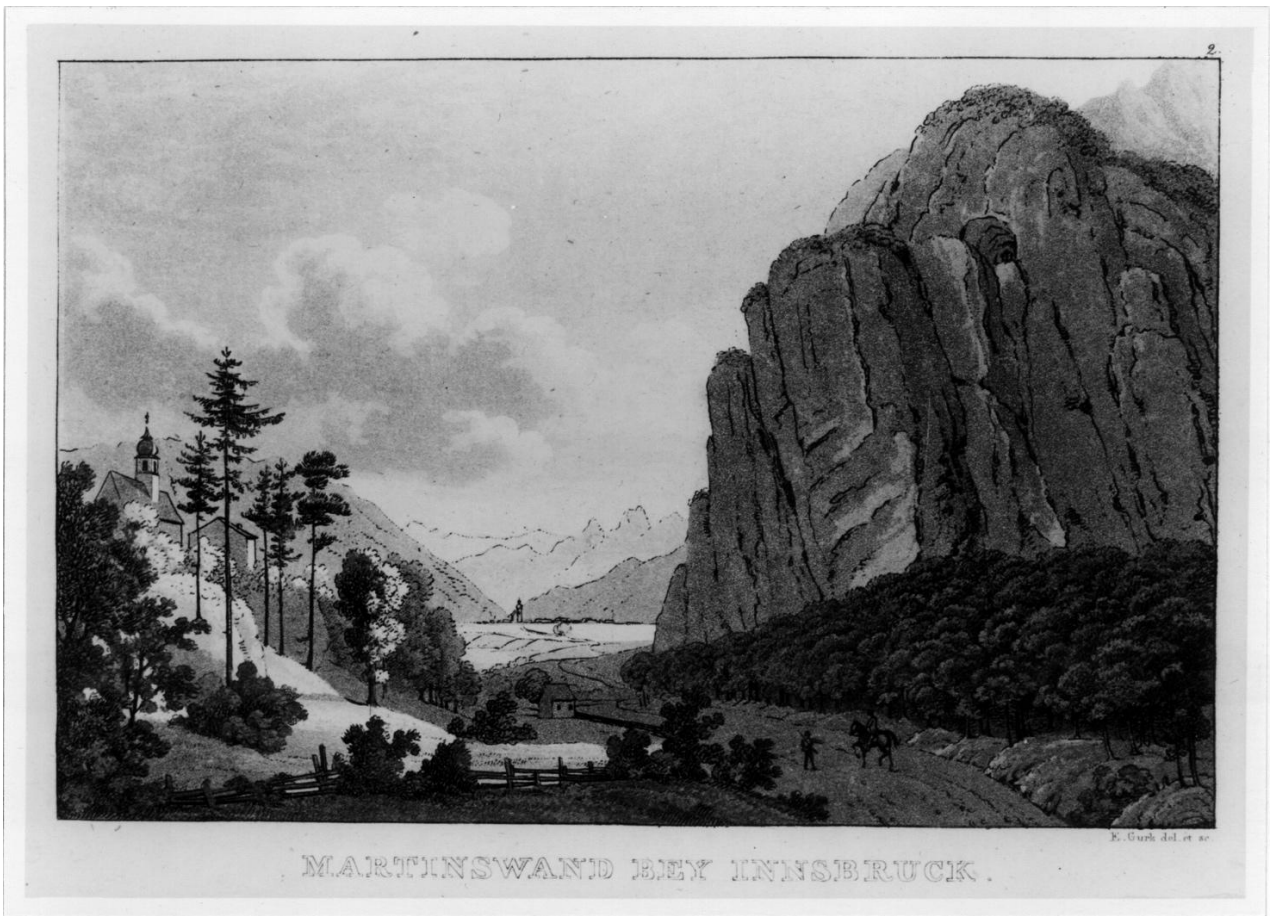



**Figure 7.** Eduard Gurk, Die Martinswand bei Zirl. Illustration in (Kyselak, 1829b).



**Figure 8.** Kaiser-Max-Grotte in the Martinswand, 2008

from days gone by, we would get an incomplete picture if we neglected the literature that came with the names. More than once, Kyselak found names and poems while hiking in the mountains. In Tyrol, up on an alpine pasture, he visited a waterfall.

Deeply impressed by the cascade's power, he finds a poem written on a stone with a red pencil: "Well done, you raging cascade, hiding yourself in this neglected abyss." This poem was brand new, as it was signed "A. Strenhelm, 1825"—the same year that Kyselak was travelling. He himself writes: "Next to this, I wrote with black oil paint: 'Whose bosom is beating with joy, whose heart is moved by gratefulness: He will win even wilder fights and will always be happy to see the beauty of God's creation'."

This is, in my view, the most interesting part of the book: Kyselak discovers a poem written on a stone at an altitude of 1800 metres above sea level, and he isn't surprised at all—and at the same moment, he grabs his painting utensils, and comes up with a poem himself. Only some days later, he refers to another poem he wrote down, sitting high above the city of Innsbruck.

"*Mag das Schicksal gleiten wie es will*
*Ich erfuhr der Seligkeiten Ziel.*
*Raubt mich auch der nächste Augenblick,*
*Diese Stunde schuf mein Lebensglück.*"

I want to find out if this kind of 'open-air literature' was an established custom in Kyselak's time. What did it mean to place down poems and one's name in the great outdoors, and which class of society was playing this game? In my opinion, the addition of poetry indicates that this is to be seen as a form of greeting from one educated man to another, as an upper-class sport, or maybe as an artistic fashion.

Many writers asked for the motif of Kyselak's famous tags.




**Figure 9.** Nikolaus Barton as Kyselak—filmstill from "Kyselak war da! Graffiti anno 1825" (Klein & Goffriller, 2008)

Many argued that Kyselak was a maniac, that it was pure narcissism or even that he might have been suffering from unrequited love. Or that he simply wanted to advertise his book. But all this seems to be pure guesswork. The locations of his many original signatures speak against these theories.

Many signatures are high up in hidden valleys, in the mountains, in caves and so on. We were full of hope to find the answer in his book, which was nearly forgotten and hard to get. The "Sketches on a journey by foot..." might suggest that Kyselak wrote and gave information on his tagging.
But he wouldn't say a word about his vision or his concept. Only once, when visiting Styria and climbing the dangerous ascent of the Kapfenberg ruins, he refers to leaving signs. But this doesn't yield any concrete statement about his reasons—he simply does it: "Ich bezeichnete diese merkwürdige Wand, an der ich mich nun fest anklebte, groß mit schwarzer Jahreszahl" - "I inscribed this strange wall, to which I now firmly stuck to, large with a black date".
After 16 years of research, I must confess that this is still an enigma. The historical and philological analyses don't give an answer.

**5. The Tag Itself Is Key**

But I have always been fascinated by the approach of art historians and their consistent belief that the key to all an-




**Figure 10.** Kyselak presents his book to Erzherzog Carl, ÖNB Austrian National Library, 1829

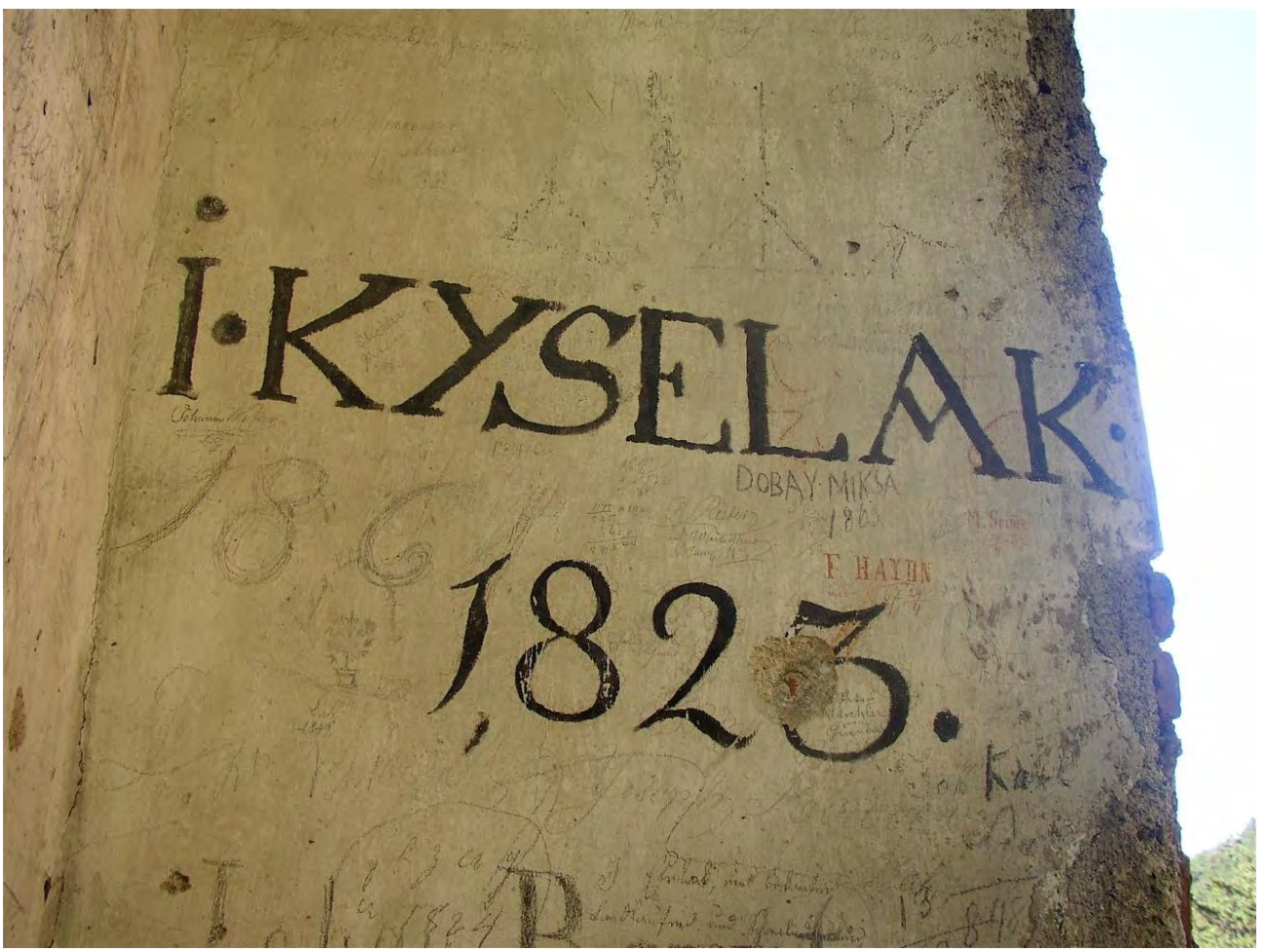



**Figure 11.** I·KYSELAK, 1823 Lower Austria

swers is hidden in the work itself. Let's try this.

Let's raise the question if Kyselak considered himself an artist. A close view of his work gives a hint of a higher motif. It's hidden in the form of his name itself. The comparison with his written signature, here on a letter in which he presented his book to Erzherzog Carl, makes clear that his tags took quite a different form.

The tag "I KYSELAK" was always written in large and memorable characters. His name appears in Latin Capitals with serifs and varying stroke widths. The name begins with an I—for Joseph—that has, despite being given as a capital letter, a dot above it as if it was a lowercase. Another dot follows and separates name and surname. This is followed by an upright K, which is facing a strange Y, that is drawn from the upper right to the lower left. The S answers this slope and is tilted slightly to the right, followed by the almost monolithic E, L and A. The second K shows the same shape as the first one; the angular parts of the Ks meet at one point in the middle of each letter.

This is the shape of the tag that Kyselak used for almost a decade. He scratched or painted the letters, measuring up to 11.5 cm in height, and he did this freehand. We couldn't find any evidence that he had used a stencil. We realised that his duality, as a graffiti writer and an author, as a literary man as well as an illustrator designing his logo, could be the key to his intentions. Why he was spreading himself about that much, writing his name on any possible occasion, we just do not know. And I wonder if anybody has done this before him?

**Conflict of Interests**

The authors declare no conflict of interests.

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*ihrer Volkssagen, Gebirgsgegenden und Eisglätscher auf dieser Wanderung, unternommen im Jahre 1825. Zweiter Teil*. Anton Pichler.

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# Cataloguing Works of Art in Urban Spaces, of an Extremely Ephemeral, Performative Nature and/or Using Organic Materials

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**Abstract**
Over the last few years, various research projects presented by institutions in different countries have made significant progress in developing a cataloguing card and protocol for urban art and muralism and even, in some cases, for graffiti (the differences between the three will be explained in the text). As such, essential research has been carried out in this regard thanks to the CAPUS International Project, the GE-IIC Urban and Public Art Group of Spain, the INDIGO research project of Vienna, Austria, the project directed by Professor Adris Díaz that catalogues artworks from the Monterrey Callegenera Festival, or the project "Pintado en la Pared. Estudio de la Pintura sobre muro en la Provincia de Jaén en los siglos XX y XXI" (Painted on the Wall. A study of Wall Painting in the Province of Jaén in the XX and XXI centuries"). However, there are still important issues that deserve further consideration that will be discussed later in this paper, such as, for example, the cataloguing of a type of art that occurs in urban spaces but that is not related to murals, which is the most common form of urban art. These pieces of art usually have a very short lifespan. For this reason, this paper proposes the modification of the urban art cataloguing card based on different experiences in which certain shortcomings have been identified.

**Keywords**
cataloguing; city; ephemeral art; relational art; urban art

## 1. Introduction

The appearance of new art forms that involve different contexts and spaces and use new materials and techniques creates a challenge for researchers who must adapt the cataloguing methods. Some of these art forms, already well known, range from Land Art to, more recently, NFTs (Non-Fungable Tokens). In general, the introduction of new technologies, of organic matter or of various kinds, which were not considered artistic before, such as plasticine, are a constant challenge, as changes are occurring faster and faster. The documentation and registration of works of art is not a trivial matter, but rather an essential step towards conservation and creating awareness. However, conventional catalogue cards are of no use for certain types of artworks. It is, therefore, necessary to implement a cataloguing card that can incorporate other registration techniques and thus enable accurate descriptions. Several problems arise, however, such as the need to use different types of cards at the same time at the same creative event. Other problems arise when the focus is on the creation process, such as how to incorporate the actual experience of the local neighbourhood in a cataloguing card. This is, without a doubt, a challenge waiting to be solved, and it is something that the GE-IIC Urban and Public Art Group (García Gayo, 2022), the group at the University of Monterrey headed by Adris Díaz Fernández (UDEM, 2020), and other studies such as the Master's Thesis by Nicolás Gallego Fernández

at the Madrid Complutense University, are actively working on by trying to develop a cataloguing card for performance art. This text proposes an incipient cataloguing card for those artworks developed in public spaces, for which the card made for urban art and muralism lacks the capacity to include the necessary level of detail.

First of all, before beginning the work, a few terminological remarks are in order. Situationism and the development of the drifts brought experiential art onto the streets (Debord, 2005). It is not the purpose of this paper, as it would become too long, to review the history of urban art and graffiti. However, it is worth noting that while contemporary graffiti (we call it that to distinguish it from historical graffiti) began to develop in the United States, a game that took place among groups of young people living in the suburbs of large cities, in Europe urban art began to develop, works generally produced by trained artists who took their work to the street to seek a dialogue with the city (Luque Rodrigo & Moral Ruiz, 2021b). However, the experience remained mainly for the artist, while the spectator remained a passive subject who was limited to contemplating the work. In this context, urban art emerged, in which walls and other elements of street furniture became the main field of action. Thus, the first seeds were sown towards the emergence of participatory (or not) art; developed in public space and going beyond the wall. It should be noted that in this text, we will always refer to urban art, graffiti and contemporary muralism, since historical graffiti are already considered heritage and are subject, at least in Spain, to legislation, but this is not the case with contemporary forms of street art, in any of its forms.

In short, in Spanish, we distinguish at least within the academic world—and this has been one of the great endeavours of the Urban and Public Art Group of the Ge-IIC—between:

- Historical graffiti, those manifestations that were generated in urban space at least as far back as Pompeii, which will not be dealt with in this paper;
- Graffiti, that which emerged in the 1960s in the USA, written graffiti with more or less decoration, which is not defined as art, but as a game between equals and which does not dialogue with the city, but imposes itself;
- Urban art, born in Europe in the same decade, in various forms, generally carried out by artists who go out into the street and dialogue with it, sharing with graffiti only its illegal character;
- Muralism, a manifestation that arose after 2000 and has developed greatly, especially since 2010, as an institutionalisation of urban art, which is developed on commission, tends to be larger and sometimes more elaborate as it is done with more time, without having to flee from the police, with a more decorative than subversive character, sometimes more oriented towards tourism and urban and heritage management policies that seek the commodification of spaces, which is why it has sometimes been accused of provoking gentrification, sometimes with social movements behind it.

The three forms, graffiti, urban art and muralism, while absolutely different, share the use of public space and the ephemeral character.

On the other hand, there are manifestations that are generated in the public space, which are not urban art, graffiti or muralism, but which are not exactly performance art either, which also have an ephemeral character, and which are difficult to catalogue. It is on this group of pieces that we are going to focus in this work.

**2. Art in Public Spaces: Beyond the Wall**

During the 20th century, and even more so in the 21st century, some artistic innovations brought about a change in the way spectators experienced works of art, as they went from playing a passive role to being active participants. In addition, art ceased to be solely visual and began to engage the other senses (Dewey, 2008). Art became experiential and participatory, and thus this direction of art was defined by Bourriaud (2008) as being relational art. However, the experience does not always directly involve active participation as it can also be contemplative, stimulating not only our sense of sight and hearing, which since the Sophists have been considered the main senses, but also addressing, for example, smell and, in other cases, touch or taste. Initially, the first avant-gardes that experimented with the senses did so by focusing on cultural spaces. Futurism introduced sound art and tactile art through Marinetti (Hoyas Frontera, 2004). Dada, through Haptism, and artists like Munari

also experimented with touch. Cubofuturism and Productivism (Molina Alarcón, 2004), both Russian movements, also experimented with sound, as did Bauhaus, by focusing on performance. However, it was in the 1960s when more experiences with sound art were developed as part of, for example, conceptual art. However, it was primarily the development of action art by means of happenings and performances, especially in the search for total art brought about by Fluxus, that led to the emergence of audience participation and the stimulation of several senses at the same time. With Land Art our senses are completely transcended, as when it comes to landscape-related works of art, all of our senses are activated. Moreover, when Land Art is brought into the gallery, it activates our senses in their entirety, especially our sense of smell, as evidenced by works such as those of Wolfgang Laib (Quirosa García & Luque Rodrigo, 2018).

Some more current examples of art aimed at stimulating other senses beyond sight are the following cases. For example, with *Translating Soy Sauce: Nuevas recetas Ibéricas* (Translating Soy Sauce: New Iberian Recipes), Filipino artist Kristoffer Ardeña got a group of housewives to cook local dishes using soy to demonstrate how food can be a way of socialising and a means of importing and exporting cultures. Miguel Ángel Moreno Carretero also carried out a project in El Carpio, later transferred to Jerez and Córdoba, where bread was the common theme in the creative experience. On the other hand, Paloma Montes López staged an art intervention focusing on the taste for Otoñeces in Córdoba in 2010, where she offered visitors circular pieces of bread with hares drawn on them. Laurent Mignonneau and Christa Sommerer have created several pieces related to taste and tactile art, such as the Mobile Feelings installation, which was based on non-verbal and emotional wireless communication through an interactive installation with pumpkins and cell phones.
Somehow sound and taste seem to be quite prevalent, especially within collaborative and relational art. The sense of smell is somehow present in the work of Claudia Frau, who constantly uses fruits and vegetables in her pieces. In addition, such artistic experiences, which are not only visual, are often used to establish socio-political criticism. Another young Spanish artist who is currently conducting similar research is Fran Pérez Rus, who works on the concept of ephemerality and the volatility of sound itself, concealing technological sounds in natural spaces.

In the following, we will consider two specific cases in addition to the examples given above to analyse the need for a cataloguing card that has been adapted to this type of artwork. The first of these events is FINDE 02: *el artista y la creación efímera* (FINDE 02: the artist and the ephemeral creation) (Torres Sifón, 2016). It was held at the MODO space in Cordoba (Spain) and was organised by the Finde (Los Vendaval + Marta Nieto) and La Maleta (Manu Jurado) collectives. A number of artists that had specifically explored the ephemeral aspects of art participated in this event. Some of the artworks were as follows:

- *Otro Proyecto directo a la basura (Another project headed straight for the trash)*. Antonio Blázquez's artwork consisted of scattering numerous balls of crumpled paper around the surrounding gardens. These sheets of paper were actually serialised illustrations. This artwork, in addition to its conceptual and reflective content, encouraged the interaction of casual passers-by and involved the impact of all kinds of weather conditions and human interaction. It is utterly ephemeral and unpredictable, and the very interaction of the paper with external elements, such as the humidity of the grass, forms part of the work, which continues to be created even after the artist has stopped working on it. It would be impossible to convey this using a conventional card.
- In this line, Claudia Frau presented the work *Rebelión en la Huerta* (*Rebellion in the Vegetable Garden*), in which she propitiated a kind of collective catharsis by throwing tomatoes at all the electoral posters of the parties. Although this work by Frau is a performance, it has been included above all because of the significance of other works by the artist, generally made with fruit and vegetables that generate, for example, smells, something that cannot be included in a conventional cataloguing file. Although it is not urban art, we take it into account because it was produced in the context of the festival we are exhibiting and in the street.
- Laura Palmer, in *Recuerdo* (*Memory*), selected fragments of her life and wrote them on the bottom of cupcake patty cases, which she filled with soil and offered to the public. It was up to each person to decide what to do

with the patty cases, whether to empty them to find out this small bit of personal information about the artist or not, or to throw the paper away, or to keep it.

- María Morilla, in *Yo estuve aquí (I was here)*, made an initialled embroidery on a water-soluble fabric that she left lying abandoned in the gardens. After coming into contact with the humidity of the grass, the fabric disintegrated, leaving behind only a tangle of threads, which were impossible to read and which were then left to the mercy of natural and human interference.
- Montse Caraballo and Sandra Carvalho created a piece in which they used chalk to paint shadows of elements in the garden at different times of the day. This work has a strong connection with the origin of graffiti in terms of the support and the materials used.
- The work *Burbujas* (*Bubbles*), by Miguel Ángel Moreno Carretero, is especially ephemeral. In the artwork, he created red soap bubbles that were blown around the surrounding space and encouraged visitors to participate.
- Rafael Jiménez made the piece *Falso estrato* (*False stratum*) (Caída/Fallen) with leaves that had fallen from trees and then covered with plasticine being strategically placed on the lawn. It is important to note here how the different elements interact: living organic matter, dead organic matter and inorganic matter.
- Finally, we have Fran Pérez Rus with his sound artwork that, although recorded, is of interest because of how it interacted with the open space in which it was reproduced.

This last artwork could have been recorded using either video or sound, even though some details would have been lost, but other exhibited artworks could not be recorded because of the impossibility of doing so, or because of the negative impact it would have had on passing visitors. In addition, there are even more complex cases in which the very same artist is unaware of the artwork itself. For example, in 2017, the Relational Art Forum made a Bolsa de Cotillón (Gift Bag) (Díaz-guardiola, 2016) with a range of different types of pieces, some of which were graphic, others inviting the owner of each bag to perform their particular action, and others that had this ephemeral aspect to them. The aforementioned Claudia Frau, for example, included a grape (because of the Spanish tradition of eating twelve grapes with the twelve bell chimes that mark the end of December 31 and the beginning of January 1). The grapes were accompanied by instructions suggesting that each owner do whatever they wanted to do: watch the grapes rot, plant the seeds, etc. Although the artist asked for photos of the results to be sent to her, the truth is that this process was completely out of her hands and thus made the registration even more complicated for the heritage specialist.

The other event we are going to refer to is the Finde Festival in El Almendral. It is a relational and ephemeral artistic creation festival, held in the neighbourhood of El Almendral, Jaén (Spain). Jaén is a city located in the so-called "empty Spain", those areas of the country that, due to a rural exodus, have lost an enormous amount of their inhabitants due to bad policies that have resulted in a shortage of certain infrastructures, equipment, investment, etc. The neighbourhood in question is a somewhat forgotten area of the city, a hill-side neighbourhood, which, although located near the historical and commercial centre of the city, has several problems: an ageing population and a complex terrain, which means that many of its inhabitants rarely leave even though there is only a small grocery store there. Recently, however, the Asociación de Vecinos Entre Cantones (Entre Cantones Neighbourhood Association) has been working on art, community, sustainability and urban resilience initiatives. Some of the actions they have performed are aimed at fighting against institutional neglect and the city's neglect of the neighbourhood by painting its streets, decorating them with flowerpots made out of discarded material, having urban artists paint murals or decorating a plot of land to make a seedbed, to name a few. This has helped to bring new life to the neighbourhood, empowering its inhabitants and making them feel proud of the place, as well as putting it back on the city map. All this was achieved thanks to self-management and without causing gentrification, and with some institutional support on specific occasions, such as from the Provincial Council of Jaén or the Caja Rural bank.

The festival was financed thanks to some grants from the University of Jaen's Cooperation and Education for Development Program "UJA COOPERA", coordinated by Art History professor Laura Luque Rodrigo and master's student Sergio Cruz. It was a creative project that focused both on neighbourhood and educational collaboration by means




**Figure 1.** A collage of photographs from the festival (https://www.plataformadeartecontemporaneo.com/pac/artista-y-creacion-efimera/#prettyPhoto).

of what is known as service-learning, as it was associated with the Teaching Innovation Project "Aprendizaje-servicio: Investigación, educación y divulgación científica con relación a la historia del arte, la arqueología y el desarrollo sostenible" ("Service-learning: Research, education and scientific dissemination in relation to the history of art, archaeology and sustainable development") (Luque Rodrigo, 2022).

The actions performed, focusing, as in the previous case, on the material and experiential components that make cataloguing difficult, were as follows:

- Nati Rodríguez carried out the *Fem Art* Project (Luque Rodrigo & Moral Ruiz, 2021a) with local older women. After visiting the Jaén Museum, which many had never visited before, they took part in a workshop where, thanks to the use of collages and photographs of the somewhat degraded areas of the neighbourhood, these women were able to change the way they viewed these spaces. Subsequently, the participants chose a wall in the neighbourhood, and a figure from a painting in the museum, and on April 2, the intervention took place. Thus, flowers and the image of the woman from the painting chosen, in this case, a Bacchante from artwork by José María Tamayo, were printed on large-format blue back billboard paper. Together, they cut out, composed, and pasted the collage on the wall. This type of artwork is a typical example of urban art, which is why the card that will be presented in the following section could be used without having to make any modifications other than those mentioned below.
- The dramatic performance *Historias de un Barrio* (Stories of a Neighbourhood) is a site-specific work, an original idea scripted by Nicolás Gallego himself, Aleiandra Ramírez, Carmen Haro and José Miguel Marín, directed by Gallego and Marín, with performances by Ramírez, Haro, Sergio Cruz, Adrián Pérez and several other people, including local people from the neighbourhood. For this artwork, we would need to use the card that Nicolás Gallego designed himself in order to catalogue the performance. Specific details such as audience participation, scenery, and props, among others, are included in the card. In addition, the piece was recorded and made into a short film (Festival Artístico el Almendral, 2022).
- Carmen Moral conducted a brief workshop with a group of locals to develop a series of ideas that they thought defined their neighbourhood and that were reflected in a collective artwork on canvas. The artwork, in turn, was to be given as a gift from the Neighbourhood Association to other associations in the city so that it could circulate among the different venues and create a sense of kinship. This is a complex artwork because it is mixed. In terms of technique and materials, it appears to be a more traditional artwork, but at the same time, it could be considered relational art because it is collective and made in the street. Nevertheless, a conventional cataloguing method could still be used, but an important part of the information would be lost, namely that which was generated with the community work that took place not only when the canvas was being created, but also in the previous workshop led by the artist, where a space for coexistence, dialogue, development of ideas and creativity, etc. was formed.
- Flor Motion came up with a collaborative project for this festival using olive branches (Jaén has the largest olive grove in the world). The olive branches, which were donated by local residents and students, were painted with Montana spray paint and, most notably, with the local Day Colours brand, with the idea of promoting local commerce and local resources, with a range of colours intended to recreate the colours of a sunset, using five shades of orange ranging from #F29F05 to #A82F01 and yellow. After painting the branches and using chicken wire and cable ties, an installation was created to humanise one of these areas of the neighbourhood that is considered a non-place, a place of transit that has been dehumanised, that is uncomfortable for passers-by and therefore makes it impossible for people to relate to one another there. This installation thus offers a place on the road to stop and simply enjoy and contemplate the view, and brings colour to a grey space. The installation, which recreates the sunset, is visible from several vantage points, as it is placed on a bridge that connects two parts of the neighbourhood, under which the main road passes. This is an example of an urban art installation that encompasses far more than the card entails. In general, this collective's installations, in particular, their Guerrilla Flora actions, incorporate elements that cannot be collected, such as a smell, or the intention behind the artist's work.
- Finally, Isidro López-Aparicio performed an action that consisted of working on a map that recreated the street map of the neighbourhood and that located it in the city, province and region, as well as including local residents' everyday activities, their own personal and family history, and their cultural backgrounds. In this way, a human map was created that captures the personal and collective history of the neighbourhood, as well as problems it currently faces that can be resolved, etc. The action



**Figure 2.** A collage of photographs from the festival. (Own photos).

was subsequently recorded and edited, creating an audio-visual piece that can be exhibited and that provides greater visibility to the neighbourhood and its inhabitants. This resulted in an intergenerational exchange that not only increased the visibility of the neighbourhood's existing problems, which could be vindicated through the performances of the piece itself, but that also recreated its collective history, showing us how it has evolved, for example, how businesses or customs such as the Cruz de Mayo (May Cross) procession have been lost. Similarly, life stories were also portrayed, which also speak of an evolution that has to do with social inclusion, among other issues. Therefore, fun and emotional moments, as well as moments of vindication, were had that went on to shape the history and identity of the neighbourhood. This initiative has generated a much-needed communication space and has helped to build community as a result.

As can be seen, in the same festival a series of absolutely heterogeneous works were created, which are difficult to catalogue using the same type of tool, hence the proposal that will be developed below.

Finally, it should be noted that, although we are focusing on urban spaces, this proposal would also be useful for art collections in natural spaces, such as this new land art that is also being created in festivals, some works of which even have a twofold urban-natural dimension. Some well-known examples in Spain could be the Centro de Arte y Naturaleza (Art and Nature Center) in Huesca; the Vostell Malpartida Museum in Cáceres; the Fundación Montenmedio Contemporánea (Montenmedio Contemporary Foundation ) in Vejer de la Frontera (Cádiz); the collection created in El Carpio (Córdoba) in the years when Scarpia (an artists' course for artists closely linked to the town) was developed; or Art Sur (Córdoba), which is precisely an urban art festival that also has a collection of art in nature.

**3. Cataloguing Urban Art**

As previously mentioned, in recent years, studies have been undertaken regarding the cataloguing of urban art by the GE-IIC Urban and Public Art Group, or international projects such as CAPuS+ "Conservation of art in public spaces" funded by Erasmus+ and directed by Dominique Scalarone (CAPuS project, 2018), or Mural Hunter, an international project by the University of Zaragoza developed to register artworks (Civitas, 2021), to name a few. There are some earlier international projects and publications on contemporary art conservation that propose cataloguing models, such as the Foundation for the Conservation of Contemporary Art (SBMK, S.d.). The proposed sections are:

The section devoted to the artist is of particular interest. Institutionally, it should be noted that in the project "Patrimonio mueble urbano de Andalucía" (Andalusia's movable urban heritage), the Andalusian Historical Heritage Institute (IAPH) included some graffiti that can already be found in the Institute's database, which is currently in the process of being uploaded to the network. In this case, the registration sheet was more conventional and did not include information on the author's opinion or an evaluation of the context. There are other online projects that register urban artworks, such as Google Street Art. Also noteworthy is the file proposed by YOCOCU for this same purpose (Macchia, A., Rivaroli, L., Caricchio, A. and Moretti, P., 2020).

Moreover, efforts have been made to possibly consider urban art as something more akin to intangible heritage, thus justifying a new category for it (Luque Rodrigo & Moral Ruiz, 2020; Talego, 2012), since it does not share the same basis as intangible heritage as it is not something that is transmitted from generation to generation by word of mouth and that is regenerated each time it is reproduced. However, the cataloguing cards that have been created for this type of heritage, more from an anthropological than from an art history perspective, can help create a card that provides answers to the questions posed in the previous sections.

This work is based on the cataloguing card used for the project "Pintado en la pared. Un estudio de la pintura mural en la provincia de Jaén en los siglos XX–XXI" (Painting on the wall. A study of wall painting in the province of Jaén in the XX–XXI centuries), funded by the Estudios Giennenses Institute (Jaén Provincial Council) and developed between December 2020 and October 2021. The idea of the project was to start cataloguing independent and commissioned urban artworks found in the province of Jaén (Spain), as well as the awareness of graffiti development (BOP, 2020). The project was directed by Laura Luque Rodrigo, PhD in




**Figure 3.** Sections propose for Foundation for the Conservation of Contemporary Art.

art history, professor at the University of Jaén and co-coordinator of the GE-IIC Urban and Public Art Group; José Manuel Almansa Moreno, PhD in art history and professor at the same university; Rafael Mantas Fernández, PhD in art history and secondary school teacher; and Carmen Moral Ruiz, restorer, PhD in history and arts, professor at the University of Huelva (Spain) and member of the Urban and Public Art Group mentioned above. The project has also been supported by the collaboration of an art history undergraduate student at the University of Jaén, Sergio Cruz Molina, who worked as an intern for six months.

The starting point for this project was the card prepared by María Isabel Úbeda García, a member of the GEIIC Urban Art Group, which was published in Ge-Conservación (Úbeda García, 2016). Numerous criteria are included in this card, such as technical and formal data, ownership, location, and description; criteria based on artistic observation, such as iconography, aesthetic evaluation, style, context, etc.; criteria based on conservation; criteria based on restoration; criteria based on external evaluation; criteria based on personal evaluation; and criteria based on the evaluation extracted from the opinion or data provided by the artist during the interviews and/or in the area surrounding the artwork. Also noteworthy in this proposal is the interest in the interview with the artist. In addition, Úbeda points out the importance of working on the creation of a glossary of the terms used in urban art, something that the CAPuS project has been working on and which will be available online soon. Finally, we must stress the need to improve some aspects of the card, especially in terms of the context and the level of interest that will be brought about by the performance cataloguing card soon to be proposed by the aforementioned Nicolás Gallego.

**4. Adapting the Cataloguing Card**

Before continuing with the proposal, we include the table with the proposed cataloguing form for urban art that has been taken as a model, and which has been published previously (Luque Rodrigo & Moral Ruiz, 2021b):

4.1. Sections

In this paper, we propose some modifications to the urban art card that will allow us to register this type of artwork, in particular ephemeral, organic, and even performative artwork. Interest is deemed to lie not only in urban pieces but also in the collections of art in natural spaces that are also being created in association with certain festivals, as explained above.

We propose that in a festival, in order for the cataloguing process to become operational, we should not have to handle multiple types of cards, but rather our first response

| CATALOG NUMBER | | |
|---|---|---|
| | | |
| **FACT SHEET** | | |
| Title of the artwork | (if it has one) | |
| Name that it is known by | (if any) | |
| Ownership | Artistic name (Real name)/Unknown. (If it is a group, names of those who form part of the group) | |
| Technique | Material | |
| | Support | |
| | Type of wall surface preparation | |
| | If there is any documentation of the process | |
| Completion date | | |
| Legal status of the artwork | (spontaneous/commissioned, public or private). If it has been commissioned, indicate who commissioned it (festival, competition…) and how much was paid, if known. | |
| Change in its juridical situation | If any | |
| Location | Address: street or road, number, town, country | |
| | Geolocation or GPS coordinates | |
| | Detailed description of the site: urban or rural setting; exterior or interior; type of road or site, context of the area, type of neighbourhood, locally listed heritage assets nearby or other points of interest , etc. If it is a building, if it is inhabited or not, if it is being looked after/maintained, if it is a wall in a vacant lot, future prospects for the vacant lot, suitable for development or not, etc. | |
| Measurements | (if possible) | |
| Orientation | | |
| | | |
| **DESCRIPTION OF THE ARTWORK** | | |
| Street Art Typology | Graffiti writing, stencil, mural, poch, Yarn bombing, paste-up or sticker, tag, etc. | |
| Formal description | composition, colour, etc. | |
| Subject matter | | |
| Iconography | | |
| Style/ aesthetics | | |
| Creative dimension | If it stems from an original idea, if it is a copy or there is an existing reference | |
| Creative context | If it is related to the context in which it is found, if the neighbourhood participated, etc. | |
| Creative Process | If it has been documented or if it's known. | |
| Signification | | |
| | | |
| **CONSERVATION STATUS** | | |
| Conservation status | a. Good<br>b. Deteriorating<br>c. Deteriorated | |
| Conservation status description | (observable deterioration or damage) | |
| Artist's interest in the conservation of their artwork | Are they interested in the conservation of their work of art? Yes/No/Unknown | |
| | If yes: | Did they prepare the wall? Yes/No. How? |
| | | Who would they like to handle it? (the artist(s) themselves; the artist(s) with expert assistance; professionals; they don't care) |
| Interventions, if any. | Description, date, ownership/artist, documentation. | |
| Conservation plan | (very justified if you are going to intervene in this case, but in general, you should not) | |
| | | |
| **GRAPHIC DOCUMENTACION** | | |
| Photographs | (general, detail, context) with data | |
| Photogrammetry | (if any) | |
| | | |
| **BIBLIOGRAPHY** | | |
| | | |
| | | |
| **OTHER DOCUMENTATION** | | |

**Table 1.** Proposed cataloguing form for urban art.

should lead us to one very similar model or another, with only minor variations. The first step would be to indicate the following:

According to the examples presented in the two festivals mentioned above, the following classifications can be made:

- Mural: Nati Rodríguez's paper wall mural artwork in el Almendral.
- Action art: Claudia Frau's work in Finde 02 that consisted of throwing tomatoes at political campaign posters, and the theatrical-performance piece Historias de un barrio (Stories of a neighbourhood).
- Organic or especially ephemeral piece: All the others, from the paper balls, the plasticine leaves, the water-soluble embroidery, the olive tree branch installation, to the piece in which the local residents marked a map, etc.

This gives us an idea of the proportions of the types of artworks that are difficult to catalogue. There are two that could raise concerns. One example is the artwork created with sound by Fran Pérez Rus, as it requires technological elements. However, we must really consider that the notion of interaction with background noise clearly makes it a piece that should be included in the last section. Another example is Carmen Moral's work on canvas, which, given the mobile support, cannot be considered a mural although it is not exactly action art, nor is it organic or especially ephemeral, so it would be necessary to see which card best suits its characteristics. In this case, perhaps as it is a painting on a flat surface, it might be appropriate to use the urban art/ commissioned street art mural card, but we would need to be able to specify that it is not either.

| CATALOGUING MODEL | |
|---|---|
| Mural | This will be limited to murals or any other type of pictorial or relief work located on more or less flat supports, not only walls but also street furniture. This would take us to the urban art/ commissioned street art murals card. |
| Action art | Any kind of performance art. |
| Organic or especially ephemeral piece | All other artworks, organic and very ephemeral installations. |

**Table 2.** Proposed preliminary cataloguing card. Own compilation.

Regarding the performance case, we would consider using the card currently under construction by Nicolás Gallego, for Urban Art, the one used in the Project "Pintado en la Pared..." *(Painted on the wall...")*, and for the third case, the one that is proposed in this paper. In the following, the urban art/commissioned street art mural card has been analysed and modified for this new use:

a) The first section of the cataloguing card covers general information.

This model worked correctly, although it was noted that it lacked a very important section in terms of the significance of the piece, which would include an analysis and description of the context and could be understood in a variety of ways. As mentioned above, the Urban and Public Art Group is working on this issue, and the results will be available soon. Although it may seem that this section is subjective, work is being done to find a way to systematise the way it is documented in order to make it as objective and real as possible. We should not enter into evaluations, but rather gather sufficiently broad information on the context, such as its social implications, if any, with the urban or rural environment, with the historical context, etc. In any case, as has been mentioned, this is something that is in process. A new section would need to be added to indicate whether the artwork was created on a mobile support, like that of Carmen Moral. In any case, the modification for the "Organic or especially ephemeral piece" section would involve

changing the "Techniques" section, especially the "Type of wall surface preparation" subsection, which would be removed. In addition, it would be interesting to specify if the materials were used naturally or if they were modified. For example, in the case of flowers or fruits, determine whether they were presented as they were or whether they were modified or coloured in any way. In this section, it would also be necessary to include whether environmental conditions, human interaction or any other elements constitute an essential part of the artwork. Finally, it should be stated whether degradation was intended and what type of degradation was being sought.

On the other hand, the "Change in its juridical situation" section no longer makes sense since the work will not have any legal status that could make it a heritage item, and it is not susceptible to being restored or sold since it will last only a short period of time.

Finally, the intended duration should be added to the date of completion. This section would therefore read as follows:

b) The second part of the card refers to the description of the artwork.

In this section, the thematic and iconography sections did not seem to work, as they proved to be repetitive in such contexts. Otherwise, it might be applicable with some modifications, which would be intended to better describe colour, smell, sound and touch (if they were involved) and to describe, in case the viewer has to interact with the artwork, what they should do. It would look like this:

| CATALOGUE NUMBER | |
|---|---|
| | |
| **FACT SHEET** | |
| Title of the artwork | (if it has one) |
| Name that it is known by | (if any) |
| Ownership | Artistic name (Real name)/Unknown. (If it is a group, names of those who form part of the group) |
| Technique | Material |
| | Support |
| | Type of wall surface preparation |
| | If there is any documentation of the process |
| Completion date | |
| Legal status of the artwork | (spontaneous/commissioned, public or private). If it has been commissioned, indicate who commissioned it (festival, competition…) and how much was paid, if known. |
| Change in its juridical situation | If any |
| Location | Address: street or road, number, town, country |
| | Geolocation or GPS coordinates |
| | Detailed description of the site: urban or rural setting; exterior or interior; type of road or site, context of the area, type of neighbourhood, locally listed heritage assets nearby or other points of interest , etc. If it is a building, if it is inhabited or not, if it is being looked after/maintained, if it is a wall in a vacant lot, future prospects for the vacant lot, suitable for development or not, etc. |
| Measurements | (if possible) |
| Orientation | |

**Table 3.** First part of the urban art card. Own compilation.

c) The conservation section is almost entirely meaningless here. In reality, it could be kept only if some remnant of the artwork remains and is able to be preserved by extracting it from its context. For example, in the case of the performance, if we could preserve and exhibit or commercialise some of the props used. It would look like this:

| CATALOGUE NUMBER | |
|---|---|
| | |
| **FACT SHEET** | |
| Title of the artwork | (if it has one) |
| Name that it is known by | (if any) |
| Ownership | Artistic name (Real name)/Unknown. (If it is a group, names of those who form part of the group) |
| Technique | Main materials:<br>(a) living organic / organic / inorganic / mixed.<br>b) Naturally occurring / intervened (in this case specify materials and intervention process). |
| | Secondary materials: if any element interacts with the piece, causing it to react in such a way that leads to its completion (as in the case of the artwork embroidered on water-soluble fabric, where the wet grass is considered to be an essential part of the artistic process, and would therefore appear in this section). Also, if it includes any electronic mechanisms. |
| | Support |
| | Type of support media: typology and preparation process |
| | Degradation: Is part of the artwork yes/no. What type of degradation is sought. How long does it take to occur. What elements influence this. |
| | If there is any documentation of the process |
| Completion date | |
| Intended duration | |
| Legal status of the artwork | (spontaneous/commissioned, public or private). If it has been commissioned, indicate who commissioned it (festival, competition…) and how much was paid, if known. |
| Location | Address: street or road, number, town, country |
| | Geolocation or GPS coordinates |
| | Detailed description of the site: urban or rural setting; exterior or interior; type of road or site, context of the area, type of neighbourhood, locally listed heritage assets nearby or other points of interest , etc. If it is a building, if it is inhabited or not, if it is being looked after/maintained, if it is a wall in a vacant lot, future prospects for the vacant lot, suitable for development or not, etc. |
| Measurements | (if possible) |
| Orientation | |
| Contexts | (urban, social, historical, digital, etc.) according to the work of the GEIIC Public Urban Art Group |

**Table 4.** Modification of the first part of the card made for urban art. Own compilation.

| DESCRIPTION OF THE ARTWORK | |
|---|---|
| Street Art Typology | Graffiti writing, stencil, mural, poch, Yarn bombing, paste-up or sticker, tag, etc. |
| Formal description | composition, colour, etc. |
| Subject matter | |
| Iconography | |
| Style/ aesthetics | |
| Creative dimension | If it stems from an original idea, if it is a copy or if there is an existing reference |
| Creative context | If it is related to the context in which it is found, if the neighbourhood participated, etc. |
| Creative Process | If it has been documented or if it's known. |

**Table 5.** Second part of the card made for urban art. Own compilation.

d) Finally, with regard to the documentation section, it would simply be interesting to add audio-visual documentation of various types: graphic, videographic, photogrammetric, etc.

4.2. Data Collection

The data collection sheet used in the "Pintado en la pared..." (Painted on the wall...) project could be useful for field work, but some additional sections should be added. Furthermore, it would be useful to add recordings, in addition to photographs. It would also be necessary to be present at the moment of creation, or to be able to interview the artist, manager or an assistant.

| DESCRIPTION OF THE ARTWORK | |
|---|---|
| Typology | These will almost always be installations |
| Formal description | Descriptive narration of the work, on a sensory and conceptual level. |
| Elements (description) | Colour:<br>Shape:<br>Touch: (if involved)<br>Smell: (if involved)<br>Taste: (if involved)<br>Sound: (if applicable) |
| Elements (at a symbolic level) | The same elements will be specified, in a conceptual rather than a sensorially descriptive way, by considering what these elements are intended to do, what sensations they produce, how they affect the viewer, etc. |
| Subject matter | |
| Style/ aesthetics | |
| Creative dimension | If it stems from an original idea, if it is a copy or there is an existing reference |
| Creative context | If it is related to the context in which it is found, if the neighbourhood participated, etc. |
| Creative Process | If it has been documented or if it's known. |
| Type of audience required | This part is similar to the performance card, here you must specify whether the spectator should be passive or active. In the second case, specify what they should do. |
| Situation created | As above, this part has been taken from the performance card, since here we should include information on how the audience acted, not about how they were supposed to act, by means of observation, subsequent interviews or questionnaires if possible. |

**Table 6.** Modification of the second part of the card made for urban art. Own compilation.

4.3 Interviews

In addition to interviewing the artist, it would also be interesting to interview participants who interacted with the piece, regardless of whether they were random passers-by or not. In this sense, the questions would be directed at finding out what they felt, what the piece made them think, if it influenced them in any way, if they liked or disliked the experience and any other questions specific to each case. If it was posted on social networks, the comments could also be collected and compared with the comments of those who experienced it in person.

| CONSERVATION STATUS | | |
|---|---|---|
| Was any material retained? Yes/no (if yes, continue answering) | | |
| Type of object preserved | | |
| Conservation status | a. Good<br>b. Deteriorating<br>c. Deteriorated | |
| Conservation status description | (observable deterioration or damage) | |
| Artist's interest in the conservation of their artwork | Are they interested in the conservation of their work of art? Yes/No/Unknown | |
| | If yes: | Did they prepare the wall? Yes/No. How? |
| | | Who would they like to handle it? (the artist(s) themselves; the artist(s) with expert assistance; professionals; they don't care) |
| Interventions, if any. | Description, date, ownership/artist, documentation. | |
| Conservation plan | (very appropriate if you are going to intervene in this case, but in general, you should not) | |

**Table 7.** Last part of the proposed card. Own compilation.

**4. Conclusions**

This paper does not offer a final solution to the cataloguing of artworks produced in public spaces—be they urban or rural—as we consider that in this respect, more work is required and that it should be done urgently, as the record of many artworks may be lost in the meantime. It is also estimated that once a clear solution is obtained, a second equally important phase would be required in order to raise awareness of the cards and the importance of professional cataloguing so that each festival would be able to count on the services of a qualified team that could implement them.

| | |
|---|---|
| **Code** | 2.02.11 |
| **Location** | Exact address and brief description of the space |
| **Coordinates** | LN 37º 46' 1'' WL 3º 47' 20'' |
| **Photographs / videos** | DC1230; DC1231; DC1232; DC1233 |
| **Title** | (real title used if known or identifier written in inverted commas) |
| **Artist** | Name and pseudonym, if any |
| **Date** | |
| **Time taken to complete the piece** | |
| **Time it took to deteriorate / disappear** | |
| **Measurements** | (if possible) |
| **Type of deterioration** | |
| **Materials used in the piece and how they have been modified** | |
| **Weather impact** | Intended or not, how it reacts, etc. |
| **Human impact** | Intended or not, how it reacts, etc. |
| **Festival/event** | Spontaneous or not |
| **Appearance in social networks and/or press** | |
| **Other** | (other information that we saw fit to note down at the time concerning the artwork, the street, the neighbourhood, etc.) |

**Table 8.** Example of a data collection sheet for street artwork. Own compilation.

**Acknowledgements**

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# Making Use of Pre-existing Street Art Object Metadata

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**Abstract**

In graffiti and street art studies, we are currently facing a paradoxical situation: vast numbers of publications relevant to our field—some of them academic, most of them not; from journal papers to coffee-table books—are continuously being published, but even the scholarly-oriented among them typically provide only sparse data about individual graffiti pieces and street art objects. It is rare to find complete metadata records containing information about the artist, the precise location, measurements, and the date of completion. Efforts are being made by individual projects and researchers to gather comprehensive and structured metadata, but those efforts take time and yield only small amounts of data. While it is important that these efforts are continued, a different, complementary approach is proposed here that aims to 'quickly and dirtily' gather 'messy' data. The idea is to make use of work that has already been carried out instead of trying to describe the same artworks in better ways time and again. This requires us to learn how to deal with incomplete data from vastly different sources. Effectively, such an approach lowers the threshold for data sources to become useful for street art researchers. Almost anything can become a valuable resource, even amateur websites (including abandoned ones) and print publications about local and obscure street art. This paper demonstrates how to extract object metadata from street art websites and digitised printed books, and how to feed it into a database that can be a potential treasure trove of street art object data.

**Keywords**

data mining; data science; data wrangling; digitisation; metadata; non-academic publishing

## 1. Introduction

In the research of street art (including graffiti; 'street art' is used as an umbrella term in this text), it is a common problem that authors provide only incomplete or imprecise information regarding the artworks they write about (discussed in greater detail by de la Iglesia, 2015). In order to unambiguously identify any such object, the metadata provided would ideally include a photograph (or multiple photographs taken from different angles and at different points in time), the date of creation (or at least the date when the photograph was taken), the location (either as street address or geographic coordinates), the artist (including a machine-readable identifier such as an authority record URI, if available), the title (or all of the titles under which the work is known), a complete and precise transcription of any text present in the work, the technique/medium/genre (to distinguish e.g. stencil graffiti from style writing), the dimensions, and possibly other properties. One kind of attempt to respond to this need for metadata is to create graffiti databases in which the desired information is gathered and provided in a highly structured way; see, for instance, the projects INGRID, INDIGO, and Spraycity.at presented in this volume, or the author's website (de la Iglesia, 2007–2020).

However, as laudable as those project efforts may be, they suffer from a major shortcoming: considering the sheer number of artworks that have been created around the world, that are currently being created, and that in all likelihood will be created in the future, it is obvious that such efforts will never cover more than a small fraction of those artworks, given the laboriousness of the generation of sufficiently rich metadata records. Those databases are typical-

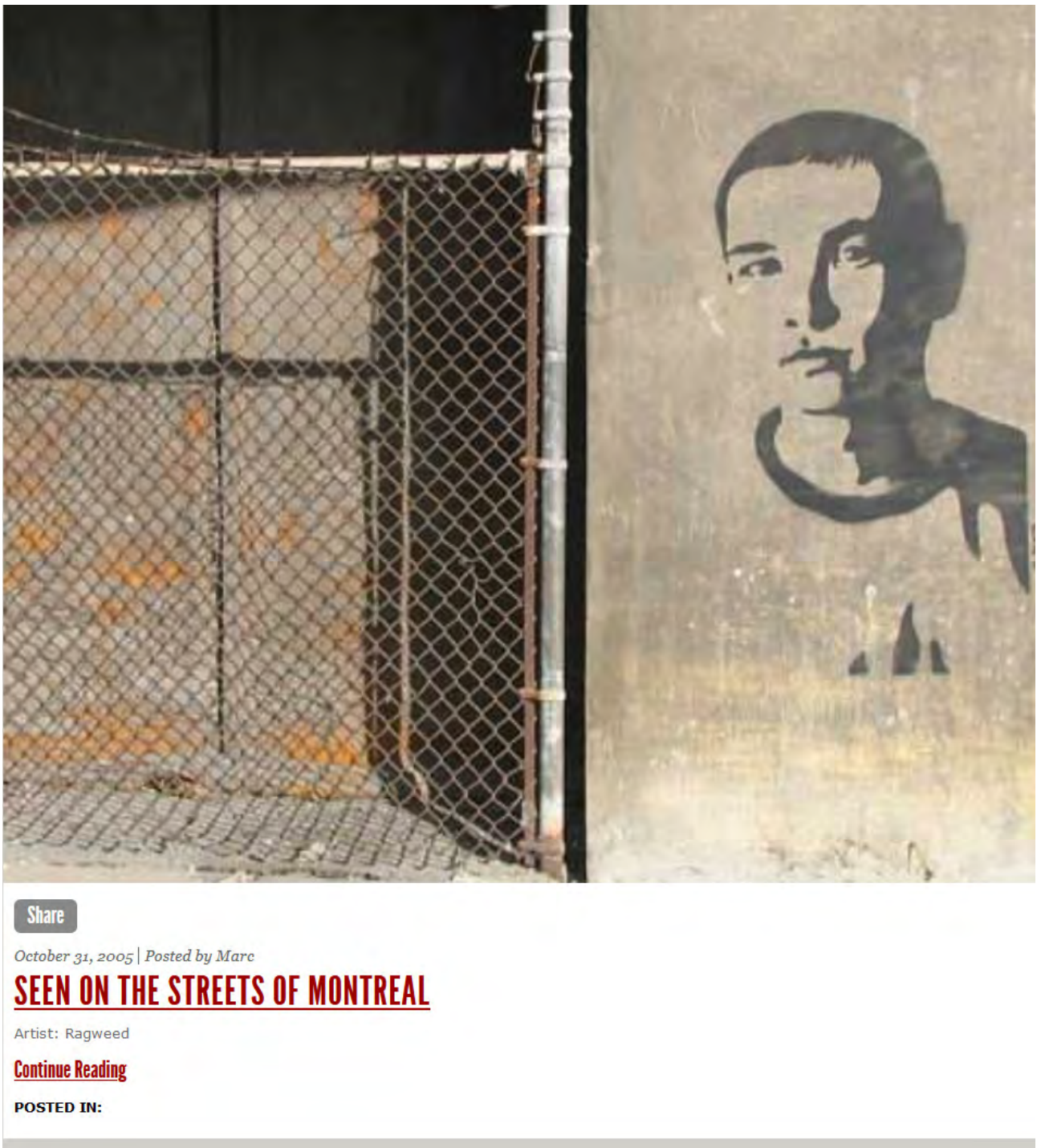



**Figure 1.** Detail of a screenshot of *Wooster Collective* previewing a post by Marc Schiller from 2005, featuring an artwork by Ragweed.

ly limited to a specific geographic area and/or period, while the vast majority of objects remain outside of their scope. Still, it is not as if all of those artworks were 'unknown', so to speak. Many of them do leave traces and are being covered by documentation efforts in a wider sense. If we take into account not only rich and structured but also incomplete and 'messy' metadata, we may find that a vast amount of graffiti-related information already exists: in the form of weblogs, photo websites and other Internet resources on the one hand, and coffee-table books, magazines and other printed matter, aimed at a wider audience beyond academia, on the other hand. Would it be possible to somehow tap into this vast amount of messy data and make it usable for research purposes at all? This is the central question that this contribution is trying to answer.

**2. Pre-existing Street Art Object Metadata**

2.1. Websites

Among the different kinds of resources on the World Wide Web, there are several with relevance to street art that come to mind: general-purpose pools of photographic images such as Flickr (which may have subcommunities dedicated to street art, e.g. "One World Street Art & Graffiti" with more than half a million of pictures uploaded since its foundation in 2009; https://www.flickr.com/groups/951083@N24), personal websites of individuals or groups dedicated to street art which often take the form of weblogs (such as *Wooster Collective*, see below), or posts on social media platforms such as Instagram which, however, are difficult to aggregate and extract data from. As an example of a street art website and how to make use of the data contained therein, let us now take a closer look at *Wooster Collective*.

Operated by Sara and Marc Schiller from New York, *Wooster Collective* (Schiller & Schiller, 2003–2018) had been for some time one of the definitive news sources about the global street art scene. The earliest retrievable post is from 2003, and after 2016 the posting activity has become so infrequent that this weblog can be considered inactive. *Wooster Collective* ran posts on various aspects related to street art, such as book releases, film releases, artist portraits, interviews, and exhibition openings, but there were also a number of posts that simply documented a new artwork that was deemed notable for some reason, either spotted by the *Wooster Collective* authors themselves or submitted by someone else. This is the category of posts that is of interest here. An example of such a post is pictured in Figure 1.

More precisely, what we see here is not yet the actual blog post but rather a preview as it appears together with other blog post previews on the front page or a search results page. Already at this point, we can distinguish four pieces of relevant metadata: an image representing the artwork in question, a date on which the blog post was published ("October 31, 2005"), a location mentioned in the title ("Montreal"), and an artist name given in the text body of the post ("Ragweed"). No categories or tags have been assigned to this post, as we can see from the empty "Posted in:" field.

When we click "Continue Reading" or the title to view the entire blog post, we find that it does not yield more information than the preview (Figure 2). We see raw HTML code—the language in which websites are written, which is normally rendered by the web browser to display websites and not itself visible to the user—that references two image files, but due to an error in the HTML code, the web browser displays the HTML snippet instead of the images. The first one of those images is identical to the preview image we have already seen, and we can also see that the entire text body of the blog post consists of "Artist: Ragweed". The only additional information we get in the full post view is the URL of the second image, but in this case, it shows a different stencil graffiti piece by Ragweed in Montreal, and as it is difficult to automatically determine whether multiple images in one blog post show the same or different artworks, it is safer for us to only extract the preview image and ignore any others, treating the blog post as if it was about a single artwork only.

"Seen on the Streets of Montreal" can be considered part of an implicit series of posts on *Wooster Collective* which have a similar title structure, "Seen on the streets of" followed by a place name (usually a city, but sometimes also a country, building, or city district). Variants include "Seen on" followed by a street name, "Seen in", "Seen near", and "Seen under", plus several times the misspelling "Seen

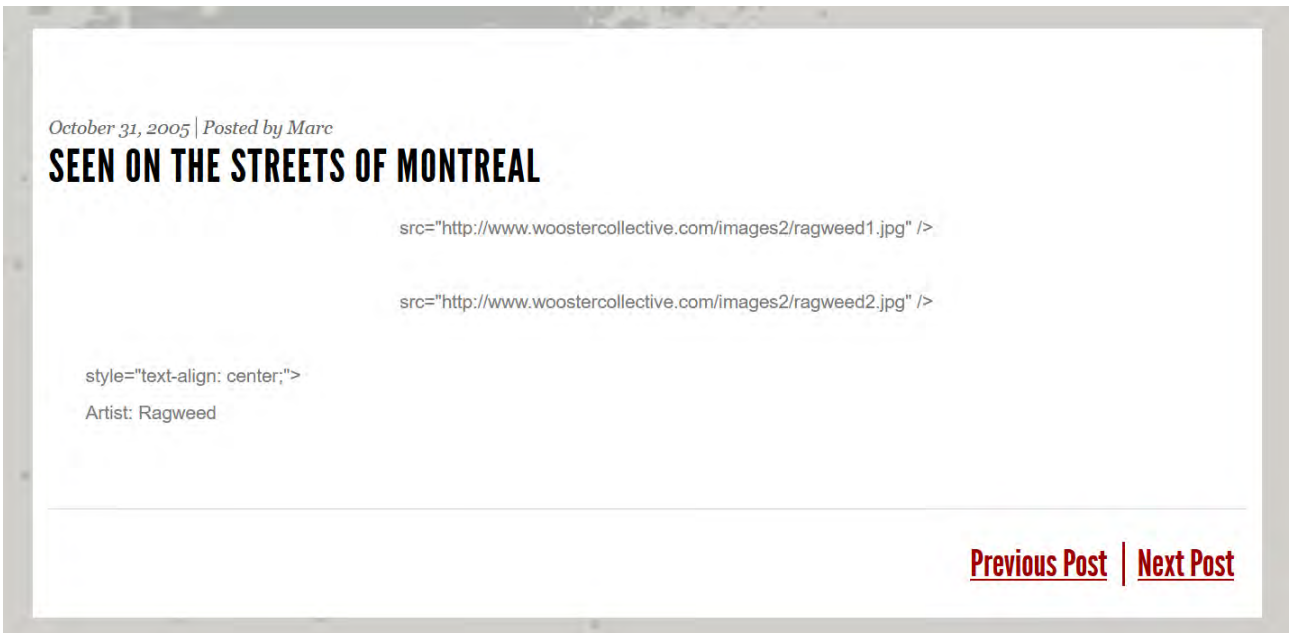



**Figure 2.** Detail of a screenshot of the blog post "Seen on the Streets of Montreal" by Marc Schiller from 2005 on *Wooster Collective* (http://www.woostercollective.com/post/seen-on-the-streets-of-montreal1).

on the steets of". If we look for these patterns in the HTML source of the *Wooster Collective* main page that lists all blog posts, we can extract the URLs of all relevant posts. However, www.woostercollective.com always only displays a certain number of posts, followed by a "Load more posts" button. One way to deal with this problem and still obtain the complete list of posts is to employ browser automation software such as Selenium (https://www.selenium.dev). Another, much simpler workaround is to fetch the monthly lists into which *Wooster Collective* compiles its posts (the "Filter By Date" button at the top of the main page); here, too, there are some months with too many blog posts to display at once without clicking "Load more posts", but one still gets a sizeable amount of posts via this method, which might be enough for the demonstration purposes in this context. Out of this sample of blog posts, a search (using regular expressions in a script written in the Perl programming language) for titles containing "seen on the streets of" and similar structures yields 85 posts, each one of which can now be turned into a metadata record relating to one artwork. (Other implicit series of suitable blog posts on *Wooster Collective* relating to individual artworks might be "X in Y", e.g. "Kaws in England", with 12 posts in the aforementioned sample; "X Shows Us How It's Done in Y", e.g. "Pøbel Shows Us How Its Done In Tokyo, Japan", 8 posts; "Fresh Stuff From X", e.g. "Fresh Stuff From Elbow Toe - 'Tastes Like Chicken'", 91 posts; or "Shit We're Diggin'", e.g. "Shit We're Diggin': NeSpoon", 44 posts.)

From the title, we can extract our first metadata field, the location of the artwork. In titles such as "Seen on the Streets of Montreal", we can simply assume that everything after "Streets of" will be a place name of some sort and put it in the location field of our metadata record. As for the three "Seen on..." posts, e.g. "Seen on Sullivan", we can safely assume that these are streets in New York (where Sara and Marc Schiller, the *Wooster Collective* creators, live), and thus automatically add "Street, New York" to each, so that the location field value becomes e.g. "Sullivan Street, New York". There are two titles out of which we cannot extract any location information: one early post from 2003 is simply titled "Seen on the Street… 'Buddy" [sic], and another




**Figure 3.** Pages 14–15 from Tapies, 2018.

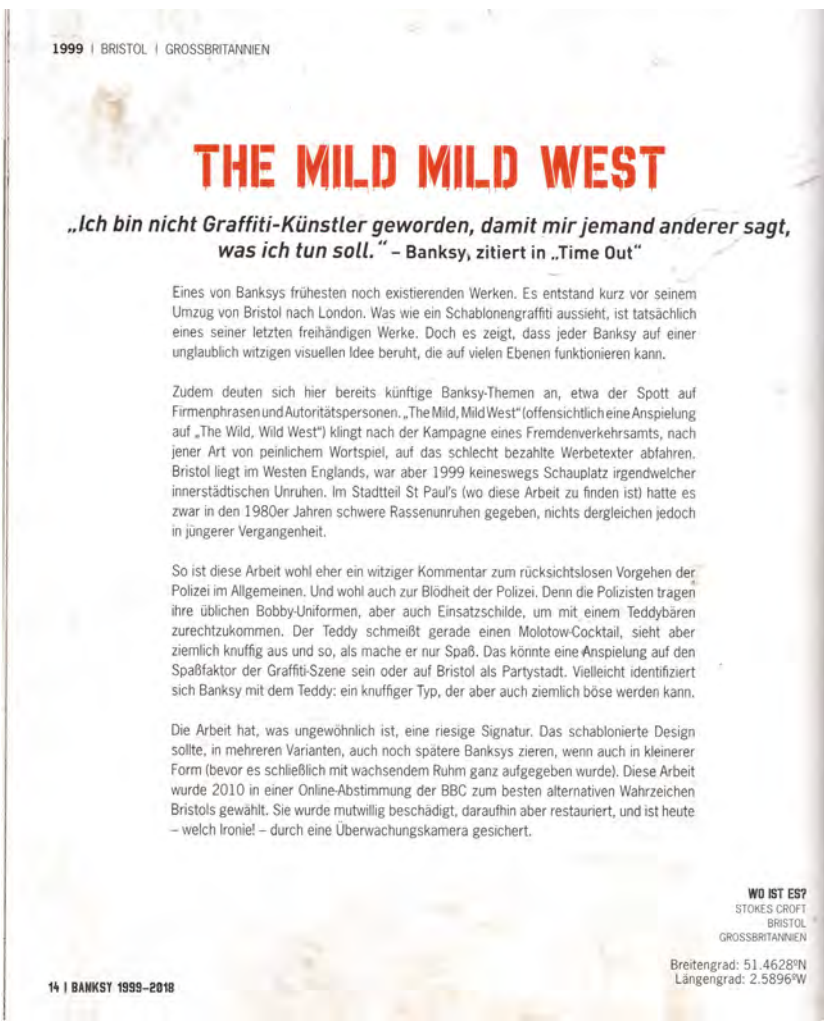



**Figure 4.** Page 14 from Tapies, 2018.

from 2016 is titled "Seen Near Lily's Juice Bar" (most likely Miss Lily's on West Houston Street, New York). The other 83 place designations are all correct, as can be seen when checking them against a geolocation web service. In this case, the place designations were queried in Google Maps, and they all returned a result and can thus be assumed to be correct. For instance, when one enters the search string "the Palazzo Reale in Milan" (from the title "Seen in the Palazzo Reale in Milan") in Google Maps, it returns the point with the coordinates N45.46319°, E9.19116°. As mentioned above, for two out of 85 location field values, no geolocation could be performed, so the location coverage in our sample is roughly 98%.

It is more difficult to extract artist names because the artist indication in the text body, if present at all, does not always follow an easily recognisable structure such as "Artist: ...". However, in 31 cases, that formula is used, and the artist name (or name of the artist collective) can be extracted. For instance, the artists in this sample include DS, N4T4, Rems182 and Zukclub. The coverage of the artist metadata field is thus approximately 36%.

It is far easier to extract dates and photographs. The date on which a post was published is always given in the format "October 31, 2005", which can be converted into a format more suitable for automatic sorting, such as "2005-10-31". Each blog post has at least one image, and for the reasons outlined above, we are only going to consider the preview image. We can automatically download all those preview images in case the website goes offline one day. In one case in the sample, however, the hyperlink to the image file is broken. Thus we have a date coverage of 100% and a photograph coverage of 99%.

Additionally, we could add each text body in its entirety as a kind of 'description' field. While it is difficult to automatically extract further information from those texts, they can still be useful to human readers. For instance, one such blog post text simply says, "More here.", the word "here" being the anchor of a hyperlink pointing to the URL http://www.coletivografico.com. Although this website is now defunct, one can still infer from the address that the artist group responsible for the artwork in question is Coletivo Gráfico, a street art collective from Rio de Janeiro.

At this point, we have assembled a data collection of 85 records, each relating to a piece of street art and consisting of four to five data fields (location, date, photograph, description text, and at least some artist names). The potential usefulness of this data collection is discussed below in Section 3.

2.2. Books and Magazines

As an example of printed matter, we are now going to consider a typical street art monograph: *Banksy 1999–2018* by Xavier Tapies, the German edition of *Where's B**ksy?* (Tapies, 2018). Conveniently, the book is rigidly structured, as each double page is dedicated to one artwork by Banksy, the right-hand page containing a photograph and the left-hand page giving textual information (Figure 3). Likewise, all of the text pages follow the same structure (Figure 4).

In the top left corner, the year of creation is given ("1999"), followed by location information on the city level ("Bristol | Großbritannien"). The centred heading of the text, in a red font that imitates stencilled letters, indicates the title of the object in question. This is followed by a quotation by either Banksy himself, as is the case here, or someone else. Then the main text body describes the artwork and gives some background information. In the bottom left corner, the page number is given, and the bottom right corner provides a more precise location ("Stokes Croft / Bristol / Großbritannien"), including geographic coordinates.

Once we have digitised the pages using a scanner or camera, we need to apply Optical Character Recognition (OCR) software to the digital images. There are different OCR applications available, and one can spend much time configuring and training them. If, however, one simply uploads the images to one of the many free OCR web services and takes the text output as it is, as will be shown here for demonstration purposes, some challenges will have to be faced when further processing the text. As Figure 5 shows, the biggest problem is not the character recognition per se—almost all of the individual characters were recognised correctly—but the layout; in the printed book, the text is distributed across several fields on the page, and the OCR software tries to re-

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14 I BANKSY 1999-2818

1999 | BRISTOL | GROSSBRITANNIEN

THE MILD MILD WEST

was ich tun soll.“ - Banksy, zitiert in .Time Out"

Eines von Banksys frühesten noch existierenden Werken. Es entstand kurz vor seinem
Umzug von Bristol nach London. Was wie ein Schablonengraffiti aussieht, ist tatsächlich
eines seiner letzten freihändigen Werke. Doch es zeigt, dass jeder Banksy auf einer
unglaublich witzigen visuellen Idee beruht, die auf vielen Ebenen funktionieren kann.

Zudem deuten sich hier bereits künftige Banksy-Themen an, etwa der Spott auf
Firmenphrasen und Autoritatspersonen. , The Mild, Mild West" (offensichtlich eine Anspielung
auf „The Wild, Wild West“) klingt nach der Kampagne eines Fremdenverkehrsamts, nach
jener Art von peinlichem Wortspiel, auf das schlecht bezahlte Werbetexter abfahren.
Bristol liegt im Westen Englands, war aber 1999 keineswegs Schauplatz irgendwelcher
innerstädtischen Unruhen. Im Stadtteil St Paul's (wo diese Arbeit zu finden ist) hatte es
zwar in den 1980er Jahren schwere Rassenunruhen gegeben, nichts dergleichen jedoch
in jüngerer Vergangenheit.

So ist diese Arbeit wohl eher ein witziger Kommentar zum rücksichtslosen Vorgehen der
Polizei im Allgemeinen. Und wohl auch zur Blödheit der Polizei. Denn die Polizisten tragen
ihre üblichen Bobby-Uniformen, aber auch Einsatzschilde, um mit einem Teddybären
zurechtzukommen. Der Teddy schmeißt gerade einen Molotow-Cocktail, sieht aber
ziemlich knuffig aus und so, als mache er nur Spaß. Das könnte eine Anspielung auf den
Spaßfaktor der Graffiti-Szene sein oder auf Bristol als Partystadt. Vielleicht identifiziert
sich Banksy mit dem Teddy: ein knuffiger Typ, der aber auch ziemlich böse werden kann.

Die Arbeit hat, was ungewöhnlich ist, eine riesige Signatur. Das schablonierte Design
sollte, in mehreren Varianten, auch noch spätere Banksys zieren, wenn auch in kleinerer
Form (bevor es schließlich mit wachsendem Ruhm ganz aufgegeben wurde). Diese Arbeit
wurde 2010 in einer Online-Abstimmung der BBC zum besten alternativen Wahrzeichen
Bristols gewählt. Sie wurde mutwillig beschädigt, daraufhin aber restauriert, und ist heute
- welch Ironie! - durch eine Überwachungskamera gesichert.



„Ich bin nicht Graffiti-Künstler geworden, damit mir jemand anderer sagt,

WO IST ES?
STOKES CROFT
BRISTOL
GROSSBRITANNIEN

Breitengrad: 51.4628°N

Längengrad: 2.5896°W
```

**Figure 5.** Text output of an OCR web service applied to page 14 from Tapies, 2018.

arrange this text into a linear order. The OCR text output starts with the text in the bottom left corner, i.e. the page number, followed by the text in the top left corner, i.e. the year of creation. After the title, the quotation by Banksy is cut in half, with the first part (“' Ich bin nicht Graffiti-Künstler geworden [...]”) given after the main text block, and the second part (“was ich tun soll [...]”) before.

Despite these problems with the layout, the text structure is still sufficiently preserved to extract several pieces of information, which was done again by means of regular expressions in a Perl script. Thus for each object in the book,

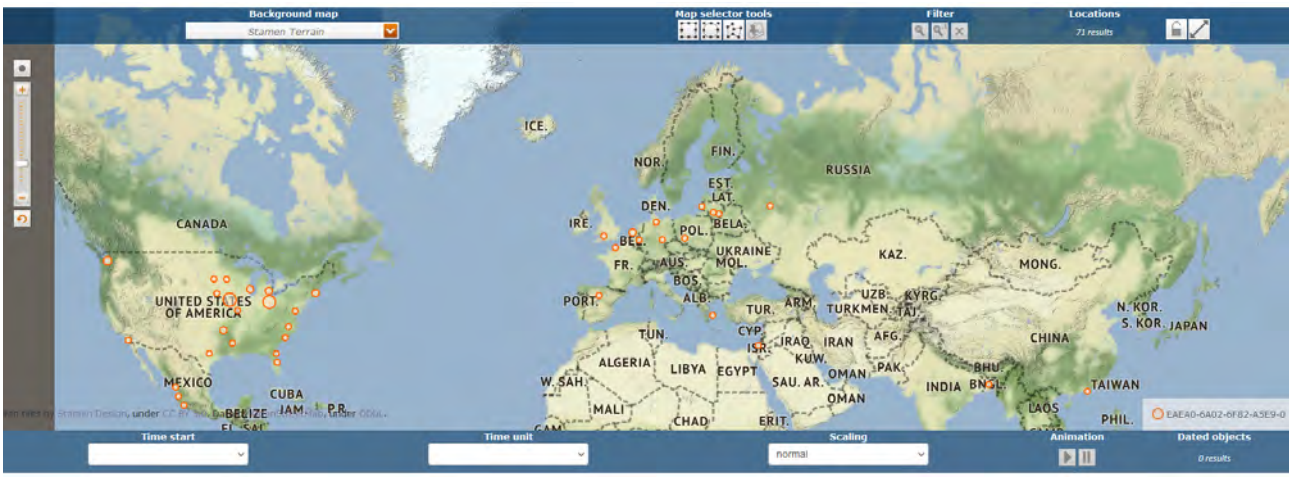



**Figure 6.** Map of records in combined dataset created with the DARIAH-DE Geo-Browser.

we are able to extract the year of creation, title, verbal location, coordinates, description text, and photograph, and of course, we already have the artist's name because it is always Banksy. However, the OCR result is not always as satisfactory as for page 14. In a sample consisting of the first 20 double pages of *Banksy 1999–2018*, all of the dates could be successfully extracted, and all of the verbal location information was correct and useful when checked against Google Maps, but only 60% of the titles and 85% of the coordinates could be recognised. Typical errors that prevented the successful recognition of these fields were the muddling up of the order of textual elements on the page, which led to the misplacement of the title, and the misidentification of the degree sign in the coordinates (printed here in the shape of °) as e.g. the percentage sign %.

### 3. The Combined Database

If we now combine the two sample datasets into one, we end up with 105 street art object metadata records (85 from *Wooster Collective* and 20 from *Banksy 1999–2018*). All of them contain a date (although that is only the year in the case of the Banksy works), all but one have a photograph, and all but two contain a location. However, only for 49% of the works, the name of the artist is known, and the title for only 11% (as only Tapies assigns titles to the works he covers and *Wooster Collective* does not). Geographic coordinates are present in 16% of the records, but as already mentioned above, more coordinates can be converted from the verbal location information. Thus the combined dataset is quite heterogeneous or 'messy'. Can we make use of it nonetheless?

Given the nearly complete coverage of location information, one of the most obvious ways to visualise the data would be to plot it on a map, which makes it easier for humans to see how the objects are distributed geographically. There are web services that carry out the conversion of addresses into coordinates and the plotting of coordinates on a map in a single step, such as the DARIAH-DE Geo-Browser (https://geobrowser.de.dariah.eu; registration required), but if we are not careful, the resulting map may look like the one in Figure 6. Orange dots represent street art objects in the dataset, and as we can see, most of them seem to be located in the United States. That is because of how the geolocation completion feature of the Geo-Browser works: many place names were seen as ambiguous and thus identified erroneously; for instance, when the location in *Wooster Collective* was simply given as "Athens", it was identified by the Geo-Browser as Athens, Michigan, whereas the location string "Athens, Greece" was located correctly. Other examples of problematic geolocation results include Paris, Texas and Rome, Illinois, when the correct locations would have been in France and Italy, respectively. Diligent selection and configuration of the geolocation application may

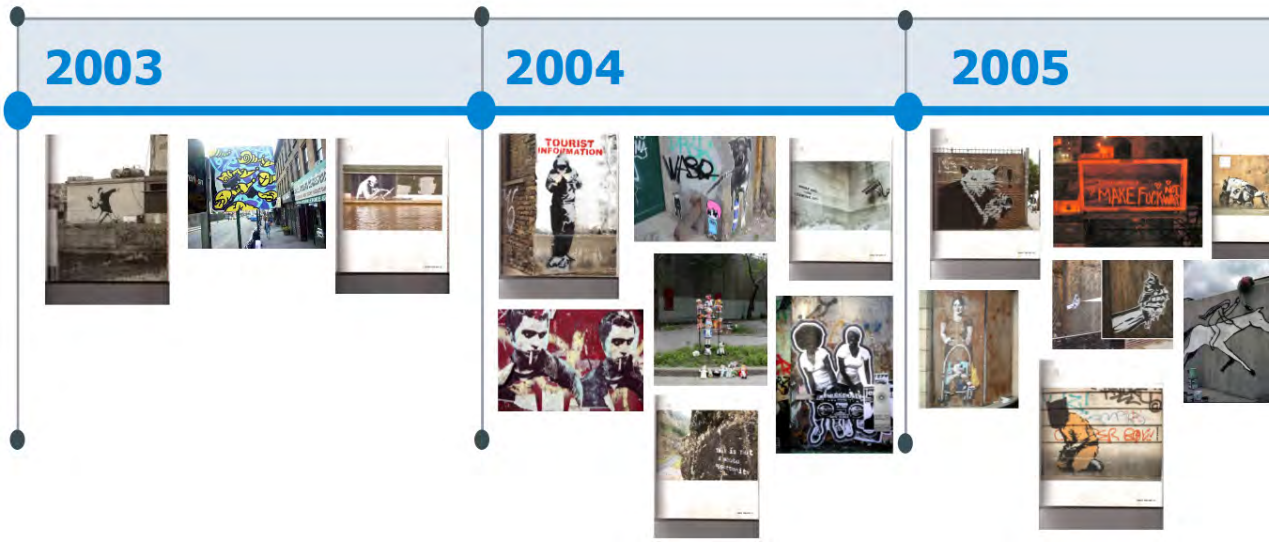



**Figure 7.** Mock-up, created manually by the author, of a timeline with photographs indicating objects from the corresponding year. Photographs from *Wooster Collective* and Tapies, 2018.

prevent such problems.

Apart from a geographic visualisation, we could also arrange our data chronologically, given the complete coverage of date (or at least year) information in our dataset. Furthermore, there happens to be a large overlap between the two subsets, as the years 2003 (when *Wooster Collective* started) through 2016 (when *Wooster Collective* stopped posting regularly) are also covered by *Banksy 1999–2018*, as its title already indicates. For instance, we could simply plot the objects on a timeline (Figure 7). Such a timeline is an efficient way to immediately convey the quantitative development (in this case increase) of objects over time, although it may not always reflect real-world developments in the field of street art but might be susceptible to possible biases in the data sources.

A different kind of utilisation of our data would be to query the database directly to obtain specific information. If, for instance, we wanted to find out what other street artists besides Banksy were active in the UK at the same time, we could simply search within the location field for places in the UK, excluding works by Banksy himself. (In other, larger datasets, we would also need to limit the date range to exclude works from before the beginning of Banksy's career.) This requires the location data to have been correctly recognised, normalised and expanded automatically by a geolocation service so that e.g. the location "Newcastle" in the source has become something like "Newcastle upon Tyne, Tyne and Wear, England, United Kingdom" in the database. If we then search for locations that end with "United Kingdom", we find four objects from *Wooster Collective*: one by N4T4 in Nuneaton from 2005, an anonymous work in Bristol from 2006, a piece by Mobster in Newcastle from 2008, and one by DS in London from 2011.

**4. Possible Issues**

4.1. Processing Complex Layouts

Extracting data from *Banksy 1999–2018* proved straightforward because of its rigid structure of one artwork per double page and one photograph on each right-hand page. However, many other street art books and magazines feature more complex layouts in which several photographs are arranged on the same page. Figure 8, for instance, shows several pages from a booklet on street art in a district of Braunschweig, Germany (Markwort, 2020). Some



**Figure 8.** Pages 23 (photographs by The Bridge e.V.), 58, 59, 30 and 31 (photographs by Dietlinde Schulze) from Markwort, 2020.

photographs, like the ones on the double page in the bottom right picture, are printed flush, i.e. directly next to each other, while others are separated by a narrow 'gutter' in the colour of the page background. Not only is it difficult for a computer to recognise where one image ends and another begins, but it is also hard to tell to which images the caption texts refer to. It would take advanced image segmentation or edge detection algorithms to successfully extract the photograph of each individual artwork and to assign the correct corresponding caption text.

4.2. Obtaining Transcriptions via OCR

As mentioned at the beginning of this paper, it would be highly useful if all metadata records came with a complete transcription of any textual content in the artwork in question, e.g. the words "THE MILD MILD WEST..." and "BANKSY!" in the Banksy mural shown in Figure 3. As we are using OCR anyway to extract textual data about the object, would it not be feasible to use OCR to also obtain the spray-painted letters within the artwork? In this example, OCR software has difficulties recognising all of the letters due to their irregular shapes, particularly in the idiosyncratic "BANKSY!" signature, but there are other, more severe problems with this approach in general. One such problem is the inability of OCR software to distinguish between background and foreground, and thus between irrelevant and relevant writing. For instance, Figure 9 shows a page from a book titled *Graffiti. From A to Z* (Campos & Valle Padilla, 2010). The number 12 is part of the artwork, but if we apply OCR to this image, we get not only "12." as the text output but also "GUAYABAS DE CALIDAD" from the print on the fruit box in the shop window, which is clearly not part




**Figure 9.** Page from *Graffiti. From A to Z*, 2010 (unpaginated). Photograph by Itzel Valle Padilla.




**Figure 10.** Page from *Graffiti. From A to Z*, 2010 (unpaginated). Photograph by Itzel Valle Padilla.

of the graffiti artwork. For a human, this fact is easy to recognise, but not for a computer.

Another problem—basically the opposite of the previous—is caused by pictures of poor quality that lead to wrong OCR results, or more precisely: the characters present may be recognised correctly by the OCR software, but the resulting text is still faulty because of truncated or partially covered words in the original photograph. Consider, for instance, Figure 10, also taken from the book *Graffiti. From A to Z*. The text on the largest of the depicted stickers is recognised by OCR software as "Que muera el celula", as the last letter, r, is obscured by another sticker. The original wording was "Que muera el celular" (roughly, "Death to the cell phone"). If the text "Que muera el celula" enters the database unchecked, the consequence is not only that a database search for the word "celular" yields no result, but also that there is the danger of mistaking that word for 'la célula' (cell). For these reasons, unsupervised mass OCR is not recommended, which raises the question if it would not be simpler to enter any transcriptions manually in the first place.

4.3. Qualifiers Add a Layer of Complexity

So far, the data fields in our metadata records had a simple key–value structure, i.e. each field, if present, was filled with a string of characters or a number, so that the entire dataset could be represented, e.g. as a table. Ideally, however, we would like to record more information *about* at least some of the data points, i.e. to add qualifying statements to them. For instance, for geographic coordinates, it would be desirable to record their accuracy, i.e. the number of decimals given in the source, so that we can tell whether e.g.

the points N34.0833, W118.3418 and N34.08325123, W118.34175987 refer to the same object. For photographs in our dataset, it is crucial to record any licence under which the photograph was originally published so that we know if and how we can re-publish it (more on that below). It would also be useful to record each source from which a piece of information was taken (or perhaps even the name of the researcher who performed the data extraction, and the name and settings of the software employed), especially if several sources refer to the same object so that there are e.g. several different titles given for the same artwork. Such additional 'meta-metadata' essentially turns a two-dimensional dataset into a three-dimensional one that can no longer be represented as a simple spreadsheet. The data gains scholarly soundness but becomes harder to handle and process.

4.4. Legal Issues

So where is this sample dataset of 105 records that has been described in this paper? Why is there no hyperlink to it so that other researchers can use it and add more data to it, instead of having to build their own dataset from scratch? The reason is that legal barriers make it difficult to put such a dataset on the Internet. (The following describes the situation in the author's home country, Germany, but the legal circumstances are similar all around the world.) For one thing, there is the 'description text' field which contains texts such as the 300-word piece by Xavier Tapies on Banksy's *The Mild Mild West*. Such texts are protected by copyright from being re-published without the author's consent (or that of his or her heirs for 70 years after the author's death). With photographs, the matter is more complicated. One might think that neither the original, publicly visible, two-dimensional artwork itself nor a photograph thereof is protected by copyright, but a recent much-discussed court ruling (Reiss-Engelhorn-Museen vs. Wikimedia, cf. Initiative Urheberrecht, 2018) suggests that such photographs do indeed have some sort of legal protection, lasting for 50 years after publication, from being shared without the photographer's permission. But even if we leave out description texts and photographs, take 'just the facts' such as location, artist, title etc. and put that information on the Internet, we might still run into trouble. While the individual factual statements (e.g. "Banksy's *The Mild Mild West* was created in 1999 and is located in Bristol") are not protected in any way and may be publicly re-stated, it can be argued that the sum of all those statements from e.g. *Banksy 1999–2018* constitutes a 'database' which took considerable effort to compile, and therefore we would be not be allowed to re-publish a substantial portion of that 'database' without the permission of the person who compiled it (Kreutzer & Lahmann, 2019). Of course, it is a matter of debate what exactly a 'substantial portion' is; this applies more likely to the 20 out of 90 artworks from *Banksy 1999–2018* than the 85 out of more than a thousand artworks on *Wooster Collective*.

In any case, if one wants to err on the side of caution, it is best not to publish any data gained in the ways described above on the Internet. It should be safe, however, to create such a dataset for one's own personal use, or even to share it among a limited number of other people, e.g. a research group. Another strategy would be to approach the rights holders and obtain permission to re-publish the data or to encourage them to apply a suitable licence to their data that facilitates re-use. This is something that e.g. the Japanese Visual Media Graph project has done with regard to fan-made databases of anime, Japanese video games, and other popular media from Japan, albeit with only a small number of data sources (Pfeffer & Kacsuk, 2021; see also the project website at https://jvmg.iuk.hdm-stuttgart.de). A third option to deal with the copyright restrictions would be to publish only small fragments of the source datasets online. For such a truncated database to be useful for research, one would have to make sure that the records selected for publication constitute a representative sample and do not contain any biases regarding, e.g. chronological or geographical coverage.

**5. Conclusions**

Is it worth it, then, despite all the difficulties described, to take the trouble and put together a database from websites and books in the manner outlined above, if the result is a collection of messy data that may not even be shared online? To answer this question, it is important to be aware of the capabilities and incapabilities of such a database. For instance, even if more data sources are added and the data pool grows to thousands of records, so-called known-item searches will rarely be successful, i.e. when you have

a particular artwork in mind about which you would like to conduct research, it is unlikely that your dataset will contain a record of it. Instead, the dataset could be useful for exploratory searches, e.g. if you want to see some examples of street art from a country or a period of time that you are not yet familiar with. Perhaps—although this would require a dataset of considerable size in order to be statistically valid—one could even use the data to devise hypotheses on the quantitative development of street art over space and/or time. The perhaps most convincing argument to simply try it for yourself and get your own dataset started is that there is so much information related to street art already out there, online or on our bookshelves, that it would be a pity not to make more use of it. Serendipitous connections between metadata records from diverse sources may be revealed that we would have never encountered by querying pre-existing online databases or flipping through books.

**Conflict of Interests**

The author declares no conflict of interests.

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# Tools to Document and Disseminate the Conservation of Urban Art: the Experience of the CAPuS Project

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**Abstract**

The Conservation of Art in Public Spaces project (CAPuS), realised under the European Programme Erasmus+ Knowledge Alliances, aimed to develop a shared approach to the conservation of artworks in public spaces. The project involved 17 partners from 5 European countries, most of which focused on street art and contemporary murals. The final goal was the dissemination of knowledge to all stakeholders involved and the implementation of e-learning and training modules for conservation students and professionals. In addition to sharing best practices, the CAPuS partnership recognised the need to set a common and unambiguous vocabulary referring to the most relevant issues in the study of graffiti and street art for conservation purposes, such as style, execution technique, deterioration processes and conservation treatments. This encouraged the creation of a multilingual glossary, divided into two sections entitled "Street Art & Graffiti" and "Conservation", with each definition accompanied by an illustrative picture. In addition to that, an open-source database, the CAPuS Digital Repository, was created to archive, organise and disseminate the wide range of information and documentation that was collected and produced about the artworks studied within the project (materials and artistic techniques, artworks' socio-cultural context, photographic documentation, interviews with artists, condition reports etc.). Both the CAPuS Multilingual Illustrated Glossary and the CAPuS Digital Repository can support teaching and learning activities. They may also be of great help for future conservation interventions on the examined artworks and may serve as a starting point for the study and treatment of other public works of art.

**Keywords**

Conservation of Art in Public Spaces; digital repository; glossary; public art; street art; urban art

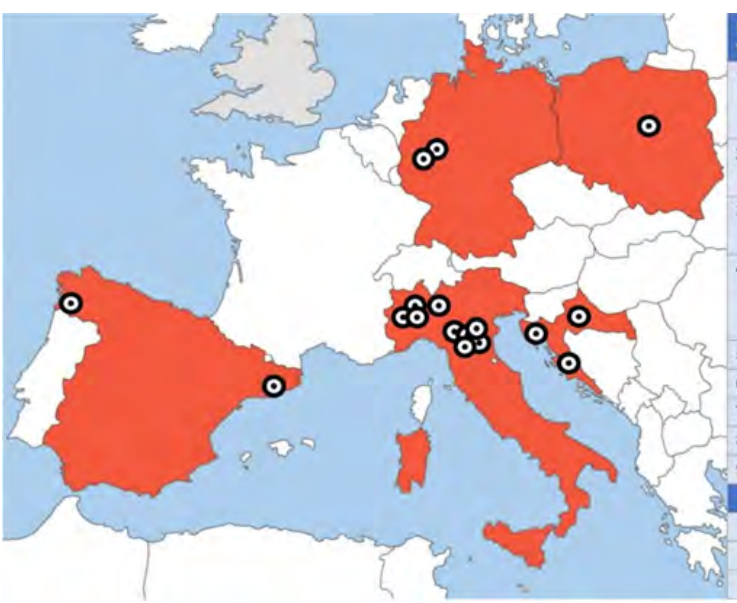
## 1. Introduction

Urban art[1] is experiencing a moment of great public and media success that concerns both traditional artistic contexts, such as open-air museums, and less canonical forms of artistic expression, such as graffiti writing and street art. The latter, initially born as acts of rebellion with which young people communicated their social discomfort provocatively and illegally, have quickly conquered a large audience, obtaining spaces even in contexts of legality. Many public and private institutions have understood the potential of urban art in the promotion and implementation of educational initiatives, social inclusion and urban regeneration events,

which over time have led to the creation of numerous works of art in the public spaces of our cities. But, if urban art, even in its less conventional manifestations, is now fully accepted as a true form of art, the debate about its conservation is still ongoing.

The conservation of urban art is certainly a controversial and complex issue, both for the great variety of works that urban art includes, and because of their fragility since they are continuously exposed to degradation agents that undermine their integrity and readability. The discussion on the intrinsically ephemeral nature of some works of urban art is still open, especially among street artists. Surely not everything is to be preserved, nor to be preserved forever, but there is a request from many sides to enhance the heritage of works of art in the public space and to extend their lifetime, defining strategies for their conservation or maintenance. Indeed, it is undeniable that more and more works of urban and public art are placed under protection or included in conservation projects, such as the mural *Tuttomondo* by Keith Hearing in Pisa (Dickens et al., 2016), some street artworks of the MAU (https://www.museoarteurbana.it/en) in Turin or the Sisak Sculpture Park in Sisak (Sunara, 2021), just to name a few examples dear to the authors of this contribution.

It is in this scenario that the Conservation of Art in Public Spaces (CAPuS) project was born and implemented. In the three and a half years of the project, 17 academic and industrial partners based in five European countries (see Figure 1), collaborated in research and training activities intending to create new knowledge and tools for the conservation of urban art.



| Research team | Partner | Partner Country | No. Researchers |
|---|---|---|---|
| 1 | University of Torino | IT | 6 |
| | Conservation Restoration Centre "La Venaria Reale" | IT | 7 |
| 2 | CESMAR7 | IT | 9 |
| | AN.T.A.RES | IT | 3 |
| 3 | Cologne Inst. of Conserv. Sci. | DE | 3 |
| | Schmincke | DE | 2 |
| 4 | University of Split | HR | 4 |
| | METRIS | HR | 4 |
| | Sisak Municipal Museum | HR | 2 |
| 5 | Academy of Fine Arts in Warsaw | PL | 10 |
| 6 | University of Vigo | ES | 3 |
| 7 | Montana Colors | ES | 6 |
| 8 | University of Parma | IT | 2 |
| 9 | Medhiartis | IT | 5 |
| | **Associated partner** | | |
| | Municipality of Torino | IT | |
| | Municipality of Milan | IT | |
| | Municipality of Reggio Emilia | IT | |

**Figure 1.** Map of the CAPuS partnership with the list of the beneficiary and associated partners, research teams (shown with black and white dots), partner countries (in orange) and the number of researchers involved in the project activities.

All the actions undertaken during the project were guided by a transdisciplinary working methodology centred on the analysis of case studies which, by choice and vocation of the project partners, mainly concerned two types of artworks: contemporary murals and metal sculptures.

The transdisciplinary approach had as key elements the analysis of the socio-cultural and historical-artistic context of the artworks, the attention to the needs expressed by the community, funding bodies of urban artworks and those responsible for their maintenance, the attention to economic, environmental and social sustainability aspects, the use of innovative technologies.

The goals of the project were the definition of guidelines (http://www.capusproject.eu/conservation-guidelines) and protocols for the protection and conservation of contemporary public art and the development of an open-access e-learning platform (https://elearning.unito.it/mooc/course/index.php?categoryid=6) (Lasala et al., 2022). In addition to these two research outcomes, other useful tools have also been developed to promote the knowledge of urban art and its conservation. The two that are reviewed in this article are the CAPuS Multilingual Illustrated Glossary (http://www.capusproject.eu/glossary) and the CAPuS Digital Repository (https://www.capusrepository.unito.it). Both are aimed at a wide and varied audience, despite having been conceived as support tools for teaching and learning activities.

## 2. The CAPuS Multilingual Illustrated Glossary

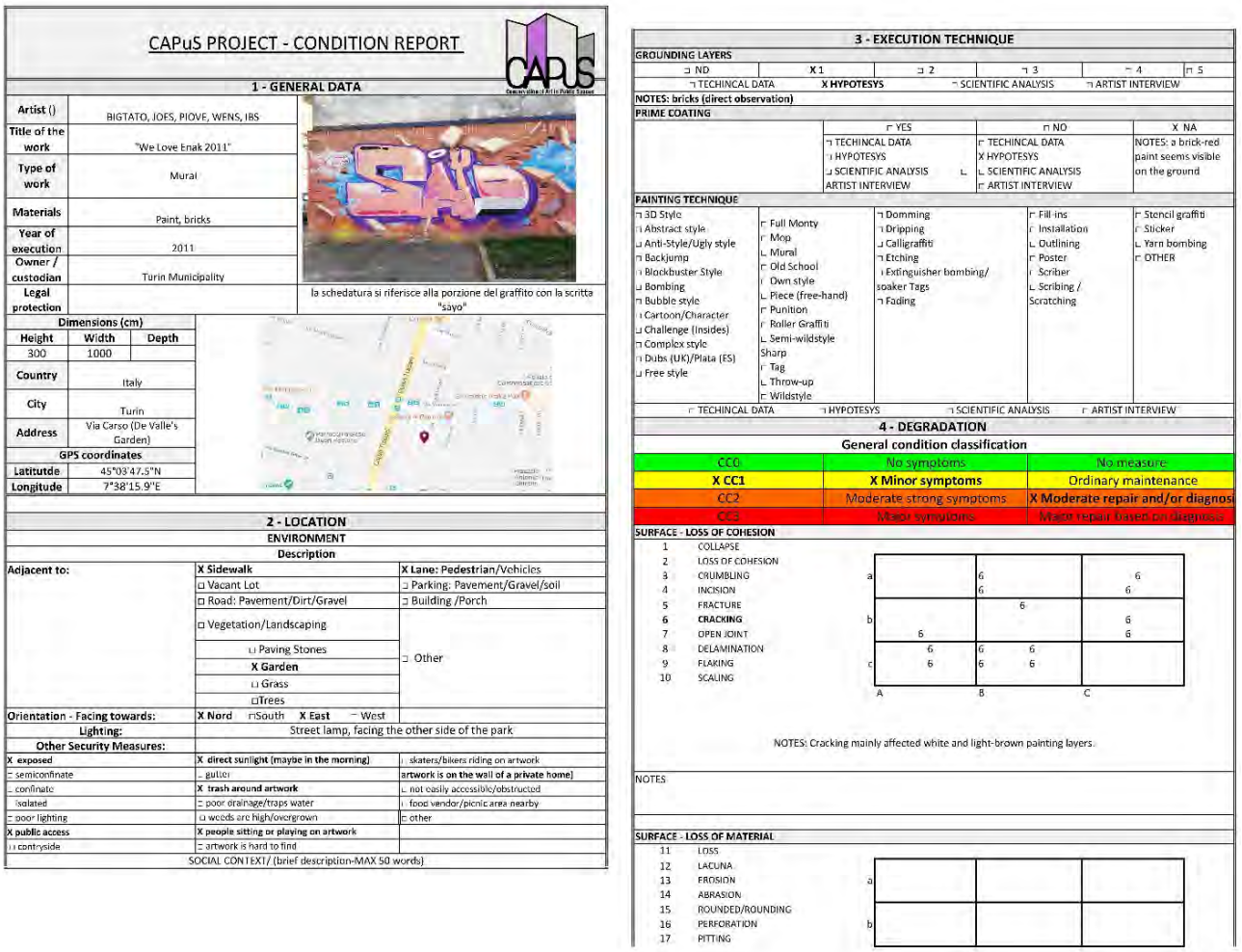
The multilingual glossary on Street Art & Graffiti and Conservation responds to the need that emerged during the initial phases of the project to define a common and unambiguous language that could facilitate communication among partners with different backgrounds and skills. It can be of help to uniquely identify and describe certain artistic techniques or conservation problems and to avoid misunderstandings due to the translation of technical terms into different languages. In order to foster the establishment of a common knowledge and vocabulary, a survey of the pre-existing glossaries on street art-related subjects, if any, and about the degradation phenomena of wall surfaces were made. Thus, as far as possible, the CAPuS glossary was built up taking as a reference other international glossaries[2], selecting the most useful terms and eventually adapting them to the description of street artworks and their state of conservation. Moreover, the glossary has been the basis for the design of other tools, such as a tailored condition report template later adopted by all project partners.

The CAPuS glossary was conceived in two forms, a detailed English monolingual illustrated glossary containing a number of terms and definitions (overall 141 entries are included), and five reduced bilingual illustrated glossaries (88 out of the 141 entries): English combined with one of the languages of the CAPuS partners' countries (Italian, Spanish, Croatian, Polish, German). All versions, either monolingual or bilingual, are accessible and downloadable from the project website (http://www.capusproject.eu/glossary).

The CAPuS glossary is divided into two sections, "Street Art & Graffiti" and "Conservation", each supplied with a list of pictures and credits, Bibliographic References and an Index. As for every specific artistic movement and technical field, the linguistic expressions related to Street Art & Graffiti and Conservation are constantly developing and changing over time, and relevant differences may occur at a national or regional level. Therefore, the expertise of all partners has been crucial in identifying the essential terms to be included in the glossary.

In particular, the section Street Art & Graffiti was developed thanks to the great help of the Montana Colors team and its contacts with street artists, who were able to report precisely the meaning and context of usage of the different entries. Despite the differences that exist in terms of the message conveyed and the target audience to address, street art and graffiti have a lot in common, as they often share spaces (exterior building walls, highway overpasses, sidewalks, etc.), materials, techniques and tools. This explains the intention to provide to the CAPuS glossary users (i.e., conservation students and professionals) a wider overview of these cultural movements, thus also including some terms related more to the graffiti scene than to street art. As it turned out that not all terms included in this section in the English version of the Glossary have a matching translation or are actually used in non-English speaking countries, only a limited number of these terms were included in the bilingual versions.

Although from the beginning the glossary did not claim to be exhaustive, the selection of terms turned out to be a challenging task. Since the glossary was designed as an ed-



CAPuS PROJECT - CONDITION REPORT

1 - GENERAL DATA

| | |
|---|---|
| Artist () | BIGTATO, JOES, PIOVE, WENS, IBS |
| Title of the work | "We Love Enak 2011" |
| Type of work | Mural |
| Materials | Paint, bricks |
| Year of execution | 2011 |
| Owner / custodian | Turin Municipality |
| Legal protection | |

la schedatura si riferisce alla porzione del graffito con la scritta "sayo"

| Dimensions (cm) | | |
|---|---|---|
| Height | Width | Depth |
| 300 | 1000 | |

| | |
|---|---|
| Country | Italy |
| City | Turin |
| Address | Via Carso (De Valle's Garden) |
| GPS coordinates | |
| Latitutde | 45°03'47.5"N |
| Longitude | 7°38'15.9"E |

2 - LOCATION

ENVIRONMENT

Description

| | | |
|---|---|---|
| Adjacent to: | X Sidewalk | X Lane: Pedestrian/Vehicles |
| | □ Vacant Lot | ⊐ Parking: Pavement/Gravel/soil |
| | □ Road: Pavement/Dirt/Gravel | ⊐ Building /Porch |
| | □ Vegetation/Landscaping | ⊐ Other |
| | ⊔ Paving Stones | |
| | X Garden | |
| | ⊔ Grass | |
| | □Trees | |
| Orientation - Facing towards: | X Nord ⊓South X East ⌐ West | |
| Lighting: | Street lamp, facing the other side of the park | |
| Other Security Measures: | | |

| | | |
|---|---|---|
| X exposed | X direct sunlight (maybe in the morning) | ⊔ skaters/bikers riding on artwork |
| ⌐ semiconfinate | ⌐ gutter | artwork is on the wall of a private home |
| ⌐ confinate | X trash around artwork | ⌐ not easily accessible/obstructed |
| ⌐ isolated | ⌐ poor drainage/traps water | ⊔ food vendor/picnic area nearby |
| ⌐ poor lighting | ⊔ weeds are high/overgrown | ⊏ other |
| X public access | X people sitting or playing on artwork | |
| ⊔ countryside | ⌐ artwork is hard to find | |

SOCIAL CONTEXT/ (brief description-MAX 50 words)

3 - EXECUTION TECHNIQUE

GROUNDING LAYERS

| | | | | | |
|---|---|---|---|---|---|
| ⊐ ND | X 1 | ⊐ 2 | ⊓ 3 | ⌐ 4 | ⊓ 5 |
| ⊓ TECHINCAL DATA | X HYPOTESYS | ⌐ SCIENTIFIC ANALYSIS | ⊓ ARTIST INTERVIEW | | |

NOTES: bricks (direct observation)

PRIME COATING

| ⌐ YES | ⊓ NO | X NA |
|---|---|---|
| ⊓ TECHINCAL DATA<br>⊔ HYPOTESYS<br>⊐ SCIENTIFIC ANALYSIS<br>ARTIST INTERVIEW | ⌐ TECHINCAL DATA<br>X HYPOTESYS<br>⊔ SCIENTIFIC ANALYSIS<br>⌐ ARTIST INTERVIEW | NOTES: a brick-red paint seems visible on the ground |

PAINTING TECHNIQUE

| | | | | |
|---|---|---|---|---|
| ⊓ 3D Style | ⌐ Full Monty | ⊓ Domming | ⌐ Fill-ins | ⌐ Stencil graffiti |
| ⊔ Abstract style | ⌐ Mop | ⊔ Dripping | ⌐ Installation | ⌐ Sticker |
| ⊐ Anti-Style/Ugly style | ⊔ Mural | ⊐ Calligraffiti | ⊔ Outlining | ⊔ Yarn bombing |
| ⊓ Backjump | ⌐ Old School | ⊓ Etching | ⌐ Poster | ⌐ OTHER |
| ⊔ Blockbuster Style | ⊔ Own style | ⊔ Extinguisher bombing/ soaker Tags | ⊔ Scriber | |
| ⊐ Bombing | ⊔ Piece (free-hand) | ⊓ Fading | ⊔ Scribing / Scratching | |
| ⊓ Bubble style | ⌐ Punition | | | |
| ⊔ Cartoon/Character | ⌐ Roller Graffiti | | | |
| ⊐ Challenge (Insides) | ⊔ Semi-wildstyle | | | |
| ⊓ Complex style | Sharp | | | |
| ⊔ Dubs (UK)/Plata (ES) | ⌐ Tag | | | |
| ⊐ Free style | ⊔ Throw-up | | | |
| | ⌐ Wildstyle | | | |

⌐ TECHINCAL DATA ⊓ HYPOTESYS ⊓ SCIENTIFIC ANALYSIS ⌐ ARTIST INTERVIEW

4 - DEGRADATION

General condition classification

| | | |
|---|---|---|
| CC0 | No symptoms | No measure |
| X CC1 | X Minor symptoms | Ordinary maintenance |
| CC2 | Moderate strong symptoms | X Moderate repair and/or diagnosi |
| CC3 | Major symptoms | Major repair based on diagnosis |

SURFACE - LOSS OF COHESION

| | | A | B | C |
|---|---|---|---|---|
| 1 | COLLAPSE | | | |
| 2 | LOSS OF COHESION | | | |
| 3 | CRUMBLING | 6 | 6 | 6 |
| 4 | INCISION | 6 | | 6 |
| 5 | FRACTURE | | 6 | |
| 6 | CRACKING | | | 6 |
| 7 | OPEN JOINT | 6 | | 6 |
| 8 | DELAMINATION | 6 | 6 | 6 |
| 9 | FLAKING | 6 | 6 | 6 |
| 10 | SCALING | | | |

NOTES: Cracking mainly affected white and light-brown painting layers.

NOTES

SURFACE - LOSS OF MATERIAL

| | | a | b |
|---|---|---|---|
| 11 | LOSS | | |
| 12 | LACUNA | | |
| 13 | FROSION | | |
| 14 | ABRASION | | |
| 15 | ROUNDED/ROUNDING | | |
| 16 | PERFORATION | | |
| 17 | PITTING | | |

**Figure 2.** Excerpt of the condition report filled out for one of the artworks examined within the CAPuS project. The terms and definitions included in the section "Street Art & Graffiti" or "Conservation" of the glossary can be used as a reference to respectively describe the "Execution technique" (section 3 in the condition report template) and the "Degradation" assessment (section 4).

ucational and working tool, the guiding criterion has been the inclusion of those terms useful to provide an objective description of the street art piece or contemporary artwork in public spaces and to fill out the condition report (see Figure 2). It is important to note that all terms and definitions were first agreed upon in their English version and then translated into the other national languages by art and conservation experts (professional translators were not involved).

Aiming to avoid any ambiguities of meaning, most terms are accompanied by an illustrative picture, selected within the photographic documentation produced by the partners during the project or collected from the surveys they carried out in the past. Furthermore, cross-references, alternative terms or terms improperly used as synonyms were indicated (see Figure 3).

# ESFOLIAZIONE
## *FLAKING*



Figure 34



Figure 35

Distacco di scaglie di piccole dimensioni, piatte e sottili, degli strati più esterni di un oggetto o di una superficie (es. dipinti murali). Come indicato dal termine stesso, le micro-scaglie si differenziano dalle scaglie per le minori dimensioni. Normalmente sono legate ad una combinazione di perdita di adesione e presenza di fessurazioni. [c]

Detachment of small, flat, thin pieces of outer layers of an object or a surface (e.g. mural paintings). Flakes are smaller than scales (see: *scaling*). It is usually a combination of adhesion loss and cracking. [c]

| | |
|---|---|
| Flaking | Abplatzung |
| Esfoliazione | Łuszczenie |
| Descamación | Ljuskanje |

CONSERVATION
> *loss of cohesion / adhesion*

73

**Figure 3.** Example of a page of a bilingual illustrated version of the glossary (here the English–Italian version): the definition, along with a few related terms, is translated in both languages, the section ("Conservation") and the sub-category ("Loss of cohesion/adhesion") are shown on the right side of the page, and the coloured box at the bottom includes the translations of the term of interest in each of the six languages considered within the project. In addition, two representative images are presented, the figure number referring to the Credits list reported at the end of the section.

The terms included in the Glossary are divided into sub-categories. As shown in Figure 4, the "Street Art & Graffiti" sections contain General (3), Cultural (38), Style (26) and Technique (15) terms. As for the "Conservation" section (see Figure 5), in addition to a few introductory General terms (5), the definitions referring to the different types of alterations have been grouped into nine broader families: Addition of substances (7), Biological alteration (2), Chemical alteration (7), Deformation (5), Loss of cohesion (10), Loss of material (11), Optical alteration (6) and Previous intervention (6).

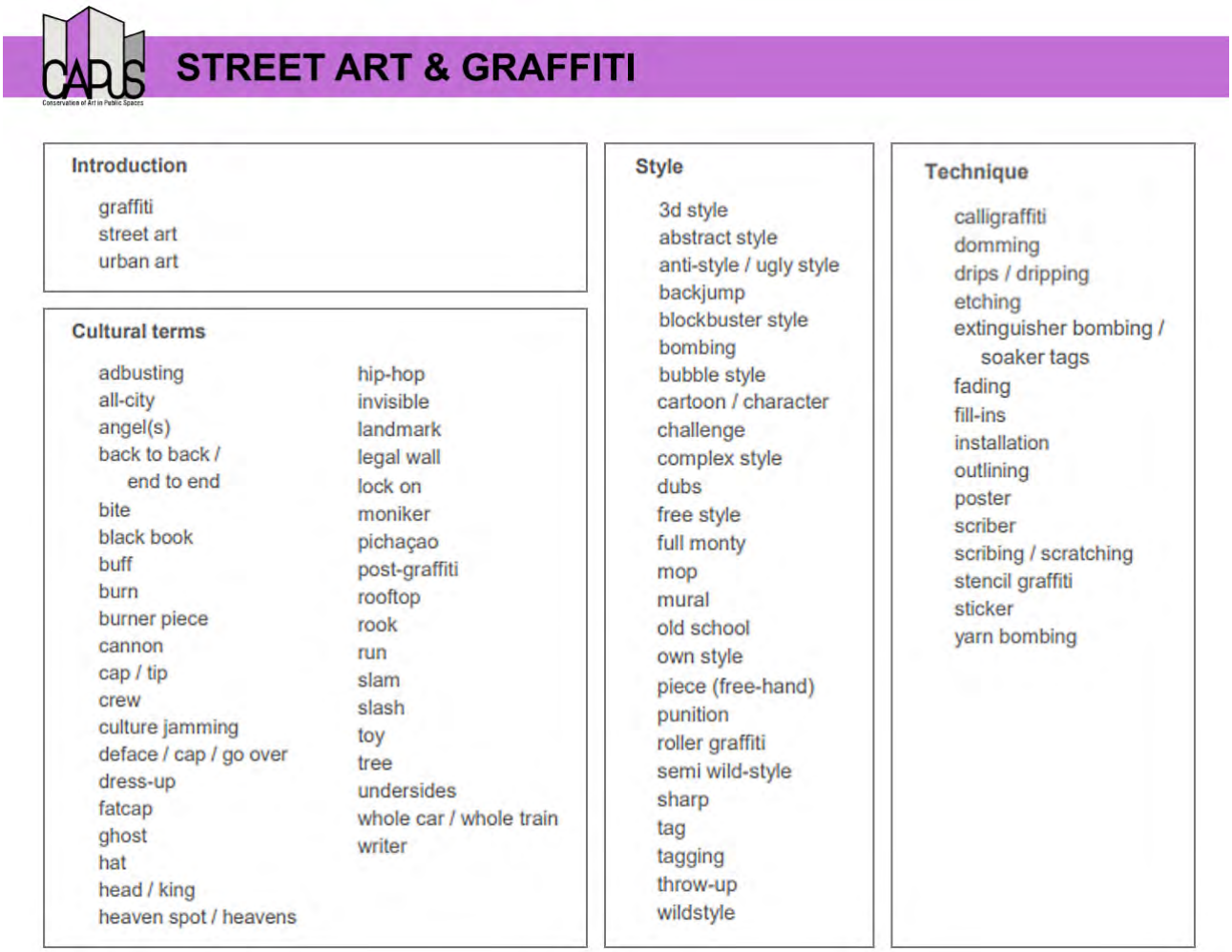



**Figure 4.** Subdivision into sub-categories of all terms included in the first section of the glossary, entitled "Street Art & Graffiti".

Since the use of the glossary should facilitate the achievement of objective recording, the definitions have been formulated to be as brief and accurate as possible and, in most cases, limited to the aspects which can be observed on-site, thus not considering the cause of damage, unless it is evident and univocal. Nonetheless, some difficulties arose for those terms which can potentially refer to more than one sub-category, or whose meaning considerably changes from one language to another. Furthermore, terms that have a negative connotation in common language and could implicate a different and subjective value judgement have been intentionally omitted (e.g., vandalism).

Several issues also came up in the selection of photos: first, it is not always simple to identify an unambiguous picture showing one single alteration form, since in real cases, often more than one degradation processes occur at the same time. Secondly, compliance with all copyright protection laws and regulations has to be ensured, although they are often slightly different from one country to another. As far as possible, photos directly taken by the partners have been preferred. Moreover, artists and owners, if known, were asked to sign a specific release form for the use of images within the project.

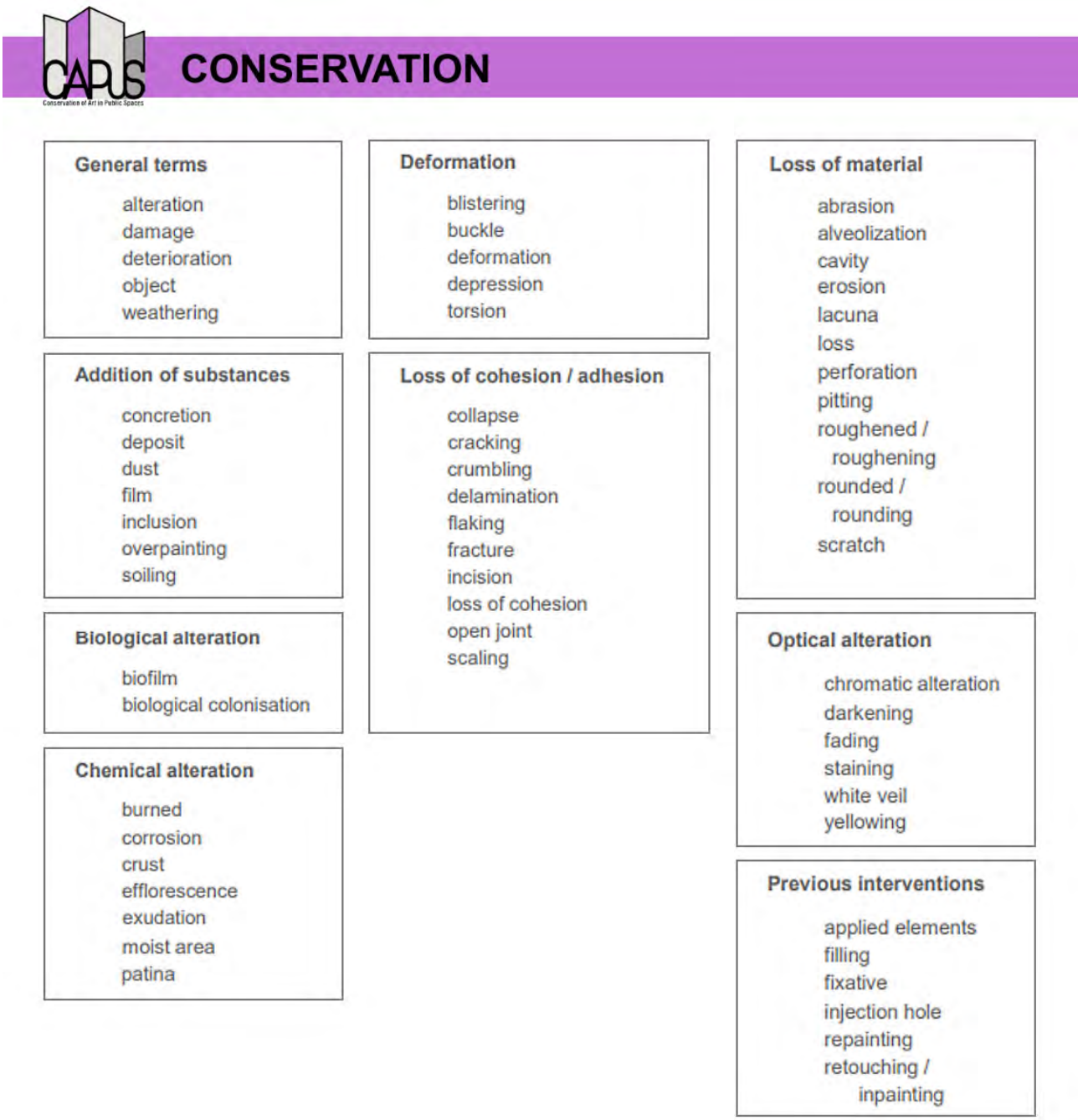



**Figure 5.** Subdivision into sub-categories of all terms included in the second section of the glossary, entitled "Conservation".

### 3. The CAPuS Digital Repository

Already in the planning stage of the CAPuS project, the need was recognised to preserve and provide access to the information and documentation about the artworks that will be studied. The 'information and documentation' referred both to the data that would be generated through the project activities, such as condition surveys and treatment reports, and to the data collected from other sources, i.e., created by other organisations and individuals, like newspaper articles and records of past conservation interventions. Various media had to be included, from images and text-based documents to drawings and recordings.

| Category | Sub-category | Additional remarks |
|---|---|---|
| ***General information*** | | Information about the artwork: title, artist, year of making, artwork type, dimensions, materials, owner or custodian.<br>Information about the artwork location: country, city, address, co-ordinates (displayed via a Google map), environmental context. |
| ***Artwork information*** | • Representative photo<br>• Other relevant information | Subcategory 'Other relevant information' includes, for example, publications about the artwork. |
| ***Art-historical context*** | • Archival records<br>• Comparative works<br>• Artist's biography | |
| ***Artist interview*** | • Recording<br>• Transcription | |
| ***Examination/ analysis*** | • Instrumental material analysis<br>• Micro sampling | Although optical microscopy of cross sections is represented in the written reports available in the sub-category 'Instrumental material analysis', photographs of cross sections have also been made available as high-resolution image files in the sub-category 'Micro sampling'. |
| ***Condition*** | • Condition report<br>• Condition photographic documentation | |
| ***Documentation*** | • 2D drawings<br>• 3D documentation | |
| ***Treatment*** | • Treatment report<br>• Treatment photographic documentation | |
| ***Maintenance*** | • Maintenance report<br>• Maintenance photographic documentation | |
| ***CAPuS publications*** | | Publications related to the artwork that were produced as a result of the CAPuS project. |

**Table 1.** Data organisation in the CAPuS Digital Repository.

The CAPuS Digital Repository was intended to be used by students and teaching staff in conservation study programmes. It was also envisioned as a tool that can support the care and preservation of the studied (and similar) artworks in the future. In addition to that, the repository was expected to serve as a useful resource to researchers and to the general public interested in learning more about contemporary public artworks.

The development, construction and design of the open-source online database was a time-consuming process that required cross-disciplinary collaboration between an IT expert and an art conservator (Sunara, 2022). Due to the large number of artworks studied in the project, creating records (entering metadata) and uploading digital files also required a significant amount of time. That part of the work was performed by representatives of CAPuS research groups[3].

The CAPuS Digital Repository was publicly launched in February 2021. It can be accessed either through the CAPuS website (http://www.capusproject.eu), by clicking 'Resources' and selecting 'Digital Repository', or at the address https://www.capusrepository.unito.it.

The repository currently contains data on around one hundred artworks from the five project countries, but, as it will be explained at the end of the chapter, there is a possibility of expanding the database to include artworks not related to the CAPuS project. At the time of writing, murals make up around 50% of the database entries. Each artwork has its data sheet in the repository, which contains the available information and documentation about that particular piece. The data range from basic information about the artwork (such as the name of the artist or the year of making) to the analysis of constituent materials and the technique of making; from interviews with the artworks' creators to in-depth studies of deterioration mechanisms. To help users navigate through this rich and varied content, the data are organised into categories and sub-categories, as shown in Table 1. Depending on the type of digital content uploaded/available in the repository, the artwork data sheet displays all categories/sub-categories, or just some of them.

Public access to the repository is secured through an interactive web interface in English (see Figure 6). The home page displays a random selection of artworks, which are shown in horizontal sections according to their type: murals, outdoor sculptures, etc. Each artwork is represented with a thumbnail-size image under which the artwork title, author and year of making are indicated. To view all artworks of a particular type, the user needs to click the 'More' button under the section he or she is interested in (see Figure 7). As mentioned above, each artwork has its page in the repository. To access an artwork's page and the related digital content about that piece, the user has to click the artwork's thumbnail image.

When an artwork's page is opened, the digital content is not immediately visible (see Figure 8). To access it, the user needs to click on the title of the sub-category he or she would like to explore. A collapsible panel will then open containing information (metadata) about the available digital object(s): file type, date of creation, originator of the content, and the holder (see Figure 9). A short textual description of an image or a bibliographic citation for a text-based file is displayed: this is intended to be used for citing. It is important to note that digital objects/files stored in the repository can be downloaded in whole or in part, but cannot be used without correctly accrediting the source. The photographs of the artworks cannot be copied and reused (clearance needs to be sought from the copyright holder, author/photographer, artist etc.).

A brief note needs to be made about the language of the text-based files. The files/documents that were created within the CAPuS project are available in English. Transcriptions of artist interviews conducted by the CAPuS team members present an exception and are available in the language in which the interview was conducted, i.e., in the language of the country to which the artwork in question belongs (Italian, Spanish, Croatian, Polish, or German). Text-based files that were created by organisations and individuals not related to the CAPuS project, such as newspaper articles, exhibition catalogues, archival documents, or art-historical papers, are also not available in English. The titles of non-English documents in the repository have been translated into English, but the bibliographic citation displayed in the collapsible panel clearly indicates that the document is in a different language.




**Figure 6.** Screenshot of the CAPuS Digital Repository homepage.

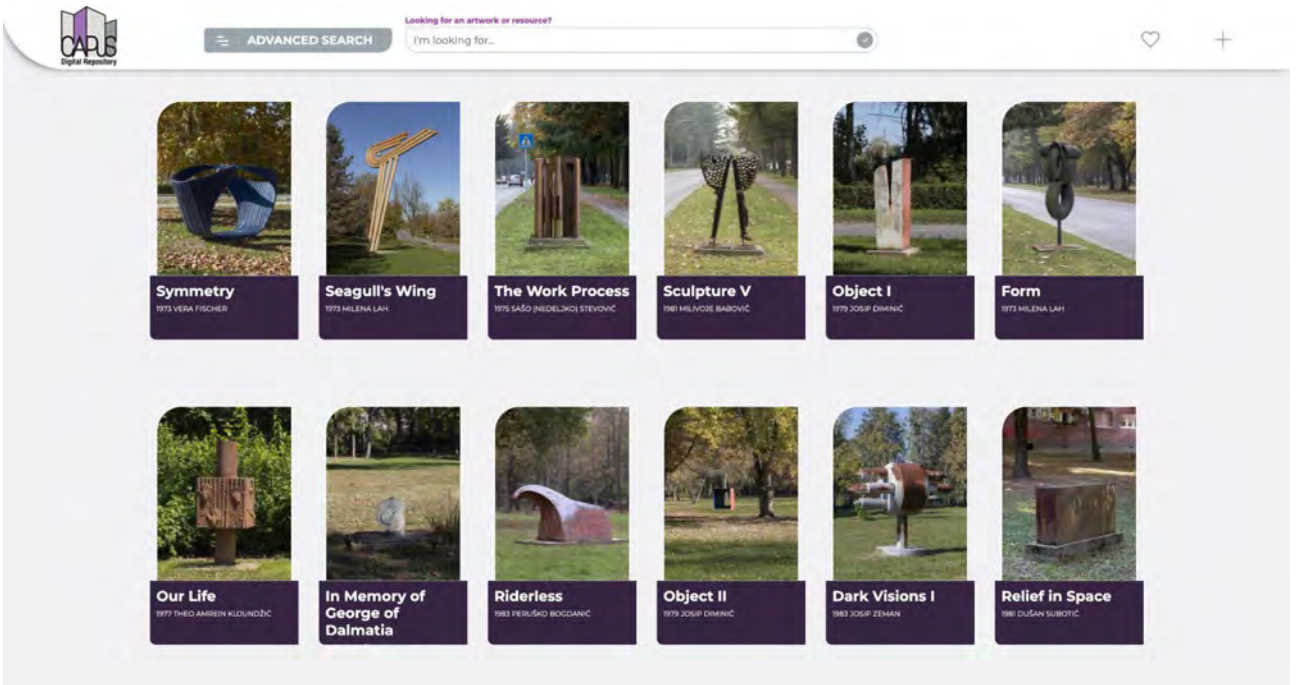



**Figure 7.** Screenshot of a portion of the page that lists outdoor sculptures.

The repository provides a search aid in the form of a general search bar, in which the user types keywords, and the advanced search option, both of which are available at the top of each page. The advanced search option (see Figure 10) provides users with the method to filter the digital content (or specific search results) in a number of ways: by the type of the digital file (scanned paper document, video, web resource etc.), by the (sub)category to which the digital object belongs, by country or city of the artwork's origin, artist, material, etc. The search tool, unfortunately, cannot search information inside text-based files, even if they are born-digital or OCRed scanned paper documents.

Readers interested in the demonstration of the functionality and content of the CAPuS Digital Repository are encouraged to watch the recordings of a three-part series of Zoom events that were held in May 2021, now available through the CAPuS website: http://www.capusproject.eu/2021/06/01/capus-digital-repository-zoom-events. Each Zoom event featured two speakers—representatives of CAPuS research groups—who showcased two public artworks that were studied in the project and are now included in the repository[4]. A detailed description of the architecture of the repository, as well as of the process of its design and construction, was given at the final conference of the CAPuS project (June 2021), the recording of which is also available through the project website: http://www.capusproject.eu/final-event-recordings (select 'Recording of Day 1', 22:46–40:57).

The repository currently includes only the artworks that were studied within the CAPuS project, but its creators are interested in expanding it through the addition of other contemporary public works of art[5]. One way in which this can be achieved is by involving conservation study programs. Through project-based assignments, students can gather information about public works of art—their social and historical context, condition, history of care, etc. —and then have those data stored (and made publicly available) in the repository.

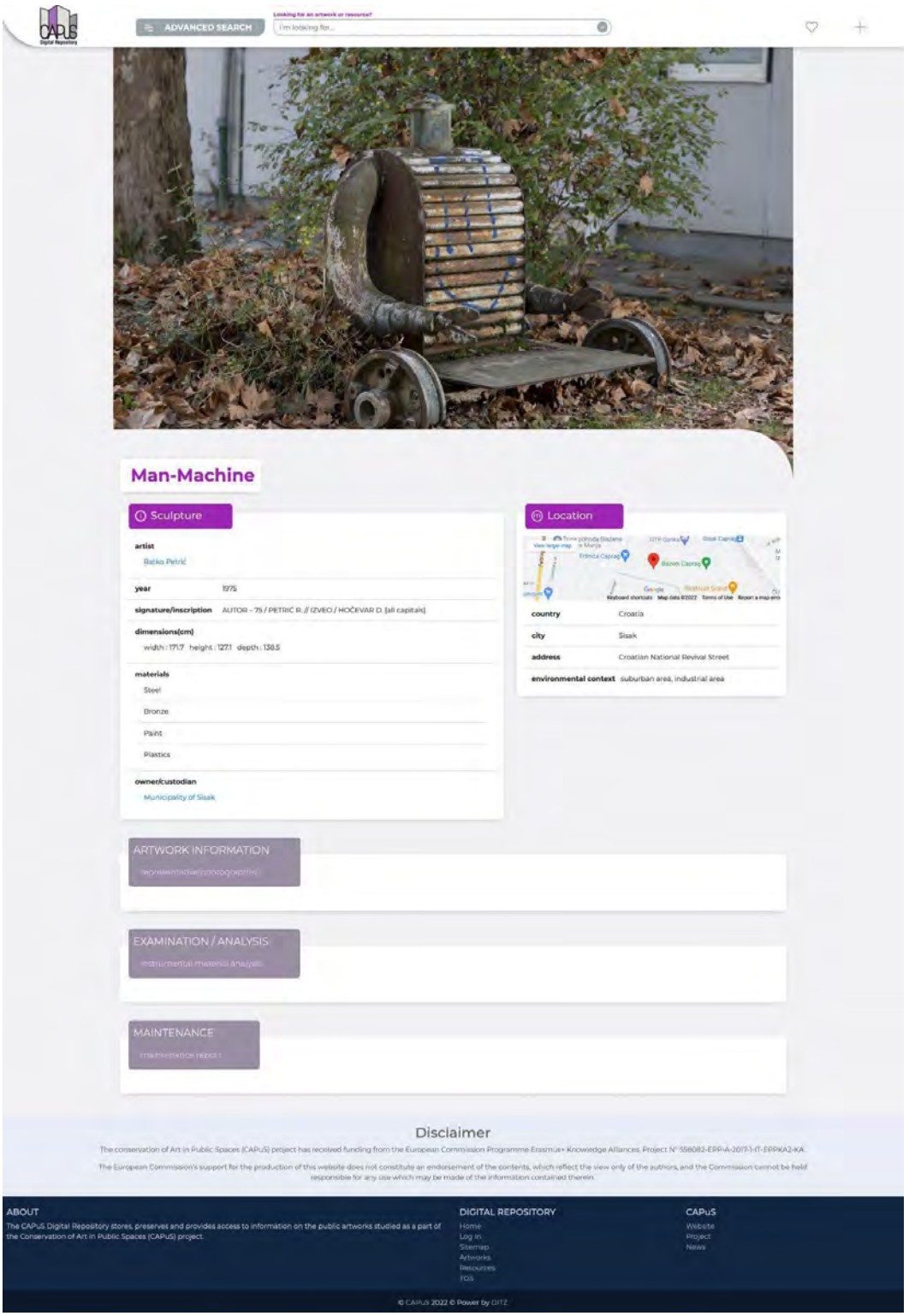



**Figure 8.** Screenshot of an artwork's page. Note that only three data categories are displayed. This depends on the type of data that has been uploaded into the repository.

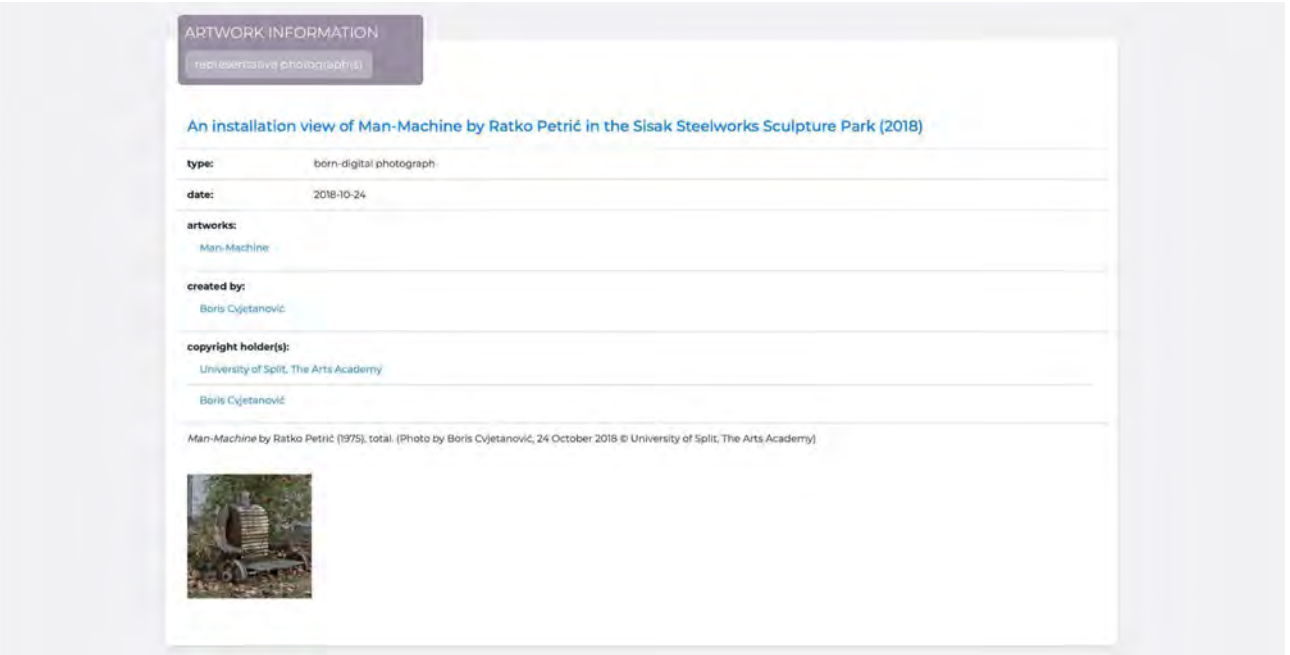



**Figure 9.** Screenshot of a collapsible panel that opens when the title of the sub-category is clicked. The brief textual description above the thumbnail image is intended to be used for citing. Left-click on the thumbnail image opens the digital file in a new tab.

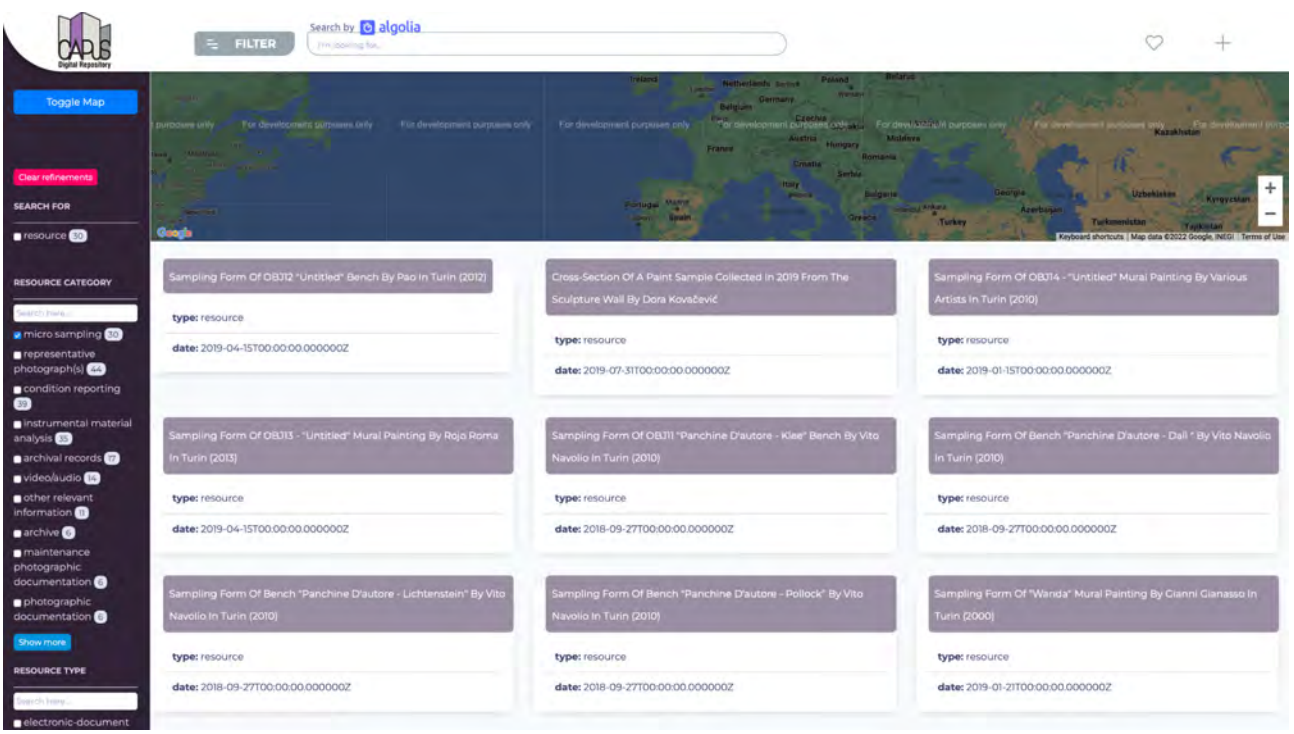



**Figure 10.** Screenshot of a portion of the page for an advanced search listing digital content related to the (sub)category 'Micro sampling'.

## 4. Conclusions

As stated at the beginning of this article, one of the main goals of the CAPuS project consisted in the creation and promotion of new knowledge and tools for the conservation of urban art, developed thanks to the collaboration among all partners in research and training activities. Two of the resources implemented within the project are the multilingual illustrated glossary and the Digital Repository.

The CAPuS glossary, drawing inspiration from other pre-existing glossaries, provides a selection of the most useful specific terms to objectively describe an urban artwork and to identify any types of ongoing degradation. The glossary is an annexe to the conservation guidelines document and is also part of the educational resources of the CAPuS e-learning platform. It has been proposed and used as supplementary material in university-level courses, classrooms and field thematic workshops.

The CAPuS Digital Repository gathers a huge amount of information collected about the examined artworks through the different phases of the project. Like the glossary, it can support teaching and learning activities, providing a number of case studies that will represent the variety of works of art found in urban art. The material contained in the repository can serve as useful documentation for the implementation of future conservation interventions on the same or similar works of art. Furthermore, the repository is proposed as an easy-to-consult tool for the general public, which, by browsing the web pages of the various murals and metal sculptures, has the opportunity to approach the theme of the study and conservation of urban art.

## Conflict of Interests

The authors declare no conflict of interests.

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## Endnotes

[1] Within the CAPuS project, the expression "urban art" has been used to summarise all visual art forms arising in urban areas, being inspired by urban architecture or the present urban lifestyle. It combines street art and graffiti and, in a broader framework, all forms of public contemporary art in open city spaces. The expression "street art" has also been used in the present work, its definition possibly including many edges: it has been traditionally referred to unsanctioned art, as opposed to government-sponsored initiatives, and strongly connected to the graffiti scene. However, street art has recently been going mainstream, often meaning to convey to a broader audience a message connected to political ideas or social commentaries. The term can include traditional graffiti artwork, sculpture, stencil graffiti, sticker art, street poster art and street installations. *See CAPuS Glossary – section 1.*

[2] The main international glossaries used as a reference for the creation of the CAPuS glossary are:

- UNI EN 15898 (2012): Conservation of cultural prop-

erty - Main general terms and definitions.
- ICOMOS-ISCS: Illustrated glossary on stone deterioration patterns - Vergès-Belmin V. (2008).
- EwaGlos-European Illustrated Glossary of Conservation Terms for Wall Paintings and Architectural Surfaces – Weyer A. et al. Michael Imhof Verlag, (2015).

[3] The following CAPuS project team members participated in uploading resources in the repository (in alphabetical order of surname): Ann-Katrin Bresser, Anna Kowalik, Chiara Ricci, Chiara Riedo, Ilaria Saccani, Dominique Scalarone, Sagita Mirjam Sunara, Enrique Alonso Villar and Friederike Waentig.

[4] The following CAPuS project team members participated in the three Zoom events: Sagita Mirjam Sunara, Moira Bertasa, Ilaria Saccani, Enrique Alonso Villar and Natalia Łowczak.

[5] Persons and institutions interested in collaboration are invited to contact the CAPuS Digital Repository administrators: Sagita Mirjam Sunara (sagita.mirjam.sunara@umas.hr) and Dominique Scalarone (dominique.scalarone@unito.it).

# Making a Mark—Towards a Graffiti Thesaurus

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**Abstract**
What does it mean to create graffiti? What exactly is (or are) graffiti? Graffiti and street art differ, right? Almost everyone has an opinion on what constitutes (modern) graffiti. Consequently, the term has taken on the most varied meanings in the conversations of academics, in media coverage, or in daily life. So how can one be sure about the meaning of the term (or any graffiti-related term, for that matter)? This is why glossaries, dictionaries, and other types of lists with definitions exist on websites, at the beginning or end of coffee-table books, and in scientific articles. However, there is currently no generally available, updateable, broadly accepted and easy-to-expand list of graffiti-related terms. Therefore, in order to meet the need for systematisation and consistency required for a more comprehensive study of graffiti, project INDIGO embarked on the journey to create a graffiti thesaurus. Being a finite set of terms (i.e. a controlled vocabulary) with hierarchical relations, this thesaurus will make INDIGO's graffiti classification explicit and hopes to serve as a reference for the broader (academic) graffiti community.

**Keywords**
controlled vocabulary; faceted thesaurus; Getty AAT; graffiti; human-made marking; knowledge organisation system

## 1. Introduction

In their current vibrant form and practice, modern graffiti appeared in the 1960s on the East Coast of the USA in cities like Boston, Philadelphia, and New York City (Papenbrock & Tophinke, 2016; Castleman, 1982; Chalfant & Prigoff, 1987). From there, they slowly conquered the world through different channels. Novak (2017) identifies three factors that influenced this global spread, the first one being gallery exhibitions, which impacted graffiti practices in the USA and Western Europe throughout the 1980s. The second one—cultural media—had an even stronger influence and included films like *Wild Style* (1983), *Beat Street* (1984) and *Style Wars* (1983), but also books like *Subway Art* (1984) and *Spraycan Art* (1987) and zines like *International Graffiti Times*, *Can Control*, and *Flashbacks*. Both factors spurred younger adults to imitate these activities around the globe in their hometowns, which Novak (2017) counts as interpersonal contact and presents as the third factor that helped spread graffiti globally.

However, scholarly interest in graffiti existed long before this modern graffiti revival. For Roman graffiti, research started as early as the 1840s, focusing on the graffitied architecture of archaeological sites like Pompeii (Avellino, 1841). Since then, coverage of various graffiti types has increasingly seeped into the scholarly literature, from religious rock graffiti in Egypt (Wiedemann, 1900) and scribbles found in toilet stalls at bars and cafés (Dundes, 1966) to scratchings on trees (Mallea-Olaetxe, 2010) and medi-

eval church graffiti (Champion, 2015). Due to this mix of research topics—each with its history and characteristics—and the generalised use of 'graffiti' to refer to both ancient and contemporary artefacts, the term became increasingly ill-defined but used throughout different research fields. The rise of street art and many other inventive forms of mark-making created by humans only compounded this fuzziness.

Although strict definitions risk isolating any academic subject from other research fields, the authors believe it is a necessary challenge for any field to properly delineate the subject of its scholarly activities and to reflect on what terms are used to indicate the objects and concepts relevant to the domain under consideration. In the framework of graffiti research, a more standardised vocabulary would also enable analysis on a larger-than-local scale. For example, suppose *database A* labels a creation 'graffito', while *database B* considers the same work as 'street art'. In that case, cross-database queries would lead to partial results and conflicts. And even if multiple people enter data into the same database, the fact that they might be using different personal definitions for the same terms could render that database unusable. To avoid the inaccurate, biased or even impossible analysis that stems from too much terminological elasticity, the academic project INDIGO (see Verhoeven et al., 2022) decided to create a broad, graffiti-centric thesaurus of well-defined terms.

Before section 3 explains the concept of a thesaurus via exploring existing attempts to organise or describe graffiti terminology, this text starts with the definitional issues concerning the term 'graffiti'. Properly defining the thesaurus' umbrella term 'graffiti' is essential to guide the inclusion of other terms and decide on their inter-terminological relationships. This structuring phase of the thesaurus—including the implications of certain decisions—is examined in section 4, along with the implementation of the thesaurus into a semantic framework.

## 2. This Text Is Not a Graffito. What Are Graffiti?

Is an "I love you" scratching on a tree bark a graffito? Are prehistoric cave paintings graffiti? Why do we denote the colourful writing of one's name on a train and the ancient Graeco-Roman wall scribblings as graffiti but refrain from using this label for geoglyphs like the Nazca lines or rock engravings? The term 'graffiti' gets used relatively arbitrarily, and there seems to be no ruleset to define what does and does not classify as graffiti.

### 2.1. A Short Historical View

To start our search for more clarity, it pays dividends to check the history of the term 'graffiti' and how its meaning might have fluctuated over time. As far as the authors are aware, the term 'graffito' (the singular form of 'graffiti') and the related term 'sgraffito' (with an intensive prefix 's-') were already used in an art-technical context as early as 1550, when the first edition of Giorgio Vasari's *Vite* was published (Vasari, 1550). In chapter 26 of the theoretical part of this work (Vasari, 1550, vol. 1, p. 90–91; contained in the section *De la pittura*), Vasari describes a technique commonly used to decorate the walls of buildings. He calls it 'sgraffito' (vol. 1, p. 90) and explicitly derives it from the verb 'graffiare' (i.e., 'to scratch'; mentioned in this passage in its past participle form 'graffiato': vol. 1, p. 91). In other sections of his work, he also uses the term 'graffito' (Vasari, 1550, vol. 2, p. 816: in the lives of *Polidoro da Caravaggio et Maturino Fiorentino*). Although this first written record originates in Renaissance Italy, the decoration technique likely has an earlier beginning, as evidenced by the numerous decorated walls from the 13th century present in the former archdiocese of Magdeburg/Sachsen-Anhalt (Danzl & Möwald, 2019).

Three basic steps constitute the '(s)graffito' technique, as also described by Lamb (1999). First, a coloured plaster (often of a darker hue) is applied as a base on a wall and left to dry. Subsequently, another layer of plaster with a contrasting colour to the first layer is added. Using a metal tool, decorative ornaments are scratched into the top layer, revealing the differently coloured layer underneath.

Therefore, what Vasari mentions as '(s)graffito' is a very specific technique, which—from a technical point of view—has very little in common with the typical modes of production of contemporary graffiti. However, Vasari's work still retains crucial value for analysing and understanding the subsequent evolution of the term '(s)graffito' in light of the more recent developments in contemporary culture.

First, Vasari's *Vite* already testifies to the multiplicity and variety of terminology that will be found in later centuries. Vasari (1550)—in addition to 'graffito', 'sgraffito', and the

verb 'graffiare'—mentions the verb 'sgraffire' (vol. 1, p. 12: in the proem to the whole work), 'graffi' (vol. 1, p. 91: in *De la pittura*, chapter 26; referring to the 'scratches' made by iron tools), 'sgraffiare' (vol. 1, p. 409: in the life of *Andrea da 'l Castagno di Mugello*; referring to more casual sketches made by the artist in young age). And, most importantly, one can already notice the use of the plural form 'graffiti' (vol. 2, p. 818: in the lives of *Polidoro da Caravaggio et Maturino Fiorentino*) or 'sgraffiti' (vol. 1, p. 90: in the heading of chapter 26), which indicates individual artefacts resulting from the application of the technique. Most of these terms can be found, for example, in the *Dizionario tecnico dell'architetto e dell'ingegnere civile ed agronomo* compiled by the Collegio degli architetti ed ingegneri di Firenze towards the end of the 19th century (1883, p. 501, where you can find entries for 'graffio' and 'graffito'; 1884, p. 375: entries for 'graffire', 'sgraffio', 'sgraffito', and 'sgraffire'; see also Danzl & Möwald, 2019, p. 91 note 4 for further references to 'graffiti' in art-technical dictionaries).

Secondly, we might also find in Vasari a hint as to how a very specialised art-technical term, which referred to a procedure outlined in well-defined steps, could be applied, as we shall see below, to the phenomenon of contemporary 'graffiti'. Vasari himself (1550, vol. 1, p. 91) identifies a characteristic that makes 'graffiti' different from artefacts created with other techniques: they are exclusively intended for use on the external surfaces of buildings, particularly the facades of houses and palaces. This is due to the relatively short time it takes to make them and their durability, which renders them waterproof.

A close connection is thus established between 'graffiti' and execution on a wall, or rather on an external surface that does not have the main function of presenting a work of art but rather the more practical one of enclosing a building and possibly keeping it standing. These surfaces can often be identified as 'communal' surfaces since they are part of a building intended for use by a community (although the community might also be a rather narrow one), or at least they are accessible and visible to everyone. This direct link between 'graffiti' and walls represents the common term that binds together the graffito productions considered by Vasari, and many of the contemporary artefacts typically referred to as 'graffiti'. We cannot be sure how much the traditional use of the term in its art-technical meaning contributed to its reuse and adaptation in the 20th century. However, the fact that the oldest graffiti were also executed on walls might have prompted some modern interpreters of the phenomenon that was taking shape in American cities in the late 1960s and 1970s to borrow (as we shall see) a term such as 'graffiti', coming from a specialised art-technical lexicon.

After all, over the centuries the term had also begun to be employed to denote artefacts other than the graffiti of Renaissance Italy. More specifically, it was used by Avellino (1841) and Garrucci (1856) to indicate the inscriptions archaeologically attested on the walls of Roman Pompeii. In the anonymous text "The Graffiti of Pompeii", written three years after Garrucci's book, the author equates graffiti to "street-scribblings" made either with a pointed instrument or possibly also with charcoal or red chalk (S.n., 1859, p. 416). The author also notes the difficulty of finding an equivalent English word for 'graffiti'. And since the French adopted it *verbatim*, he or she resorts to using it throughout the text, thereby likely introducing it into the English language.

However, the current standard use of the term 'graffiti' no longer exclusively refers to marking walls with either chalk and charcoal or a sharp object. In everyday language, creating graffiti also implies the usage of different materials like paint or ink on various surfaces such as waste bins and trains. Many of these connotations date back to the 1971 *New York Times* newspaper article "'Taki 183' Spawns Pen Pals" (S.n., 1971), in which the tags of TAKI 183 are called 'graffiti'. However, the term did not initially find acceptance among the practitioners, who referred to their sprayed tags as 'writing' (Castleman, 1982). This becomes also very clear from a comment by *micoaslatinpride* on Schutz's (2014) blog post "Jack Stewart and the documentation of early graffiti writing": "Those of us who were there, DID NOT call what we did "graffiti." Instead, we referred to what we did as "writin' ", which is the reason why we called ourselves "Writers"…. Writers who wrote our names." The American graffiti creators of the 1970s wrote on walls, so they perceived themselves as 'writers'. This basically means writing one's name, the crew's name or a moniker on a wall or anywhere in a public space (Papenbrock & Tophinke, 2016).

Knowledge of all this material, such as the texts by Vasari or the exploits by TAKI 183 and his tagging colleagues,

prompts us to ask the question: Should the term 'graffiti', both in its ancient and contemporary connotations, solely refer to mark-making on urban surfaces like walls and train carriages, or can other surfaces also be graffitied? Do graffiti have to be created in public space, or can they be practised in private areas? Can 'graffiti' be considered a child of a broader concept, or is 'graffiti' the most comprehensive term possible? And what about 'writing' or a term like 'street art'? Should we consider only illegal and unsanctioned creations as 'graffiti', leaving other designations for authorised or commissioned works? Trying to solve these questions has not been an easy undertaking, and it is something project INDIGO is still continuously working on. However, we have come to agree on various aspects and characteristics of graffiti. Although those are detailed in sections 2.2 and 2.3, it does not mean they are set in stone. Every book, every video, and every blog post with graffiti-related content consulted by the INDIGO team has the potential to challenge our notions.

2.2. Singular and Plural

The Italian word 'graffiti' is plural, with 'graffito' being the singular form. Strictly following its first written mention in the work of Vasari, one should thus write "graffiti are" and "a graffito is". In the 1980s and 1990s, the word 'graffiti' became increasingly used as a singular noun. Since most English plurals end with an '-s', treating 'graffiti' as singular can be considered in accordance with the normal evolution of the English language (Aitchison, 1997). However, to facilitate a proper distinction between one and more 'creations', we keep on using the singular 'graffito' and plural 'graffiti' (as was common in the early literature, e.g., erný, 1947; Gustafsson, 1956; Habachi, 1957; Landy & Steele, 1967; Woolner, 1957).

2.3. A Triple Concept

Graffiti are a form of mark-making in which "all marks are material signs in the basic sense of an index: they signify the action or movement (intentional or unintentional) that produced them" (Malafouris, 2021, p. 99). But since mark-making includes everything from one's fingerprints to a dog barking in its owner's garden, it is essential to define clear characteristics that can narrow down mark-making, so it only includes graffiti. For instance, not many would debate that graffiti are a form of human mark-making (or human-made marks). However, which other distinct properties do graffiti possess? A present-day, illegally spayed mural is often considered a form of graffiti. But does that view change when one knows this mural has been commissioned? If so, then legality is a limiting characteristic for graffiti. But if not, how does a medieval fresco differ from such a commissioned graffito? Of course, they might vary in technique, but only the former is typically considered valuable and denoted as 'cultural heritage'. But what, apart from 'age' and 'appreciation', are the criteria to separate these two legal, visual expressions on a wall? Although age is commonly relied on as a criterion of significance, INDIGO refrains from such a measure, which it considers ill-founded and personalised, because it prevents the build-up of a well-defined, individual-independent terminological hierarchy. Using the same logic, INDIGO omits nouns like 'art' and 'artist' or properties like 'arty', as they only make sense in the eye of the beholder.

After embarking on this academic quest for a suitable categorisation, the authors realised that graffiti is a multi-faceted term that changes meaning depending on its use. One year into project INDIGO, the authors consider 'graffiti' to be a term with three possible connotations:

- graffiti as activity, referring to "the creation of a mark".
- graffiti as objects (graffito as object), referring to "the mark resulting from graffiti as activity".
- graffiti as style, referring to "the mark looking like graffiti writing".

Let us start with the former. Narrowing-down 'mark-making' so that it only refers to 'graffiti as activity' can, according to the authors, only work if:

- mark-making is performed by a human (or multiple humans), thus excluding animals. Marking could be done by robots, as they are considered a tool used to create a mark (that is, as long as sentient artificial intelligence is still fiction).
- mark-making is done on purpose, ruling out the accidental creation of fingerprints or mark-making from walking on a dusty floor.

- mark-making constitutes a visual intervention, ruling out other sensory mark-making like the sound of an ambulance's siren, shouting "help", or farting.
- mark-making takes place in the real world, excluding mark-making in digital environments, virtual reality worlds, or the metaverse.
- mark-making takes place on or through all possible public, communal or private surfaces, like the building walls around a town square, waste bins, tables, trees, rocks, cars, the toilet of a local football club, bones, human and animal skin. Mark-making cannot take place on private surfaces visible only to the creator, since mark-making amounts to the generation of a visual exchange—which is impossible in isolation.
- mark-making involves appropriating a surface (i.e., the adoption of a surface as a canvas despite the fact that it was not originally meant to be one), ruling out mark-making like drawing on paper or oil painting on canvas.
- mark-making can be done in different ways, using either additive techniques (like painting, spraying or covering surfaces with knitted creations) or reductive techniques (such as incising, picking, carving or abrading).

In other words, 'graffiti as activity' can be defined as *the act whereby a human (or a group of humans) uses one or more ways to purposely make a visual intervention on any real-world, appropriated surface that is not just visible to the creator*. 'Buffing' and 'bombing' can then become possible subconcepts of 'graffiti as activity'. The result of that activity is a 'graffito as object', which has the same characteristics as the activity:

- the mark is anthropogenic, ruling out animal marks.
- the mark has a purpose, ruling out casual lip prints on a wine glass. Of course, purposes can range from entertaining a child, declaring love, damaging property, and creating something beautiful. Although defining the purpose or the intentionality of the mark is often impossible and a matter of interpretation, this issue does not apply to the definition but solely to the uncertainty of classifying something as purposeful mark-making.
- the mark is a visual intervention, ruling out marks that rely purely on sound, smell, or touch.
- the mark is a real-world analogue entity, ruling out a digital location pin in Google Maps or a tag digitally sprayed in an online game.
- the mark is on or through any possible surface, except a private surface only accessible to the mark-maker, because the mark is always a personal and visual statement, and a statement needs a human receiver.
- the mark is found on or through an appropriated surface, ruling out notebook sketches, a billboard, or a manifesto on papyrus.
- the mark can be made in different styles with various techniques, ruling out graffiti writing or sgraffiti (made by scratching) as the only valid graffiti forms.

Even though these rules apply to (what we consider) the different types of 'graffito as object' (writing, street art, symbols, and verbal graffiti), our definition still needs fine-tuning. The examples in Figure 1 illustrate this.

If we include marks made for purely practical reasons, whitewashing tree trunks (Figure 1A) to minimise insect damage and sunscald would be 'graffiti as activity'. By the same logic, plastic ear tags (Figure 1B) or firebrands to identify livestock ownership would render it 'graffito as object'. Suppose we stipulate that graffiti (as activity and objects) cannot be merely practical. In that case, the definition might exclude *tituli picti* (i.e., the ancient Roman commercial marks painted on the outer surface of amphorae; Figure 1C) or the phallus engravings in Roman cities indicating brothels. This highlights that our features for differentiating 'graffiti' from all other mark-making practices and results have yet to be refined, but also suggests that most descriptions of 'graffiti' are generally too vague. The commonly cited definition by Ross makes this clear:

> "graffiti typically refers to words, figures, and images that have been drawn, marked, scratched, etched, sprayed, painted, and/or written on surfaces where the owner of the property (whether public or private) has NOT given permission to the perpetrator." (Ross, 2016, p. 1)

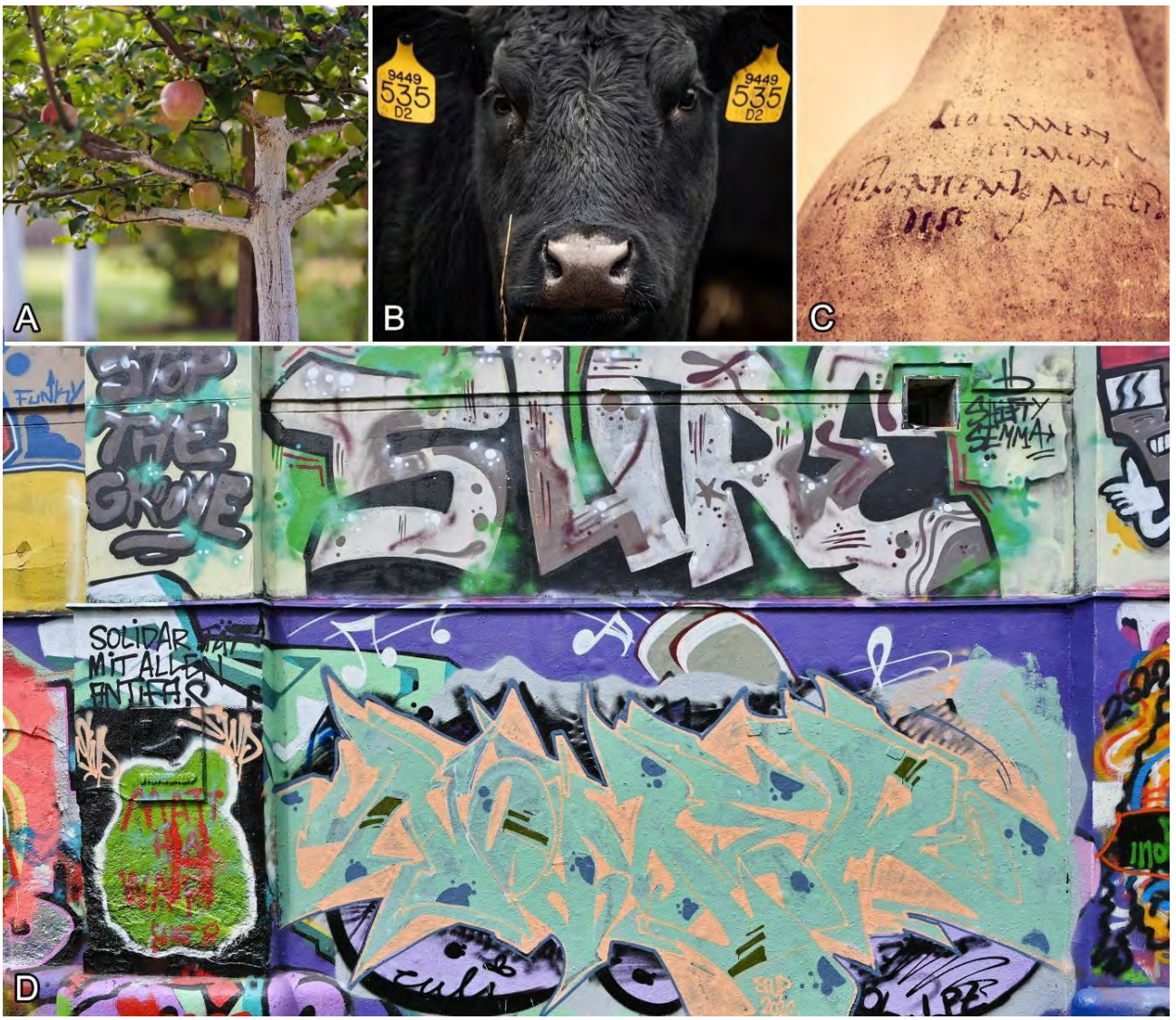



**Figure 1.** Four distinct mark-making results: A) white-painted tree barks; B) plastic tags to identify livestock ownership; C) a *titulus pictus* on the neck of an amphora for fermented fish sauce (photograph by Dr. Sophie Hay); D) graffiti created on one of Vienna's legal walls.

The word 'typically' invites personal opinion and randomness, opening the door to include whatever one might (not) find appropriate. If we leave out the word 'typically', the tag made by a lady on the outside wall of her house is not considered a graffito. If one scratches an animal on a tree or a rock, this definition does not consider the mark to be a graffito. And what about graffiti created on a legal wall? This last example indicates that the often perpetuated notion that "all graffiti are illegal" no longer works as a characteristic and defining property of graffiti. Very often, graffiti have been approved explicitly by law or implicitly through easements (Cloon, 2016), making them either legal or unapproved but not illegal. In Vienna, 22 legal (sections of) walls form the 'Wienerwand' (Eng. 'Viennese wall'), a joint label given to all these legal graffiti surfaces in the city (see https://www.wienerwand.at). Therefore, excluding the

marks depicted in Figure 1D from the category of 'graffiti as objects' would be incorrect in the authors' opinion and no longer be in line with the tendencies that have appeared worldwide in the last two decades. In addition, limiting graffiti on the basis of their legality would rule out most of the marks studied by archaeologists (and those marks were referred to as 'graffiti' long before the same label was given to more recent creations, as explained above).

Creating a thesaurus implies that all terms must be clearly defined and the decision-making criteria made explicit. Since this has proven to be more difficult than initially thought, the authors welcome any constructive input on this matter, also regarding the concept of 'graffiti as style', which we reserve for cases where the mark looks like graffiti writing. Although the 'graffiti as activity' concept stipulates that marks can be made with various techniques in different styles (such as graffiti writing, symbols, verbal graffiti, and street art), it must be possible for something to be labelled 'graffiti as style' although it did not result from 'graffiti as activity'. A good example would be a drawing on a piece of paper. Drawing on paper cannot be considered 'graffiti as activity', and the result is not a 'graffito as object'. However, the drawing can be reminiscent or imitate tags made in the street that do classify as 'graffiti as objects'. And this 'looking like' can only be undeniably established in relation to graffiti writing, whether satiric, humorous, obscene, or gang related.

2.4. The Proof of the Pudding Is in the Eating

Let us now consider a few examples to clarify the categorisation outlined above. The following are some edge cases that serve to illustrate the unlikelihood of finding a perfectly binary graffiti classification scheme.

- In a black book, creators often sketch the piece or mural they will later create on a real-world public or communal surface. These books are private objects; they are sometimes exchanged between creators, but cannot be defined outright as communal or public surfaces. This highlights the fuzziness in defining a private surface. The sketching takes place on paper, which excludes them automatically from 'graffiti as objects', although some of them might still meet the requirements to be categorised as 'graffiti as style'. Nailing that black book onto a tree would turn it into a public mark and qualify as 'street art' or 'landscape art' for most people. The exact definition of these terms is still being worked out within INDIGO.
- A facial tattoo is a mark that fulfils both surface criteria. It sits on an appropriated surface, and the face is not just visible to the tattooed person. As such, it qualifies for 'graffito as object'. However, a tattoo on private parts is an edge case. Although the tattooer saw the surface, it might later solely be visible to the person having that tattoo—but the tattooed private parts of a prostitute might be accessible or used for public or communal purposes.
- Can the act of creating a large painting in a locked, desolate building be considered 'graffiti as activity'? At the time the painting is created, the surfaces of the building do not have public or communal use. Still, the question is if the inner building walls can be considered private. Assuming nobody enters that building any longer, it is not wrong to consider the painting as a mark on a private surface only accessible to the mark-maker. However, as soon as a second person enters the building, the painting fulfils its visual exchange function, turning into a 'graffito as object'. This also showcases that 'graffiti as activity' and 'graffito as object' can be both legal and illegal, sanctioned and unsanctioned, thereby invalidating the still often encountered statement of graffiti being an unauthorised act.
- A tree on a private property gets covered with colourful, knitted garments after somebody climbs over the property-surrounding fence. Despite being privately owned, the tree's bark is an appropriated surface not just accessible to the mark-maker, which makes this knitted creation a valid example of 'graffito as object'. Sometimes, this type of graffiti is also called 'kniffiti'.
- Mark-making in one's bedroom is an edge case for 'graffiti as activity' because it is hard to establish in what sense this could be a visual exchange. The latter observation might also prevent the mark from being a 'graffito as object'. However, if that wall were removed from the house and included in a large new shopping centre, the same surface would change its status, thereby changing the mark's categorisation to 'graffito as object'. If the mark were a self-portrait in 17$^{th}$-century Dutch style,

however, it would still not be 'graffiti as style'.

- A shirt with a print of a Pompeian graffito or a famous Banksy creation is none of the three 'graffiti' concepts. The textile might show a 'graffito as object', but it is a derivative which does not classify as 'graffiti as style'.
- The Dutch Theo Brandwijk is known for peeing eagle-shaped marks on walls (https://www.mediamatic.net/en/page/87561/theo-brandwijk-eagle). As he 'works' in public space and creates on purpose a visual mark on an appropriated surface, the creating is 'graffiti as activity' and the outcome a 'graffito as object'.
- A man defecates on the streets. Although this act has a purpose and creates a visual intervention on a real-world public surface in a distinctive style, most people would never accept this to be a graffito as object, activity, or style. However, some could consider it street art (which INDIGO considers to be a sub-concept of graffiti). This conflict highlights that odd human-made markings might be considered graffiti; otherwise, one would need to establish an unquantifiable 'in the eye of the beholder' property. In that sense, (some) graffiti can be similar to art. Nobody considered a urinal to be art until the French artist Marcel Duchamp shocked the world in 1917 with his signed and dated urinal titled *Fountain*. Nevertheless—and as mentioned before—, project INDIGO prefers not to use the nouns 'artist' and 'art' (as in 'graffiti art(ist)') or the adjective 'arty' with graffiti, because they carry too much subjectivity to describe graffiti.

The urge of people to leave a mark wherever they go is as old as humanity itself. Prehistoric rock paintings, inscriptions on Greek and Roman ceramics, scratches in medieval church walls and all variants of modern graffiti: from scribbles on the bus shelter windows and tall murals for advertisements to chalk mandala drawings on the pavement and yarn-bombed statues. INDIGO's triple approach to the concept 'graffiti' makes it now possible to identify and categorise what should be, or cannot be, included in a thesaurus on graffiti (although some fine-tuning is still needed). The next section will explore the world of knowledge organisation systems to grasp the need for, as well as the scope and the limits of, a thesaurus.

**3. Knowledge Organisation System**

'Knowledge Organisation System' (KOS) is a term that can be used broadly to define a discipline's models or theories that structure information and knowledge. However, even more often, KOS refers to a kind of scheme that helps organise data and retrieve information and knowledge. Some of these KOSs are called 'controlled' or 'uncontrolled vocabularies' (but not all KOSs belong to one of these two categories).

To understand some of the important KOS principles and terminology, it pays off to delve deeper into the world of knowledge organisation and controlled vocabularies. Both are generally used in museums, libraries and archival settings. However, this paper focuses explicitly on the domain of graffiti (and by extension all human-made marking terminology).

3.1. Controlled Vocabulary

Controlled vocabularies enforce the idea that only a limited set of terms, names or phrases, collectively called 'concepts', can be used to describe and look for data, information or knowledge in a given system. The concept is described in ISO 25964-1:2011 as a "unit of thought" (International Organization for Standardization, 2011, p. 3; see also Figure 2 left). A single concept can be expressed by more than one term, and a single term can express more than one concept. Terms can change over time, take various forms, and be translated into many languages (Aitchison et al., 2000). If a list with terms, names or phrases claims that "one can only use these concepts", it is a controlled vocabulary, as it establishes control over the concepts that get used.

Creating, maintaining, and using a controlled vocabulary is denoted 'vocabulary control'. A controlled vocabulary represents and describes a specific domain or has a defined scope (for example, analysing graffiti or describing medieval castles). This list can be organised in alphabetical order (but need not be) and should enable browsing and searching through that list. Some controlled vocabularies are structured vocabularies, meaning they record the hierarchical (e.g., 'graffito' is subordinate to 'human-made making') and equivalence or preferential relations between the concepts (Harpring, 2013). The preferential relations control the links between synonymous terms or lexical variants for the

same concept and indicate the preferred term. For example, an inexperienced graffiti writer could be called 'toy' or 'beginner', while orange can be considered a 'colour' or a 'color'. Selecting 'toy' and 'colour' as the favourite terms—and doing the same for any other vocabulary concept—supports consistency in their use. When all spelling variations, antonyms, synonyms and abbreviations are linked to the favoured concept, the full scope of each listed term, name or phrase is really unlocked (Harpring, 2013).

3.2. Uncontrolled Vocabulary

If controlled vocabularies exist, then there must be many uncontrolled ones. The use of an uncontrolled vocabulary occurs when a given system allows the use of any word or phrase, like hashtags on Twitter and Instagram or tags for YouTube videos. Another excellent example of uncontrolled vocabulary practice is the use of keywords to describe scientific articles (like this paper). Most journals permit any word (or word combination) as a keyword. The problem with this uncontrolled approach is that there are no longer preferred terms, and misspellings happen all the time. Furthermore, uncontrolled vocabularies might include many concepts that are duplicates or near-duplicates. However, even some structure emerges from uncontrolled vocabularies over time; this structure often gets visualised via word clouds (see the editorial introduction of this volume for an example).

At the end of the day, there is no such thing as 100% controlled or uncontrolled vocabularies, because even controlled vocabularies often see concepts being added and dropped. All actual vocabularies thus fluctuate between lesser or greater degrees of control (Pomerantz, 2015). Two final examples can illustrate this: dictionaries and glossaries. A dictionary is typically not considered a pure controlled vocabulary. Despite being a snapshot of a language's vocabulary, that vocabulary changes and dictionaries do not claim to be complete. The same can be said of glossaries: they are traditionally found at the end of a book or article and contain a list of alphabetically ordered terms with a definition. A glossary thus explains specific terms but does not limit the terms one can use; instead, it represents terminology present in the given book or article, not across all works. To call a list of concepts a controlled vocabulary is thus highly dependent on the goal of that list. The concepts must limit how data can be described, or information can be retrieved in a given system.

3.3. Types of Controlled Vocabulary

There are several types of controlled vocabularies, which all serve different purposes and functions. The following sections describe six types based on Harpring (2013). Each of these types is accompanied by an example from the world of graffiti. Figure 2 shows an Euler diagram of seven controlled vocabulary types, with six described in this paper. The diagram is structured in order of increasing complexity, with 'controlled vocabulary' as the overarching concept and the others as subsets of this concept. For example, a thesaurus is a subset of controlled vocabulary with the additional characteristics of ambiguity control, synonym control, a hierarchical structure, and associative relationships. A thesaurus is always a controlled vocabulary, but not every controlled vocabulary is a thesaurus.

The first type of controlled vocabulary is a 'subject heading list'. These lists consist of fixed terms or phrases which can describe and cluster subjects and are allocated to books, articles, and other written or recorded documents. Subject heading lists are organised alphabetically, and links exist between favoured, non-favoured and other headings (i.e., ambiguity control). So, using a subject heading list, all materials regarding one topic are gathered under one designated term, making it especially applicable in a library environment, as this allows one to look up several synonyms of a word to find all the information on the topic in question. The headings can derive from a combination of strings, e.g. a period, a location and a type like 'Medieval church graffiti' (see Figure 2 top left).

The second controlled vocabulary type is a 'controlled list' (also referred to as a 'flat term list', 'simple term list', or 'pick list'). These are straightforward lists of terms (or phrases) arranged either alphabetically or logically. The terms should be unique, not overlapping in their meaning, all part of the same category and with an identical level of detail. An example would be an alphabetical list of the materials used for producing a 'graffito as object' (e.g., brush, marker, paint, roller, spray can, etc.; see Figure 2 top middle). Controlled

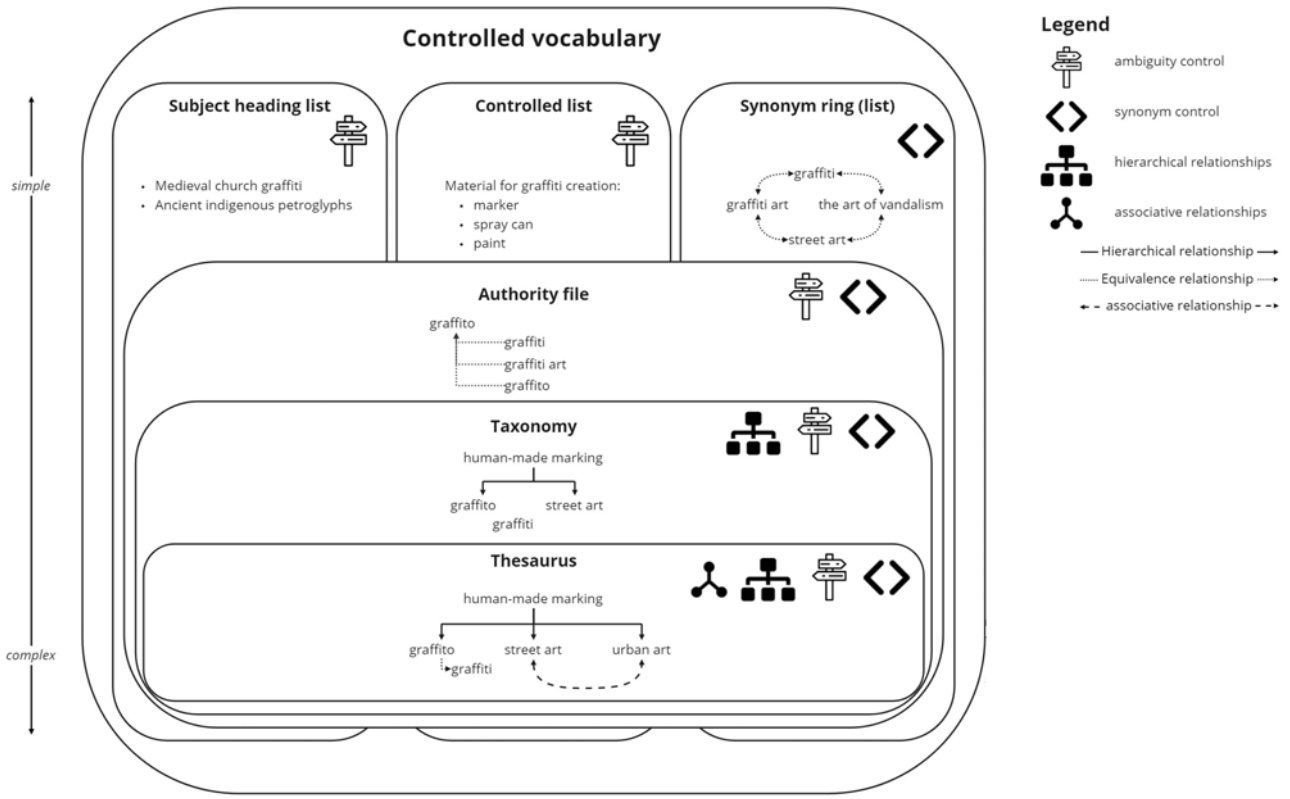



**Figure 2.** Different types of controlled vocabulary with examples.

lists are best used in a database environment if a short list of synonym-free terms is needed; these terms could be part of a simple drop-down menu in a graphical user interface.

The third type, a 'synonym ring' or 'synonym ring list', refers to the retrieval of information rather than the indexing of terms. Suppose one uses Google.com to search for the term 'graffiti'. In that case, the search results will also include websites, images, documents and other results which are tied to associated keywords like 'graffiti art', 'the art of vandalism', and 'street art' (see Figure 2 top right). Terms (or phrases) in a synonym ring are connected to their synonyms and near-synonyms.

The fourth form of controlled vocabulary is an 'authority file'. This is a valuable tool in a database or search environment as it enables both ambiguity and synonym control. Thereby, the preferred terms (of a concept) are always used in indexing rather than any variations or alternatives. So, if one were to search the terms 'graffiti', 'graffito', 'graffiti art' on INDIGO's planned online 3D platform, the system would automatically return the term used in that environment, which is 'graffito', after having linked the user's terms to this authorised term.

'Taxonomies' are the fifth type of controlled vocabulary presented here, and they mainly include the preferred terms to be used. These concepts are structured hierarchically, which means that concepts feature a parent-child or broader-narrower relationship (see Figure 3 right—connection from 'graffito' to 'writing'). Overall, a taxonomy follows a simple structure and has only relatively shallow hierarchical relations between concepts. An example is given in Figure 2, which shows the hierarchical connection of 'human-made marking' as the parent term of 'graffito', and the equivalence relationship between 'graffito' and 'graffiti'. A 'thesaurus' is a semantic network of unique concepts, the sixth type of controlled vocabulary. These terms are con-

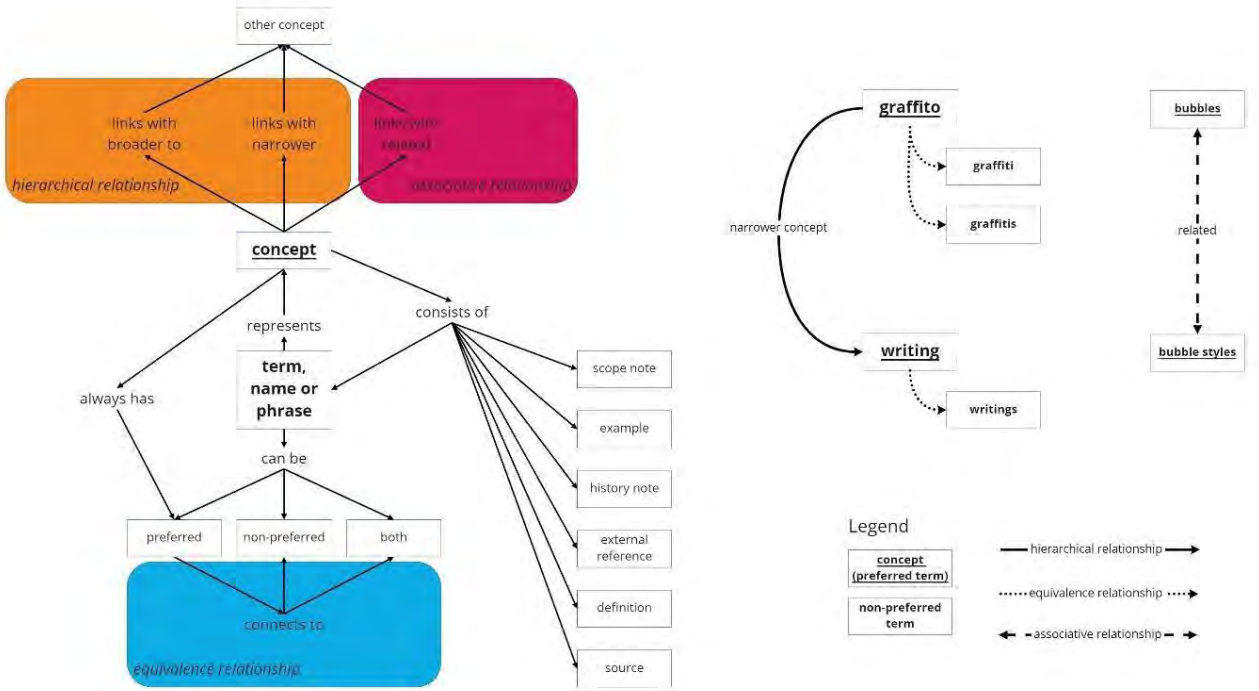



**Figure 3.** On the left: visualisation of the different elements in a thesaurus, including 'concept' as the centrepiece and the three different types of relationships; on the right: visualisation of the different relationships that are present in a thesaurus.

nected via three different types of relations. The first one is the hierarchical relation (see also the previous paragraph on 'taxonomies'); the second is the equivalence relation (i.e. synonyms and lexical variants); and the third one is the associative relation, which is unique to a thesaurus and links related concepts like 'bubble styles' to 'bubbles' or 'street art' to 'urban art' (on the right in Figure 3).

### 3.4. Knowledge Organisation

In the existing body of graffiti literature—both popular and scholarly—many attempts have been made to describe or structure graffiti-related terminology. Table 1 presents a small sample of the numerous lists of terms, glossaries or different types of controlled vocabularies inventoried by project INDIGO. However, most of those attempts are deficient in one or more aspects. They often cannot be updated (e.g., when printed in a book), do not include relationships, hierarchies, and synonyms, or lack accessibility (e.g., when included in old magazines or PhD theses of which no (digital) copies are available). How project INDIGO aims to fill these gaps, is further detailed in section 4.

## 4. Building the INDIGO Thesaurus on 'Graffiti'

So far, no thesaurus has been developed for the specific domain of graffiti. But the use of controlled vocabularies in a cultural heritage environment such as graffiti, which is intricately connected to human creativity and expression, would not only enable these works to be discovered, studied and compared but also appreciated (Harpring, 2013). To construct and implement a thesaurus properly, it is recommended to start by outlining its structure as it would be displayed in a hierarchical diagram. To do this, one of the more common, "well-established and reliable method[s], underpinned by a rational, scientific theory" (Broughton, 2006, p. 107) is 'facet analysis'.

'Facets' are groupings of terms of the same inherent class or

| | Graf, 2018 | Gottlieb, 2008 | INGRID, 2019 | Cooper & Chalfant, 1984 | ArtCrimes (graffiti.org, accessed 08/10/2022) | INDIGO |
|---|---|---|---|---|---|---|
| **Type of KOS** | Simple term list | Simple term list | Simple term list | Glossary | Glossary | Thesaurus |
| **Controlled vocabulary** | Yes | Yes | Yes | No | No | Yes |
| **Term definitions** | Yes | Yes | Yes, if not self-explanatory | Yes | Yes | Planned |
| **Includes illustrations** | No | No | Yes | For some | No | Planned |
| **Umbrella term** | Street art and graffiti art | Graffiti art style | Graffiti | Subway graffiti and writing | Graffiti | Graffiti |

**Table 1.** Overview of different types of KOSs published in the domain of graffiti.

category (see ISO 25964-1:2011, section 2.20 Facet; International Organization for Standardization, 2011, p. 4) and can be seen as the most general concepts in a thesaurus. One thesaurus that has been structured using facet analysis and furthermore contains numerous concepts regarding art and architecture is the Getty Research Institute's Art & Architecture Thesaurus (Getty AAT). Its development started in the 1970s, and the thesaurus gets updated regularly. The Getty AAT is concept-focused and takes the form of a hierarchical database with eight facets representing the main subdivisions: Associated Concepts (abstract concepts), Styles and Periods (visual and geographical classification of human-made works), Physical Attributes (appearance, design choices and quality of a human-made object), Agents (role of a single person or group), Activities (actions, endeavours, and tasks), Materials (natural or synthetic materials), Objects (human-made and tangible or visible), and Brand Names.

The scope of the Getty AAT is not only the cataloguing, discovering, and retrieving of information on art and architecture, but also on visual heritage and works (Harpring, 2013). Therefore, terms related to 'graffiti' can also be found among the available concepts (see Table 2). Each of the concepts is assigned an ID that uniquely identifies it, a preferred term (the name most often used for this concept in the scholarly literature), alternative terms (if any; there may be one or more), a scope note, related terms, hierarchical relations, and affiliation to one of the eight facets. The complete list of fields used in a concept record can be found in the Getty AAT Editorial Guidelines (Harpring, 2020, section 2.5). The concepts related to graffiti that are already present in the Getty AAT help us understand that it is possible—and productive—to construct a thesaurus on graffiti using facet analysis and that we can build on the Getty AAT. Unlike the Getty AAT, the INDIGO graffiti thesaurus will be subject-based, meaning all terms and concepts will be focused on graffiti—as activity, object, and style. Therefore, using the Getty AAT structure of hierarchies, facets, and associative relationships is likely too complex for a subject like graffiti, but nevertheless, it will provide a basic structure (see Figure 4). Of course, some adjustments will be necessary: the hierarchy needs to be flattened and filtered to make it usable for a thesaurus of more restricted scope, as the original hierarchy of the Getty AAT is rather deep.

Eventually, INDIGO's thesaurus should provide the terminology to describe graffiti in a structured and consistent way, just as the Getty AAT can be used to describe a work of art.

| ID | Preferred term in English | Alternative terms [only selected terms in English] | Facet |
|---|---|---|---|
| 300379259 | black books (graffiti) | black book (graffiti); blackbooks (graffiti) | Objects Facet |
| 300410273 | bombing (graffiti) | bombed (graffiti); bomb (graffiti) | Activities Facet |
| 300410278 | burners (graffiti art) | burner (graffiti art) | Objects Facet |
| 300410279 | end to ends | end to end; E-E (end to ends); E2E; E-to-E | Objects Facet |
| 300015613 | graffiti (casual notations) | graffito (casual notations) | Objects Facet |
| 300410270 | graffiti art | art, graffiti; graffiti (graffiti art) | Objects Facet |
| 300312066 | graffiti artists | graffiti artist; artists, graffiti | Agents Facet |
| 300428775 | paint stencil | - | Objects Facet |
| 300410272 | pieces (graffiti art) | piece (graffiti art) | Objects Facet |
| 300379258 | placas | placa; placazos; plaques (graffiti) | Objects Facet |
| 300053436 | pochoir (technique) | - | Activities Facet |
| 300410281 | productions (graffiti art) | production (graffiti art) | Objects Facet |
| 300266416 | sgraffito (technique) | decoration, graffito; graffiato; graffito (decoration) | Activities Facet |
| 300028878 | stencils (visual works) | stencil (visual work) | Objects Facet |
| 300056477 | street art | art, street; street works; works, street | Associated Concepts Facet |
| 300264511 | subway graffiti | - | Objects Facet |
| 300410284 | tags (documents) | tag (document) | Objects Facet |
| 300410271 | throw-ups (graffiti works) | throw-up (graffiti work); throwies; throwie | Objects Facet |
| 300400516 | urban art | urban arts; art, urban | Associated Concepts Facet |
| 300410274 | whole cars | whole car | Objects Facet |
| 300410277 | Wildstyle | wild style; Wild style | Styles and Periods Facet |
| 300410377 | yarn bombing (graffiti art) | yarn storming (graffiti art); graffiti knitting (graffiti art); bombing, yarn (graffiti art) | Objects Facet |

**Table 2.** Some of the concepts incorporated in the Getty AAT that are related to graffiti.

The construction of the graffiti thesaurus is currently going through a series of discussions and restructuring phases. Initially, the first step was to collect books, papers, blog posts, websites, and YouTube videos, focusing on any part of the domain of graffiti. Helpful information was recorded in a spreadsheet, where each new row was considered a new term and references to literature were added in new columns. The result was an alphabetical list of over 700 preferred terms. The number of bibliographical references added to a term made it possible to find out which terms are most often used and, thus, probably the most important and most widespread in the graffiti community.

In a next step, the terms will be filtered according to their relevance to project INDIGO and their importance and usage throughout the literature. This will result in a list of concepts focusing on the most common terms in the modern graffiti community. Train-related community terms like 'end to ends' and 'whole cars' will initially not be included, as project INDIGO currently only covers immovable surfaces. Afterwards, these concepts and terms will be structured visually using a mind map tool (like Miro—https://miro.com) and considering the three different relationships that make up a thesaurus (equivalence, hierarchy and association). Furthermore, these selected concepts will be assigned to the facets of the Getty AAT.

However, there are further aspects that must be considered in the development of the graffiti thesaurus: the grammatical number of the preferred term, the overall language of the thesaurus (which also impacts its accessibility), and the properties through which each concept will be described.

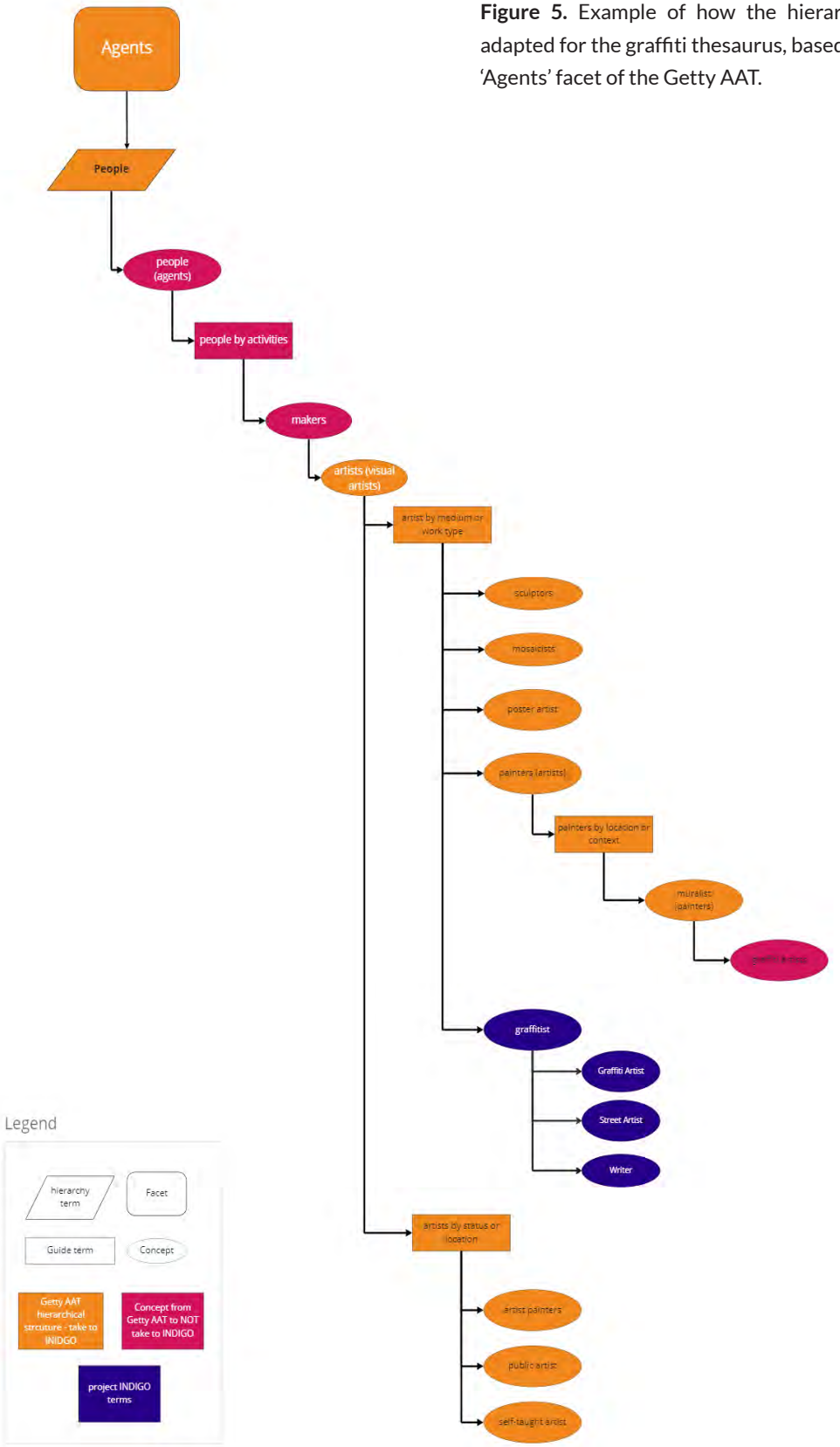



**Figure 5.** Example of how the hierarchical structure is adapted for the graffiti thesaurus, based on a section of the 'Agents' facet of the Getty AAT.

In the Getty AAT, preferred terms are presented in the plural form of the word; the singular form is usually recorded among the alternative terms. Furthermore, the terms are generally written in lower case, unless it is a proper noun like 'Wildstyle'. The same grammatical and stylistic conventions will also be adopted for the graffiti thesaurus.




**Figure 4.** The hierarchical structure of the concept 'graffiti (casual notations)' in the Getty AAT.

The modern graffiti community mainly relies on English for its terminology; therefore, it is common practice that an English term is not translated but used in other languages to describe the same element. This also stems from the fact that the graffiti scene became globalised through films like *Wild Style* (Ahearn, 1983) and *Style Wars* (Silver, 1983), as described at the beginning of this paper. Therefore, English seems the most logical choice as primary language for a graffiti thesaurus. However, there are many regionally developed graffiti styles and types, such as 'pochoir' (French) or 'placas' (Brazilian), for which there is no equivalent English term. In these cases, the original terms are also used in English to refer to these styles and types. Terms like these will also be adopted in the graffiti thesaurus as preferred terms for the related concepts.

To describe a concept, we will rely on the concept scheme provided by the Simple Knowledge Organisation System (SKOS), which can be used to publish different types of controlled vocabulary on the web. SKOS is based on the Resource Description Framework (RDF), the data model to which, ideally, all linked open data should adhere. This means that we will have concepts linked together by semantic relationships and that all information represented by INDIGO's thesaurus will be machine-readable and interoperable in a wide variety of contexts. SKOS was established by the W3C Semantic Web Best Practices and Deployment Working Group (Miles et al., 2005) and became a W3C recommendation in 2009 (a practical guide to SKOS can be found in Semantic Web Deployment Working Group, 2009).

A further step will be to make the INDIGO thesaurus publicly available. For this purpose, we will use the Vocabs service (https://vocabs.acdh.oeaw.ac.at) provided by the Austrian Centre for Digital Humanities and Cultural Heritage (ACDH-CH). Vocabs is based on Skosmos (https://skosmos.org), an open-source, web-based SKOS browser and publishing tool for controlled vocabularies. Skosmos also supports multilinguality for browsing and searching and allows for the publication of different types of vocabulary (Suominen et al., 2015). The publication on Vocabs will offer the possibility of updating and expanding the thesaurus iteratively.

**5. Conclusions**

'Graffiti' cannot be viewed from one single angle. It is a complex term that can refer to different concepts, which is why we are using a threefold approach—'graffiti as activity', 'graffiti as objects' and 'graffiti as style'. To capture the complexity of this term and related terminology, one needs not only a detailed exploration of the domain but also an effective way of representing this knowledge. In different projects and publications, various KOSs have been applied to the domain of graffiti, but nevertheless, the best-suited type of controlled vocabulary for cataloguing, archiving, and retrieving graffiti information is a thesaurus. Furthermore, the specific method of facet analysis and the choice of the Getty AAT as basis for INDIGO's thesaurus showed several advantages, including the possibility of capturing and representing the many-sided nature of the concept of graffiti.

The INDIGO thesaurus is not intended as a tool in the hands of a few. Ideally, it might become a standard instrument for anybody in graffiti research willing to increase systematisation and improve interoperability. Moreover, the workflow and the decisions made during the construction process could serve as an example for similar initiatives in other sectors.

**Conflict of Interests**

The authors declare no conflict of interests.

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# One Ontology to Rule Them All—CIDOC CRM in the Humanities and Its Use in OpenAtlas

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**Abstract**
The CIDOC Concept Reference Model (CRM, https://www.cidoc-crm.org), developed by the International Council of Museums' International Committee for Documentation (CIDOC), is a widespread ontology in the field of digital humanities. Its version 7.1.1, used within OpenAtlas (https://www.cidoc-crm.org/version/version-7.1.1), consists of classes that can be connected via properties to structure data in a standardised way and create entity-relationship models.
Mapping one's research data using an ontology that is accepted and widely used in the community is consistent with the FAIR Principles (https://www.go-fair.org/fair-principles). Using CIDOC CRM on the INDIGO dataset enables the recombination with already existing research data in this structure as well as the contentious use in new projects is easily possible. This significantly extends the life cycle of the data and prevents the laboriously collected data from remaining unused after the end of the project.
However, the use of ontologies including the CIDOC CRM, requires a certain training period and the time and resources to learn how to use it. OpenAtlas (https://openatlas.eu), as an open-source database system, allows for easy input of research data without prior knowledge of ontologies or other digital humanities applications. The stored data are mapped to the CIDOC CRM model in the background of the application without the user needing to engage with it.

**Keywords**
CIDOC CRM; cultural heritage; digital humanities; FAIR principles; ontologies; open source software

## 1. Introduction

This article aims to give a short introduction to ontologies in general and CICOC CRM (https://www.cidoc-crm.org) in particular. It will be presented how the use of an ontology can help to fulfil the requirements of the FAIR Principles (https://www.go-fair.org/fair-principles). In addition, arguments will be given why the use of ontologies is important when dealing with topics in the context of cultural heritage sciences and especially in the scientific research on graffiti.
In the second part of this article, the database system OpenAtlas (https://openatlas.eu) will be discussed. It allows the easy input of relevant data from the broad field of humanities and cultural heritage without further knowledge in the field of digital humanities. For this purpose, the application offers a user-friendly interface that can be freely adapted to the respective project.

## 2. CIDOC CRM—On the Importance of Ontologies

### 2.1. An Ontology in the Scope of Digital Humanities

The term "ontology" has different meanings in different fields of (academic) research. In philosophy, for example, ontology refers to the study of the nature and structure of all things-real or imaginary (Guarino et al., 2009). It is concerned with the study of being or existing (Stuart, 2016).

On the other hand—in the scope of computer science and digital humanities—ontologies are defined as "explicit specification of a conceptualization" (Gruber, 1993, p. 199)[1]. They are formal representations of knowledge (Merrill, 2011) and are meant to uniformly model the structure of a system (Guarino et al., 2009). By providing such a structure, information becomes automatically and unambiguously readable for humans and machines (Guarino et al., 2009; Stuart, 2016). Thus, ontologies are an important element of the semantic web.

Ontologies are composed of two basic elements: classes and properties. Classes are sets of things with shared properties (Stuart, 2016) and define unambiguously which data belong to a certain class and which do not. For example, an "actor" class comprises everyone in a dataset taking part in the research or creation of graffiti. These classes can further be divided into subclasses (Stuart, 2016), e.g. the aforementioned "actor" class could have the subclasses "graffiti researcher" and "graffiti creator".
Properties are attributes associated with certain classes (Stuart, 2016). They enable the linkage of classes via relations. Clear rules determine which class (referred to as domain) can be linked to which other class (range) via which property or properties (Figure 1) (Stuart, 2016).




**Figure 1.** Classes and properties as basic components of an ontology (Graph: Nina Richards via https://arrows.app).

A class can be linked to any number of other classes via any number of properties. In this way, a dense network of information is created that can be interpreted by humans as well as machines—since the data are unambiguous. A single class can act as a domain for one connection as well as a range for another link (Figure 2).

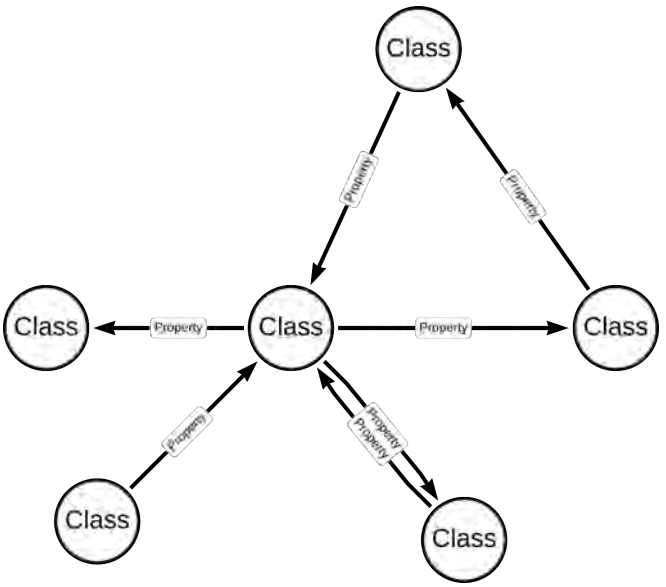



**Figure 2.** Network constructed by linking the classes via properties (Graph: Nina Richards via https://arrows.app).

This can be well explained with a simple example. For this purpose, the INDIGO graffito will be used, which was created jointly by the participants under expert guidance in the workshop of the project's kick-off meeting at the Danube Canal (Figure 3 and 4).

Of course, an infinite number of other classes and properties could be added—for example, with information about colours or used utensils, but for a rough overview of the functionality of classes and properties within ontologies, this should suffice.

One last thing to note about classes and properties. A distinctive feature of an ontology is its richness in tracking relationships via properties (Hedden, 2010; Stuart, 2016). However, to make the content that is mapped within an ontology more comprehensible, the usage of (controlled) vocabularies and/or gazetteers is highly recommended. They define terms, taxa, places, persons etc. with a unique identifier and make the content comparable with other datasets, especially against the background of linked open data and the semantic web.




**Figure 3.** INDIGO graffito, created 2021 at Danube Canal during the INDIGO kick-off meeting (Photo: Geert Verhoeven).

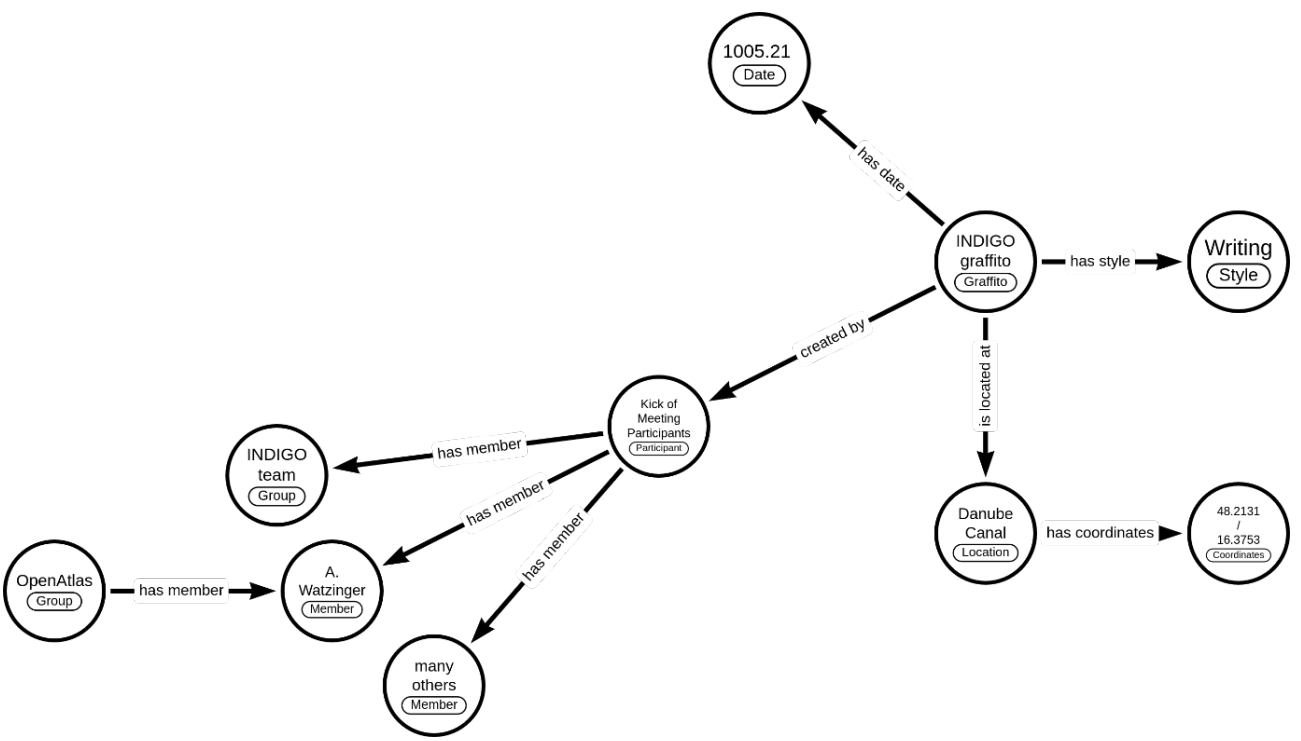



**Figure 4.** Network of the INDIGO graffito, created with a fictional ontology (Graph: Nina Richards via https://arrows.app).

Ontologies need to constrain what can be expressed by using them (Stuart, 2016), as none of them can represent all research fields with all details and in their entirety. Therefore, ontologies are highly domain-specific, and an ontology used in the medical field will have different properties and classes than one in the scope of heritage science or human resources (Janssen et al., 2010). It is, therefore, up to each team of researchers to identify the ontology best suited for their project and to use it for all data collected as part of the project.

Heritage science, including graffiti research—understood as material evidence of human activities of social relevance in the past—is very interdisciplinary as well as incomplete at some scale (Doerr, 2009). Finding the right ontology for this topic area is, therefore, particularly important.

2.2. Why You Should Use One?

Collecting, organising and using information is not possible without a system of classification. Ontologies can provide this classification and make the collected information manageable, analysable and interpretable (Merrill, 2011).

By providing a standardised way to represent a specific domain with entities and relationships—and thereby structuring data—ontologies allow for semantic interoperability and exchange of knowledge between different projects that use the same ontology (Janssen et al., 2010). A well and efficiently constructed ontology is thus an essential component in the engine of contemporary science (Merrill, 2011). They do so by supporting the indexing of data via the use of uniform terms and by supporting data ontologies which allow for complex queries of the information via their classes and numerous relationships represented by their properties. They also support the findability of information and related concepts by organisation/navigation and browsing rather than searching or querying. Last but not least, they serve as knowledge bases (Stuart, 2016).

So, by using an ontology with agreed-upon meanings and labels, the data become interoperable with other datasets and accessible to all involved parties (Janssen et al., 2010), which allows for data to be widely shared (Stuart, 2016). The unambiguous definition of terms within the ontology enables interoperability with other data sets that use the same structure; this is in accordance with the FAIR Principles, which will be discussed in more detail below. Through interoperability and reusability, the life cycle of the own data is extended, which can be used for further research even after the end of the project.

Sharing data in the research community and with the broader public is not only in accordance with the FAIR principles (see below) but also prolongs the life cycle of said information. Structured data are more likely to be re-used in other projects and for other purposes. Even more so if data are not only readable for humans but machine-readable as well. In that case, it can also become part of the semantic web when two or more computer systems exchange information and can interpret the meaning of the information automatically (Ceusters & Manzoor, 2010).

2.3. CIDOC CRM

A widely used ontology within cultural heritage is CIDOC CRM which is also used in the scope of the INDIGO project. It is a formal ontology developed by the International Council of Museums (ICOM) to ease the integration, mediation, and exchange of heterogeneous information derived from cultural heritage research (Doerr, 2009). While CIDOC stands for the Comité International pour la Documentation (English: International Committee for Documentation), an international committee connected to ICOM CRM is an abbreviation for Conceptual Reference Model (Doerr, 2003, 2009).

CIDOC CRM has been developed since 1996 (Doerr, 2003). Its official version 7.1.1—used in the INDIGO project—was released in April 2021 and consists of classes and properties. While classes are indicated by a preceding "E" followed by a numeric code—e.g. "E29 Actor" or "E67 Birth" —properties are indicated by a combination of "P" and a numerical sequence-think "P26 moved to" or "P52 has current owner" (https://www.cidoc-crm.org/versions-of-the-cidoc-crm). The ontology was developed by a varying team of domain experts to achieve semantic interoperability of museum data but also enable information integration for data derived from related fields as well as their correlation with library and archive information (Doerr, 2003).

In 2006 the model was accepted as an ISO standard (Doerr, 2009) and renewed in 2014 as ISO21127:2014 (https://www.iso.org/standard/57832.html). CIDOC CRM, as a middle-level ontology, is not designed to be universal but

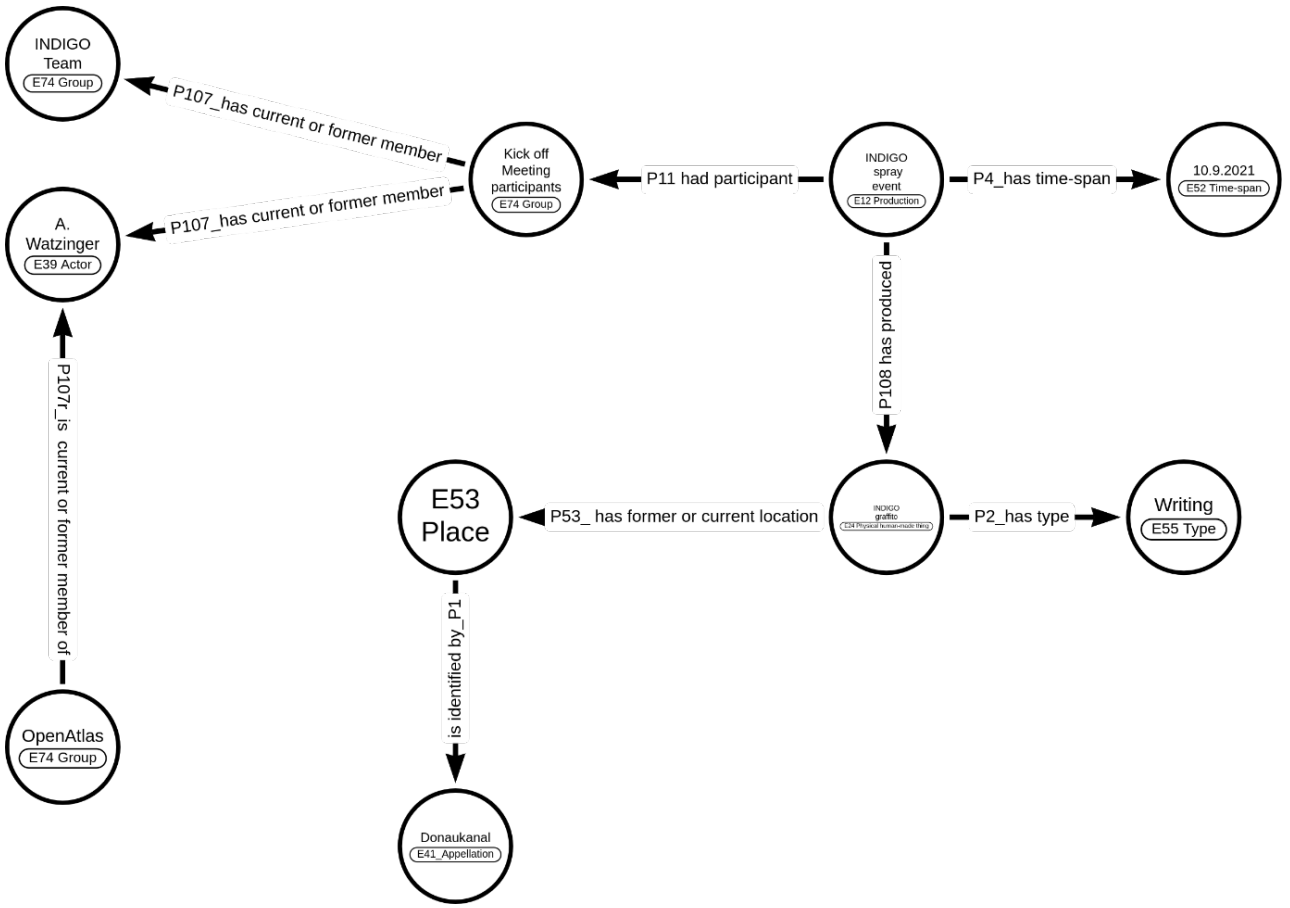



**Figure 5.** Model of INDIGO graffito following the CIDOC CRM specifications (Graph: Nina Richards via https://arrows.app).

to accommodate data from a large number of domains. While other ontologies are commonly designed to encode resources of one specific domain, in the scope of cultural heritage ontologies such as CIDOC CRM deal with a wider range of topics due to the interdisciplinarity of the field and are designed to be extensible to accommodate new developments (Stuart, 2016). If one takes up the model discussed before to the INDIGO graffito again, it can be modelled according to the constraints and rules stated in the CIDOC CRM by using some of their predefined classes and properties (see Figure 5).

**3. Being FAIR and Being Open**

3.1. FAIR Principles

In the digital humanities, FAIR principles (Wilkinson et al., 2016, https://www.go-fair.org/fair-principles) take an important role as it is not enough that data and code are being published open and available to everyone. The information has to be findable and reusable by those who want to keep working with them (Stuart, 2016) (Figure 6).

With the increasing popularity of the digital humanities in the field of the humanities, funding agencies are also placing increasing emphasis on data management and publish-

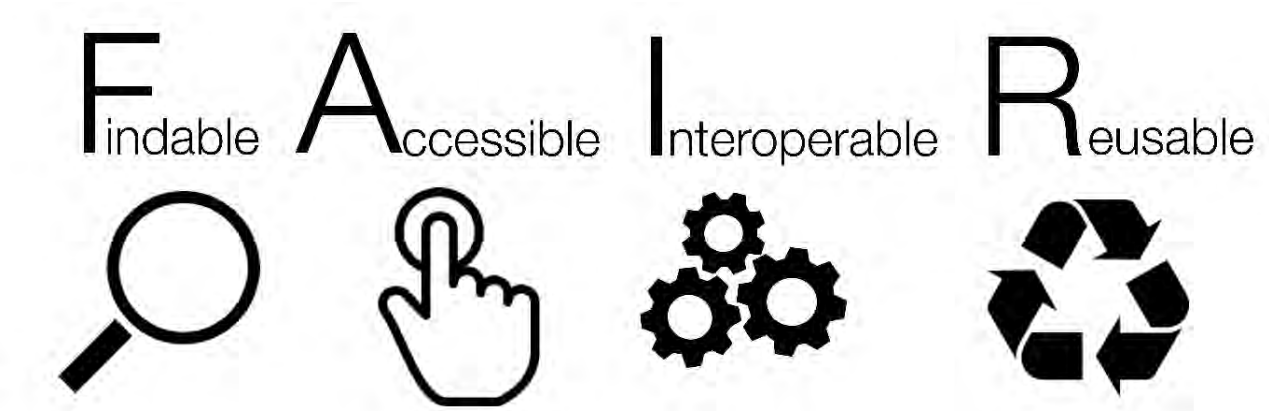



**Figure 6.** Fair Principles (Graphic by SangyaPundir published under a CC-BY 4.0 licence, see also https://creativecommons.org/licenses/by-sa/4.0).

ing project data in accordance with these principles.
More specifically, the FAIR principles state:

- Findable: data and metadata should be easily findable for humans and computers.
- Accessible: the conditions under which data are accessible should be provided in a way that humans and computers understand.
- Interoperable: data and metadata should be based on standardised vocabularies, ontologies, thesauri, etc. to be able to integrate them into already existing applications and workflows.
- Reusable: data and metadata should be well described so that they can be replicated and/or combined with other research data

This again illustrates the important role ontologies have in creating FAIR data.

3.2. Linked Open Data

Linked Open Data and the use of external (controlled) vocabularies also play an important role in fulfilling the aforementioned FAIR principles. Linked data are essential for building the semantic web (Tim Berners-Lee, 2006) and a best practice to publish structured data online (Stuart, 2016). It is an approach to making data interoperable (Murdock et al., 2012) by following the four rules of linked data principles as stated by Berners-Lee (2006, see also Stuart (2016), https://www.w3.org/wiki/LinkedData):

- Use URIs as names for things.
- Use HTTPS URIs so that people can look up those names.
- When someone looks up a URI, provide useful information.
- Include links to other URIs. so that they can discover more things.

Linking information to external sources creates a web of interconnected data-the semantic web-and makes it, therefore, possible for humans and machines to explore said web (Tim Berners-Lee, 2006; T. Berners-Lee & Hendler, 2001).

It allows homonyms to be uniquely assigned to their actual meaning in that specific context. Think, for example, of a data set about graffiti in Vienna, available online. Without further information, the mentioned Vienna could be the capital of Austria. However, the text could also refer to Vienna in Ontario (Canada) or talk about one of the many Viennas in the US—think of Vienna, Alabama, or the eponymous towns in Georgia, Illinois, Maine, or Wisconsin, to only name some of them. Humans might be able to distinguish between those possibilities, but machines, on the other hand, can not. By linking the city of Vienna in this record to the Austrian capital of the same name in another data set—e.g. the GeoNames thesaurus (http://www.geonames.org)—it unambiguously specifies which Vienna is being discussed.




**Figure 7.** OpenAtlas logo, designed by Jan Belik and released under a CC-BY SA 4.0 licence (https://creativecommons.org/licenses/by-sa/4.0).

**4. On OpenAtlas and Its Use in Cultural Heritage**

4.1. OpenAtlas in a Nutshell

OpenAtlas (Figure 7) is an open-source database software meant to acquire, edit and manage research data from various fields of the humanities, such as cultural heritage sciences, history, prosopography, and archaeology as well as related fields of the natural sciences. It is developed by a small, interdisciplinary team, which is mainly based at the Austrian Centre for Digital Humanities and Cultural Heritage (ACDH-CH) as part of the Austrian Academy of Sciences in Vienna (ÖAW).

Open Atlas provides a customisable and highly adaptable user interface. Freely selectable types allow the input mask to be adapted to the requirements of each project. Numerical values of any kind, such as length, width and height, can be entered via so-called Value Types. This user interface can be accessed via any standard web browser.

Within the INDIGO project, OpenAtlas is used to record and edit all data connected to each graffito while the images will be stored in the CoreTrustSeal-certified ARCHE repository hosted by the ACDH-CH (https://arche.acdh.oeaw.ac.at). The use of the database application enables the recording of the relevant data in a structured and standardised form throughout the entire project. Creator and graffito-specific information (like location, time of creation, style, colours, and dimensions) is easy to add via the browser-based user interface. Besides entering all information manually, OpenAtlas provides a way to import already existing structured information.

Furthermore, the system gives researchers opportunities to further process and analyse the entered information. For direct visualisation of the entered data, OpenAtlas offers the possibility to display them directly in the application as network graphics (for a representation with example data, see https://demo.openatlas.eu/overview/network). In addition, the OpenAtlas API (short for Application Programming Interface) provides all entered information in a machine-readable format and therefore serves as an interface between the database and a presentation website. On this web application, relevant information can be presented in an understandable, state-of-the-art and appealing way for scientific audiences as well as the general public. The API also allows for numerous other possibilities, such as data analyses. For example, one could run statistical tests with other specialised tools and to answer project-specific research questions.

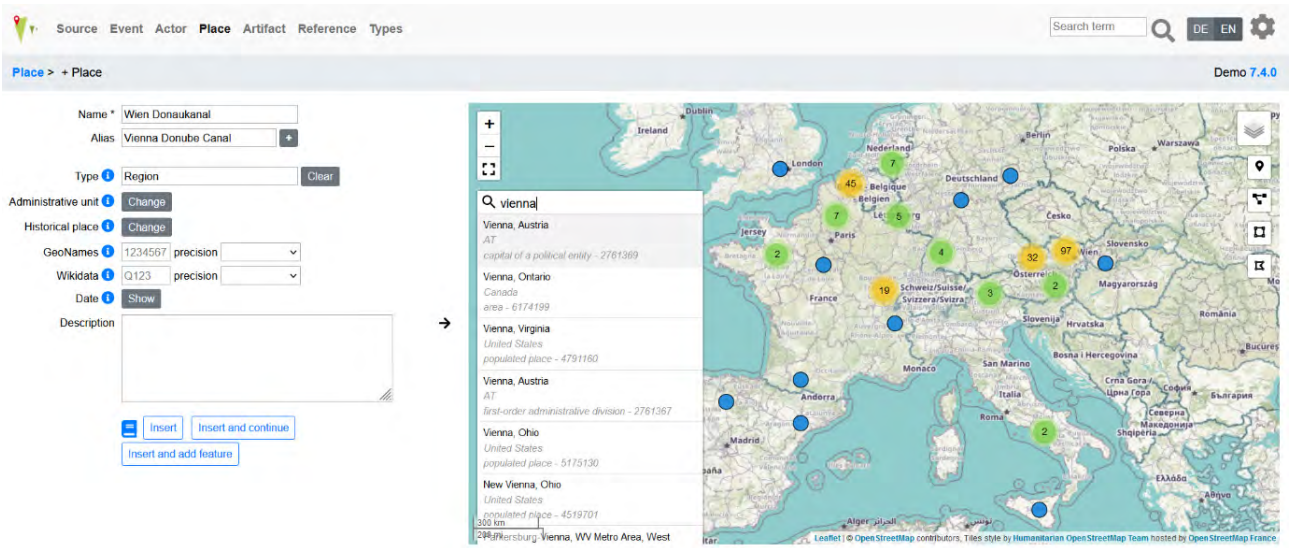



**Figure 8.** Enter new data about the Danube Canal in Vienna (Austria) via the OpenAtlas user interface.

4.2. The OpenAtlas Data Model and Why You Might Not Have to Worry Too Much About Ontologies or being FAIR and Open After All

As discussed earlier, ontologies play an important role in the scope of digital humanities. However, the application of these requires some knowledge and experience. The modelling of the data is not always intuitive and various ontology-specific rules must be followed. OpenAtlas provides a way to collect data and map it to CIDOC CRM through its user-friendly interface (Figure 8) without first becoming familiar with the ontology.

The entered data are mapped according to the CIDOC CRM specifications in the background of the application (Figure 9). The users do not need to be familiar with the complexity of the CIDOC CRM, as the software takes care of the mappings. To ensure data integrity and compatibility, no CRM extensions are used (e.g. CRMsoc https://cidoc-crm.org/crmsoc or CRMarchaeo https://cidoc-crm.org/crmarchaeo; for an overview of all CIDOC CRM extensions see: https://cidoc-crm.org/collaborations). Where possible, the system uses the CRM class that represents the lowest common denominator for the respective entity. However, as mentioned above, the users are most often not familiar with the CIDOC CRM, and therefore, superior classes are used to define the respective entity to guarantee a classification that is not incorrect. Of course, these mappings could be extended later by experts on ontology using the CRM extensions to go deeper into detail (Eichert, 2021).

Being open wherever possible is a key value of OpenAtlas. Therefore, in addition to offering an easy way to map data to CIDOC CRM, OpenAtlas allows for the creation of fair and open data in other ways as well. As already mentioned, OpenAtlas is itself an open-source project. The code developed by the team is freely available on GitHub (https://github.com/craws/OpenAtlas) under GNU General Public Licence Version 2 (GPL2, https://www.gnu.org/licenses/old-licenses/gpl-2.0.html). This allows other researchers and software developers to adapt the code to their needs and guarantees that work on it can continue even if the current key personnel or institutes are not available anymore. If technology developed by a third party is used in OpenAtlas, care is taken to ensure that it is also open source (for an overview, see: https://openatlas.eu/software). Since open source and open access play an important role in the development of the application, care is also taken in collaborations to ensure that the information collected in the projects is subsequently made available to a broad public as open access.

Therefore, OpenAtlas offers the possibility to link each project's data directly with external information of their

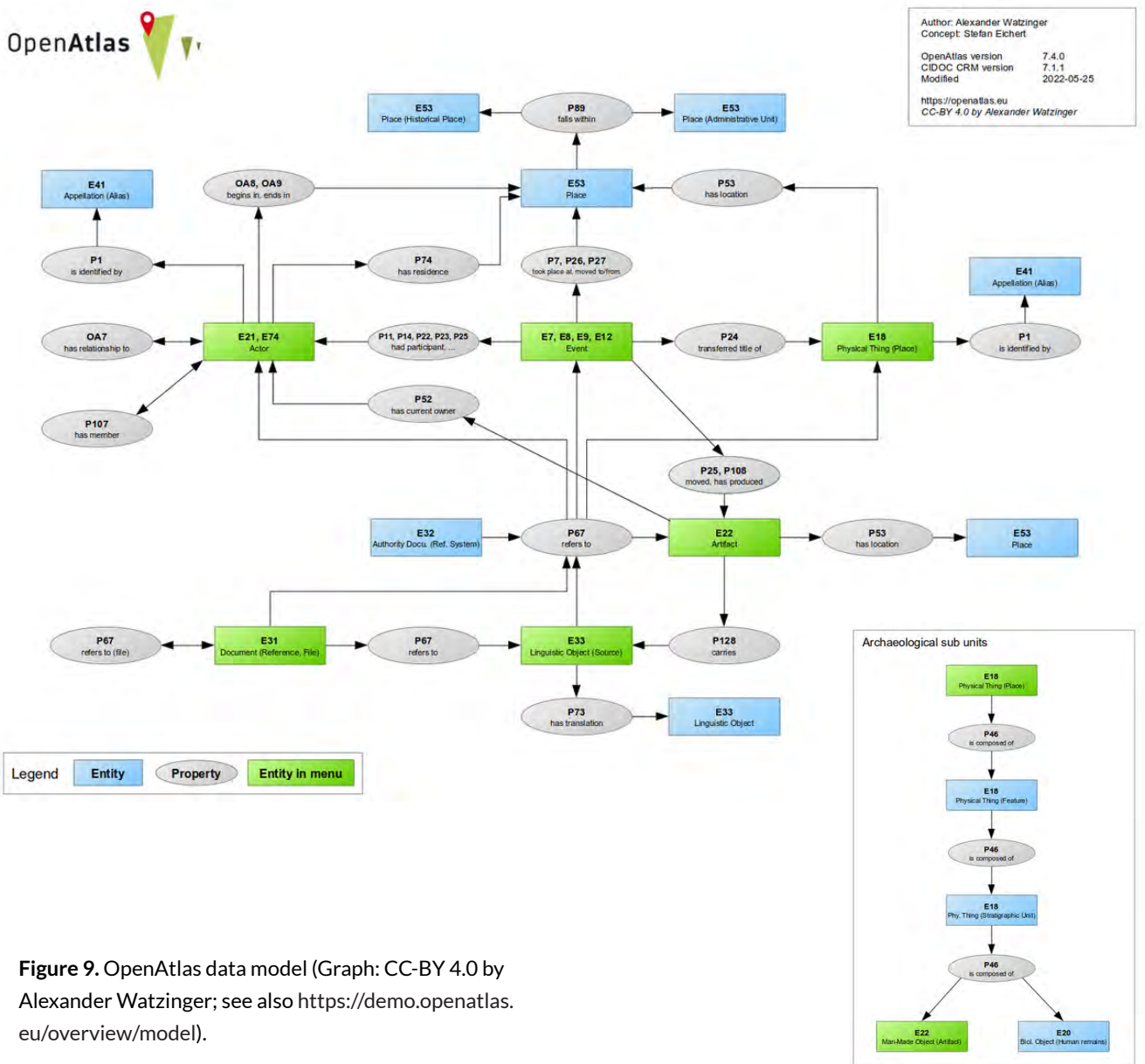



**Figure 9.** OpenAtlas data model (Graph: CC-BY 4.0 by Alexander Watzinger; see also https://demo.openatlas.eu/overview/model).

choice. This can be gazetteers and controlled vocabularies like Wikidata (https://www.wikidata.org), Getty's Arts and Architecture Thesaurus (https://www.getty.edu/research/tools/vocabularies/aat) or GeoNames (http://www.geonames.org), but also offline sources like inventory numbers of museums or old card catalogues of libraries.

From a technical point of view, the OpenAtlas users, respectively the hosts of the server, have full control over their data and can decide whether or not to provide them open. However, OpenAtlas provides the technical prerequisites to select, e.g. Creative Commons licences for the content, link it to controlled vocabularies and provide machine-readable data and metadata via an open API.

## 5. Conclusion

Using an ontology for any (research) data has numerous advantages. Ontologies give structure to the collected data and make them easier to re-use—both in their application areas and for other scientists. Structured data can be presented much more easily and coherently in various web applications and can thus be made available to the interested scientific community as well as to the general public. In addition, the use of an ontology that is established and widely used in one's science domain allows easy re-use of the dataset by integrating it into other data pools using the same ontology. Last but not least, this extends the life cycle of the collected data and can ensure that it does not become obsolete after a project is completed. The use of an ontology is thus an important step towards fulfilling the FAIR principles with respect to one's data set.

## Conflict of Interests

The authors declare no conflict of interest.

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Special thanks go to the entire INDIGO (https://projectindigo.eu team under PIs Geert Verhoeven and Norbert Pfeifer for their support of OpenAtlas as well as for organising the goINDIGO 2022 conference and this publication.

## Endnotes

1 - This most widely used definition was later supplemented by Borst (1997) as "formal specification of a shared conceptualization" and as "a formal, explicit specification of a shared conceptualization" by Studer et al. (1998) (see also Guarino et al., 2009; Stuart, 2016).

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# INGRID—Archiving Graffiti in Germany

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**Abstract**
The article introduces the research project INGRID (Informationssystem Graffiti in Deutschland/ Information System Graffiti in Germany), which was founded in 2016 and provides a scientific database for graffiti. INGRID is an interdisciplinary cooperation project between the Karlsruhe Institute of Technology and the University of Paderborn and offers a systematic registration of graffiti. INGRID contains over 130,000 photographs of graffiti. Different sources provided the images. A large part of the pictures comes from the police departments in Mannheim, Cologne, and Munich. Another part consists of photographs from private collections and public archives.
This paper focuses on INGRID's ontology, the usability of the database, and the annotation and acquisition of graffiti. Furthermore, there will be a presentation of exemplary studies, which examine the database from a linguistic, a historical and an onomastic perspective. With INGRID, it is possible for the first time to take a look at developments and changes in the phenomenon of graffiti over longer periods based on extensive, secure, and high-quality research data as well as to research its visual aesthetics, its specific scripturality, notational iconicity, grammaticality, urban location as well as its social function and meaning.

**Keywords**
archive; art history; document; graffiti; linguistics; ontology

## 1. Introduction

INGRID is a graffiti database within the framework of an interdisciplinary cooperation between art historians at the KIT (Karlsruhe Institute of Technology) in Karlsruhe under the direction of Martin Papenbrock and linguists at the University of Paderborn under the direction of Doris Tophinke. As graffiti is a cultural form with both written and pictorial aspects, a cooperation between linguistics and art history was an obvious choice. Since 2016, the "Information System Graffiti in Germany (INGRID)" has been funded by the DFG (Deutsche Forschungsgemeinschaft/ German Research Foundation). With INGRID, it is possible to look at developments and changes in the phenomenon of graffiti over longer periods based on extensive, secure, and high-quality research data. Furthermore, an important goal of the project has been the cooperation between the academic team and the graffiti scene itself. The creation of the ontology and the annotation of individual photos has been supported by the two local graffiti writers Volker Heisener and Denis Kelle. 85,709 graffiti are currently accessible for scholarly use from the project website (as of July 2022).

### 1.1. The first phase

The first phase ran from April 2016 to June 2019. It aimed at building an ontology and terminology to systematically document and analyse graffiti in Germany. The categories created here were derived from the inventories. The creation of this ontology is an ongoing process which is reviewed constantly. Over 40.000 graffiti from Mannheim and Munich were annotated and made accessible for research. The original images of the graffiti may be used publicly under the license CC BY-SA 4.0. Our generated metadata are available under the license CC0. The collection of the police department in Mannheim can be classified as particularly worthy of preservation and especially suitable for scientific research, including approximately 32,000 analogue images (35mm negatives) from 1998 to 2005 and approximately 18,000 digital images from 2006




**Figure 1.** Dedication to the investigation group of the police department in Mannheim.




**Figure 2.** Character by RAY.




**Figure 3.** A dove as a symbol of peace.

to 2014. Based on this collection, it is possible for the first time to document and examine the development of graffiti in a major German city over a period of more than 15 years. Unlike most police investigation groups, the Mannheim investigation group worked operatively. This means that it not only recorded and processed reports, but it also observed and photographed the "hot spots" of the graffiti scene and the typical routes taken by the sprayers. There has been a special relationship between the graffiti scene itself and the investigation group so that dedications and greetings to the members of the police department were also found on the walls (see Figure 1). In addition to the Mannheim collection, it has also been possible to preserve the collection of the ethnologist Peter Kreuzer. As part of a cooperation between INGRID and the Munich City Archive, the slides were digitised and added to the database. These photographs document the very beginning of style writing in Munich (see Figure 2), political graffiti (see Figure 3) and stencils. Furthermore, Peter Kreuzer preserved works of the artist collective Die Aachener Wandmaler and Richard Hambletons Shadowman in Munich.

1.2. The second phase

In the second phase, which started in July 2020 and ends in June 2023, more than 50,000 photos of the police departments in Munich and Cologne as well as photos of the private collector Dirk Kreckel will be annotated. The collection of Dirk Kreckel contains photographs taken at famous graffiti hot spots and hall of fames in Germany, for example, the former company grounds of Iveco in Kirchseeon, the former tank hall in Lüdenscheid, or the Schlachthof in Wiesbaden (see Figure 4). This collection is a useful addition to the photos taken by the police, especially the graffiti sprayed on a hall of fame or in abandoned areas, as these sometimes take on very complex shapes. The collection consists of a total of 14,145 photographs taken in 72 cities in Germany. The photographs from the police department in Munich were captured in and around Munich between 2002 and 2012. Through this inventory, it is possible to examine the development of graffiti in Munich and contrast it with the early phase in the early 80s and the Peter Kreuzer collection, which was registered in the first project phase. The collection of the police department in Cologne contains more than 29,000 photos that were taken between 2002 and 2019. This collection documents the tags and pieces of the graffiti scene in Cologne as well as numerous cases of graffiti by the local football teams 1. FC Köln (see Figure 5), Fortuna Köln and Bayer Leverkusen.

The second phase aims to create a comprehensive RDF knowledge graph (Resource Description Framework) of annotated graffiti images, which is updated constantly. The INGRID knowledge graph was designed to enable search, question answering, and machine learning. With the help of the graph, it is possible to statistically evaluate the metadata in INGRID and to create queries for questions that cannot be answered with the expert search in the database itself. For example, it is possible to compare the average number of style elements of graffiti in a legal hall of fame with the graffitis that are sprayed illegally. Furthermore, it



**Figure 4**. Wall Street Meeting 1999 @ Schlachthof in Wiesbaden.



**Figure 5.** Football graffiti in Cologne.

is possible, for example, to examine the frequency of the letters within the pseudonyms of the writer and crews in the graffiti culture. It turns out that due to their visual form, certain letters are preferentially sprayed (see Radtke (2020) p. 254). Another aim of the second phase is to test and use crowd-sourcing methods. From May 1st, 2022 to June 30th, 2022 the inhabitants of Paderborn had the opportunity to take photos of graffiti in the city area and upload images to the database INGRID through the app LingScape. The photos were imported into the INGRID database in July 2022 and were shown at an exhibition in September 2022. The accessibility of the data will also be optimised, and free access will be made possible within the second phase. The Kreuzer Collection (3139 graffiti in Munich, photographed between 1983–1985) has been freely accessible since February 2022.

**2. Process of archiving graffiti**

A key point is that the INGRID team does not take photos. The project's approach is rather to identify existing collections, examine their suitability for graffiti research and bring them together in a central database. The images were provided by different sources. A large part of the pictures comes from the police departments in Mannheim, Cologne and Munich. Another part consists of photographs from private collections and public archives. This idea resulted in a long process involving, among others, the legal departments of the participating universities, police investigation groups, police headquarters, state police directories and ministries of justice. Finally, it has been possible to obtain larger image collections from investigation groups in Cologne, Mannheim and Munich for research. These repositories contain secure and high-quality research data about the place where the graffiti was sprayed and the time when the photo was taken. In order to be able to use the images, a contract was made between the University of Paderborn and the right holders, which transfers the rights for the scientific use of the images to the INGRID project. This agreement allows INGRID users to publish images in a research paper, for example. A part of the collection in Mannheim and the entire image repository of the Kreuzer Collection are available in analogue form. In the first step, they were scanned according to the DFG's digitisation guidelines. The database itself is based on the flexible web application easydb that was configured to meet the needs of the project by the data centre for Information and Media Technology (IMT) at the university of Paderborn under the direction of Gudrun Övel and Heiko Nöthen. In the second step, the annotators of INGRID check the quality and the content of the photo before the process of annotation starts. In some cases, parts of the images are pixelated because they contain personal data. After the annotation is completed, the images are made accessible for research and permanently stored in the library of the University of Paderborn.

**3. Ontology**

In addition to the collection of images, a central task of the INGRID project was to develop standards for research and analysis of graffiti. The development of these standards led to an ontology that captures constitutive aspects of graffiti



**Figure 6.** Piece by CAN2.



**Figure 7.** Tag by SCARE.



**Figure 8.** Character in Mannheim.

(imagery, scripturality, context, locality, materiality, time, actors, etc.). On the one hand, terms and categories are used that are relevant to the scene itself, such as the distinction between different types like piece (see Figure 6), tag (see Figure 7), or character (see Figure 8). On the other hand, these categories are extended by subject-specific categories of the subjects linguistic and art history, such as linguistic constructions, formal techniques and symbols.

The ontology can be divided into three main categories: event, scripturality, and iconicity. The following table shows these categories and some examples of their subcategories.

By using the advanced search in INGRID it is possible to search for every single category of the ontology. It is also possible to combine the search categories. This allows, for example, searching for pieces with a political message in the database by searching for the categories theme/politics + type/piece. To analyse a graffito in more depth, the users have the option of collecting individual images in folders. The following table gives an example of a full annotation of the main categories. The example shows a graffito painted

| Event | Scripturality | Iconicity |
|---|---|---|
| **writer and crew** | **function** (signing, dedicating, locating…) | **motif** (animal, plant, fantasy…) |
| **place** (city, postal code, context, carrier medium and surface | **language** (English, German, French…) | **letter style** (simple style, bubble style, graphic style…) |
| **time** (recording date and dating given in a graffiti) | **linguistic construction** (writer name, finite construction, acronym…) | **elements of style** (background, crown, outline…) |
| **technique** (spray-can, stencil, marker…) | **character type** (letter, number, symbolic mark…) | **colour** |
| **type** (piece, tag, character…) | **theme** (music, politics, drugs…) | **figure style** (linear, flat or modelled) |

**Table 1.** The ontology and its upper categories



**Figure 9.** Piece by Mason in Dortmund.

| Event | Scripturality | Iconicity |
|---|---|---|
| **writer and crew**<br>MASON | **function**<br>name-calling | **motif**<br>- |
| **place**<br>city: Dortmund<br>postal code: -<br>context: crossing, aggregated<br>carrier medium: wall, train line<br>surface: concrete | **language**<br>English | **letter style**<br>simple style |
| **time**<br>15.08.1998 | **linguistic construction**<br>writer name formed from a proper name | **elements of style**<br>outline, fill-in, sides, bubbles |
| **technique**<br>spraycan | **character type**<br>letters | **colour**<br>blue, black, white, purple, grey, brown |
| **type**<br>piece/writing/style | **theme**<br>- | **figure style**<br>- |

**Table 2.** Annotations of Figure 9.

by the writer MASON in Dortmund (see Figure 6).

**4. Research Perspectives**

The ontology of INGRID examines graffiti from multiple perspectives. The annotation analyse, the use of language, meaning, space, and style. By preserving graffiti and annotating metadata, INGRID helps to answer questions arising within the practice of graffiti writing, for example: What type of languages are used? What is the function and the meaning of a graffito? Which techniques are used? How does a graffito interact with its environment? How has graffito developed over time?

The database and its annotation system have already been used in research and journal articles. The following part of this paper gives a few examples of research questions based on the INGRID data.

Papenbrock (2017) examines the visual form and the look of tags in Mannheim and contrasts some cases with the tradition of New York tagging in the mid-1970s. He points out that tagging is about deforming and reshaping letters, putting names in flow and motion, and adding symbols and signs to the pseudonyms. In her PhD thesis, Heidi Pfeiffenberger (2018) analyses stylistic characteristics of regional and personal styles in the German cities Mannheim and Karlsruhe. She uses the categories of city and type to examine personal and regional graffiti styles within the framework of art history. Another goal of her thesis is to create a systematic registration of graffiti. Martin Papenbrock (2019) analyses the origins and evolution of style writing in Munich based on the collection of Peter Kreuzer. He outlines how style writing made its way from the subways of New York to the walls of Munich in the early 1980s. One interesting observation was that some early graffiti writers like PHANTOM, HOG105 or ZEPHYR in Munich tended to paint messages instead of their names in the centres of a piece. As examples, Papenbrock mentions Street Spray, Spray of Life or Wild Style.

Radtke (2020) analyses the language and iconography of graffiti pseudonyms within the framework of onomastics,




**Figure 10.** Piece by SHARK.



**Figure 12.** Tag by CRIPS.




**Figure 11.** Piece by MAREK.




**Figure 13.** A Beat Street Kupfi in Munich.

| type | non-standard spelling | standard spelling |
|---|---|---|
| homophone spelling | punx, kingz or kash | punks, kings, cash |
| colloquial spelling | Nazis boxn, representin | Nazis boxen, representing |
| interlingual spelling | däncer, LSD vorever | dancer, LSD forever |
| regiolectal spelling | Huschte, a bische tagge, Mannem | Husten, ein bisschen taggen, Mannheim |

**Table 3.** Types of non-standard spelling.

linguistic landscape studies and linguistics. Her research is based on a total of 11,624 photographs of the police department in Mannheim. She demonstrates that graffiti writers in some cases are choosing words with meaning. This forming of pseudonyms is often based on certain semantic fields. The pseudonyms refer to certain semantic concepts. As examples, she mentions the concepts of danger and risk (for example, the pseudonyms SCARE, FEAR, or SHOCK), the concept of strength (for example, POWER, FIST, or STONE) or the concept of courage and daredevil (for example, RAMBOS, REBEL, or RISK). The different types of forms being used to form a name of a writer or a crew can be shown in the database via the category linguistic construction. Within the ontology, a distinction is made between pseudonyms from lexicon words with meaning (see Figure 10 SHARK), proper names (see Figure 11), and neologisms and other forming patterns. Another result of her work was that tags use a pattern-like decorum. This includes the use of crowns, arrows, or quotes (see Figure 12).

Niemann (2022) examines football graffiti of the team SV Waldhof Mannheim in INGRID and their frequency of colours. By combining the categories of theme and colour in the advanced search, he explored that over 60 per cent of the graffiti are using the colours blue and black, the club colours of the team Waldhof. Doing this, this survey analyses the importance of visual aspects in the practice of graffiti. Moreover, Niemann explores the emergence and evolution of the vocabulary and terms in the early graffiti writings in Munich. This analysis has shown that in addition to the English terms toy and bite, the German term Kupferer or Kupfi is also used to insult other writers in the 1980s. Later collections of graffiti in INGRID starting in the mid-1990s no longer include this alternate form. This emergence of a writer's jargon, slang and specific language can be an interesting subject matter for future research. Androutsopoulos (2000), Wacławek (2011) and Jørgensen (2008), for example, have found out that alternative spellings and languaging play an important role in the practice of graffiti writing and other youth cultures. The users can find examples of over 2000 cases of alternative spellings in the database INGRID. Androutsopoulos (2000, p. 520) argues that non-standard spellings "based on graphic-phonic relations and on additional formal criteria (...) can be divided into six types". Table 3 shows examples for different forms of non-standard spelling.

**5. Conclusions**

This article has shown how the database INGRID can help to examine graffiti in Germany over longer periods based on secure high-quality data. The purpose of this article was to identify possible research perspectives for dealing with the verified empirical metadata in INGRID. Based on the analysis conveyed, it can be concluded that the metadata are important for multiple subjects, such as media science, political science, social science, art history, and linguistics. Future exploration can obtain a deeper analysis of textual data that cannot be carried out with the advanced search via the INGRID knowledge graph (IKG). The IKG will be linked to three other knowledge graphs DBpedia, WiKiData and LinkedGeoData.

The INGRID database is also an excellent tool for teaching at schools and universities.

In the past few years, the system has already been used in teaching at the University of Paderborn, at the KIT in Karlsruhe, and at the Gymnasium Höhenkirchen Siegertsbrunn. In addition to scientific use, the preservation of urban art is also of interest to the fields of art, culture, and tourism. Since 2018, project member Sven Niemann has been leading graffiti tours in Paderborn and, with the support of the tourist information, has created digital tours. This cooper-

ation is creating a closer network of knowledge transfer between the university and the inhabitants of the city of Paderborn. In addition to the support of educational institutions and city tourism, cooperation projects with museums and archives have also emerged in the second phase. It turned out that the preservation of ephemeral art is of great public interest. In 2022 INGRID already supported exhibitions at the Museum Schnütgen, CO3 Galerie and Fort A in Cologne and Minden.

**Conflict of Interests**

The author declares no conflict of interests.

**Acknowledgements**

All figures have been taken from the INGRID database. Papenbrock, M., Tophinke, D., Doris/Oevel, G., 2016. INGRID – Informationssystem Graffiti in Deutschland. https://www.uni-paderborn.de/forschungsprojekte/ingrid.

The following list contains information about the location where the photo was found, the year when the photo was taken and the graffiti object number under which the photo can be found in the database.

Figure 1: Mannheim 2012, #46184
Figure 2: München 1983 – 85, #67302
Figure 3: München 1983 – 85, #65066
Figure 4: Wiesbaden 1999, #167453
Figure 5: Köln 2016, #187622
Figure 6: Unna 2001, #165115
Figure 7: Mannheim 1998, #116948
Figure 8: Mannheim 2010, #114716
Figure 9: Dortmund 1998, #154757
Figure 10: Dortmund 1998, #154757
Figure 11: Mannheim 2009, #102194
Figure 12: Mannheim 2008, #45030
Figure 13: München 1983 – 85, #64858

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# Spraycity.at—Graffiti Archive and Online Map

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**Abstract**
Spraycity is a documentation archive dedicated to the graffiti writing movement in Austria. The archive was founded in 2001 by art historian Stefan Wogrin to react to the transience that goes hand in hand with writing. The works of the graffiti writing movement are usually ephemeral and not destined to last forever. The 'Spraycity' archive aims to record, archive and catalogue the resulting works as photographs and makes them accessible to the public for a longer period. While some works have already disappeared from the public, photographs are often the only possibility to let them remain. The archive currently includes about 300,000 image documents from all over Europe (mainly in Austria), Asia and the USA. The 'Spraycity' website (https://www.spraycity.at) forms an interface through which a selection of around 100,000 photos can be accessed online. Each photo contains metadata and is also searchable through its categorisation and keywords.

**Keywords**
archive; Austria; documentation; graffiti; Vienna; writing

## 1. Introduction

Already at the beginning of the graffiti writing movement in North America at the end of the 1960s, it was clear that the resulting works were not intended for eternity and would be removed from their image carriers or painted over after a very short time. Fortunately, we now have photographs by the creators themselves or by amateur and professional photographers which were taken shortly after a work's creation and before its removal. Based on the photographs, the works of that time can still be viewed, classified and analysed today. As early as the 1980s, it was the media that was responsible for the worldwide distribution of the movement using photographs and films, which was also accompanied by a stylistic takeover in Europe (Hinz, 2018). However, canvases made by the writers in response to the demands of the art market have also been preserved from that period. Those canvases were also responsible for the worldwide reception of the movement, as they were displayed in galleries, museums and at art fairs in Europe (Stahl, 1992). However, those canvases show the original content from the subway exteriors in a more romanticised way. On the canvas, graffiti became the subject of the painting, while photographs and video recordings are predominantly of a documentary nature. In particular, cinema films such as 'Wild Style' (1982) and 'Beat Street' (1984) or the documentary 'Style Wars' (1983), along with books like 'Subway Art' (1984) and 'Spraycan Art' (1987), are often cited by first-generation European writers as the most influential publications and sources of inspiration—also with regard to the reception and adoption of the North American form language. During the 1980s, graffiti was still primarily conveyed via mass media. In the 1990s graffiti magazines, such as the German 'On the Run' or the Swiss '14k' magazine followed. Those magazines were often produced by the writers themselves (Kraus, 2021). The magazine 'Servus Wien' was also published a little later in Austria, in the mid-1990s. Those magazines were mostly focused on the local area, i.e. a city, a region or a country. Usually, international photo submissions were also shown, which resulted in a lively exchange across national borders. A decade later, around the turn of the millennium, the internet was becoming increasingly important among writers for the distribution and display of their works, which resulted in countless websites being created in the short term (Mininno, 2021).

The website 'Art Crimes', for example, which is also known as 'graffiti.org' and which can still be accessed today, acted as a hub (https://www.graffiti.org). Many websites from that time were hardly and often badly structured or limited to the work of an artist or a crew. 'Art Crimes', on the other hand, has a clear structure. The content can be accessed both geographically (by continent, country and city) and by the artist's name. In addition to photo galleries, there are countless links to other websites, even if some are no longer accessible today. Some photos from Vienna can also be accessed here, although the selection of images is more of an exemplary nature. In addition, the photos contain hardly any metadata. The artist and recording location are sometimes completely missing. Austria itself also had its first websites around the turn of the millennium, such as that of the 'IFG, Institute for Graffiti Research' run by Norbert Siegl. Here one can find an extensive collection of information, some of which is scientific, as well as a graffiti encyclopaedia that illustrates parts of the archive and makes them accessible via the website (http://www.graffitieuropa.org). But there is no possibility to search for specific places or artists. Another website from Austria was 'graffiti.dadasign.at' from 'Tesa', which was online until approximately 2006. The website provided a photo gallery, which was structured through the federal states. Each photo had a unique identification number, along with artist's and location information. However, the classification was limited to the Austrian federal states. A subdivision was not possible except for Vienna, which is both a city and a federal state. In addition, a so-called 'Hot Spots' list was made available via the website. The list contained both permitted spray areas as well as places in Austria that were not permitted to paint but were popular among the writers. From the list it was not clear whether the mentioned area is a legal wall or not. There was also no map with a general overview, but a map for each spot with the marked location. A short time later, other websites such as 'flasht.org', 'graffiti.stare.at' and 'innsbrock.at.tf' were created ('graffiti.stare.at' is no longer accessible today but since June 2022 the complete archive of 'innsbrock.at.tf' is available again through the 'Spraycity' website). In my opinion, there was a lot of Austrian material that was accessible online, but there was no comprehensive collection that provided the recipient with all the extensive information, like about the culture, the community or the history. The incipient interest in graffiti culture probably leads the inexperienced layman to the internet very quickly these days, which I can also confirm from my own experience. With the knowledge of the Austrian websites, I founded the website 'Spraycity' in 2001, with which I am still trying to create a central, comprehensive place for graffiti in Austria.

In particular, the following goals should be achieved first:

- Creation of an online accessible archive
- Structure by country, city and category (Allover, Hall of Fame, Line, Street, Trains)
- Creation of a map with all legal graffiti areas in Austria, including sources that confirm the legality of a wall
- Collection of press articles

**2. Archive**

The 'Spraycity' archive now includes around 300,000 photos, of which around 100,000 are accessible via the online platform (all other photos are exclusively in use for other projects, such as the 'Offline Graffiti Magazine', newspaper articles or books). The archive is also constantly expanded - with photos from 'Spraycity's own documentation tours, photos sent and photos from external archives. 'Spraycity' collects photos from graffiti created worldwide (currently, photos from Asia, the USA and Europa are accessible).

The archive is divided into:

- Online archive (publicly accessible)
- Collection and digitisation of photographs acquired before 'Spraycity' was founded in 2001, in particular for use in the ongoing book project on the history of graffiti in Vienna
- Collection of photos for exclusive use in the 'Offline Graffiti Magazine'
- Collection and archiving of publicly accessible archives, blogs and social media accounts
- Collection of books and magazines
- Press archive (thousands of articles from the 1980s to today)
- To make it easier to search, most of the archive material has already been provided with metadata.



**Figure 1.** Part of an installation by 'Spraycity' showing photos alphabetically ordered by the painted words. Exhibition 'Take-over', Wien Museum, 2019, Photo by Stefan Wogrin

**3. Documentation**

Since many works are only visible for a short time, there is a constant, systematic ongoing documentation by 'Spraycity'. The geographical centre of the documentation are the city of Vienna and its surroundings. The documentation in the federal states takes place at irregular intervals. Due to its size and population, Vienna can also be considered the centre of the Austrian writing movement, which is also reflected in the number of works. The documentation usually takes place as part of our documentation tours, which have the purpose of photographing as many new works as possible (mainly works not in the archive yet). A photo tour usually takes 2–6 hours and is done 2–4 times per week. A specific target is typically selected, and the environment is then examined for new works. When choosing the destination, previous photo tours are also taken into account, so that certain places are not visited directly one after the other. Specific locations with increased frequency, such as the Danube Canal or certain 'Wienerwand' (legal graffiti walls in Vienna) areas, are recorded every three days on average. Planning a photo tour is usually preceded by an investigation of online content (like social media platforms) for potential newly created works, as well as anonymous tips.

3.1. Photography

New works are taken almost exclusively in the form of an overview photo. Thereby, the work is positioned in the middle of the picture. Since the selection of the location is often essential, the surroundings are also partly recorded. In addition, graffiti in the public space is always connected to it and should, therefore, not be seen separately from it. The image carrier or background should also be visible in the photo. Detailed photos are only used very rarely, for example for small-scale works like stencils or stickers—although an overview photo is always created here as well. On average, 1 to 3 photos are recorded for each work. At specific locations, overview photos of entire walls or wall sections are also taken to ensure later comparison with older photos from the same place. In this way, the development but also the stratification of the individual works can be tracked and analysed over time. For the recordings, we use mostly full-frame single-lens-reflex (SLR) or system cameras. In case of spontaneous encounters, backup photos are also taken with the smartphone. On average, between 10,000 to 15,000 photos are taken each year.

**4. Online Plattform**

Historically Spraycity was founded in 2001 as an online

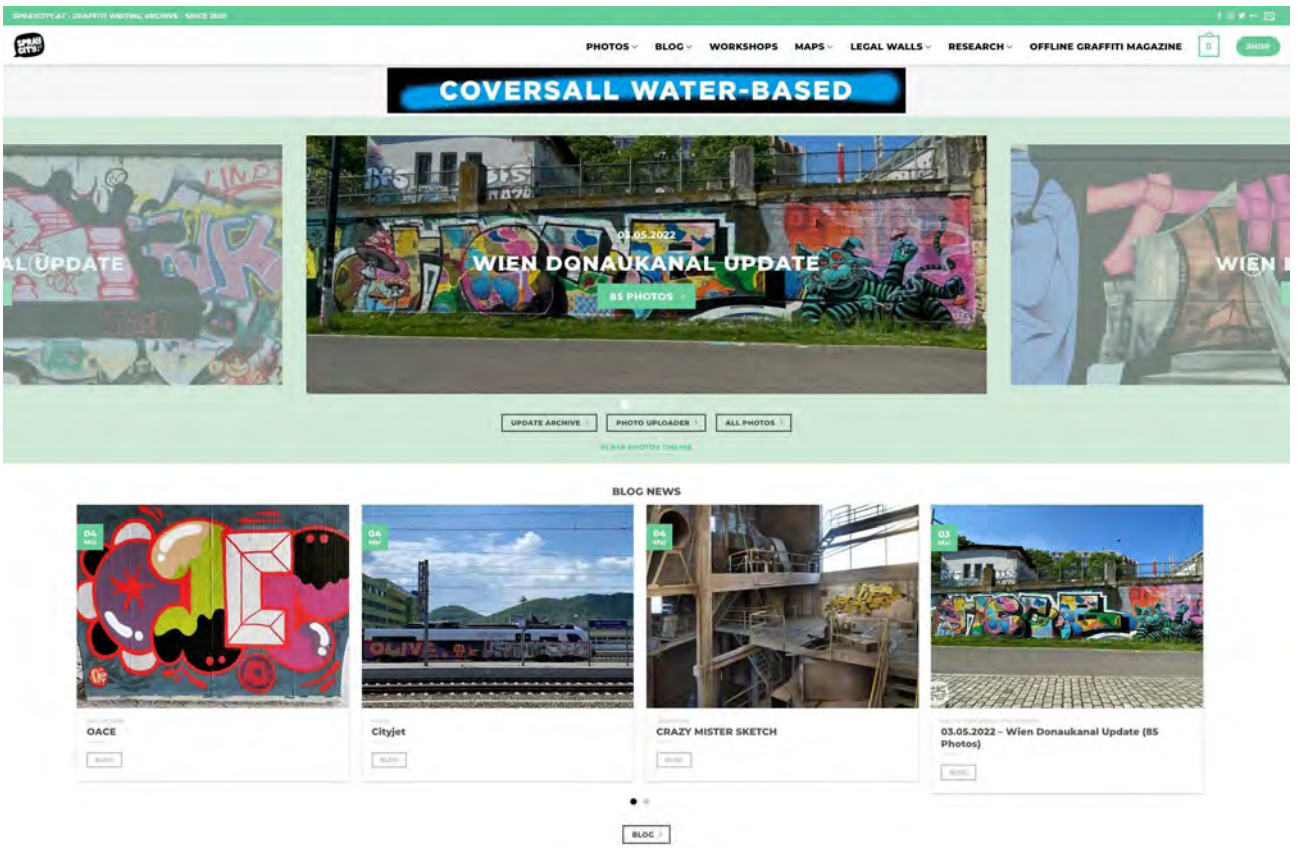



**Figure 2.** Screenshot of the homepage, available at www.spraycity.at (2022-05-04)

platform, which exists to this day and has been constantly renewed and expanded. The main components are the online photo archive, the blog and the maps, as well as an online shop.

4.1. Online Photo Archive

In the beginning, the photo archive was implemented with HTML (HyperText Markup Language) and the scripting language PHP (Hypertext Preprocessor, but initially "Personal Home Page Tools). As the archive grew over the years, this was no longer sufficient, and the gallery was converted to open-source content management systems (WordPress and Piwigo). The photo archive can be accessed via the home page. On top, there is the 'Spraycities' map, which gives an overview of the cities that are available in the archive. Below one can choose between the main categories. On the one hand, geographically (Austria or International) and also according to specific categories such as events (jams and exhibitions), sketches, street art & murals or atmosphere photos. On the other hand, external archives can also be accessed directly from here. Such are digital or analogue photos from external photographers as well as collections or inventories from former websites. A separate folder is also created for each photo update. Updates are usually grouped geographically, showing an average of 30 to 150 photos from a city, state, or country. Photos of events are also uploaded to the online archive. If there are photos from different cities in one update, the content in the folder can also be displayed separately according to the associated subfolders. The sorting in the respective folders shows the newest photos. The user can add his photos to the archive via an uploader. However, the photos are not immediately visible, but will be reviewed and added to the archive with one of the following updates. The upload is anonymous or,

if desired, an archive with photo credits can be created. The administration is currently carried out by 'Spraycity'; user registration is not (yet) possible. The online photo archive currently shows around 100,000 photos from 31 countries and 300 cities.

4.1.1. Metadata

All photos in the online archive are provided with metadata. The archive material can already be sorted according to specific metadata via a menu bar on the start page of the online archive. The selection can be made by 'Category', 'Type', 'Colour' or 'Year'.

- 'Category' contains the main categories. Here all photos on trains or on the street can be displayed, for example. It is also possible to show different content, like old-school works, political slogans or football graffiti. The latter have gathered enormous popularity in Vienna and Austria in recent years, which is why a specific gallery is dedicated to football graffiti. For example, it is possible to search for works related to a specific football club.
- 'Type' describes the image content and its superordinate classification. For example, any abstract or photorealistic works can be retrieved. In addition, displaying photos according to classic writing terms such as 'Throw Up' or 'Wildstyle' or 'Wholecar' and 'Wholetrain' is also possible.
- 'Colour' enables the display of 13 different basic colours of one work. In the annotation, the most fre-

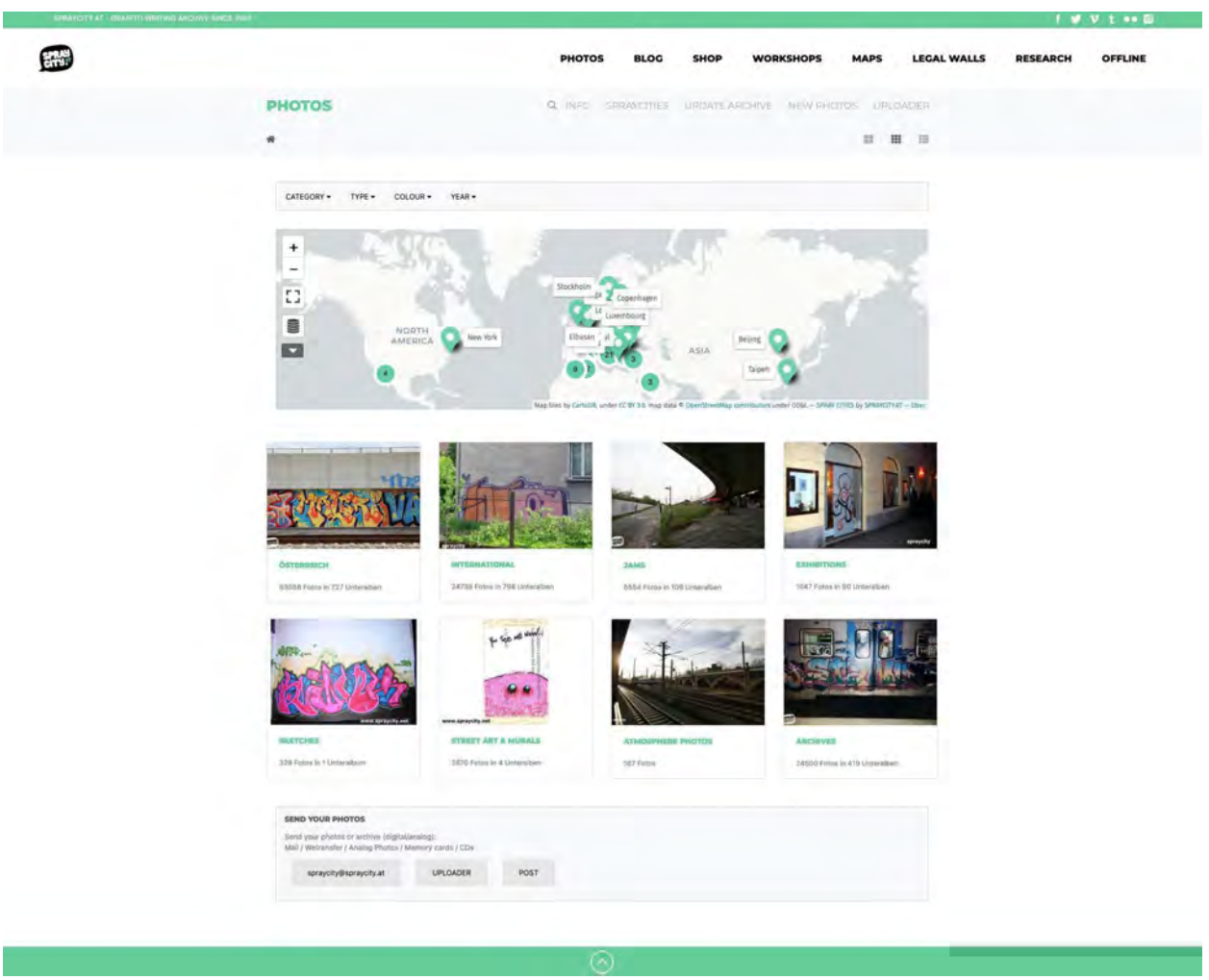



**Figure 3.** Screenshot of Spraycity's online photo archive, www.spraycity.at/gallery (2022-05-04)

quently used primary colours of a work are recorded. In addition, colour combinations of two or more colours can be retrieved using the search function.

- 'Year' means the year in which a work was created. The display is currently possible without gaps from 1991 to 2022. The oldest classic writing works in the archive were created between 1984 and 1989. A category with historical graffiti is currently under construction.

At the photo detail view level, each image contains a selection of metadata. In addition to photo credits and the classification in the different folders, the publication date and the number of page views can also be displayed. In individual cases, the recording date can also be called up. Additionally, each photo is tagged with country, city, and location information. The keywords are also used for the search function, which means that many keywords can also be combined. In particular, the location is given in detail for many photos. For example, specific addresses with street and house numbers can be found. But a classification according to different image carriers is also possible.

The keyword 'content' can be used to describe both the stylistic and the content level of a work. These can, for example, be attributes from the formal language of writing, such as arrows, crowns, highlights or drips. However, certain designs like clouds or bubbles, can also be displayed in isolation. In addition, specific content such as different animals, body parts or objects can be called up. Political content or people can also be found in this way. With so-called 'messages', the actual written text content is transcribed. It is also possible to sort the archive by artist, which is only used for legal walls and projects. In the case of walls that are not allowed, the term 'text' is used instead in some cases, with which an attempt is made to decode what is written. However, this is usually a subjective interpretation that does not always have to refer to the artist's name.

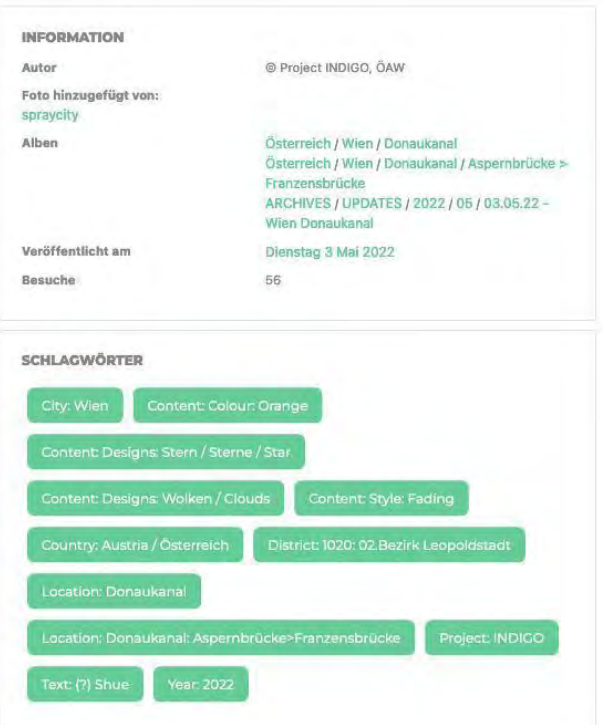



**Figure 4.** Screenshot of the metadata like keywords (Ger. Schlagwörter) stored in Spraycity's online photo archive, www.spraycity.at/gallery (2022-05-04)

4.2. Blog

The blog acts like a news portal and is updated daily. Current photos from social media sites or videos are published several times a day. Currently, around 18,000 photos are accessible through the blog. In addition, there are references to current press articles. The blog also contains useful information for the community about events such as jams or exhibitions. The published content on the blog has a major focus on Austria.

4.3. Interactive Maps

To simplify the presentation of the archive material and to locate legal areas, 'Spraycity' creates interactive maps that can be accessed using OpenStreetMap or Google Maps.

4.3.1. Legal Walls Map

This map shows all permitted, legal graffiti walls in Austria. It often seems to be difficult for graffiti writers to find legal walls in other cities or the legal status of specific walls can't be determined sufficiently, because sometimes information about these walls is not released by city administrations

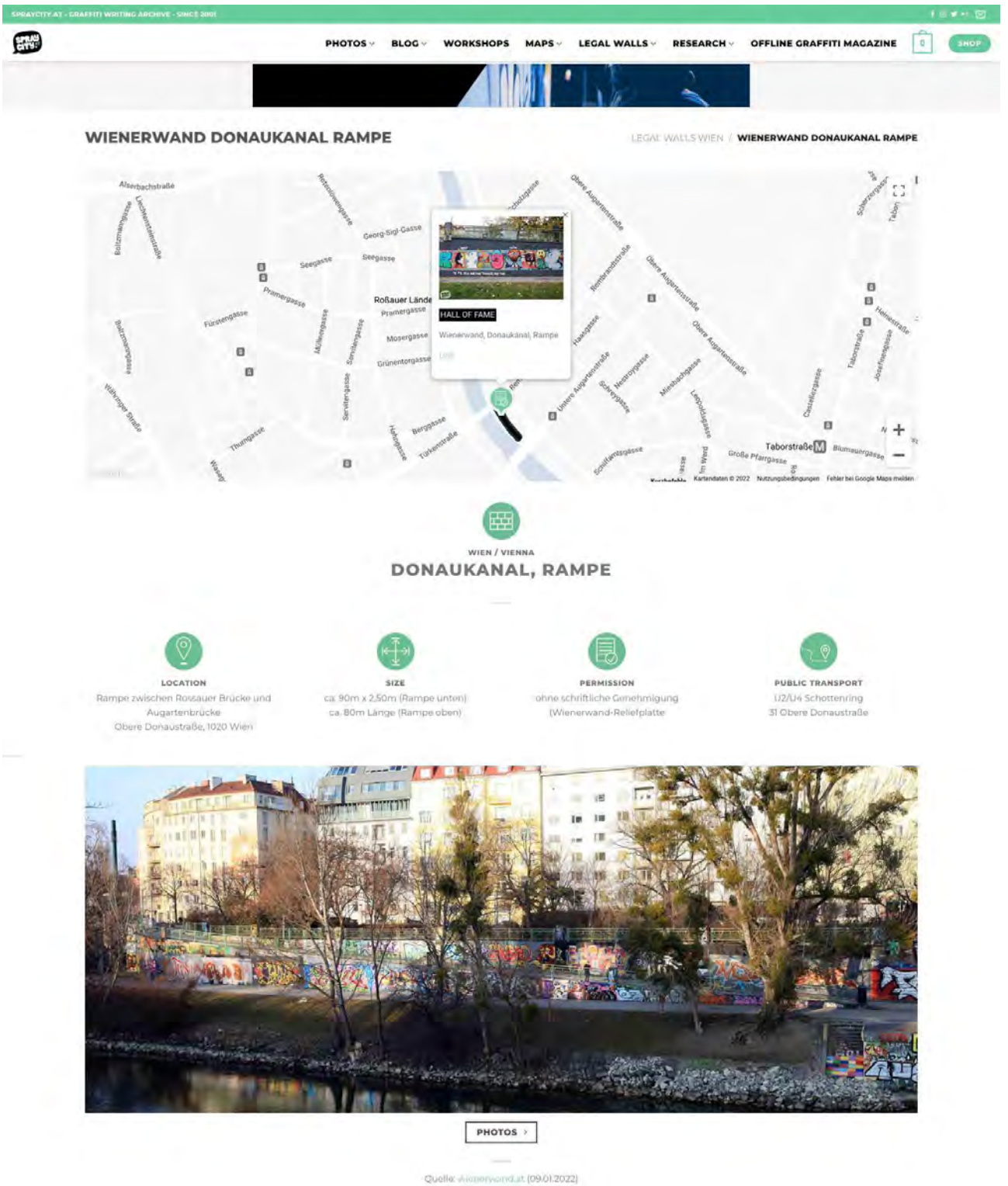



**Figure 5.** Screenshot of the Legal Walls Map, www.spraycity.at/legal-walls-wien (2022-05-04)

or the organisation is completely done by free initiatives. Many walls are often not marked as a legal wall on site. The map is intended to support the writers in their search for those permitted areas. For better orientation, there is one map for each federal state, which is additionally accessible by city (the federal state of Burgenland is an exception; there are no legal walls at the moment). The colour of the marker also shows the status of the area. The green marker shows areas that can be painted freely and no registration or approval is required. However, there are also some areas that can only be painted after consultation with the owner or another contact person. Those areas are marked with a yellow marker and highlighted by an exclamation mark. In the detailed view, additional information such as an address, size and reachability can be found. There is also an external reference that also ensures the legality of the wall. In addition, each entry contains photos of the areas or a link to the photos in the archive. Today the map is well known to the community but also to city administrations or projects, which get in contact to inform about newly built legal walls. 'Spraycity' also supports interested city administrations in finding the optimal places for setting up new legal zones.

4.3.2. Graffiti Map Vienna

With the map 'Graffiti map Vienna' nearly all existing but also already disappeared graffiti spots in Vienna can be displayed online. The systematic documentation allows it to see how the entire development of a specific spot has changed over the years. The map is connected to the online photo archive and photos can be retrieved directly by clicking on the markers. For a better orientation, each marker category has a specific colour. In the menu bar, it is also possible to hide all layers that are not currently needed.

If there is more than one photo in the archive, the marker shows a plus sign (+). There are also clustered locations with different spots or walls in one location, for example in parks. The markers show a star sign for these locations. Usually, there is also a polyline around the border.

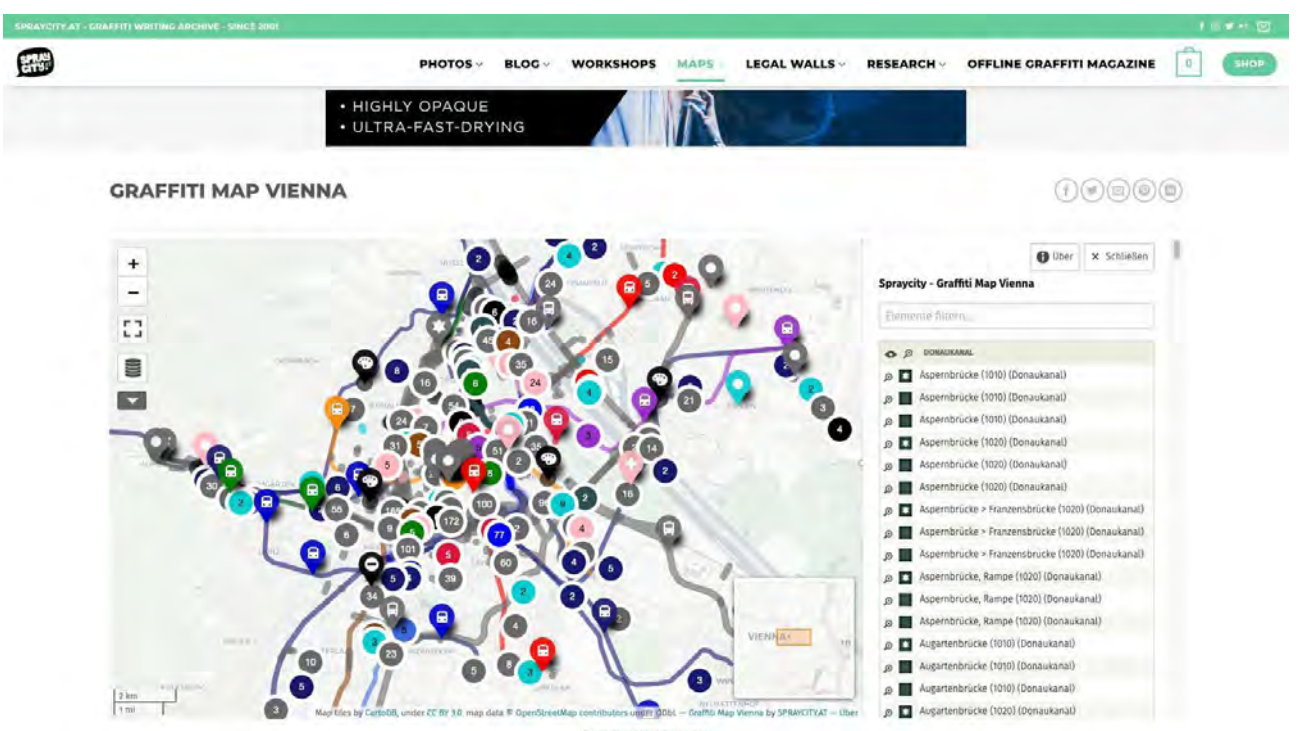



**Figure 6.** Screenshot of the Graffiti Map Vienna, www.spraycity.at/map (2022-05-04)




**Figure 7.** Screenshot of the Graffiti Map Vienna with a detailed view of the Danube Canal, www.spraycity.at/map (2022-05-04)

There are different categories:

- Hall of Fame: 'Wienerwand' spots
- Donaukanal: Since the Danube canal is a very popular graffiti location, there is also a separate section for this area (Ringhofer & Wogrin, 2018). More than 15,000 photos are available in the online archive from this location. The Danube canal on the map is divided into the areas between and under the bridges, which can be retrieved separately. In addition, some popular spots are also highlighted. For some walls it is also possible to see the entire development, from the first layer to today's condition.
- Line: Spots next to the train lines are also divided into specific lines, like the subway (U1, U2, U3, U4, U6) or the different S-Bahn lines. All lines are separated into areas within one or between two stations, so one can find specific works more easily on the map. A special case comprises all walls next to the main S-Bahn line ('Stammstrecke'). Here it is possible to separate the existing parts in-between the stations further into all existing walls next to the railway lines, also in both riding directions. This kind of display will be the role model in the future also for walls next to all other railway lines in Vienna that are featured in the online archive.
- Street: All works painted in the streets can be displayed by the district. This allows one to see how many works are located in one street for example. The street spots are furthermore divided into specific subcategories which represent popular locations like the 'Gürtel', 'Donauinsel', 'Naschmarkt', 'Wienfluss' or 'Autobahn' (Highway).
- Murals: allowed street art murals
- Allover: all other locations which are not completely categorisable

**5. Offline Graffiti Magazine**

The 'Offline Graffiti Magazine' was founded on the occasion of 'Spraycity's tenth anniversary. The print magazine has published eight issues since 2011 and shows, in addition to some text contributions, primarily photos with a focus on Austrian train writing. The content on 96 pages is divided according to the specific train categories: 'S-Bahn', 'U-Bahn', 'Austria Trains' and 'International Trains'. The magazine mainly shows exclusive photos, i.e. photos that have not previously been published on the internet or in other print media. Due to the popularity of the internet and the increasing publication of photos, it is getting difficult to obtain exclusive photo material. Therefore, a further focus




**Figure 8.** Offline Graffiti Magazine, Issue #4, Photo by Stefan Wogrin

is also placed on the composition of the photos. For example, preference is given to photos that also include the surroundings or works that especially refer to the location instead of typical photos on the platform.

**6. Graffiti History Vienna**

'Spraycity' furthermore explores the history of the writing movement in Austria, which includes the collection (and first-time digitisation) of photos from the beginning of the writing movement in Austria until now from all kinds of archives. In the period from 2013 to the present day, around 10,000 analogue photos have been scanned. The research material comprises around 30,000 photos that have been sorted and categorised. For several years, 'Spraycity' has been working with its project partners on a representative compilation of image material from the period from 1983 to the present day. The result will be published as a printed publication.

**7. Conclusions**

With the 'Spraycity' archive, a comprehensive photo collection with a geographical research focus on graffiti writing in Austria was founded. Large parts of the archive are publicly accessible online. Thanks to the archive's long history, countless works that had already been destroyed have been preserved in analogue or digital photographs for more than two decades. With a systematic categorisation and the use of an extensive metadata catalogue, the material can also be retrieved very easily for different research purposes. In addition, 'Spraycity' uses existing online map services to display the material in a new way. Due to the constant documentation, 'Spraycity' can continuously add current material to the archive, while users can also make their photos or archives centrally accessible through the online archive. With the additional collection of older photo material, a central archive for the graffiti culture in Austria was created.

**Conflict of Interests**

The author declares no conflict of interests.



**Figure 9.** Digitisation of analogue photos, Photo by Stefan Wogrin

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# Conservation of Graffiti: Ethics and Practices

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**Abstract**

The conservation of contemporary graffiti has been a topic of study scarcely addressed by researchers, practitioners, or the public. Largely, with graffiti being a cultural phenomenon worldwide since the 1970s/80s, the conservation and dissemination of the pieces and murals have always been presented through photographs, in the form of records that allow the collection, admiration and exhibition of what pioneer graffiti writers did, and what later generations have evolved into.

Documentation can maintain the essence of what is seen, but the reality of admiring a piece in the flesh will always go beyond it. Over the years, graffiti writers and followers have tried to maintain certain throw-ups, pieces, and murals *in situ*, for a multitude of reasons and with different results—some better than others. In other cases, and from the other perspective, simple luck has given the public the opportunity to rediscover and appreciate works thought lost (and many times hidden) at the locations where they were first created. In most of the cases of these rediscovered productions, the condition of the works became unstable and slowly faded until disappearing completely. Nevertheless, many graffiti pieces have become valuable parts of the urban environment. This plays an important role in opening possibilities regarding extending their life and appreciation through conservation. The same tools conservators use on public and private works can be adapted and applied to accomplish a better treatment of contemporary graffiti and urban art.

This paper aims to present the opportunities and limits of graffiti conservation, taking into consideration ethical and respectful approaches and the importance of advocating and extending the conservation practice to the support and understanding of Graffiti as a part of the contemporary art repertoire.

**Keywords**

conservation, contemporary art, ethics, graffiti, preservation, urban art

## 1. Introduction

*Graffiti* as a term relates to that part of our nature as humans needing to express ideas (Figueroa-Saavedra, 2014), a collective way to share experiences, views, or thoughts inside the society we live in. It has been present since the beginning of history, and although it has always been visible and accessible to all, it was not until the 1970s that it started to make a point in the world—rising to what is now considered *contemporary graffiti* or graffiti as a movement.

From the first accounts, we have learned the first contemporary written tags appeared on city walls in Philadelphia in the late 1960s (Powers, 1999), and this practice quickly expanded inside and outside the New York train network. From tagging on trains, throw-ups and pieces, to whole cars but also around the neighbourhoods. This movement was first known simply as *writing* by its practitioners, but later named *graffiti writing*, considering themselves graffiti *writers*[1]. Graffiti writing is connected to the traditional form of writing/drawing on the walls (from γράφω—/grə́.pʰoː/ in ancient Greek) and the English term for the same action, which would later be shortened to *graffiti*.

1 - Some practitioners prefer to refer to themselves as 'graffiti artists'. It can also be found the term 'graffitist' to refer to them, although this is usually used by external or mainstream sources (e.g. dictionaries).

This information reached us in written formats from the first sociologists, anthropologists, reporters, and curious people that found interest in what was at that time a new and uncommon practice (Castleman, 1982). However, the most accessible and visual format was the photographic documentation—thankfully recorded by the graffiti writers themselves and those street photographers that saw the potential of these interventions (Chalfant & Prigoff, 1987; Cooper & Chalfant, 1984). Photography has helped other graffiti writers—and those later preferring the term *graffiti artists*—to develop their work and extend their imagination in order to build an alternative art movement, now fully embedded in urban society. And for others, such as researchers and professionals that come across the movement or show interest in it, both written and visual documentation has been vital to understanding how it started, how it evolved, and how it has reached current times.

However, there is more to the use of the documentation tools to study and comprehend the movement, as Martha Cooper put it in London at the Chasing Visual Play talk in February 2016: *"I think I am preserving graffiti when I am photographing it"* (Cooper, 2016). Documentation is the key to being able to appreciate, study and value old productions, as well as extending the limits and bringing them to future generations, and currently spreading the information further than the location where the productions were or are made. But is preservation through documentation the only possibility for the conservation of graffiti? Nowadays, and after more than 50 years, graffiti continues, together with street art, to be an unmissable part of contemporary cities. They present themselves as independent, located in the public space, free and open to all, something the public has seen evolve, and in many cases, has started to accept and appreciate to a level that means that not only documentation but also conservation is being raised as a necessity, or at least a debatable idea on how the maintaining of graffiti must be approached.

This paper aims to analyse the aspects that allow conservation mechanisms to be applied in contemporary art, and how those transfer to alternative movements inside the current artistic repertoire, focusing on graffiti. The methodology section will present how contemporary graffiti, and some particular productions, have been preserved, conserved and restored[2] over the years, and what considerations researchers and specialists should bear in mind when facing future projects or possibilities in graffiti conservation.

**2. Conservation of Cultural Heritage**

From the perspective of a conservator-restorer, the elements in society that present significant value are considered part of the heritage, which leads to accepting them as objects to be preserved, conserved, restored and displayed. In similar terms, those valued elements are maintained to be appreciated by current and future generations, as they play a key role in spreading ideas of the past and the present to those that might not be able to enjoy the object or the moment when it was created in the first instance. Therefore, conservation will focus on tangible and intangible parts of the heritage, adapting to the needs of each case.

Traditionally, conservation has focused on tangible or physical objects which are iconic parts of societies. These include art, architecture, instruments, and anthropology objects. When the condition of those objects is affected by damage and their significance is altered, conservation and restoration would come into the picture, following principles that would ensure the recuperation of the artwork from a moral approach. The most latent principles are those presented by Cesare Brandi as the three "Rs": the need to *Respect* the artwork or heritage element, the application of *Reversible* materials, and making any treatment *Recognisable*, so no addition would interfere with the originality or history of the piece (Brandi, 1963).

Intangible heritage is related to immaterial assets such as customs, traditions, music, or any practice or event occurring as a part of society (UNESCO, 2022). In conservation, this is a recent topic of study because, although consid-

2 - The paper will present various terms regarding different aspects of 'conservation', including 'preservation' and 'restoration'. For a better understanding of their differences, please refer to *Terminology to characterize the conservation of tangible cultural heritage* ICOM-CC (2008).

ered in the past, its application would have been usually linked to the conservation of a tangible part of the asset within a society (e.g. an archaeological site whose objects show the customs of that particular part of society unveiled). Despite the connection between physical elements and abstract assets, the conservation of intangible heritage can be treated individually and separately from tangible elements, which is effectively done through documentation.

Documentation offers the possibility to record and reproduce, at different levels, any non-physical (and physical[3]) aspect of modern society and culture, but it also extends to conceptual aspects of art production, opening the door to its relation with the conservation of contemporary art and new media.

**3. Conservation of Contemporary Art and Heritage**

Contemporary conservation theorists and researchers have started to raise awareness about the limitations of Brandi's theory and consider it insufficient to meet current needs—both in traditional and contemporary art (Santabárbara Morera, 2016). Especially in the latter, new ideas and possibilities made those old theories obsolete and unable to cover very important aspects such as heritage works, as well as artwork's—and the artist's—requirements. Therefore, the conservation-restoration field has been opening up to other aspects, focusing on understanding the new forms of art and cultural heritage.

Focusing on the new art, its limitless condition, the synchronicity of the artist's production to preservation interests, and especially, the challenges of a new art form such as Conceptual Art, Time Based Media (TBM), or Eat Art, among others, had changed the way conservators, curators, historians, collectors, art handlers, etc. face an artwork. As new rules apply, those traditional conservation theories fail to cover aspects now imperative to analyse in any conservation approach. New ideas such as conceptuality over materiality, ephemerality, degradation, programmed obsolescence, technical reproducibility, the artist's interview (Beerkens & Abraham, 2012), artist collaborations (Fuentes Duran et al., 2017), contact zones (Ortiz Miranda & et al., 2022), intention and identity (del Fresno-Guillem et al., 2022) or even, the use of modern and non-conventional materials, raise more challenges in the decision-making process. Taking into consideration all those assets will hopefully lead the specialists to establish correct and respectful procedures for the benefit of an artwork and its survival in the short, mid and long terms.

As previously anticipated, documentation will play a key role in any conservation project. The conservator will depend on it not only to identify the condition of the artwork but also to discover and understand what is physically and abstractly in front of them. Thus, the documentation process will start with the assessment of an artwork and its condition reporting. The physical parts of an artwork (the complete piece or only partial elements of a whole) will commonly be evaluated by identifying its structural and aesthetic condition at that specific moment. Additionally, that idea of discovery will make the contemporary art conservator search for: 1) what was the artist's intention during (and after) the creative process, what were their expectations in the production and for the final object; 2) what are the materials used, and if those should be considered intrinsic to the artwork in its current condition or replaceable when altered; and 3) what life expectancy the artwork have been assigned. In addition to this, the conservator will conduct research identifying similar artworks, the artist's career, and they will even contact the artist's studio or estate to complement the information gathered during the assessment. Paralellaly, understanding the value of the location and surroundings is, in many cases, a fundamental part of the artwork (e.g. interactive or public art), as it is necessary to find if there have been issues of any kind (unexpected/expected, harmful/beneficial, unchanging/transformative).

All that information will bring the conservator into planning the next steps in the preservation, conservation and/or restoration of the artwork, considering the condition and issues, the potential changes that treating or leaving a piece untreated would influence its condition, the artist's opinion, the appreciation by external stakeholders (the public) and the care holders opinion (owner, lender).

3 - Technical reproducibility to be considered later in the paper.

**4. Conservation of Graffiti**

In terms of conservation, graffiti forms part of the current heritage repertory. Also, in terms of conceptuality and the use of artistic and plastic procedures (conventional and unconventional), the movement establishes a close link to what conservators recognise as contemporary art and the need to apply contemporary conservation theories and approaches to it. Therefore, graffiti as a cultural, and in this paper understood as an artistic, movement offers similar issues to other contemporary (art) productions, with the add-on of specific aspects related to the more internal elements of it.

Unfortunately, the conservation of graffiti has been rarely studied when compared with other research disciplines (history, anthropology, geography, law) that benefit from more extensive research on the topic. This has been perhaps because of conflicts between what is traditionally expected of heritage conservation and the graffiti movement's identity. That can be related to its alternative nature, the limitations to access graffiti writers, the usually secluded public and followers, the presumption and concurrent rejection by the general public (who grew up being told that graffiti was just a crime, a pure act of vandalism), as well as a lack of interest by conservators—more pronounced for graffiti and street art than for other parts of the heritage. Both these and other matters interfered and prevented for years the consideration of graffiti as an element to research in conservation. Furthermore, when the topic was raised or suggested, many addressed graffiti as ephemeral, and thus not even supposed to be studied any further[4]. However, as contemporary art has shown, acknowledging something as ephemeral does not mean this should not be 'conserved', as there is more to know about what is actually 'ephemerality'. This reasoning also inducted the idea that conservation should not have been sought after because the complex characteristics presented above would offer limitations for researchers to delve deeper into the topic at hand (e.g. the difficulty in establishing connections with graffiti writers).

4 - Based on the author's first research approaches to conservators and related specialists, and the lack of published research sources prior 2010.

In order to understand the limitations and possibilities of the conservation of graffiti, it is necessary to understand what ephemerality means in this context and how it is understood inside the movement, as well as the thoughts on conserving it, including documenting it, and what has been and is the reality of this topic worldwide.

4.1 Ephemerality and Beyond

Cities change and evolve, and so does graffiti or any other type of expression in public space. On the one hand, there are limited surfaces to work on, so the writers reuse them to continue producing. On the other hand, graffiti productions of any type might be cleaned off by external stakeholders who do not like it or follow regulations regarding the city scenery, but also it can be just because of a loss of interest in the production at its original location (e.g. area reconversion). Therefore, when a graffiti production disappears, this is very often accepted as a part of its nature. The situation is skimmed over in a very light way without considering important points such as whether this was its intended end or just something agreed upon because there is a lack of knowledge about conservation possibilities.

During interviews with graffiti writers (Amor Garcia, 2017), it was found that the ephemerality of graffiti is assumed and accepted in line with the considerations of the space and the practice. Writers are positive towards the fluidity of this matter, as continuous change is considered positive for the practice. However, when asked if they contemplated the durability of their productions during the creative process, the majority of writers interviewed offered affirming opinions regarding this, even stating that, when possible, they use specific materials to allow the productions to last longer. This is, for example, connected to the use of aerosol paint and household paints. The aerosol is a simple tool (and technique) which goes beyond the usability, effects, and preparation of colours in a unique packaging; their cellulose, alkyd and alkyd-acrylic formulations have always been produced to last longer compared to other techniques. Graffiti writers are also familiar with the wide range of emulsion paints with specific finishes and properties (e.g. compatibility in

hard surfaces and environments), which they selectively use depending on their expectations (durability, results).
Also, when they were asked if they thought graffiti is ephemeral, the opinions varied, showing the ephemerality overall depends on the artwork, the environment and the possibilities of maintaining the production for longer, or even forever, but many consider the movement as not completely ephemeral. This leads to a two-fold situation between change and maintenance. The continuous practice helps graffiti to be alive, and thus, the movement itself cannot be viewed as ephemeral but in constant change. In return, that change accepts the loss of old productions in the interest of both new graffiti and the evolution of the movement. However, in a movement where style is often the way of standing out, the past will always be present. Graffiti writers continuously check visual records on past generations aiming to get ideas, appreciate the productions, grow and go beyond: collecting fanzines and books, following others on social media, and even having the opportunity to meet (and paint with) 'old-schoolers'. Many graffiti writers remember productions that made them start or carry on writing. Iconic productions that, as found out in the interviews, they would have liked to conserve in situ, to be able to keep enjoying and for others to appreciate later on.

4.2. Conservation Approaches and Ethics

From a tag to a throw-up, to a sticker, a piece, to any mural production in a hall of fame[5] or in any part of a city, graffiti as a movement continues to have the same idea as the graffiti from earlier civilisations: to express as individuals or as a part of a group, inside of the world. The product of that expression generates an interaction with the public, which adds significance. As a cultural asset in the contemporary world, and a valued element of society (for some or many), the product becomes part of the heritage, and so conservation might be desirable.
When values are given, and there is an interest in conserving the object that has them, conservation mechanisms should be prepared. This will not particularly change depending on the legality or illegality of the work, as conservation will focus on giving a response to an already raised need. In the case of graffiti, this will concentrate on the particularities inherent to the movement and help it in providing solutions that do not interfere with its meaning or the author's intention. The same would be applied to other street artworks and other artistic manifestations beyond a traditional mindset or the art world.

The strategies for the conservation of graffiti go further than a traditional approach based on respect, reversibility and recognition of the conservator's labour. Before establishing conservation approaches for graffiti, it is important to consider the particular aspects that can affect the decision-making for providing conservation procedures. As described above, in contemporary art, conserving anything related to the significance of a piece, including its elements (concept, material, expectations) should be included in the assessment process and condition reporting. Also, specific questions regarding what the artist expects in the short, mid and long terms (ageing), or understanding alterations already present or likely to happen (inherent issues or accidents during the life of the piece), need to be taken into account. In the conservation of graffiti, these also apply, and it is something that any conservator or specialist involved in the conservation of a graffiti production should bear in mind at any time and in any case. In the assessment of a piece, conservators should consider the intentions and ideas that relate to the movement, to the artist, and to the public, as well as the geographical and temporal situation of the production, as well as considering the current condition and appreciation by its surroundings and stakeholders at that stage. Learning about the past of the work and its influences would also be beneficial to prepare an adapted report and conclude with objective reasoning of why the piece should or should not be conserved.

In addition to those new 'conceptual' challenges of this contemporary movement, when proposing a potential remedial treatment (conserving or restoring the piece), it is compulsory to identify the materials and technique used by the artist and whether there is any specific information about their creative process, and how the conservation processes and materials to be used would adapt

5 - Reclaimed spaces by graffiti writers to paint without disruptions and where the pieces are documented by the same practitioners, visitors and connoisseurs.

to the original materials, its conservation and the future of the work. This complements setting up adapted decision-making depending on the considerations already presented and different or new ones that can be found in other cases. Based on all that, it would be necessary to identify potential issues and solutions that might occur due to the treatment, examining alternatives to the proposed plan.

The benefits of conducting prior research before initiating a treatment would be two-fold: firstly, presenting a bespoke project plan considering the characteristics of the artwork to be conserved as well as alternatives and limitations, preventing issues later on; and secondly, following a considerate method prioritising the ethicality of the proposal and being respectful for all parts involved (artist, artwork, public), avoiding repeating mistakes from the past.

4.3. Case Studies

As with any type of art, heritage or collection item, we humans tend to offer value to the object as a way of recognising a connection with them. The same appears to happen with graffiti. Over the years, graffiti and street art productions have been conserved, with a growing interest over the last decade as more regulated and amateur conservation cases appear every year. In some situations, this is related to a connection with widespread practices in the conservation of works that might enter the art market (e.g. Banksy); in many others, an interest to maintain or refresh a piece for a bit longer (e.g. late writers, iconic productions). These actions come from a multitude of positions, sometimes with more or less effort to maintain the productions in situ, others, with some work done by the same artists whenever it was needed or the opportunity came, using the tools accessible in each case; but in all cases, the conservation intention seems to be there. Certainly, it is common to see that the knowledge about conservation can be limited, which sometimes clashes with potential correct approaches. Nevertheless, thoughtful intentions and consideration of the writer or artist are many times present. The cases shown below try to exemplify the relationship between the significance given by the public, the resources available and the diverse interests in the conservation of graffiti productions and other street works.

As found during the interviews with graffiti writers, it was noted that many graffiti pieces and murals had been iconic for them in their path to becoming better writers or active professionals. This is related to artistic value, as elaborated graffiti murals with complex compositions would frequently stand out and will be appreciated technically by other writers and passers-by. One of the murals



**Figure 1**. How to Kill a Nazi, 1999 (left) and 2019 (right)

that was often mentioned by graffiti writers from south of Alicante (Spain) was '*Cómo matar a un nazi*' (How to kill a nazi) by graffiti artist pioneer Pepo. Produced in 1990, it lasted for 20 years, ageing without being disrupted by other writers or the community. This happened due to the artistic strength the production presented in the composition at that time with more basic tools than the ones currently available, and the respect for the artist inside and outside the movement for what he accomplished. Unfortunately, the need for structural rehabilitation of the wall and building—a school—completely covered the artwork recently. Despite this, it does not mean it is lost forever, as unveiling the artwork from the overcoating might be possible in the future with the correct methods.

Regarding historical and social closeness, the case of the throw-up chrome by graffiti writer Nekst in Bowery, New York City, proved the community could play an important role in maintaining the person and their work even if their production might be outside what is commonly considered aesthetic or correct. Sean Griffin, aka Nekst, painted the iconic façade of the Germania Bank Building at 190 Bowery in 2007, and it remained there for years, even after the building was bought and restored, removing all the graffiti inside and outside, except from Nekst's (Warerkar, 2016). Since he died in 2012, the chrome has been repainted by the community in order to maintain alive the memory of the late writer.

Some of the most riveting and recent cases in terms of the conservation of graffiti pieces are the *freshen-ups* or retouching projects done by graffiti writer Ekto One in Romford (England). The active graffiti writer has found a way to restore almost lost and neglected pieces painted by old-school graffiti writers decades ago. In all cases published in his Instagram account, he has not only researched the origin of the pieces, consulted coetaneous writers, and completed the reconstruction/repaint of the pieces himself, but also used educative stencils next to the works indicating part of the history of the pieces and asking to leave the work "*for the future generations so they can be inspired as we once was*" (@ekto.1 [Ekto], 2019). The projects Ekto has completed so far are the case of 'Evil' by Talent Tyrant and Wizard in 1986 (Ekto, 2019), and a piece by writer Note, painted in 1991 (Ekto, 2020). The historical, sentimental and social values he gives to the artworks can now be shared with others inside and outside the movement.

Beyond the treatment, reconstruction or repainting of

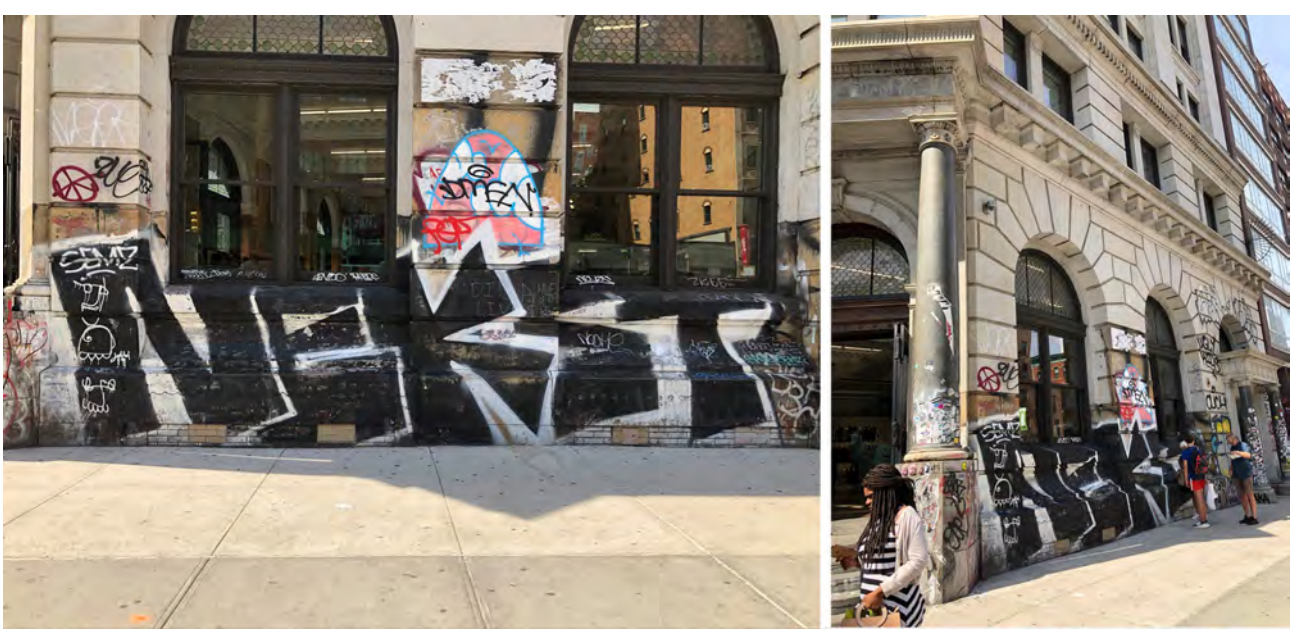


**Figure 2**. Nekst's chrome at Bowery in 2019

iconic pieces, there is also the conservation of locations. Places where graffiti has been present for short or long periods without an interest in being regulated. This is commonly visible in the preservation of the graffiti practice in graffiti halls of fame. Some, like the iconic Leake Street and Stockwell in London (UK) or Hosier Lane in Melbourne (Australia) are proof of that, although not the only ones. Holcim Gallery is located in what was an abandoned industrial state in Ontario (Canada). The building was acquired to become a community centre, and part of the rehabilitation and restoration process for the location took into consideration maintaining the graffiti productions done in the space when this was abandoned. The space is no longer used for painting graffiti freely but as a gallery space for arranged exhibitions, where visitors can still see the history and ideas of the use cases the space had over the years.

As previously mentioned, the addition of values and conservation considerations are not only offered to graffiti, but street art has many cases of conserving pieces. The 'Madonna and Child' painted by Blek le Rat in 1991 in Leipzig (Germany), was abandoned for years and rediscovered in 2012, and later conserved thanks to the help provided by many groups of the community, which permitted it to be reinstated as a symbol of group identity for the city. Furthermore, it has been granted 'heritage protection' recently (Julke, 2022). However, cases like this are not the rule. The growing interest in Banksy in the art market has made his works in public space preservable, although the aim of preserving the pieces is moved by an interest in the economic significance of the productions over applying ethical approaches to the conservation aim.

When preserving a graffiti production, street artwork or any form of art or expression in the public space, the location adds a lot of importance and significance to the artwork. It was created in a specific location for a reason. The artist expected it to stay there, and the community expected it to be undisturbed. However, the legal frame around the productions tends to benefit the owner of the location where the object lies, which due to an increasing

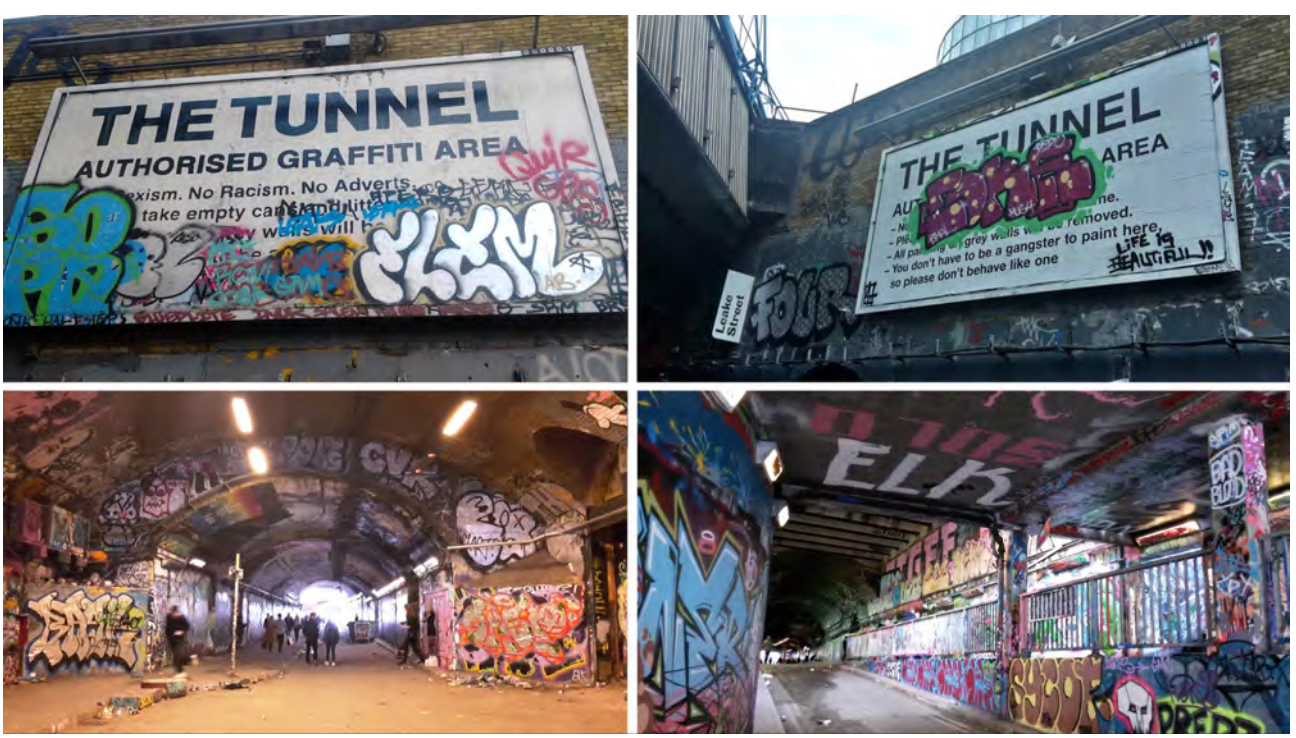



**Figure 3**. Leake St Hall of Fame, London

interest in collecting uncommon contemporary art and heritage, makes it easy to relate to conservation from the monetary side—denying what the intention of the artist or the expectations of the public were. Banksy's stencilled murals are sold and transferred to new locations, depriving the community of their free access afterwards. Unfortunately, this has not been a unique case, as it has happened to other artists. In 2016 in Bologna, some of Blu's mural works appeared detached and displayed inside a museum space for an exhibition. Seemingly the procedures and intentions were not fallacious, but the artist's opinion was not part of the decision-making process, and so, he opposed what was done and decided to delete his remaining murals in the city (Vimercati, 2016).

**5. Conclusions**

It is clear that graffiti possesses an element of ephemerality that relates to the limited time productions survive. Also, ephemerality is associated with the beauty of evolution, providing more to the current and future generations. However, this is not a strict element of the movement. As documentation has played an important role since the beginning, the—lesser-known—conservation-restoration of productions is something that has been ongoing over the years. This has been done many times by the same writers and artists to commemorate others, or by a collective of interested stakeholders that appreciate what was done and would like to keep it alive.

The paper does not present a unique way of conserving graffiti or street art. Rather it presents a way to see the possibilities and limitations many forms of contemporary art might face if not considered as they should, and tries to fight any intervention, opinion or thought based on a lack of principles or a lack of interest by mainstream society and experts. The paper aims to make a point and raise awareness mainly among conservators and specialists of other disciplines, but also including anyone involved in the conservation of any graffiti or alternative artwork in the public space. Many of the steps proposed here might not be accessible to all as the research proposed could be long and unavailable to some. However, intending to cover as many aspects as possible from a very thoughtful perspective would be more than enough most of the time, as has been proven in some of the case studies presented.

For conservators and specialists, it is believed there is still a lot to do, to be more prepared in case conservation might be required for a graffiti production and in so, to establish an adequate practical and theoretical approach, following adapted decision-making and using the materials that will allow the artwork to be conserved with respect not only to the artist but also to the public.

**Conflict of interest**

The author declares no conflict of interest.

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# Street-ARt. Communication of Street Art Works Through Augmented Reality

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**Abstract**
Street art is a growing global phenomenon. The frequent appearance of works, projects and events reveals its increasing social and cultural role worldwide. Unfortunately, Street art creations are often hardly visible in urban areas. Besides, few national and international databases collect the characteristics of these artworks. The chance of digitising artworks represents a way to gain these cultural paths on the urban areas, providing an additional tool to understand and interpret it, connecting with other creations in the same area, freezing their memory, and mapping its change over time. Street art is characterised by aspects that make it unique in the artistic panorama. The contents' democratisation and the work's physical decay are two pillars. Any digitisation and communication project should consider them carefully, proposing a knowledge model respectful of the artwork. Augmented Reality (AR) is a representation tool that achieves that delicate balance between the real and the digital, enhancing both specificities. The chance of connecting the artwork with descriptive and multimedia content can significantly improve its visibility, enhancing its presence in the urban context. AR can also fill this information gap in the artwork, providing a stimulus for multigenerational reading that brings different audiences to Street art, integrating with existing platforms and proposing new cultural paths. The authors** start with artwork digitisation, showing experimental data about the connection between image deterioration and image AR recognition. Besides, they show some possible applications in Rome through a critical domain analysis, opening some future multifaceted scenarios.

**Keywords**
Anna Magnani; art impermanence; augmented reality; feature recognition; marker tracking; Rome

** Authors developed the research together. In the writing step, authorial attribution is the following: F.C. is responsible for paragraph 6; E. I. wrote paragraphs 1 and 7; A.M. worked on paragraphs 2-3; finally, M.R. is responsible for paragraphs 4 and 5.

## 1. Introduction

Street art, considered a free graphic representation of artistic subjects on vertical or horizontal surfaces, is experiencing a moment of a global renaissance. These representations, which characterise the urban scenes, belong to everyone: creators, citizens, tourists, and critics. It is an art without boundaries, free from museum routes but limited in protection and affiliation (Balocchini, 2012). Street art has different goals. On the one hand, it wants to enhance degraded urban areas and architectural structures, introducing new signs of cultural rebirth. On the other hand, it radicalises the memory of places (Ciotta, 2012). The increasing number of artists confirms the growth of this phenomenon on a national scale, promoting events such as Super Walls (https://www.biennalestreetart.com) or CHEAP (https://www.cheapfestival.it). Besides, there are many events and projects worldwide, like SHINE Mural Festival in Florida (https://www.instagram.com/shineonstpete), Upfest in Bristol (https://www.upfest.co.uk), Street art Fest in Grenoble (https://www.streetartfest.org), Afri-cans Street art Fest in Kampala (https://afri-cans.org/street-art-festival), HK walls in Hong Kong (https://hkwalls.org), MURAL Festival in Montreal (https://muralfestival.com) and Brisbane Street art Festival in Brisbane (https://bsafest.com.au). Different international projects aimed to connect artistic works within urban fabrics in Madrid

(http://madridstreetartproject.com), Barcelona (https://www.streetartbcn.com), Lisbon (Guimarães et al., 2016), Glasgow (https://www.citycentremuraltrail.co.uk), Vienna (https://www.startnext.com/viennamurals), and USA (https://streetartunitedstates.com).

Instead, Street art shows a slow development in areas with strict regulations, like the movement "Streets are yours" promoted in Japan. In China, Street art was applied to the walls of many schools in 2016 to promote the return to class in disadvantaged areas through the project "Back to school China" (https://www.graffitistreet.com/back-to-school-street-art-project-china-2016). Finally, the foundation of extraterritorial associations that promote Street art linked to specific global issues, such as slavery and child labour, is growing (i.e., https://streetartmankind.org).

From this first concise and not complete depiction of the development of Street art, several compatible or conflicting features emerge. The desire to achieve a high level of visibility of individual works and to be included in a network of local or global knowledge necessarily clashes with the desire to be outside the schemes and rules that often manage the events that provide such visibility. A second element, closely related to the first, concerns the contradiction between rules and laws and the desire to produce illegal and outside-the-rules acts. This condition engenders a paradoxical situation in which cities present free and permitted zones alongside forbidden parts. The channel of the Danube that runs through Vienna (German: *Donaukanal)*, which makes this alternation a distinctive feature, provides a striking example. The relationship between the sense of belonging to a place and freedom defines a third element of interest. Indeed, while reflecting the artist's soul, training, and purpose, the works become an integral part of the places, reinforcing the sense of belonging to a specific city area. However, the artists mainly desire to be free and not tied to a place. In this regard, the layering of works determines a multi-cultural process in which the same place becomes an expression of different cultures over time, connoting an ever-changing sense of belonging. Finally, it is essential to emphasise the scalability of the message in the Street art, which can move from strictly local content (as in the reported Chinese school example) and on a specific theme versus global issues of ecology, and human rights or other.

The topic's relevance has led to the creation of journals devoted to Street art, such as the Street art & Urban Creativity Scientific Journal (SAUC), and thematic journal issues devoted to the Street art domain (http://disegnarecon.univaq.it/ojs/index.php/disegnarecon/issue/view/27), or specific workshops (Casimiro, 2019). In a global communication framed by the massive use of images and videos, the growth of this artistic movement may benefit from these digital channels. The link between artworks and descriptive or multimedia content can significantly improve Street art understanding, valorising the presence in the urban context. Augmented Reality (AR) is a tool to read beyond the visible, providing a multigenerational stimulus that brings different audiences closer to Street art proposing new cultural paths. A cultural approach compliant with the Street art principles and its contents requires answering the following questions:

- Can the digitisation process be respectful of some Street artwork values? What is the balance between permanent digital data and temporary art?
- Could the interest in applying AR tools overcome the attraction in the artwork?
- What is the relationship between the chromatic-graphic aspects, the state of preservation, and its AR recognizability? Is there a relationship between the acquisition characteristics of the cameras, the acquisition distance and the image recognition process which lead to the AR activation?

The authors try to answer these questions by proposing a critical analysis of the main characteristics of Street art and the pros and cons of AR in the domain.

**2. Analysis of Street Art Contents**

Urban art can be considered a wide container within multiple artistic currents, from graffiti to Street art, with specific materials, communication, and representation (Arnaldi, 2014). Often Street art describes contemporary subjects or political themes, provoking people and creating a deep relationship with public spaces and inhabitants. Some features are relevant for understanding the Street art essence and establishing a respectful relationship (see Figure 1). The "democratisation" of content and communication is the first one. Street art has become




**Figure 1.** A Venn diagram of the democracy and impermanency pillars in the upper part, with related sub-items. On the bottom are some images of creations (acquired by the authors) that reflect the two domains. The intersection has in the digital domain, specifically in the AR, the field that preserves both aspects.

a socio-cultural phenomenon defined by changing connotations with no precise edges. For these reasons, the artistic subjects expand the audience to all ages and cultural backgrounds. The flourishing of many events organised by cultural associations collaborating with public institutions exemplifies this trend, leading the art into a more framed flow. On a national scale, the Cultural Association MURo (http://muromuseum.blogspot.com) promotes festivals and urban art projects, fostering the idea of a diffuse museum of Urban Art in Rome. In the same district, the social projects Big City Life in 2015 and Moltitudini - Big City Life in 2018 (http://www.bigcitylife.it) allowed requalifying some buildings in Via di Tor Marancia and Tor Bella Monaca. Other projects are "Diciamo Insieme Grazie" (https://www.diciamoinsiemegrazie.it) and "Dominio Pubblico - MILLENNIALS A(r)T WORK - MA (r)T"; the first left a testimony on the COVID-19 emergency, and the second brings up young people's contact the urban fabric and contemporary art. Despite these examples, several artists want to preserve a connotation of illegal activity and free experimentation, working in degraded urban areas or abandoned buildings. At last, art democratisation refers to the urban transformations and human sensory limitations that can neglect art accessibility.

The concept of Temporary Street art, named "impermanence" (Meschini, 2020), is a second pillar. Artists are aware of the limited durability of their works due to the materials and techniques used or due to the "illegal act" connotation that makes them subject to removal. Tears, vandalism, removals, thefts, and natural deterioration subject artworks, exploiting the incisiveness of the image through its dissolution. Some techniques are devoted to speeding the realisation and the communicative impact. They are often ephemeral results that become heritage imprinted in the collective memory. This latter is conceived in a participatory form to relate people and places through installations designed to be destroyed, torn, disassembled, and taken away in fragments as memories. They are subject to people's good decisions, bad intentions, and weather events, determining all their transformation during the time. The disappointment for the limited lifetime arises from external people, while the artists claim their crucial role in the art. Some other artists are searching for a new meaning of permanence in terms of techniques and experimentation, assigning a function of environmental sustainability. The restoration of artworks, removing graffiti and tags that limit the art reading, represents a valuable example of permanence preservation.

**3. Street Art Digitisation**

The physical and digital worlds, framed in the Street art domain, highlight a complex relationship with apparently antithetical characteristics. The digitisation of artworks improves their visibility in the urban context, facilitating their search, accessibility, and classification (Novak, 2015) and digitally freezing their state of conservation (Rodriguez-Navarro et al., 2020). Few national and international databases collect artists' works and relative characteristics. An example is the Street art Cities platform (https://streetartcities.com), which catalogues and collects many Street art works worldwide, linked to a geographical map. In Rome, David Diavù Vecchiato and MURo association conceived similar projects, such as the GRAArt project (http://www.graart.it). It traces the history and myth of Rome on the walls of the Grande Raccordo Anulare, mending the cultural gap between the monumental historical centre and the suburbs (Brucoli & Battisti, 2020). A second project is STREETART ROMA (Artribune) which allows finding the artworks in the capital area within mobile systems. The project has a broad audience offering geo-data integrated with text, images, and videos. Finally, there are some examples devoted to single artists. Banksy Street art Treasure Map is a free app for IOS mobile systems dedicated to Banksy's works worldwide. Besides, Millo's official website (https://www.millo.biz) presents a map for exploring and viewing his works. In this framework, artworks digitisation and geo-localisation simplify the construction of virtual itineraries, strengthening different cultural and thematic connections. It also allows freezing creations, fixing their conservation condition in a digital trace. However, despite these pros, the digital replica lacks a physical relationship with its urban context.

The digitisation can provide additional content (2D/3D iconic-graphic info, static or animated data), simplifying the understanding of the representative mechanisms behind the artwork without interfering with a direct reading (see Figure 2 schema). Firstly, it can help reading the connection between different creations through descriptive information and links to the artworks, such as Sirante's "The Depo-

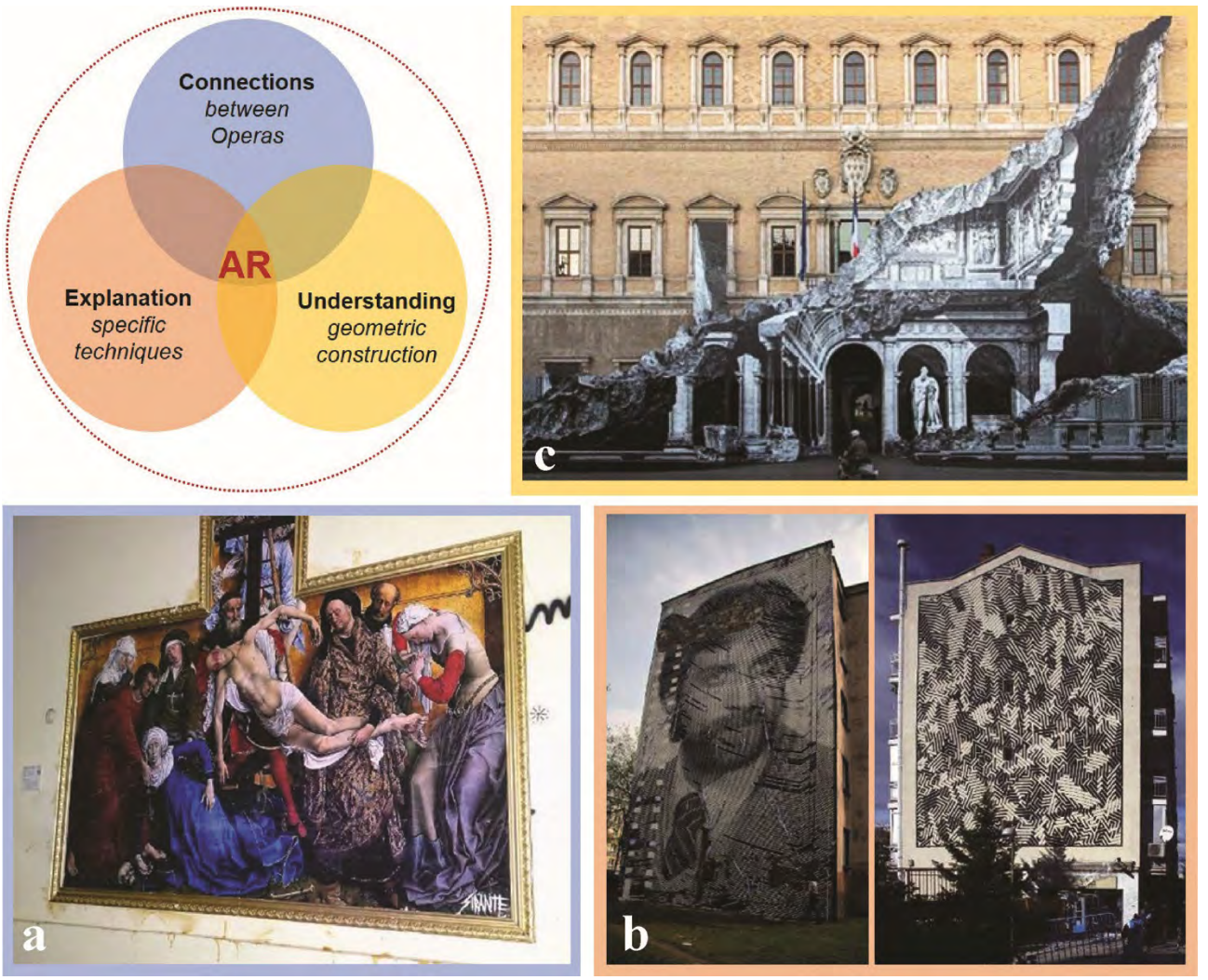



**Figure 2.** Types of activities and content conveyed by digital, particularly AR, result in the intersection of the types of digital communications of artworks. The authors have acquired pictures of the creations.

sition of Truth", based on "The Deposition from the Cross" by the painter Rogier van der Weyden (see Figure 2a). A second application may explain particular techniques to achieve specific results, like Sten&Lex creations (see Figure 2b). According to black and white lines, they work with the stencil poster technique based on very fragile paper matrices. The artwork generates different perceptions according to the viewing distance, recalling the world of Optical Art. So, the artwork can be better explained by deepening the optics principles. Finally, it can be crucial to use digital data to explain the works' geometric construction by referring to perspective principles. An example is JR's perspective anamorphosis of "Punto di Fuga" artwork, a large-scale poster art (see Figure 2c).

Augmented Reality represents a solution that may preserve the characteristics of the works and provides integrative digital content. Real and digital converge, allowing exploring information not contained or not immediately/visually perceivable (Metrick-Chen, 2015). However, the interest in applying this tool may overlay the attraction in the actual artwork. For this reason, it is appropriate to plan a critical design process that identifies the most suitable content, improving the art perception without replacing its direct reading and the relationship with the environment.

**4. AR for Street Art**

There are several steps, declined to multiple application areas (Russo, 2021), which may define an augmented reality process. Content democratisation, art impermanence, and image recognition are all crucial aspects of Street art applications in AR (see Figure 3). Urban art belongs to everyone, so democratisation refers to the user's domain, consistent with the purpose of the work.

The AR users range from children to the elderly. Accessibility is, therefore, a critical prerequisite, reflected in the type of device, the AR applications, the virtual interaction, and the content complexity. Smartphones and open-access applications are considered suitable solutions because, on the one hand, they are the world's most widely used photo capture and image recognition tool. On the other hand, the ever-improving performance of cameras combined with increasingly powerful graphics processors make them the most popular and convenient integrated system to use. The possibility of access to open source applications does not tie users to an expense, spreading their application. The level of interaction must be engaging and straightforward, enlarging to a broad audience. Finally, avoiding trivial and too complex content is appropriate for promoting accessibility and meeting the interests of multigenerational people.

Data simplification and description must consider the audience, the work of art, the user experience, and the level of interaction (see Figure 3). The content linked to the work is critical since it defines the relationship with the work and the cultural growth of the user. First, it must be consistent with the type of work, offering insights of a geometric-constructive nature, transversal reading, descriptive content, or inspiration suggestions. Besides, the content visualisation should neither replace nor hide the work, highlighting the creation, and its relationship with the context, feeding a new experience and interaction. The content may range from texts to photos and drawings to interpretative 2D/3D models and videos.

Besides the content, a second AR pillar concerns art recognition techniques. The geolocalisation makes it easy to build itineraries, simplifying the recognition of artworks with low accessibility. On the contrary, it can lead to a possible mismatch in the artwork recognition, because it is invariant to the urban and artwork transformations. For example, the

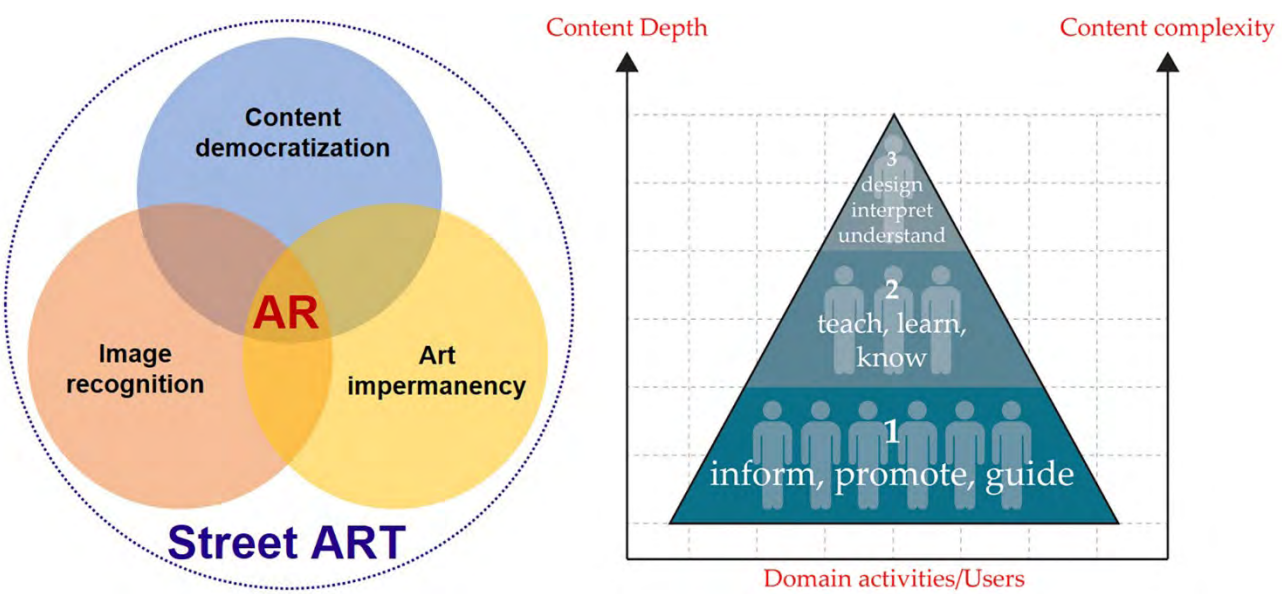



**Figure 3.** Two diagrams of the relationship between AR and content communication. Highlighted on the left are the most important aspects to remember when designing AR content to respect the work. On the right, the diagram shows the content learning pyramid, highlighting how the AR human target should focus on the bottom, with a low level of complexity and depth, to ensure the widest access.

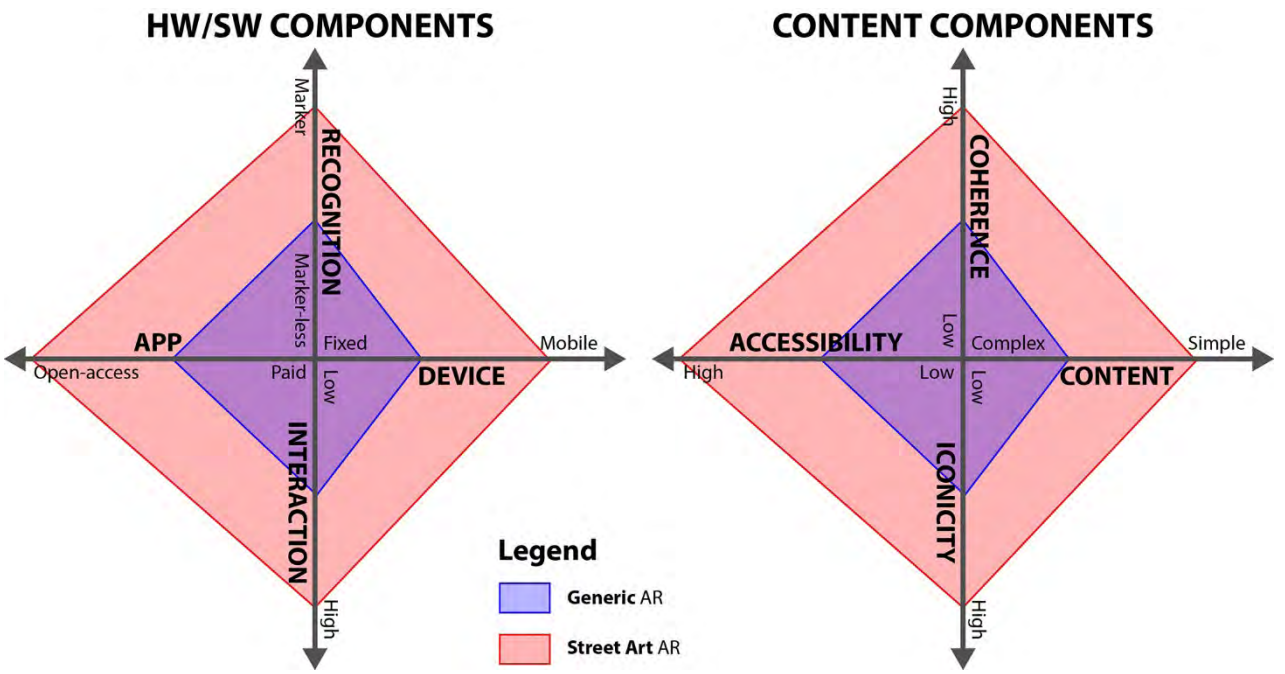



**Figure 4.** Star diagrams with main hardware/software and content components related to AR for Street art.

geolocation may remain valid even if, in the meantime, the artwork has been removed or the building has undergone changes. In all cases, therefore, it is unsuitable for preserving the link between art, its transformation, and the environment. Marker recognition, expressed through coded images or 2D/3D geometries, creates a direct relationship with the subject. It offers a more consistent solution with art impermanence, the context of insertion and access. This approach can show some limitations in the construction of itineraries and artwork visibility if they are in confined places (see Figure 4). In fact, it implies gaining a suitable position to frame the interested area. If there are obstacles (vegetation or artefacts) that prevent its recognition, the AR is no longer usable. This example highlights the strong relationship between the recognition process, the environmental conditions and the state of conservation of the wall representation.

Several AR projects for Street art communication and promotion have been proposed recently. MAUA (https://mauamuseum.com) is an open-air museum project spread over several cities, allowing the transformation of the works in a participatory way. This project has ignited the interest in AR Street art, even if it suggests an overlap of graphic reinterpretations that only partially preserve the reading of the original work. Besides, the desire to connect multimedia content to artworks with AR, improving storytelling and expanding their access, is a theme felt by several artists. An example is the free app *JR:murals* (Google Play and App Store), which allows interacting with some artworks and accessing audio-video content.

### 5. Analysis of AR for Street Art

The experimentation was quantitative and qualitative, analysing several factors influencing the correct visualisation of AR for Street art. Specifically, it investigated the relationship between the characteristics of pictorial works and their different preservation condition concerning their recognition by different digital devices. Different variants of the same work were produced to emulate some possible alteration effects of the artwork. The first test focused on computer extraction of the recognition value (score) by two different feature recognition algorithms: the one used by Vuforia and the one used by ARCore (Lanham, 2018). Both algorithms work on the recognition of feature points within the image. The Vuforia Engine[1] transforms the image into

1 - https://library.vuforia.com/objects/image-targets-optimization-techniques

greyscale before performing this analysis. In both cases, the algorithms identify high-contrast points, so the repeatability of patterns or the presence of similar pixels significantly reduces the value and, thus, the ability to be recognised as a target. The image scores allowed us to compare the two algorithms. It also led to some critical considerations in the relation between the state of conservation and feature recognition. Alongside this first phase was the second outdoor experimentation, which allowed for qualitative analysis. This step verified the scoring results, highlighting similarities and differences between the images. Besides, the ability of the camera to distinguish the work at a greater distance was investigated. It tried to connect the characteristics of the sensor and lens to the ability to engage the augmented content. Both experiments were conducted with three different smartphones: Samsung A3 (13 Mp, 4128 x 3096 pixels, *f*/2.4), Samsung S4 (13 Mp, 4128 x 3096 pixels, *f*/2.2), and One Plus 6 (16+20 Mp, 2160 x 3840 pixels, *f*/1.7). It allowed us to compare the different performances of the phones (camera and sensor) and carry out an initial comparative analysis based on the results obtained. All experimentation took place outdoors to simulate the light conditions closest to what is a shot of the original work. The content of the AR is a simple text, very small for data management but sufficient to verify the image's attachment to the content.

5.1. Quantitative Experimentation on Single Image Feature Recognition Algorithms

The first phase of quantitative experimentation focused on quantifying the number of features in each image. This recognition is carried out by applying recognition algorithms specific to each AR system. In our case, those of Vuforia and ARCore were tested. Three case studies were analysed, similar in scale and position, located in the Tor Bellamonaca neighbourhood: the work of artist Solo entitled "Jeeg Robot," (Figure 5a) the work of artist Diamond entitled "No Surrender," (Figure 5b) and the work of artist Musa One entitled "To Go Beyond." (Figure 5c)

Different variants were produced starting from the ortho-image (Figure 6, Img Type 1) to simulate physical alteration effects while at the same time going to verify the response of the recognition algorithm. Specifically, three different levels of colour saturation and transparency (25%, 50%, and 75%) were introduced to simulate the effect of colour loss and surface washout due mainly to natural reasons. Then six layers overlap the original artwork, which gradually disappeared, replaced by the underlying surface. This effect simulates detachments and localised deterioration processes, often related to anthropogenic causes. Finally, we simulated tags in the base of the artwork, introducing the concept of superstructure between different artworks.

At this experimental stage, each image was analysed separately. It means that the value or "score" provided by the algorithm, corresponding to its ability to identify features within it, is relative to each image and not in comparison to an absolute condition of initial artwork. This relationship has been tested in the following experimental phase.

This first experiment showed some interesting aspects (see Figure 7). The algorithms work similarly but not equally. Therefore, it is essential to open some reflections on feature recognition as a function of camera working conditions and art variants, comparing the different behaviours of the two algorithms. On the most recognisable targets ("Jeeg Robot" and "To Go Beyond"), ARCore's algorithm is more stringent, in contrast to the less recognisable one. The level of transparency in the images determines the most significant variation, resulting in some behaviour dissimilarities. As for "Jeeg Robot," the features of the work make it well recognisable, and the loss of colour is invariant to its recognition. The appearance of the gaps only partially affects it. Instead, what causes the transparency of the colour dictates a sudden loss of recognizability. Similar behaviour can be seen in the work "To Go Beyond." On the other hand, a joint reflection on these first two works concerns that the incremental presence of the gaps does not generate an equally linear loss of recognizability. It is because a delicate balance between the work itself and the geometry of the gaps is probably engendered. As long as the image recognition process shift from the gaps (very well defined) to the artwork's original painting, the recognition capability decreases. However, with an essential presence of the gaps, they become a recognition element, and thus the recognition capability of the algorithm goes back up. Concerning the work "No Surrender," it is seen that the work has low recognizability due to the intense, dark colour and black pattern, as well as the presence of numerous uniform ar-

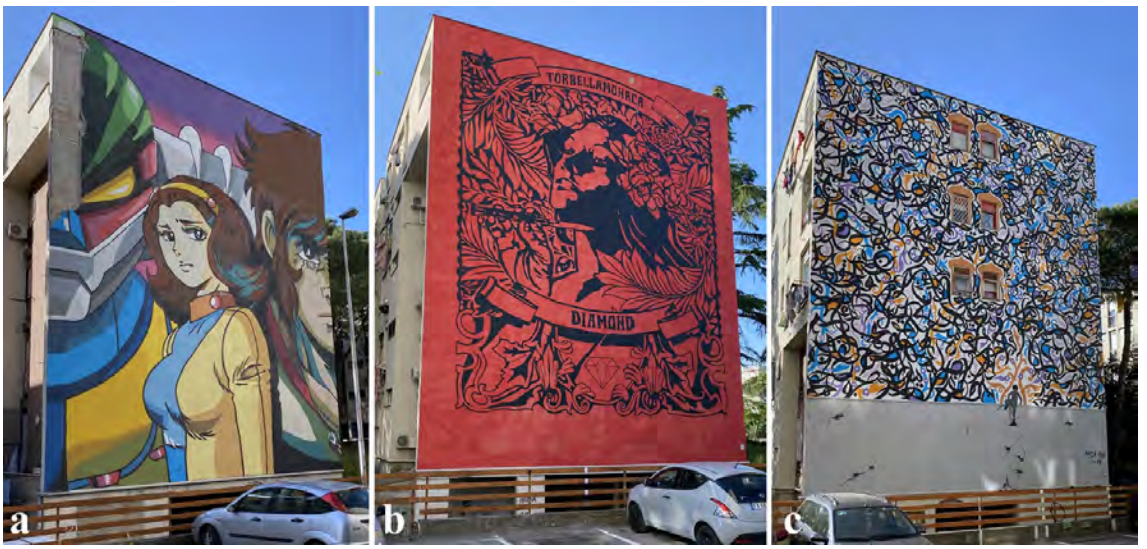



**Figure 5.** Three case studies analysed: a) Jeeg Robot, b) No Surrender, c) To Go Beyond.




**Figure 6.** Above is the diagram of the outdoor experiment. The image set refers to the work "Jeeg Robot," but we replicate the experimentation on the other two works with three different smartphones. Bottom the three different scenarios of the experimentation on the three works.

eas. Both algorithms gain recognizability with the total loss of colour. The real change occurs when the work is no longer the main subject of recognition as much as the gaps, so a substantial increase is visible in that case. This step will also be highlighted in the experimental phase outside. Besides, we note for all artworks how the presence of tags at the base does not substantially change the algorithm's behaviour, given the small area involved.

5.2. Qualitative AR Experimentation on a Complete Set of Street Art Variation

The first phase of outdoor qualitative experimentation was based on shooting from close range (about 1 meter) a sequence of images printed on A4 size sheets. The AR exploited Vuforia's feature recognition algorithm, linking straightforward textual content. These 13 different variants for each work (14, including the original) were placed on the same exterior wall with the same illumination level. They were then photographed separately with the three smartphones at 1 meter, testing both the different behaviour of the phones on the different images and which images were challenging to engage with AR (see Figure 6, station 1). The summary data of this first phase are reported below:

From the first test, only two modified images gave recognition problems: the image with 75 % opacity and the image with the most gaps (see Figure 8). On the first one, different behaviours were evident among the three cameras. Specifically, the OnePlus6 was the best at linking AR content to all images with higher transparency. On the other hand, in the case of the image with many gaps, the presence of windows in the work of "To Go Beyond" probably made it easier to engage the information, which was not possible in the other two cases. Finally, we point out that the characteristics of the "No Surrender" work made it impossible to link it to AR content. The only additional test was introducing the image with the gaps into the targets. In this case, their presence made it possible to extend the reading for all cameras to most images with gaps (see Table 1).

5.3. Qualitative Experimentation on AR Application as a Function of Working Distance

The second test concerned the working distance (see Figure 6, stations 2-5). The three pictures were framed with two levels of feature detectability (original and low) initially at five distances (1 to 5 meters) signalled by ground targets. Progressively moved farther apart to test the maximum working distance of each phone. The following are the re-

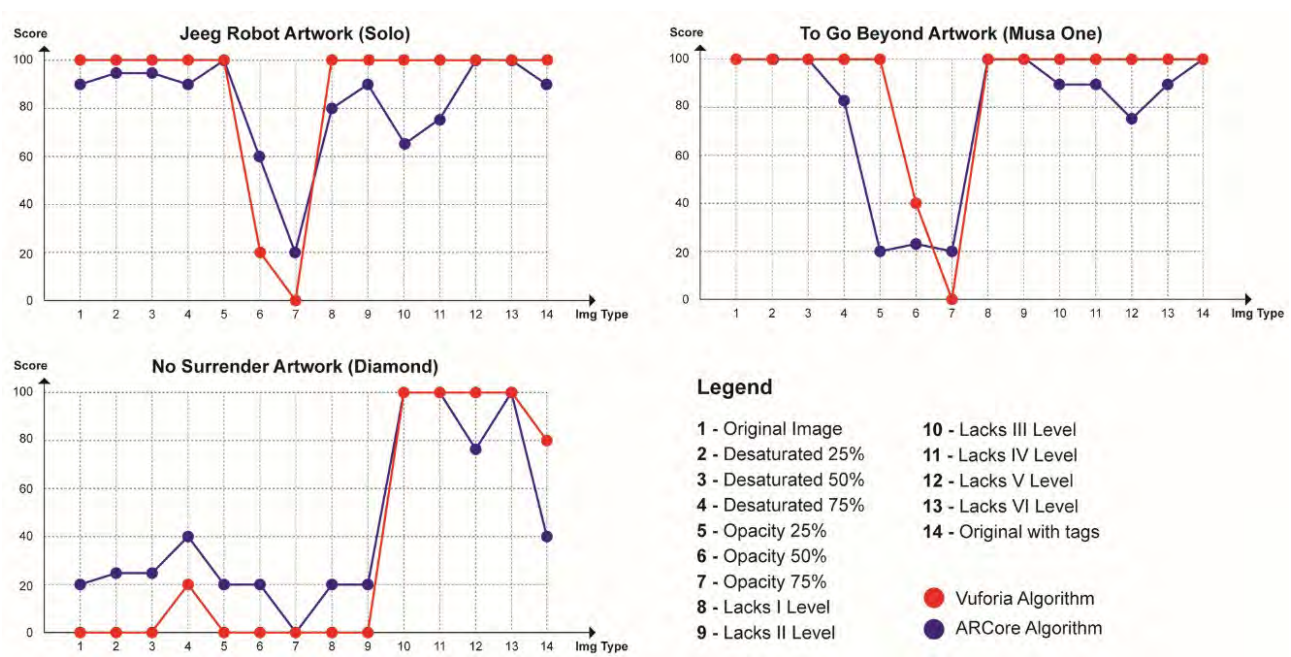



**Figure 7.** Comparative graphs on the score of different types of images according to the recognition algorithm and the work analysed. Vuforia values have been normalised on the 0-100 scale. The Type 1 correspond to the original data (ortho-image) without any image transformation.

sults obtained:
It is interesting to draw the following critical insights from this experimentation (see Table 2). The first evidence links camera brightness to the ability to recognise the artwork. The Samsung A3 has Ground Sampling Distances (GSDs) twice the size of the others. Considering the same exposure parameters set manually on the three different cameras (ISO value and shutter speed), it can be concluded that Samsung A3 captures much more photons, which helps recognise features and link content. Although the One Plus 6 has two cameras that can create more detailed images, sometimes the image recognition algorithm can struggle with data overload. In this sense, a lower detail can lead to better recognition. So, it is not easy to find the best balance between the image characteristic, the acquisition condition and the camera's capability. The behaviour between the low and high recognition score target is relatively consistent. The OnePlus6 is the phone that can read transparencies better, but while it is the higher performing one, it loses in the distance test.

**6. Street Art in Rome**

Based on the experiences, an AR application has been tested on three case studies in Rome (Cavallari et al., 2022) with the figures of Anna Magnani (see Figure 9). The first example is a large-scale mural on a flat surface, created using the paint mural technique by Lucamaleonte. The work depicts three different faces of the actress with two yellow-red roses, recalling the city of Rome, the Roma team, and the film "La rosa tatuata" (1956), directed by Daniel Mann (see Figure 9a). For these reasons, it was deemed appropriate to link a film clip to strengthen the cinema connection. The second case study is a stencil painting by Diavù made on a series of parallel surfaces belonging to a staircase (see Figure 9b). The work is titled "Anna Magnani - La Diva," which does not reference a specific film (see Figure 9c).

For this reason, the example lends itself to the connection with an explanatory content of the representative model, underlying the realisation of the work by anamorphosis of decomposition. In this case, two additional elements do not favour artwork recognition. The anamorphosis requires seeing the artwork from a specific point of view and extracting the correct representation. It works both for the target acquisition and for the AR application. Besides, the multiple planes of the representation do not fit well with the camera's focal plane and the normal of the planes to fix the digital content. Therefore, the recognition process depends on the point of view, the number of projection surfaces, and the features in each plane (see Figure 10). The third and final case is a small flat surface affiches (poster) using the stencil technique. The work is by Lediesis, part of a series of stencil posters whose meaning is more linked to women and their capacities. Therefore, Anna Magnani's

| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jeeg Robot | Samsung A3 | | | | | | | | | | | | | | |
| | Samsung S4 | | | | | | | | | | | | | | |
| | OnePlus 6 | | | | | | | | | | | | | | |
| No Sur-render | Samsung A3 | | | | | | | | | | | | | | |
| | Samsung S4 | | | | | | | | | | | | | | |
| | OnePlus 6 | | | | | | | | | | | | | | |
| To Go Beyond | Samsung A3 | | | | | | | | | | | | | | |
| | Samsung S4 | | | | | | | | | | | | | | |
| | OnePlus 6 | | | | | | | | | | | | | | |

**Table 1.** Results of the first trial: green images recognised, orange images recognised, but after some trials, red images were never recognised.

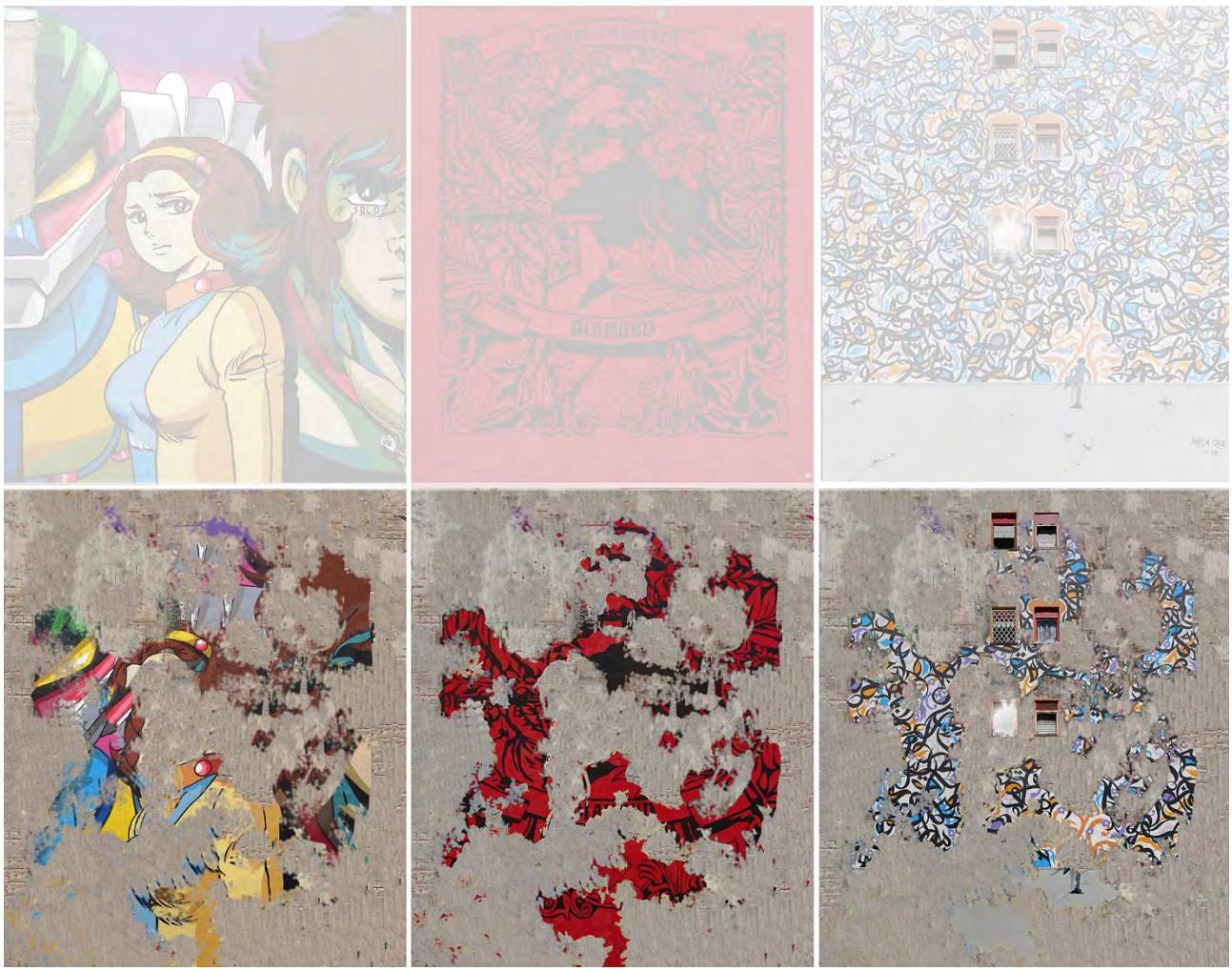


**Figure 8.** Hard-to-recognise images with AR. On the top row are the creations with 75% transparency, while on the bottom, many data lacks have been introduced, removing the original content.

| | 1 m | 2 m | 3 m | 4 m | 5 m | 6 m | 7 m | 8 m |
|---|---|---|---|---|---|---|---|---|
| **Samsung A3** | | | | | | | | |
| **GSD (mm)** | 0.50 | 1.01 | 1.51 | 2.06 | 2.52 | 3.02 | 3.53 | 4.03 |
| **Samsung S4** | | | | | | | | |
| **GSD (mm)** | 0.27 | 0.54 | 0.81 | 1.08 | 1.35 | 1.62 | 1.89 | 2.16 |
| **OnePlus 6** | | | | | | | | |
| **GSD (mm)** | 0.24 | 0.47 | 0.71 | 0.94 | 1.18 | 1.41 | 1.65 | 1.88 |

**Table 2.** Results of the second experiment: in green, the images recognised; in red, the distance at which it does not recognise the target; and in orange, the working limit of the smartphone.

image represents the universe of strong women. So, it was considered more consistent to link the work to an interview with the Lediesis, explaining the general meaning of using female figures.

The experimentation revealed several bottlenecks in the application process. In the case study of Lucamaleonte, a determining factor was sunlight, which illuminates the entire surface at certain times of the day. This boundary condition has obliged to balance the AR video's transparency, preserving the balance between the work's readability and AR content (see Figure 11). Diavù's staircase showed the importance of identifying decomposition's correct vanishing point of the anamorphosis. It determines the correct legibility of the AR. The presence of numerous planes makes identifying the image by the camera complicated, so we simplified it by using the central part of the image as a target. At the same time, the presence of steps in the video's transparent background confuses the visualisation of the content, preferring a non-transparent visualisation. Lediesis's artwork presented an obstacle that prevented the work from being read in its entirety. The contents have been presented without transparency, while the transition from nadiral to tangential makes the AR unstable.

**7. Conclusions**

The proposed research focuses on AR to enhance and understand Street art, suggesting a respectful digital-real relationship with the artist. It is critical to keep the democratic content and the possibility of non-durability of the work, suggesting a consistent interaction in a multi-platform open-source application. Besides, the image recognition approach establishes a direct relationship with the physical artwork, setting the digital function according to the art conservation. This passage preserves the direct link between the work and the digital content concerning the durability of the work. The art recognition highlights some bottlenecks given by the applied techniques, the external light conditions, and the shape in which the artwork is represented.

Anthropic or natural transformation of artworks, which can develop differently, introduces variation in the artwork's recognizability, as demonstrated in the experimental outdoor simulation. Even the working distance is not invariant for the readability of the artwork, which is mainly related to the sensor's sensitivity and the camera's characteristics. All these factors must be carefully evaluated concerning the boundary conditions of usability when designing an AR display system. For example, in the anamorphosis, recognition




**Figure 9.** Case studies analysed in the experimentation: a) Anna Magnani in Tiburtino III (Lucamaleonte), Anna Magnani. La Diva e la donna in Nuovo Mercato Andrea Doria (Diavù), Anna Magnani in Trastevere (Lediesis).

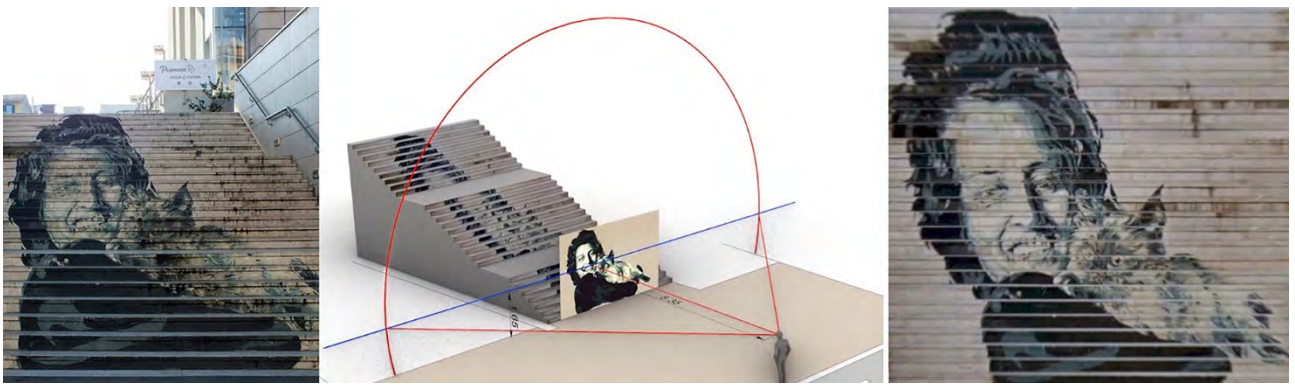


**Figure 10.** Photographed staircase (left), geometric-perspective scheme with vanishing point and projection of the plane onto the steps (centre), anamorphosis reprojected in original shape (right).

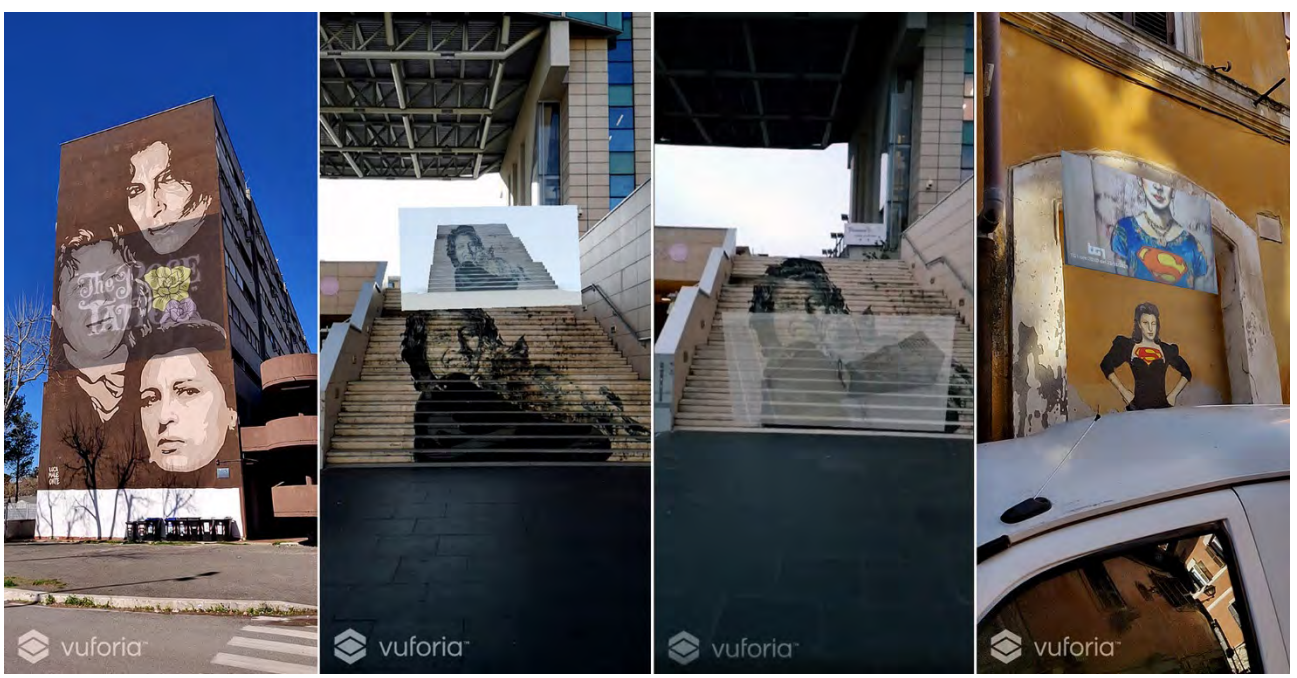



**Figure 11.** Experiments with AR in the three case studies with video in transparency (left), animation (the two images in the centre of the image composition), and top video (right) within Unity and Vuforia environment.

requires solving both the reverse perspective, looking for the preferred point of view and the mismatch in the recognition by the camera. This problem may change when dealing with works projected onto different (e.g., cylindrical) and complex surfaces. Finally, the AR content must enhance the work without hiding it, choosing the most suitable textual, multimedia, or 3D data. The content is strictly related to democratisation, iconicity, and target audience. AR in urban art can substantially contribute to fuelling the growth of this domain if designed according to a priority of content consistent with Street art. The experiment in the paper suggests a possible critical approach to the problem. Besides, the topic traces a research domain defined by a multidisciplinary connotation, opening new research scenarios.

**Conflict of Interests**

The authors declare no conflict of interest.

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# Art in the Streets in the Virtual World: A Case Study of the First Graffiti and Street Art VR Exhibition in Serbia

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**Abstract**
Art in the streets, especially if unsanctioned, might be the most liberal art in the art world today. Yet such art is full of controversy because of its status as potential vandalism. For those who do not participate in the art world, it is important to see that there is a choice, and it sometimes comes in the form of street art. The choice. The option. Different perspective. Accessibility. Starting from this premise, the Urban Heritage Hub project set a goal to make art in the streets of Belgrade, Serbia, more visible and even more accessible by using digital technology. Apparently, we were made to believe that everything was possible using new technologies. However, it became clear at the beginning of the project that while this might be true in some cases, it was not for ours. This paper aims to map the process of creating an exhibition that, firstly, deals with digital preservation and presentation of more than 50-year-old art form that has not yet been acknowledged as cultural heritage, and secondly, with the fact that it is not so easy to transfer unpredictability of the streets into a virtual reality which is imagined for the controlled environments of galleries or museums.

**Keywords**
art in the streets; digital archive; heritage protection; virtual reality

## 1. Introduction

Ever since its emergence at the end of the 1960s, graffiti, and later street art, have been perceived both as the most authentic and raw form of art and vandalism. As such, they were interesting enough to manufacture hype, but not deemed valuable enough to be properly documented. This has made its documentation and preservation, at first, limited to the very subculture and, over time, to random researchers and photographers. The 21st-century shift has made these visual expressions more visible in official institutions and policy papers, but up to this point, not many projects related to archiving and systematising this art have survived. We can mention some of the most notable examples in Europe, like INGRID in Germany or SprayCity in Austria. In this attempt to preserve, document and promote the artworks in question, we face several issues that we will address in this paper.

As a very tight subculture, graffiti became self-sustainable already at the end of the 1980s. But it was only with the rise of the internet that its members got a chance to interconnect more significantly than before. And it became immediately obvious that the graffiti culture used this new technology to its advantage and was able to project its influence even further. The ArtCrimes website, which we can still find at www.graffiti.org, and the EcoSystem forum were some of the most important hubs for sharing photos and ideas. Street art stemmed from graffiti writing, and it became more visible and appreciated by the general public in the early 2000s. But as the zero-tolerance policy spread over European cities, there was a very alarming trend that enveloped both graffiti writing and street art. Firstly the big European cities started introducing strict laws and penalties in order to keep graffiti writing and street art off of public walls. That strategy proved to be costly and had irreversible consequences on many young lives, as we can see in the

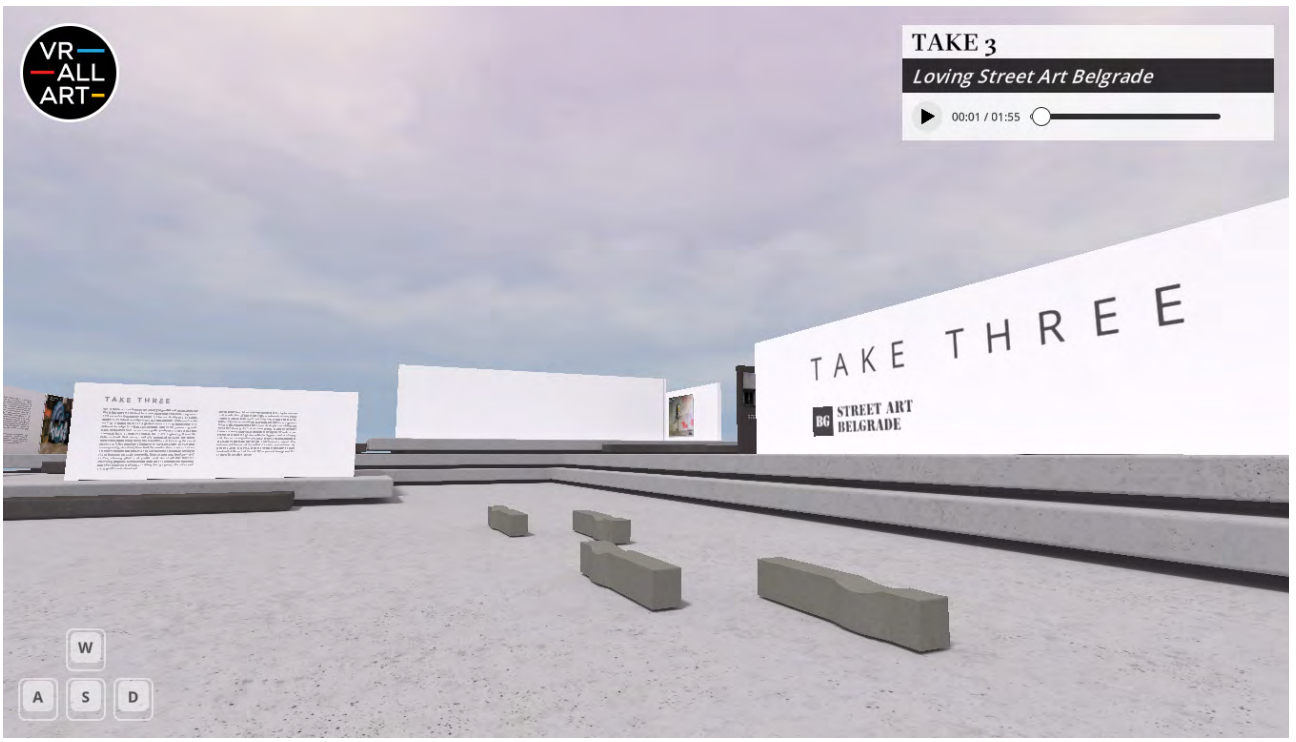



**Figure 1.** Screenshot of the exhibition Take 3: Loving Street Art Belgrade. It showcases the open space gallery in virtual reality.

study about the effects and costs of zero tolerance policy in Helsinki between 1998–2009 (Brunila et al., 2011).

At the same time, the trend of producing large and well-thought-out exhibitions about graffiti writing and street art in some of the most prestigious European museums seized its momentum. Examples include the exhibitions "Street Art: Graffiti Revolution" in TATE Modern in 2008, "Born in the Streets" in Foundation Cartier in Paris in 2009, and the most recent one that happened in 2019 in the City Museum of Vienna called "Takeover Street Art and Skateboarding". Another parallel trend is the usage of street art in urban regeneration projects and festivals as an easy and cheap way of making a difference in the cityscape. These trends naturally have their positive and negative sides, but if they continue at this pace, we are going to end up with art that is allegedly free and independent, but is, in essence, taken off the streets, recycled in museums and festivals and put back on the streets as a more manageable product.

Therefore putting these unique artistic expressions in a standard system of art presentation would destroy their essence and deprive future audiences of experiencing the most contemporary of contemporary art. Because we need to understand that we, as well as contemporary artists, are the product of the same society, and we are, therefore, most suited to understanding it. The problem is not in the art or in the audience but in mediation process.

**2. How to Store Our Collective Experience?**

Museums, archives and libraries are places where we, as humanity, store our collective experience. And it goes without saying that our descendants will reap the biggest benefit from these essential institutions. The world of today is a very different place than it was in the 19th century, and the rapid rate of changes overwhelms many institutions, rendering them unable to cope with it. While it is important to preserve our heritage institutions for posterity, we

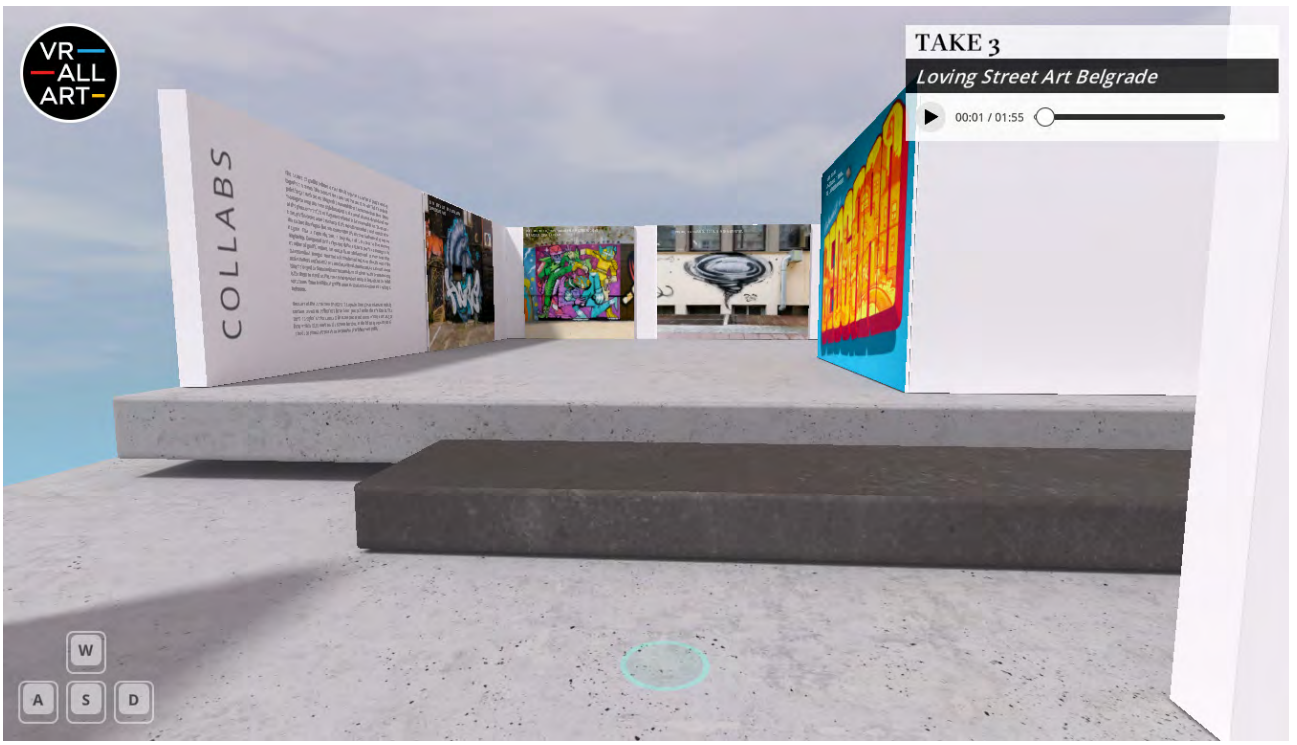



**Figure 2.** Screenshot of the exhibition Take 3: Loving Street Art Belgrade. Represents segment that showcases the collaborations.

also need to use them today—we need real-time/real people connection. Since the 1980s, it was obvious that the traditional museum would struggle to survive and adjust to new technological developments, and even to a faster pace of life. We all remember the virtual museum CDs when it was "possible to see the Louvre from your own room." Next, we witnessed video games and hologram technology used in different museums to attract more audiences and make museum visits more appealing. Some museums were more successful than others, and those that protected science and technology artefacts succeeded in finding the right fit for their exhibition spaces. Then we came to an era where the physical museum, or an archive, is not needed to store, preserve, research, and promote heritage. A museum's program is not based on the quality or even on the actual artefacts but on generating ideas, new meanings and creating awareness. Today, in 2022, we finally have the possibilities to apply the "cybernetic philosophy of heritage" that Šola (1997) talked about already in the 1980s. Since cybernetics' main concept is circular causality of feedback, each new piece of information that enters the loop changes the outcome according to the goal that was set. Museums should accordingly adjust to the needs of the ever-changing society. And in our example, this means that museums should learn how to see, interpret, understand graffiti writing and street art and let them live their natural life in the streets. Not according to the standard museological practice but from the ethical standpoint of these artistic forms.

Today there are many museums of street art and graffiti in the world, and they all have different approaches to preserving these art forms (Senserrich Espuñes & Gayo, 2019). The first historical site that most resembled what graffiti writing and street art museums could be, was 5 Pointz, in New York. An abandoned building was scheduled for demolition but managed to survive for decades thanks to the people who managed the building, but more importantly, the artists from all over the world that were able to do their art in this place. This truly was a graffiti writing and street art dinosaur. After the demolition of the original building, the Museum of Street Art (MoSA) was established in its place, and they are trying to maintain the original concept




**Figure 3.** Screenshot of the exhibition Take 3: Loving Street Art Belgrade. It showcases the open space of the virtual reality gallery.

(Bruce, 2019). In Europe and Latin America, the selection of these museums is larger, and the concepts of presentation differ from the traditional concepts to the no-building approaches. Almost all of them recognised that the only way to properly see graffiti writing and street art is in its natural setting, in the streets, so they organise specialised guided tours around certain areas of the city. One of the most interesting examples in that regard is the Museum of Street Art Amsterdam. But there are also institutions like Urban Nation: Museum for Urban Contemporary Art in Berlin, Art 42 in Paris, and Millennium Iconoclast Museum of Art (MIMA) in Brussels, that use different approaches and traditional concepts of what it means to exhibit and preserve graffiti and street art. But we need to keep in mind that the essence of graffiti writing and street art lies in their site-specificity and ephemerality, so their true forms are only found in the streets. Artworks that were made by graffiti writers or street artists in order to be exhibited in the gallery or museum settings are slightly different in their nature since they are missing the element of the streets. They tend to live a different life that is more in tune with what Howard Becker (1982) calls an art world. Therefore, to truly understand these art forms, we need to follow their development in the streets, where they are left to the influences of the elements, legal or regulatory provisions, unexpected interventions and so on. So, if the streets already represent gallery or museum space for graffiti writing and street art, why do we need to remove them and place them in the actual institutional setting? In a way, it is more logical to leave graffiti writing and street art where they are and document them properly for future reference.

### 3. Project Urban Heritage Hub as a Place for VR Experience of Graffiti Writing and Street Art

The Urban Heritage Hub (UHH), a project by Street Art Belgrade, was created to find new ways of tackling the issue of preserving graffiti writing and street art beyond simply photographing them. And even though the members of Street Art Belgrade look at these art forms as an inherent part of contemporary art, they do understand that some representatives of the general public see them as vandalism. This naturally presents quite a challenge for the




**Figure 4.** Screenshot of the exhibition Take 3: Loving Street Art Belgrade. Represents a segment that showcases old-school graffiti.

researchers and curators; not only is their natural setting the street, but there are also legal ramifications of presenting and promoting art that is not officially sanctioned. The multi-layered nature of this challenge is beyond the scope of this paper, which will focus on the issues that arose from the curatorial practice.

This project was envisioned by a group of professionals from Belgrade who have been documenting and researching graffiti writing and street art for two decades. The idea was to document, digitally preserve and make available everything related to graffiti writing and street art in Belgrade. One thing was clear from the very start: no amount of photography and documentation was ever going to be a proper substitute for an in situ experience of the art in question. In order to truly feel and understand graffiti writing and street art, one has to be immersed in the city, its public spaces, urban decay and the subcultures that emerge from it. Therefore, standard systems of documentation and presentation of artworks do not apply in this case; the closest we can get to this experience is via new technologies, more precisely, via virtual reality (VR), augmented reality, etc. Currently, the best way to preserve these very ephemeral visual expressions is by uploading them in their entirety to the virtual world.

The Urban Heritage Hub was designed to exist only in virtual space and time, allowing it to offer a perfect means for the protection of the cultural heritage of our descendants. It achieves that by creating a photo archive, presenting 3D walls and preparing curated VR exhibitions. Within this project, it was possible to combine online archives, which came naturally for the subculture, with the work of researchers and curators. Every artwork presented in the archive is meant to be thoroughly described and contextualised. With this tradition of online archives, it was possible to combine a new way of documenting these art forms via conservation in three dimensions. There have been experi-

ments related to this feature, but it has never been systematically done in one place, and it has never been developed further. So the idea was to scan the walls that could offer timeline possibilities, meaning not only that the actual wall would be presented, but that it could also take you through the time and show you what that exact wall looked like in 1999 or in 2003. Lastly, the project would host curated exhibitions in the VR spaces, thematically selected and processed to bring a new understanding of the topic they deal with. Some years ago, the Universal Museum of Art prepared VR exhibitions about graffiti and street art, but their platform was dedicated to art in general, so these exhibitions were an exception rather than a direction in which they planned to develop. Together with these three pillars of the UHH project—online archive, VR walls and VR exhibitions—guided tours around the city were offered as the element that connects it all. Providing for the audience in real-time both online and in the streets, where the real art is, and putting together extensive heritage documentation, preservation and presentation systems of the future, the UHH project thought it covered all its bases.

**4. Topic of the Exhibition "TAKE 3: Loving Street Art Belgrade"**

The section discusses the curatorial process and all the challenges that arose from the clash of new, old and forbidden. No matter how the process of selection develops, one common element for all exhibitions is the extensive research of the matter at hand. From the research, we extract the threads of meaning and the points of discord between the artworks that allow us to create new meaning that aims at educating the audience. Therefore, the curator is not satisfied simply with collecting and displaying random pieces of art but also strives to create an understanding of how artefacts fit together and the ideas they represent if put together. The same applies when it comes to representing graffiti and street art. One problem is that they are already displayed in the gallery: the city. So trying to put them in the closed spaces either takes away their appeal, or what is presented is not graffiti writing and street art at all. Hence, if we wish to present these forms of art in a gallery or museum, the most ethical way is by presenting documentary photographs of the art pieces from the streets.

As this was to be the first exhibition of Belgrade's graffiti writing and street art in VR, one could assume this was an important undertaking, and that the topic and selected artworks were to be in accordance with this need. Belgrade's graffiti writing and street art scene is pretty extraordinary, and it was not hard to come up with ideas that would make a grandiose and yet very relevant exhibition from the point of view of art history. Therefore, the first idea that was most inspiring and which was to enable the curator to effortlessly move through the history of Belgrade's graffiti writing and street art, was focused on the stylistic development of characters through a 25-year-long history. This was very significant since it would allow us to talk about differences and similarities between graffiti writing and street art as related but ultimately independent visual expressions, as well as about the history of this phenomenon in Belgrade. It meant going through the painstaking process of archival research, consultations and interviews, noting ideas and outlines for the catalogue and display in order to understand what we were dealing with. Once the photographs were assessed by experts, it was concluded that two-thirds of the material were of too low quality to be of use. Only one-third of the most recent photographs could be properly presented in VR (those that had between 18 Mpix and 24 Mpix). And it was here we faced the first obstacle that stemmed from the archaic system of thinking on behalf of the curator. There was nothing wrong with the traditional approach in curating per se, and until most of the photographs were found, we could not know if they were of sufficient quality. So the biggest problem in the curatorial process was that there was no proper understanding and consideration of new technologies and of their potential. There was only a need to apply a well-known system in curating to the new technological inventions that, as we saw, yielded no results.

Since we learned from the start that photographs are determining factor, we created a second exhibition being mindful that having professional photos was essential. So the vision of how graffiti writing and street art entered important art festivals in Belgrade was born. The first example dates back to 1997, and that would allow enough time to talk about many different layers that would include not only the development of the local graffiti writing and street art scene but also an understanding of the social and political changes of

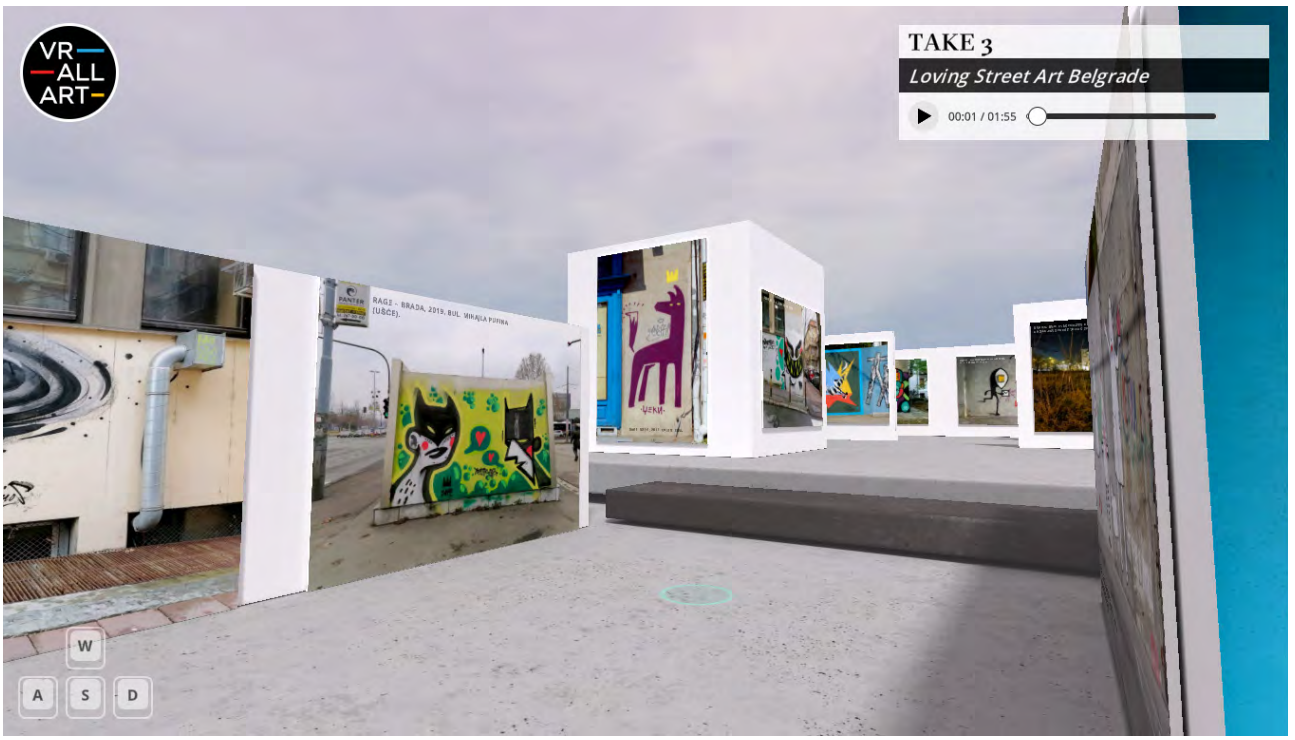



**Figure 5.** Screenshot of the exhibition Take 3: Loving Street Art Belgrade. Represents a segment that showcases the characters.

the Serbian society in general as well as an understanding of the role and influence of visual art festivals on the contemporary art scene. Festivals do employ professional photographers and document their activities; therefore, this knowledge was taken as the absolute truth. Long and demanding research had to be done before we could conclude that the oldest visual art festivals do not have appropriate photo archives that date back 25 years. In one case, the photographer that took photos of one of the most important events was deceased, so asking him for the materials was not even an option. The second obstacle closely resembled the first one, dealing again with the failure to recognise that 21st-century technology does not necessarily get along with the 19th-century curatorial process of selection.

We then decided to let technology decide for us. Instead of going to the sources, we turned to the social networks of our organisation. We took the photographs of artworks with the highest number of views and likes at that moment, and decided to experiment with possible outcomes. Although this selection system went against everything that an experienced curator and art historian stands for, it was necessary to retrain one's brain to consider different systems of thinking. Luckily it turned out that viewers and followers of our social networks had diverse tastes and liked pieces that could be arranged in segments, which allowed for better contextualisation. If we checked our social networks today and took photos following the same selection process, the final outcome would surely be different. However, the final number of photos for the exhibition "TAKE 3: Loving Street Art Belgrade" provided the possibility of telling a story of Belgrade's graffiti writing and street art with relative ease and with good examples that were understandable to both graffiti writing and street art lovers, as well as to the general audience that had no particular preference for these art forms.

### 5. Selection Process

When considering the technical aspects of the VR exhibition, we need to pay close attention to the photography, especially because photos have their own limitations. Firstly, it is hard to get the same impression from the artwork from

the street and the artwork in the photograph that is exhibited within the gallery space, no matter the quality of the photograph. Secondly, we need to keep in mind the historical approach (no matter how short the span of time we deal with) is of quite high importance. This allows us to understand the developmental process within the topic we have chosen, whether it be the oeuvre of one artist or a common theme within an artistic movement. History represents the passage of time, the passage of time represents technological development, and that undertook quite a rapid transformation since the appearance of graffiti writing and street art. In our case, most of the documentary photographs that were made in the 1990s and the early 2000s are on film. And at the time they were scanned in digital format, their resolution was of inferior quality, and they were, unfortunately, the ones that were kept instead of the original negatives. Even more problematic are the photos from the early digital cameras. Their resolution was worse than the scanned versions of the negatives and was not suitable for exhibiting in VR. Even though some digital cameras had been present on the market since the 1980s, they became available to the general population only in the second half of the 1990s. Before that, digital cameras were simply too expensive for general use. These first-generation digital cameras generated images of 320 by 240 pixels meaning that the average size of the photo was 2.7 cm by 2 cm when printed at a typical setting of 300 dots per inch. The next generation quadrupled the image size to 640 by 480 pixels. It turns out that if curators want to follow a historical development of a particular topic, they better have an understanding of the technological demands and restrictions of the VR environment and the physical state of materials they wish to put in the exhibition. The oldest technology seems to pose the least problems because negatives produce a quality resolution when scanned. The bigger issue is how to deal with the poor-quality photographs from the early digital cameras. Technology is progressing fast, and there are indications that new AI photo upscaling technology might resolve this problem in the near future, but at this point in time, these early digital photographs are lost to us. Hence, presenting the continuation of a phenomenon, at least in the development of graffiti and street art,

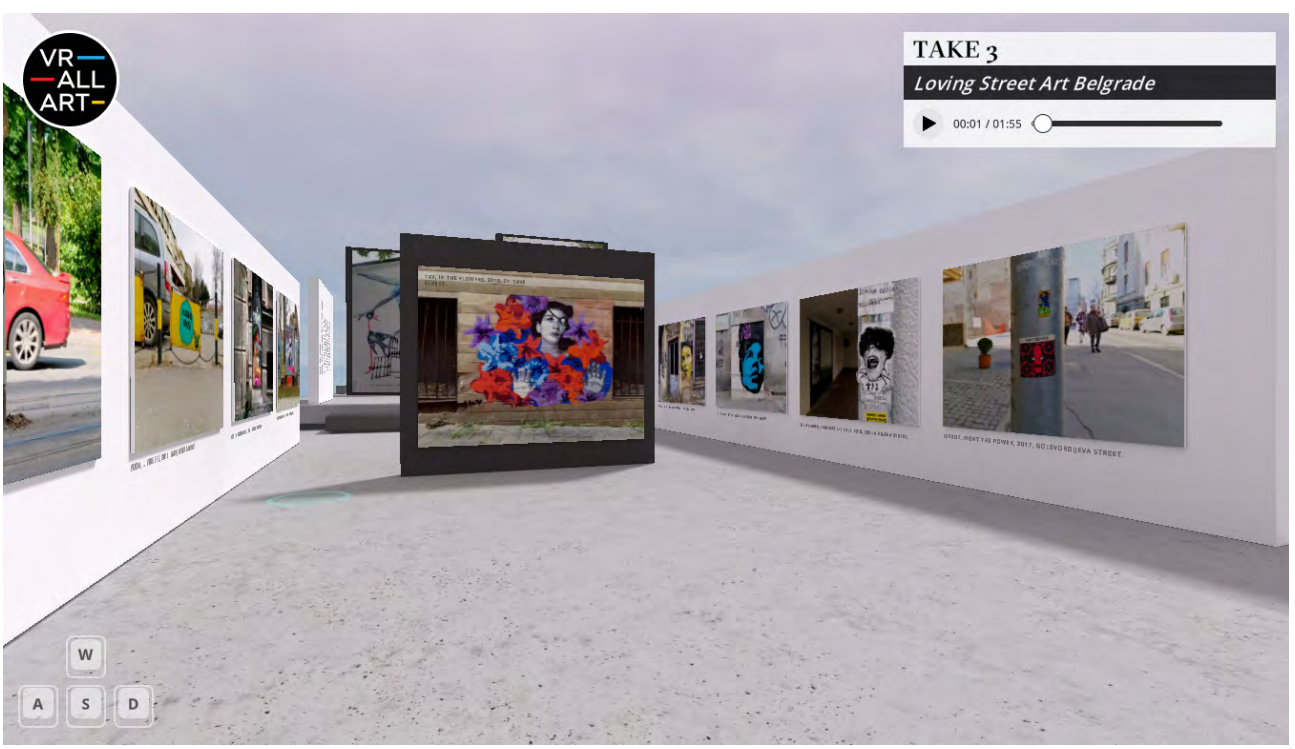



**Figure 6.** Screenshot of the exhibition Take 3: Loving Street Art Belgrade. Represents a segment that showcases the stickers and stencils.

will have a serious gap, especially since this is the period of time when street art was starting to separate from the graffiti subculture, and when we witnessed the overpowering strength of the internet. We have plenty of materials from that time, and they were readily available, but they were not compatible with this new technology. As graffiti writing and street art are not meant to last long, it is ephemeral art, and in most cases, we are lucky if a particular piece lasts for a couple of weeks or a couple of months (unless they were created in the areas of zero tolerance policy in which case they will be removed within 24 hours). Photography is usually the only proof that a particular piece of art ever existed, and unless we can work with photos, precious little is still available to us.

So the first level of selection is the availability and usability of materials which, depending on the topic, can seriously hinder curators' options. If, however, they manage to overcome this challenge, they have to understand the legal consequences of exhibiting the art without permission. Because of harsh penalties and possible imprisonment, most artists do not want their recent artworks to be exhibited. In some cases, only artworks that are older than twenty years can be put on display, which brings us back to the problem of available materials. Luckily, in our case, the Serbian legal system is such that even though there are laws against interventions without permission in the streets, they are not enforced for a myriad of different reasons. For the time being, we can safely present artists and artworks from Belgrade without fear of legal consequences both for artists and for curators/institutions.

If curators want to include 3D walls in the exhibition, the problem of selection arises once again. Virtual reality tools, at least those that were developed for museological use, were meant to be used in controlled environments, and the street could not be further from that concept. It is relatively easy to document and scan artworks in museums and galleries because artefacts can be placed in such a way that would allow them to be presented in the best possible light. The street, however, is a different story. We have no control over the spaces graffiti writers, and street artists decide to use for their art. Very often, these surfaces are unapproachable and sometimes even dangerous. So photographing

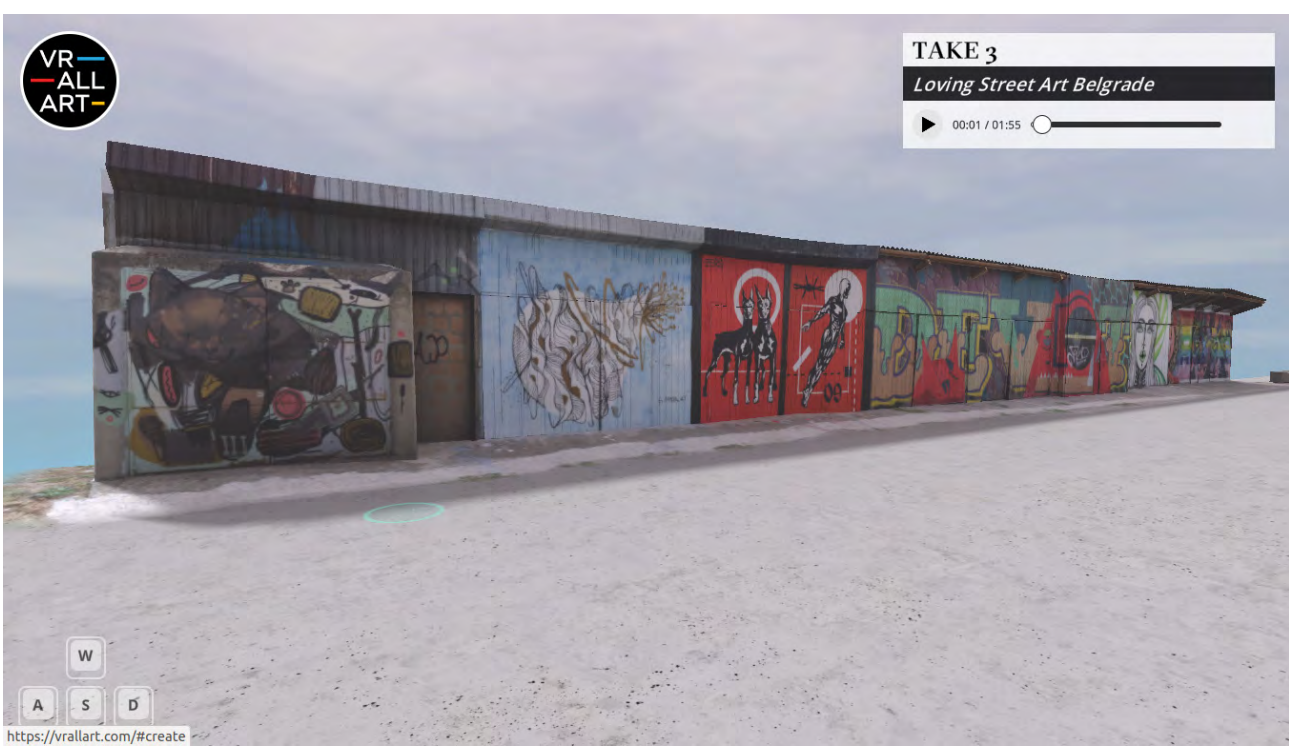



**Figure 7.** Screenshot of the exhibition Take 3: Loving Street Art Belgrade. Represents a segment that showcases the 3D wall.

a wall in photogrammetry can be quite challenging. Even things like bushes, lampposts or parked cars can represent insurmountable problems from a technological standpoint. As a researcher or curator, one cannot just decide that they want a particular wall to be scanned in 3D just because it is the most important spot in the city that has been in use for the last 25 years. If the wall is too long or too tall or, as mentioned previously, there is unwanted shrubbery or objects in front of it, it is harder for non-photogrammetric experts to properly digitise it in 3D. Once again, you are faced with the fact that you must choose a wall that might not be really what you need to create new meaning, and with something that does not truly support your idea or the theme of the exhibition.

If people managed to digitise in 3D the great pyramids of Giza and Machu Picchu, how hard can it be to do the same with a wall in the city? Well, this is a simple problem of finances. If one wants to create something great in VR, one has to be ready to pay for that and sometimes even pay for the development of particular features of software that were not available on the market. But if one is trying to do great things from the position of a small association that deals with art that is considered to be vandalism, then options are limited to what is already available. Simply, one has to settle with what is offered. Therefore if there is a need for a digital 3D surface of a wall, one must select one: that is free-standing, has no permanently positioned objects or plants in front of it, is not too large and the one for which you have a scanning permission from the owner. The photogrammetry process is simple enough: take as many photos, from as many angles, of the wall as possible. Then the computer takes over the process; the program specialised for this work processes photos, and this can take days. Not only is the process long and sensitive, but the content is heavy and requires high-quality servers. The more numerous and the larger the photos, and the longer the process, the more expensive it is going to be. Keeping all these restrictions in mind, it seemed that the only suitable materials were the ones that dated back no more than ten years, and the options for the walls were even smaller. So, when we finally had a selection of photos and a possible topic to deal with, it was time to put these into virtual reality.

**6. Gallery Space in Virtual Reality**

Once we had a random selection of photos and a wall, we needed to come up with a general idea of how they were going to fit in together in the gallery space. This again represented a new challenge. When representing graffiti writing and street art, the general idea is not to put it in a space that would resemble an actual real-life gallery or a museum. Rather, these visual expressions need open spaces, especially if we try to follow the line of thought that distinguishes them from the rest of the art, and that is—if it's not on the street, it is not graffiti and street art. This was the main reason why pre-existing gallery spaces that were offered to us by the VR-All-Art platform could not be used for our exhibition. This line of reasoning was highlighted by the presence of the 3D wall at the exhibition. We needed programmers to create space that would accommodate the wall and open-air gallery, while at the same time gallery needed to be divided into segments to convey meanings and contexts of the segments better, but also to be open enough to allow a glimpse at the wall. Because of the limited funding, we needed to come up with these solutions on our own.

Fortunately, the programmers we collaborated with had enough interest in our topic and exhibition that they put more thought into it than we could afford. Once the space that held both the 3D wall and the open-air platform was created in the Unity game engine, it was up to the curator to learn how to position the walls of the improvised gallery that would hold the photos of the artworks. Having the curator create not only a concept of the exhibition but also an actual space for the exhibition is a rare opportunity. This, more than anything else in this process, sparked the imagination of a curator in terms of what possibilities VR could mean for the curatorial practice in the future. We received comments that the final product looked like a 1980s video game, and as much as this comment holds some merit, it completely missed the relevance this exhibition had for the future of the curatorial practice. Being able to create both the content and the space at the same time, even if very stressful and time-consuming, is a game-changing concept. Moreover, the open space gallery that was created for us is now available to the other users of the VR-All-Art platform.




**Figure 8.** Screenshot of the exhibition Take 3: Loving Street Art Belgrade. It showcases the open view of the VR gallery space.

One of the most important possible uses of VR exhibition spaces is as a training tool for students of art history and young curators. Today it is tough for inexperienced cultural workers or students to get the opportunity to try and fail, to learn from their mistakes without being afraid that they will not get another opportunity or funding after that. If working in VR could become a part of an art history curriculum, it would bring a much-needed change in this area. First, it would train young professionals to familiarise themselves with the technology that would be their future. Second, it would allow branching out and creating curatorial studies specialising in the creation of VR spaces for those that have an affinity for new technologies and programming. However, even if used only as a tool, this approach can revolutionise curatorial practice. We could expect new generations to move from the traditional systems of constructing the exhibition, leaving the 1980s video game look, introducing interactivity or other systems of learning and experiencing art. There are already available video games in which you can learn how to use a spray can and how to draw graffiti. This would be the next best thing to real-life workshops that are necessary educational part of big exhibitions. The possibilities are endless, and the end product would not only be a new breed of curators but also a new breed of audience. This could tip the scale and attract hard-to-reach audiences and consequently raise their numbers that have been in decline for decades. This, however, does not mean that dealing with art in real life and real space has an alternative, only that we have the potential to branch out and, in that way, provide necessary training and prepare for the future those that deal with the history and heritage—past, present or future.

## 7. Conclusion

Although graffiti writing and street art as we interpret it today have existed for more than fifty years, they still have not been officially classified as cultural heritage. Though they are "not" our cultural heritage today, they surely will be the cultural heritage of our children. Therefore, documenting, preserving and promoting these ephemeral artistic expressions that border on intangible should be a general goal of all that deal with them. Attention should

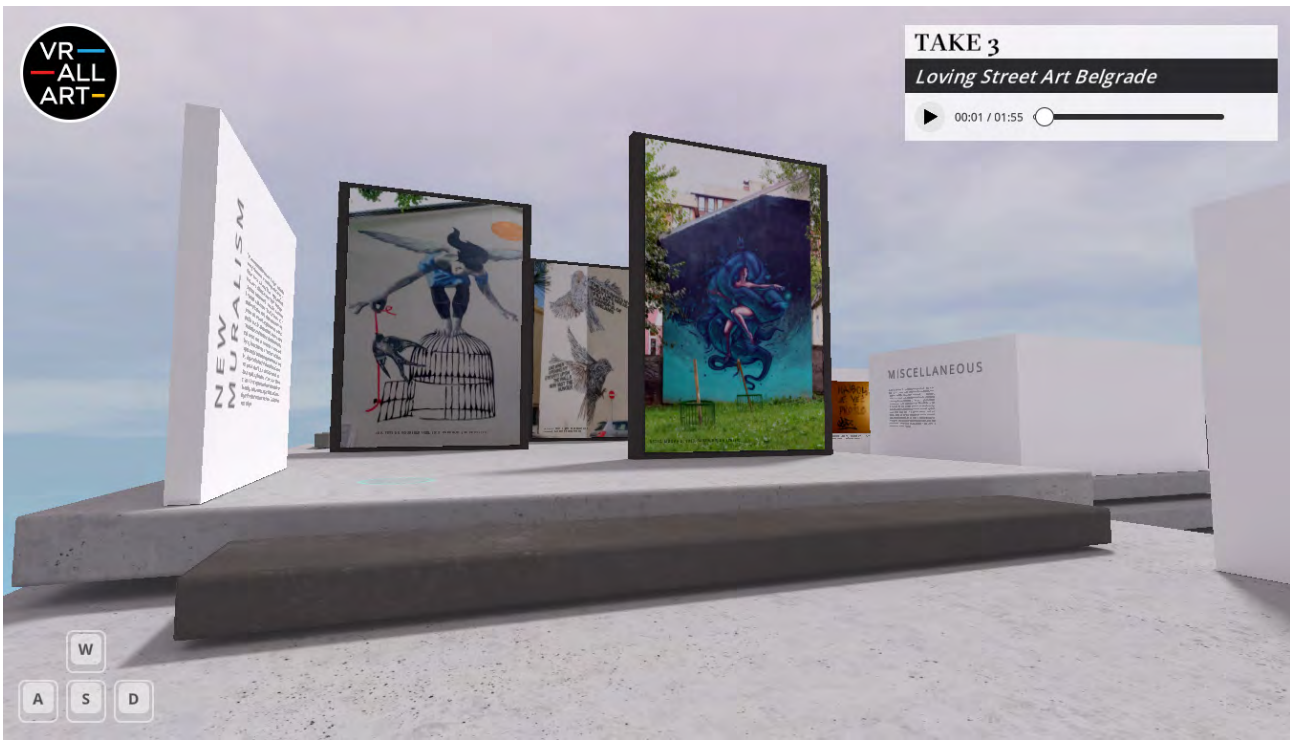



**Figure 9.** Screenshot of the exhibition Take 3: Loving Street Art Belgrade. Represents a segment that showcases the new muralism.

especially be dedicated to the artworks that belong to the streets, which are naturally ephemeral and exposed to the life of the city. As we can see in Nomeikaite's (2017) overview of institutional, meaning UNESCO and ICOMOS, and academic discourse on whether graffiti writing and street art should be understood and evaluated as tangible or intangible heritage, we are still dealing with issues that cannot be easily resolved. Academics tend to think of these art forms as both tangible and intangible, and there is evidence for graffiti writing and street art being both. Yet institutions that deal with heritage evaluation and systematisation still lack the tools to understand them properly. We agree with Bengtsen's (2015) assessment that "actual street art cannot exist in an institutional context". Still, maybe the next best thing would be to document these art forms and disseminate them in virtual reality. And even though they are still being de-contextualised in that manner, at least there is an option of "walking" by the art piece and experiencing it in a different setting.

From this standpoint, creating the first exhibition of graffiti writing and street art in Belgrade within the Urban Heritage Hub, it was revealed just how complex and unpredictable it could be to present these art forms in virtual reality. And yet the exhibition that was made became quite a hit among the cultural workers in Serbia, and managed to show that a traditional, white cube system of thinking can be transgressed and overridden. There were multiple challenges that were a matter of the nature of the art forms represented, a matter of not understanding the possibilities and constraints of new technologies, a matter of the need to transcend old systems of thinking on the part of the curator, but all these opened new possibilities. With a better financial support system and the possibility of a no-building heritage institution producing some revenue, these new technologies will become more accessible. It is important to capture important sites in the city in 3D before they disappear. Therefore, we cannot wait for this technology to become cheaper and available to a larger pool of users. This, too, shall happen, and until then, curators and cultural workers will need to

top up their knowledge and skills and adjust to the new paradigm so that they will be able to use new technologies to their benefit and to the benefit of the audience.

**Conflict of Interests**

The author declares no conflict of interest.

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# Graffiti & Bananas. Street Art in Linz

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**Abstract**

Is this art, or does it go into the bin? Graffiti and street art polarise. Vandalism and damage to property in the eyes of some, added value or even art for the City and its inhabitants for others. Born as a US American subculture in the 1960s, graffiti has today conquered public space all over the world. Since the 1980s, a street art scene has developed in Linz, which came of age and became attractive for tourism and business at the latest with the foundation of the Mural Harbor, 'Europe's biggest outdoor graffiti and street art gallery. Covering a wide range from signatures, political slogans, stencil images and stickers on dust bins to large-scale colourful spray paintings, these anti-establishment comments are to be found practically everywhere in Linz's urban landscape. Unauthorised art invades the City and playfully raises the question of who public space belongs to. Heteronomy, permission culture and self-empowerment as parts of our social structure have significantly been gaining importance in this context, especially since COVID-19 took on pandemic dimensions. The exhibition "Graffiti & Bananas", curated by Klaudia Kreslehner, documented for the first time the development of graffiti and street art in Linz. Photos, reports and contemporary works of art testify to an urban movement whose pithy pictorial language paints the social climate on our City's walls.

**Keywords**

(City)museum; exhibition; graffiti; hidden town; Linz

## 1. Let's go Bananas!

'What's the connection between graffiti and bananas?

Export hit, baby food, art motif, phallic symbol, achieving fame as an album cover, stuck on the wall with tape, elevated to a high-priced work of art and reproduced as a stencil—this is how the banana made its reputation. When the exotic fruit first reached Europe, it was a luxury item, but later it became a mass import commodity. In post-war Austria, it was an icon of the economic miracle and the new consumer society; in the era of the German Democratic Republic, it was in short supply and finally became a symbol of the fall of the Berlin Wall.

"Banana" has even gained currency in linguistic usage, whether as a counterpart for the bum bag as an accessory that reappeared in the 1990s, as a term for "crazy" in the sense of "totally bananas", a description of shapes such as a boat, a bicycle saddle or a cap for a spray can, or in the term "banana republic" with its economic and moral associations indicating exploitation of the Global South, international disequilibrium and corruption. Notably when the East opened up after the fall of the Iron Curtain, Linz was considered the "Banana Capital". From 1989-2011 the company Mathy was based at the Linz freight yard and operated a banana ripening facility there. Most of the bananas came by railway wagon from the seaports and were sold from Linz. To this day, a bunker which the company had decorated at one time with large sprayed-on bananas still stands on railway land. Some rail travellers still consider this an unofficial Linz sign.

The banana is also promoted in artistic circles, ranging from a luxury item to a mass commodity. In 1967 pop-up artist Andy Warhol placed the banana in stencil format on the album cover of "The Velvet Underground & Nico". German artist Thomas Baumgärtel uses the same technique: known as the "Banana Sprayer", he reproduces the stencil in a wide range of variations and has even left a few examples on walls in Linz, such as at the LENTOS Art Museum and the entrance gate to the Museum Francisco Carolinum. Imitated stencils are also to be seen throughout the City. When

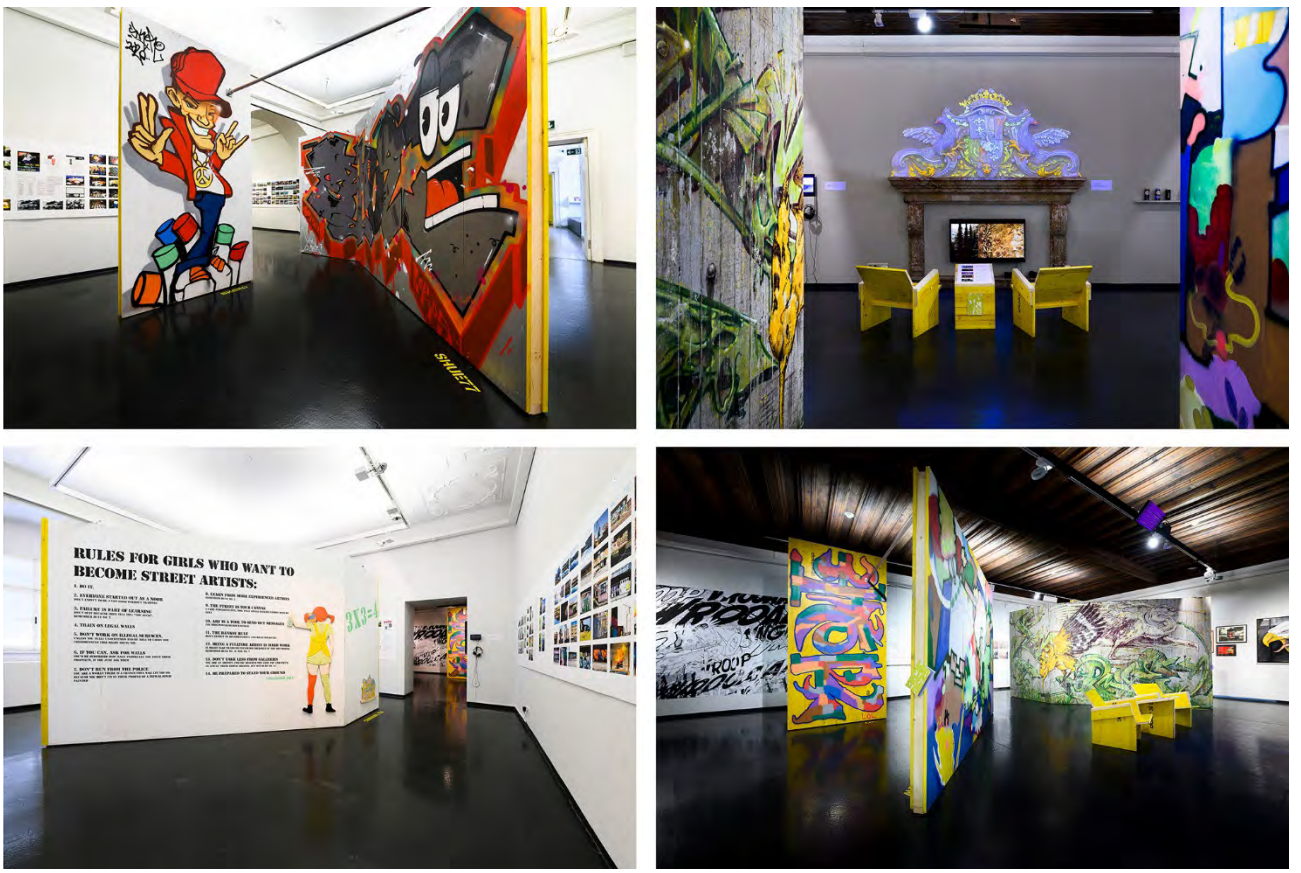



**Figure 1.** Exhibition views of "Graffiti & Bananas", 2020, Nordico Stadtmuseum Linz © Norbert Artner



**Figure 2.** Banana bunker view from the train (left) and a banana graffito by Thomas Baumgärtel at the Francisco Carolinum (right), 2019 © Klaudia Kreslehner.



**Figure 3.** Exhibition view of the Installation Marta Grossi, © Norbert Artner.

Italian artist Maurizio Cattelano stuck a banana to the wall with tape at the Art Basel Miami Beach 2019, thus declaring it to be art, this event caused a new sensation in street art in the form of memes created by Australian graffiti artist Lush Sux. Italian artist Marta Grossi finally created banana graffiti in the most diverse forms.

The banana and its use are ultimately as wonderful, quirky, alienated, characterised, flexible and contradictory as the scene surrounding graffiti and street art itself. In this way, we push the boundaries of conventions and expectations and open the door to new art forms. Let us simply accept that graffiti, in all its variations and related disciplines, is an exciting, sensual, flexible and elastic part of a colourful urban world.




**Figure 4.** Murals produced for the exhibition, 2020, Nordico Stadtmuseum Linz. A. SKERO, B. ONETWO CREW, C. MAMUT&KRYOT, D. WALZE, E., SHUE77, F. CHINAGIRL TILE, G. VIDEO.SCKRE, H. SHED © Norbert Artner.

**2. Hidden Town—The City within the City. Or: Depends on Where You Put the Focus.**

> *The public has a right to art. The public needs art, and it is the responsibility of a "self-proclaimed artist" to realise the public needs art, and not to make bourgeois art for the few and ignore the masses. Art is for everybody.*
> *KEITH HARING*

2.1. Who does the City belong to?

We live in a time where we are permanently exposed to a barrage of stimuli emanating from the consumer world. Capitalistically motivated structures dominate this world. Our gaze is at the beck and call of economic and political concupiscence. In an urban environment, there are ads wherever we look, blatantly clamouring for us to shell out. Bargain competes with bargain in one shop window after another. Discounts, special offers, and markdowns slog it out. A garish wall of price labels in the glaring light of halogen spotlights. Most of us have become used to this by now. To tuning out and following the prescribed path in a stupor. To being needy. To shopping. The urban centre pulsates ever faster. We are meant to go ever further, faster, higher. Soon all vacant spaces will be occupied. But who is to decide to what extent urban residential and working spaces may be exploited? How can we make use of public space and are we allowed to do so? How can you shield yourself against the messages and the temptations to which you cannot help being exposed? What is this curated inundation with information doing to us? Are there still spaces where individuals can express themselves? What needs to be accepted as given? What is preordained? What is still permitted? Who does the City belong to? All those questions have been part of the research process for the exhibition "Graffiti & Bananas" (which took place from 04/09/2020 to 21/03/2021. But while observing the City, this process suddenly was interrupted by the pandemic regulations and thereby somehow changed the point of view on the show's topics.

2.2. Explore the City

March 2020. A virus had everyday life in its grip. Questions of self-determination and permission, injunctions, restrictions and sanctions imposed by law were given a new presence and significance. We found ourselves suddenly ejected from a structure we were familiar with, from a life on autopilot. The government's restrictions as a remedy for a dystopian pandemic world produced a cityscape that was temporary, alternative, utopian perhaps, and certainly hitherto unknown. Car-free streets. Unfrequented eateries. Sidestepped by hectic everyday life. Seemingly business as usual, but minus the people. All of a sudden, it seemed the City had lost some of its function, streets had been emptied like an abandoned fun fair. 'Linz's pulsating artery had fallen silent. The market criers had disappeared, as had the acoustic bombardment in the shops, the traffic noise, the bustle, the flashing lights of the shop windows, the stench of the car




**Figure 5.** Sticker and Graffiti in Linz, Urfahranermarkt-Gelände, 2020 © Klaudia Kreslehner.




**Figure 6.** Sticker and Graffiti in Linz, 2020 © Klaudia Kreslehner

exhaust fumes and the oppressive mixture of food odours, smoke, scent, and sweat. A new urban emptiness had begun to spread, shouldering aside the consumer 'society's *horror vacui*, the dread of emptiness, that was formerly one of its characteristics. Distraction was no longer the order of the day. This was the time when the protective blinkers of selective perception could be removed so that people discovered pure space as such at their own pace.it

An unusually pacified atmosphere and the entire decelerated environment made it possible for people to adopt a new perspective and discover their City afresh. Take up a new viewpoint. Focus was possible. Quiet versus distraction. The City morphed into a museum. The exhibition waiting to be discovered outside is still there for the taking, despite the traffic being back to pre-pandemic levels, despite the hectic pulse of everyday life. It has many faces: shaped mainly by business and politics clamouring for attention, by decisions—partly excellent, partly disastrous—made by urban planners, property owners, restaurateurs, and shop owners. And by people who dispose of their chewing gum on the pavement and stuff their fag ends into crevices in the wall—and by those who scribble protestations of love or hatred on walls and park benches. Time also leaves its detritus everywhere: exhaust fumes disfigure facades, wind and weather leave their imprint on surfaces. What was new grows old. And what was old is given a new lease of life. A timeline in perpetual flux. Add to this painted and sprayed pictures, messages, and all kinds of decals and stickers: provocative, streetwise, hilarious, critical, ironical, silly, attractive, and repugnant. Evaluation, as always, is in the eye of the beholder in line with the context of the times. Art for some, for others disfigurement and wilful property damage. Nuisance, added value, part of urban identity.

Even the attempts at removing graffiti and stickers left a record: the differences in colour in the patches on facades that have been repainted or touched up, the residue of glue that decals affixed to junction boxes and garbage bins have been left behind. Replies to messages in the form of edits (spelling mistakes), comments (affirmative or corrective of the original message) or overpaintings (presumably with a diametrically opposed statement). This generates dialogues, groupings, verbal sparring, jokes, questions, and pictures attesting to the mood in the City. Boundaries are drawn and are tolerated or pointedly ignored. Top dogs defend what they consider their domain and seek to outcompete newcomers. It's worth paying close attention to. As in a hidden picture puzzle, you may discover the City within the City. Never before seen details become visible. It is all human-made; the intention behind it is as individual as are the inhabitants themselves. A participative show. The crew of designers and artists is made up of invitees and those who have empowered themselves.

**3. Graffiti in Linz**

Curating an exhibition about Graffiti in Linz means: doing the work. Starting the research about this town's graffiti history made it clear that there is no written book or paper about this specific topic published. This exhibition had thus to start with building a base: looking through archival stocks, even police archives, flipping through old newspapers, interviewing private collectors and—most importantly—talking to those who had been part of the very early graffiti community in Upper Austria. Thanks to them, it was possible to give an overview of the forty years of graffiti history of Linz.

Officially, Linz has eight venues[1] where graffiti may legally be sprayed today. Five of them are in underpasses: two in the eastern part of Urfahr and three at the 'City's southern periphery. In the Donaupark, a wall has been put up specifically for this purpose, complete with seating. In the central residential area between Kaisergasse, Lüftenegger- and Honauerstraße, the back sides of garages have been cleared for sprayers. Clearly visible from the banks of the Danube in Alt-Urfahr West, the arguably longest wall is to be found below the Römerberg tunnel.

Attempts in the 1990s to hedge in illegal graffiti ultimately led to a resolution to make walls within the urban context accessible for sprayers. The first attempts in this direction on the part of the sprayer community date back to the late 1980s. A 'boy's handwritten letter addressed to the 'City's mayor with an attached map of Linz complete with proposed venues attests to attempts to provide officially approved surfaces for 'Austria's up-and-coming graffiti generation. The political establishment reacted to this with different voices, not all sympathetic. Some came out in support of youth culture, and others worried about the disfiguration of the urban environment and an uncontrolled surge in graffiti. Upper Austrian urban environments, such as those in Linz and Steyr, had come into contact with graffiti relatively early on. This may partly be due to the proximity to Munich, considered one of 'Europe's premier 'graffiti 'cities'. This is why a deeply entrenched scene developed here, whose harder core has survived to this day.

The first legal graffiti in Linz on the bunker at the Andreas-Hofer Square date to 1990. They proved highly controversial among the 'City's political actors. In addition, an event that occurred here twice in the 1990s was quite unique: the *Stay Original Jam*, organised in and around the Neues Rathaus by 'Linz's Socialist Youth. This was a meeting point for the scene that proved attractive far beyond Upper Austria's borders for renowned artists in the fields of breakdance and graffiti: they sprayed specimens of their art onto custom-built walls while the *breakers* demonstrated their skills in the street. Inevitably, painting did not remain confined to legitimate surfaces, much to the annoyance of the neighbouring property holders. This was one of the reasons why the event only took place twice.

It has presumably always been the case that graffiti cause a certain polarisation. In Linz and other cities, there are self-proclaimed urban cleaners, who feel that the City is being disfigured by illegal graffiti. An elderly lady makes a point of regularly picking stickers from junction boxes in and near Dametzstraße, where she lives. She has set her sights, particularly on some local football-fanclub stickers. Another Linzer has set himself the goal to make his neighbourhood graffiti-free by the time he retires. He draws motivation, as do many others, from the *Broken-Windows* theory by James Q. Wilson and George Kelling (1982), which claims that any problems that go unattended in a given environment lead to other problems, eventually paving the road for crime. Guided by his initiative and research, he has become quite an expert in the field. He is regularly asked for advice on cleaning sensitive surfaces, like those on police cars. A Linz cleaning company, relying on his expertise, has specialised in removing graffiti and offers the impregnation of surfaces, making it easy to remove graffiti. Watchful Linzer's document, comment, and report graffiti. The 'City's website, www.schauauf.linz.at, receives a steady stream of relevant information. Others put the colourful surfaces to good use: photo shootings are staged in front of decorative graffiti and feature in marketing campaigns. There are even graffiti that end up as wallpaper in the conference rooms of corporations. The male or female creators of these graffiti do not stand to benefit financially from the adoption of their works. Public space and the artists' anonymity make it difficult to press legal claims for royalties. Artists and pho-

1 - The website www.spraycity.at lists all *legal walls* in Austria.




**Figure 7.** *Skulpturenpark* in Donaulände, a.k.a. *forum metall*, 2020 © Klaudia Kreslehner.

tographers who use this urban narrative for their needs and base new work and entire picture archives on them include Anton Kehrer, a Linz artist and photographer who has been documenting the development of the graffiti scene in the noughties, producing a comprehensive narrative. Together with other images in the exhibition, his photographs built the base of the current inventory of Linz graffiti.

Squares and monuments in the centre are preferred locations for the placement of messages. For the *Skulpturenpark* in Donaulände, a.k.a. *forum metall*, this means that it undergoes a permanent change. Communication takes place under the cover of anonymity. The recipient is the public. Everyone may feel targeted yet is free to ignore it. Topical political events that are underreported in the media and therefore remain under the general radar—or are sometimes deliberately suppressed—are brought to the public's attention in highly frequented locations. A case in point is demonstrations of solidarity with *Grup Yorum*, a Turkish band, known for their political songwriting, who is the victim of political persecution in their home country. Obituaries of two band members who died after a hunger strike in the spring of 2020 were affixed in various places.[2]
Freedom of opinion and questions of heteronomy and autonomy are significantly gaining in importance also in Austria, especially in view of the pandemic and how it has been dealt with in the media and politics. It became clear very quickly how fragile our legally defined and socially accepted possibilities and our freedom is. Resistance against the COVID regime and the restrictions imposed by the government has become visible. Protests both against ex-US President Donald Trump and against local politicians put an appearance in the hidden picture puzzle of our streets. Sexist, racist, national socialist, paedophile and homophobe slogans, and catchphrases that seek to glorify violence appear side by side with calls for justice, gender equality, fairness, feminism, freedom, peace, love, and calls to save the climate. Scrawled swastikas are often crossed out immediately, overpainted or removed, while symbols that are not in breach of criminal law are often tolerated for longer timespans. In this league, you will find drawings of hearts, CCTV cameras, bombs and submachine guns, or a roll of toilet paper at the end of a rainbow. Slogans include '*Ausländer raus*' [Foreigners out], '*Nazis raus*' und '*Alles wird gut*' [Everything will be o.k.]. A.C.A.B., which means All Cops Are Bastards—a widespread abbreviation for which 1312 serves as an alternative code. Right and left. Black and white. Fan communities of football clubs pay tribute to the glory and prestige of 'their' club by populating public space with their initials. It is obvious that the supporters of Linz's Athletik Sportklub (LASK) and the FC Blau Weiß (formerly Stahlstadt Klub VÖEST) are trying to deny each other supremacy

2 - In the Donaupark, someone scrawled 'Freiheit für Mustafa Kocak' in April 2020 on the sculpture *Evolution* (by Helmut Gsöllpointner, 1987). Mustafa was a political prisoner in Turkey, went on hunger strike to demand a renewal of proceedings and died in Istanbul on the 297th day of his hunger strike in April 2020.




**Figure 8.** ASK, legal wall, 2020 © Klaudia Kreslehner.

on the City's walls. As a consequence, the walls of our City provide an impressively varied picture.

Unlike regions where graffiti and/or wall painting have a long tradition, there are relatively few large-scale murals in Austrian cities. It may well be that the size of a city and the degree of its urbanity are a factor in the spread of graffiti. Vienna has come in for much more colour in recent years. Street Art focussed exhibitions and festivals[3] have contributed to the expansion of legal surfaces, and the City now boasts artistically valuable murals. The graffiti scene, which is generally considered highly committed and networked, is attracting more and more attention in Linz. For some artists who joined the graffiti scene right at the start, graffiti was simply part of a youth culture that reflected their age at the time; for others, it became a way of life or part of their calling. First commissions were not long in coming; as things stand now, quite a few artists can make a living from commissions. Motives and styles are becoming more and more varied. Graffiti on indoor and outdoor surfaces have long ceased to be only a youthful test of courage. It has matured into an art form. Leaving behind its origins in the streets, it has now firmly established itself in the market. Businesses, caterers and even hospitals in Linz make use of it in their interior design. What you get is a mixture of illegal *tags* and *pieces* with legal Street Art and commissioned works in the urban landscape. Since 2012, *Mural Harbor*, an outdoor gallery in Linz's port, has been putting well-known national and international graffiti artists on display on its 135 hectares. Boat tours open up an impressive vista on this unique venue. The Tabakfabrik was twice made the stage of a graffiti meeting, organised by Erich Willner aka SHED and the *Schule des Ungehorsams*, whose results were put on display on walls that are not part of the listed building. Admission was free. (Unfortunately, most of these walls have now been demolished.) In the city centre, the number of murals is gradually edging upwards. Most walls of the building used by the cultural association KAPU are already covered with graffiti by LUSH SUX, OMEGA WORLD ORDER, Michael Hacker Illustration & KRYOT. (First deliberations and efforts to redesign the facade of the building facing Kapuzinerstraße date back to the 1990s. In 2021, this project was realised with works by VIDEO.SCKRE and ONE TWO CREW.) The arguably largest inner-city mural is located not far from KAPU in Lessingstraße: a large surface above the Römerberg tunnel is covered with the work of VIDEO.SCKRE (an artist duo consisting of the Linz artist VIDEO ONER and her partner SCKRE27= and Via Donau's measuring point has been refurbished by NDZW. (The pseudonym NDZW is used by a Polish-born illustrator and Street Art artist, who is active mainly in Vienna. The previously mouse grey measuring point in Linz's Obere Donaulände, not far from the Nibelungenbrücke, was given a colourful makeover in 2019 on the occasion of the 125th anniversary of hy-

3 - The best known examples in Vienna since 2013/14 are: CASH, CANS & CANDY, curated by Katrin-Sophie Batz (formerly Dworczak), since 2014, CALLE LIBRE, curated by Jakob Kattner, since 2018, HANDS OFF THE WALL the feminist Street Art Festival curated by CHINAGIRL TILE. 2019 TAKE OVER at the Wien Museum, curated by Christine Koblitz and Karina Karadensky.




**Figure 8.** Nibelungenbrücke, Linz, 2020 © Klaudia Kreslehner.

drography.) It is likely that other Street Art projects will be realised in the near future in the steel city. A glance at Linz and other European cities goes to show that wall design has become part of urban identity in this country as well. Graffiti as an expression of individual concerns and social trends, issues, and moods has claimed its rightful place. It keeps on changing and evolving. It is exciting and it keeps on giving us things to discover. This is done best during a stroll across the City. Change the focus, away from shop windows and billboards, in the direction of occasionally hidden messages, codes and images, as if you were on an expedition. Then what becomes visible, emerging like a miniature parallel world, is the City within the City.

**Conflict of Interests**

The author declares no conflict of interest.

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# TAKEOVER – Street Art & Skateboarding: Turning the Museum into an Urban Playground

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**Abstract**

In the summer of 2019, the 'old' Wien Museum opened its doors one last time. The galleries had been emptied for a substantial renovation and expansion project, affording unprecedented opportunities for interaction. Located right in the city centre, more than 2000 m² were turned into a playground for street art and skateboarding.

The museum invited prominent local protagonists, affording everyone the opportunity to discover the scenes in entirely new ways. The building was split into two zones: on the ground floor, it was DIY and skateboarding; the first floor was a 'Hall of Fame' featuring main figures of Vienna's street art scene. More than 80 artists took possession of the museum's walls. Old exhibition furniture was turned into a skate park using concrete. There was much to discover and much to do—from breakdancing to workshops on various painting styles.

Street art and skateboarding still polarise, even though they have the status of pop cultural phenomena with a growing number of exhibitions. Yet the question remains: how can these outdoor practices be brought into a museum without losing their original spirit?

This case study gives an insight into the making of a collaborative project that became an overwhelming success: How the museum became a meeting spot for street artists, skateboarders and visitors of all ages; the difficulties we faced and the support we got, and especially how we made the first exhibition of Viennese street art.

**Keywords**

community project; exhibition; outreach; participation; skateboarding; street art

## 1. Introduction

Wien Museum is a general-purpose metropolitan museum with a wide range of collections and exhibitions—from the history of the city to art, fashion, and modern culture. It has 22 sites throughout the city. When we learned that the main building on Karlsplatz would close for renovation and expansion, we wanted to make use of the empty space before the construction work began. Why not do something with street art and skateboarding—two subcultures that are appropriate for unused areas and challenge our understanding of participation in public space? In 2016 and 2017, several local street artists were invited to paint the large wall in the central atrium of the museum, thematically linked to our exhibitions. This laid a foundation for what became one of the greatest adventures in the history of Wien Museum: "Takeover – Street Art & Skateboarding". From the 5th of July to the 1st of September 2019, the former historical museum of Vienna was turned into an urban playground (Figure 1).

Since I had suggested the idea and initiated the previous activities, I was asked to curate the project. At a later point, Karina Karadensky joined our small team as curator and producer. We wanted to create something quite different from a normal exhibition, more like a festival with various activities, open for collaborations and a space where everybody would feel welcome. Following the idea of the 'open museum' with one main goal: it should be fun!




**Figure 1.** Opening Night 04/07/2019 "Takeover – Street Art & Skateboarding "at Wien Museum. Mural by Frau Isa and Nychos, members of The Weird-crew, photo: Kramar/kollektiv fischka.

**2. Reference Project**

If you want to convince a museum director, who also has to stand up for your idea, it is always good to refer to someone who has done it before. Especially if you want to paint the whole building and do something quite unconventional for a museum.

2.1. BundeskunstHALL OF FAME. Graffiti- & Street-Art-Festival at Bundeskunsthalle 2015

Bundeskunsthalle Bonn reused street-like architecture that was left over from the previous fashion exhibition for a graffiti and street art festival. One part created an atmosphere mimicking a 'normal' surrounding where prominent local artists like MOSES & TAPS painted directly on the walls. The other part presented exhibition-like sketches, photographs and other artworks telling the history of the local scene. This was combined with an intense event program. Lucky for us, a book was published that documented all of the activities (Kunst- und Ausstellungshalle der Bundesrepublik Deutschland, 2016).

2.2. Street Art at Wien Museum

In the summer of 2016, Skirl, Ruin and Perk_up became the first street artists to paint at the museum. They decided to split the 27m-long wall in the atrium into three parts to show their interpretation of the Viennese amusement park 'Prater'. This was connected to the exhibition "Meet Me at the Prater! Viennese Pleasures since 1766" (Storch, 2016).

A year later, the same wall in the atrium was again devoted to street art inspired by "Vienna Calling. A History of Pop Music". This time the paintings evolved during several jam sessions, among others with Chinagirl Tile, Deadbeat Hero and PEKS.

**3. How to Bring the Streets into the Museum? (Concept)**

Of course, we dreamed about beautiful murals, but at the same time, we wanted to show the ambiguity of a subcultural scene which has its roots in vandalism. How can interventions like stickers, tags and other forms of writing be included? How could we bring outdoor practices into an institutional setting without losing their original spirit? Is it possible to invite graffiti into a museum? These thoughts lead to an idea: What if the exhibition was not completed at the opening, but left open spaces to slowly evolve? A takeover, so that people who would not so easily trust an institution could also join. And also allow visitors to contribute.

We had several discussions concerning the title. Which term should we use—graffiti, street art or urban arts? Graffiti being the most common expression, but for the reasons above seemed not fitting. Urban arts sounded too broad. We settled for the popular 'street art' as a term that people could relate to.

With less than a year of preparation time and a limited budget, several decisions were made for pragmatic reasons. While we could make full use of the whole building, the interventions had to be temporary, and everything was to be destroyed afterwards.

The building was split into two zones: the first floor was a "Hall of Fame" featuring 40 protagonists of Vienna's street art scene. Painted from top to bottom, but otherwise exhibition-like with labels introducing the artists.

The ground floor was an interactive space for Do-It-Yourself (DIY), events, workshops and skateboarding. The collective Spoff Parks turned old exhibition furniture into a skate park using concrete. Not only for decoration but free to use by our visitors. Everybody was invited to contribute and fill the walls with their artwork. The space evolved and changed from week to week. Outdoors, a stand-alone wall provided a legal spraying zone in cooperation with Wiener Wand, the Viennese municipal institution for legal walls. Three Murals on the façade of the museum showcased different crews.



**Figure 2.** Skirl adapting his lines to the 1950ies design of Oswald Haerdtl, photo: Rafael Bittermann/SAE.

3.1. Which Space to Use?

The museum not being a museum anymore since it had closed for visitors on the 3rd of February 2019, there was one thing we had plenty of: space. All the walls were empty, looking as sexy as empty buildings do when pictures were hanging in the same spot for years and years. Nothing like a white cube. Street art can adapt to any surface, so in a building, about to undergo refurbishment, the space grew even bigger. The floor, glass windows, elevator—almost everything became an option (Figures 2 and 3).

3.2. Cultural Heritage and Monument Protection

The museum was built in the 1950s. It opened in 1959, designed by the Austrian architect Oswald Haerdtl. As one of the few cultural buildings from the post-war era in Vienna, it has protected cultural heritage status and is under monument protection. Even though many parts of the house were to be completely renewed, some elements—like the entrance and the foyer—were especially sensitive. Covering them seemed a strange signal at the starting point of an interactive zone: "You can paint everywhere, but not here!" Instead, an installation with old storage boxes functioned as an information board and seating area. A museum guard



**Figure 3.** Video Oner lets a deer loose in the atrium, photo: Christoph

was placed for customer service at the information desk. To our relief, this proved sufficient.
The staircase was going to be covered with wood for the construction work later on. We chose to move this forward and thus gained additional painting space.
Much to our surprise spraying the façade was less complicated than expected. The stone cladding on the outside of the building was already in poor condition and no longer original. For several years, a fence had protected pedestrians from the danger of falling slabs.

**4. Outreach**

In the beginning, we were anxious about whether we could convince artists of our idea. Many had bad experiences with other institutions, galleries or fellow artists in the past. We established the museum as a neutral space, not tolerating any beef, and they set aside any quarrels they had amongst each other. They were surprised to hear that we did not want to hang canvases or other studio works but wanted them to interact with the building itself. Soon they realised that this was a once-in-a-lifetime chance with a lot of freedom for their ideas. All of the artists showed a lot of respect and contributed particularly fine pieces, reflecting the museum's surroundings and playing with the institutional versus the rebellious character of street art. Their commitment to the project was the key to the success.

4.1. Hall of Fame

The focus on Vienna turned out to be a real asset. We could meet everyone, show them the space and make plans together. Looking for artists that were (still) active in the streets of the city. We started by asking around and talking



**Figure 4.** MALR's STYLES ÖRTCHEN before the opening night of "Takeover – Street Art & Skateboarding ", photo: Christoph Schlessmann.

to artists we had previously worked with and questioning them: whom would you invite? As our list got longer, big names like Frau Isa and Nychos confirmed. Soon we heard: "With this line-up, it's an honour to be part in Takeover."
We also wanted to include graffiti writers that did not have shiny Instagram accounts. With help from one of the participating artists, we made acquaintance with MALR, a quiet guy who only paints abandoned houses and is friends with everyone in the scene. Whenever somebody thinks they discovered a new spot, usually one person has already been there: MALR. The invitation to the museum came as a surprise to him. He was thrilled and uncomfortable at the same time—much too clean. When we explained that he could choose any spot he liked, he asked: "Is somebody doing the toilet?" That's how the secret highlight of Takeover began (Fig 4).

The toilets on the 1st floor had been out-of-order for some time. They became "MALR'S STYLES ÖRTCHEN" (referring to 'stilles Örtchen' a slang word for toilet) with his writing and empty cans in the lavatory bowls to signal their dysfunction. He added lots of little details, like a dead plant that had been left behind in our former offices. He even put up his own sign "Das betaggen der Toiletten ist ausnahmslos erwünscht!" (Tagging the toilets is explicitly welcome!) making fun of the museum-sign "Wir ersuchen Sie die Toiletten so zu hinterlassen, wie sie diese gerne vorfinden würden" (please leave the toilets as you would like to find them). Everybody was invited to contribute and so they did. All the artists sponsored MALR's installation with the empty cans from their set-up and added their tags. As many more did during their visit. Little messages popped up on the walls and were sometimes commented on, and stick-




**Figure 5.** MALR's STYLES ÖRTCHEN at the end of "Takeover – Street Art & Skateboarding ", photo: Christoph Schlessmann.

ers appeared. In short: day after day, they looked more like toilets in a club with decades of patina. Nothing you would ever expect in a museum (Fig 5).

The basic rule in allocating spaces was that artists had to make use of things as they were. For those who needed a clean wall, we found fitting spaces. Those who wanted to interfere with leftovers from previous exhibitions were encouraged to do so. Bombing or Paste-ups with old museum posters? Welcome, Friend, Knarf and Lym Moreno! Calligraffiti emerging from a pillar to the wall? Yes, please, Moiz! Who wants to make use of an old cabinet? Thank you, Tabby. Can a chunk missing from a column be given a facelift with a vagina sculpture? Sure, Kollektiv Kimäre. Do you like the smooth surface of the plastic floor? Enjoy, Kryot! (Fig 6) Junek used a former projection space as a frame for her writing that also had an AR animation. Others fooled around with single letters from old exhibition labels and created funny new messages.

Paul BUSK wanted to break through a wall to create a huge stencil. He then used a fire extinguisher—cautiously filled with black paint to spray his name through the wall-cum-stencil onto the wall behind (https://youtu.be/Jgz_Ava_UT0). Something that he could never do in the streets because it takes too much time. Even in the museum setting, this was a tricky task and took much longer than any of us expected. We had a stand-alone double-wooden wall that fitted his plan. It had been unchanged for at least ten years, so nobody knew what was inside. Carefully Busk started to cut out his name. After a week, the stencil was ready for action. The result was impressive and honoured the prominent spot it occupied on the first big wall that visitors encountered upon entering the “Hall of Fame”. It had been a




**Figure 6.** 3-dimensional Stencil by Paul BUSK, floor by Kryot and writing by Skero, photo: Christoph Schlessmann.

much coveted spot (Fig 6). The large wall in the atrium also attracted a lot of interest. Size does matter in graffiti and street art. When they heard it was reserved for Nychos, they nodded with respect.

Nychos, probably the most well-known Austrian street artist, now living in L.A., was in town for a short time during our set-up and was able to fit a few days into his otherwise tight schedule. Watching him paint was fascinating. It looked like dancing with a can. Without a sketch, just an idea in his head, he sprayed layer upon layer and created a group of swimming crocodiles in the translucent, dissecting style he is famous for. (Fig 7) On the façade, he dissected one of Frau Isa's beautiful female characters—a thing he had longed to do for some time. The mural later became our key visual and cover for the book "Takeover. Vienna Street Art Now" (Fig 1).

With documentation being important to the genre, we invited photographers who had been working with the local scene for years to be involved. The urban explorer-collective, Die 78er, presented photographs of different underground tunnels and entrance doors. Only those familiar with the locations would know which two matched. Since urban exploring is about entering hidden places, Die 78er used a hidden spot behind the exhibition walls to display a set of urbexing-tools. Only those daring enough to crawl there could see it (Fig 8).

Another one was Spraycity, the web platform for all kinds of graffiti, especially train writing, hosted by the art historian Stefan Wogrin (see also the Spraycity contribution in



**Figure 7.** Nychos painting in Wien Museum, photo: Rafael Bittermann/SAE.

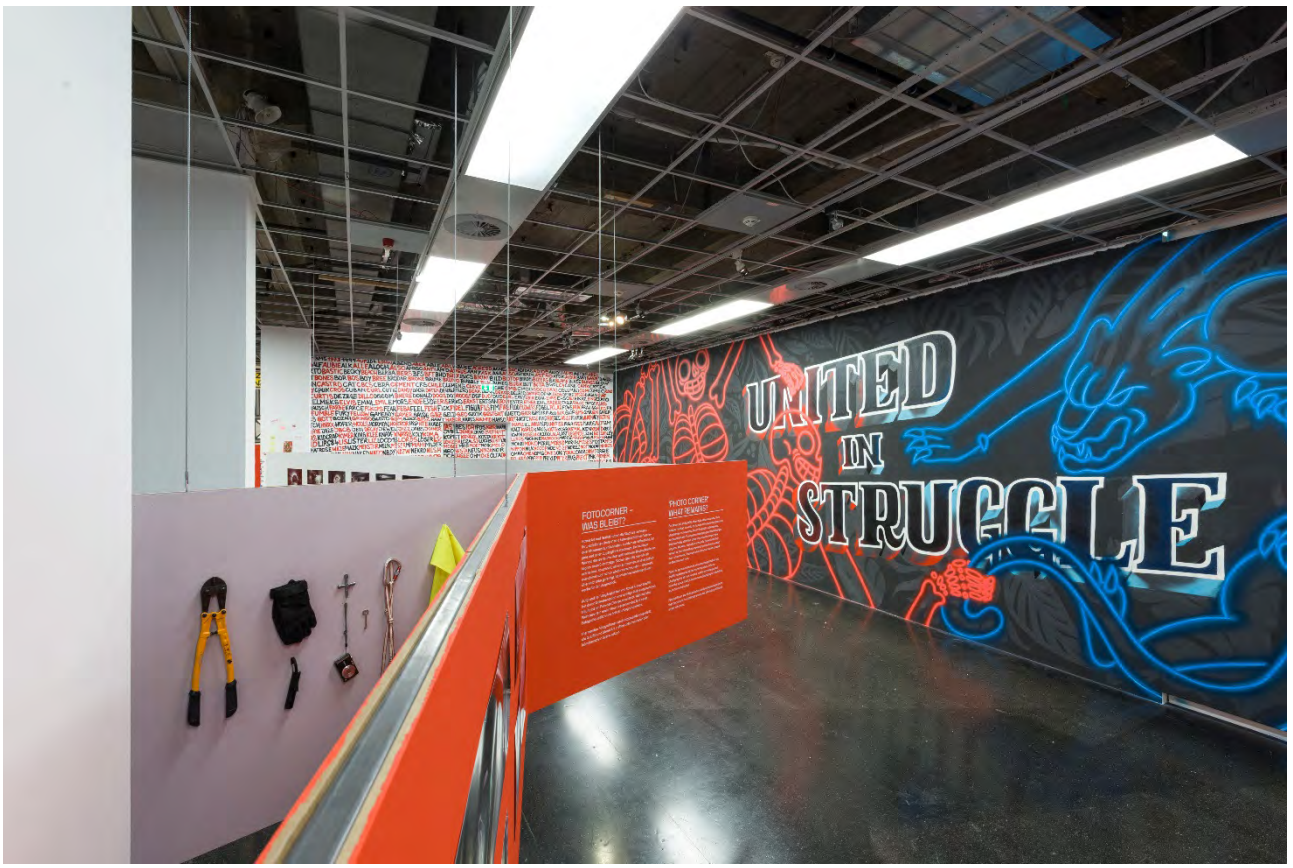



**Figure 8.** Ripoff Crew "United in Struggle "and a set of urbexing-tools hidden by Die 78er. In the back the long list of Viennese sprayers by Phekt, photo: Christoph Schlessmann.

this volume). He created a huge poster featuring pictures of all writers in alphabetical order. PHEKT had the same approach, wanting to bring in everyone, spraying a long list of names as a shout-out to those who had left their name on the streets of Vienna. By chance, both walls were situated next to each other.

Only female creators were scarce. Despite extensive research, at some point, we had to accept that we would be unable to avoid a gender imbalance. We were happy to have 30% female artists, which is more than can be seen in the streets of Vienna. Käthe Löffelmann, Mariella Lehner and Linda Steiner had only started as Ripoff Crew a year before. 'United in struggle' in Wien Museum they enjoyed their breakthrough that summer, visually communicating female empowerment ever since (Fig 8).

The Hall of Fame featured the artists Abend, Paul Busk, Cane, Chinagirl Tile, Deadbeat Hero, Flör, Frau Isa, Emanuel Jesse, Friend, Golif, Wolfgang Hartl, Olivier Hölzl, Junek, KLITCLIQUE, Knarf, Kollektiv Kimäre, Kryot, MALR, Thomas Mock, moiz, Monsterzeit, Lym Moreno, NDZW, Nychos, Peks, Perk_up, Phekt, Ripoff Crew, Ruin, Seco, Shue, Skero, Skirl, Speaker-23, Tabby, Video Oner and the photographers die 78er, Herbalizer, Spraycity and Vienna Murals.

4.2. The Secret Society of Supervillain Artists (SSOSVA)

With the focus on Vienna, there seemed to be no real reason to invite international artists. Yet travelling and leaving marks in other cities is an essential part of the street art game. I knew that Chinagirl Tile, a ceramic street artist, was a member of the SSOSVA. She supported our crazy adventure and made a call to her fellow members to send us paste-ups, posters or other small works as a tribute to




**Figure 9.** Secret Society of Suppervillain Artists – SSOSVA, photo: Kramar/kollektiv fischka.

"Takeover". More than 60 supervillain artists including their big boss, Silent Bill, followed her invitation and sent in pieces. Overwhelmed by the volume we received, we decided to present them in a separate area (Fig 9).

**5. Transformation**

When we started with the set-up six weeks before the opening, packing the museum objects that had been on display before was still in progress. Boxes were waiting for transportation, and conservators were anxious that nothing would harm them. Careful logistics ensured parallel work. The last two weeks, everybody else had moved out and we could tackle the more tricky things.

5.1. No Cans Allowed

Spraying almost killed the whole project. The empty building on the brink of renovation was still a museum building. We could not open the windows (the high risk of pests and unwanted humidity is avoided in museums for conservational reasons), and the desolate ventilation system was from the 1950s. This had not been a problem in the previous projects as the atrium had a separate ventilation system and windows in the glass ceiling that could be opened. The danger was not so much the toxic substances in the paint, but the highly inflammable gas that is necessary to push it out of the can. We needed extra fire prevention, ventilators, and security. A carefully structured plan avoided more than two people spraying at the same time. Several artists switched to brushes, for others—like Golif or Skirl—it was their normal technique anyway.

5.2. Jam-Sessions

For safety reasons, we had to move the jam sessions in the DIY area to closure days. Spraying workshops had to take

place outside. For all other painting activities, we established a strict no-can-policy.

The jam sessions had different hosts from the scene reach out to other artists, focussing on female artists (Chinagirl Tile/Hands-of-the-wall) and graffiti (Cane and Speaker-23). The first session took place a few days before the opening. Even though the entire ground floor was considered an open space, we did not want it to be entirely empty. Also painting the skate park would become difficult once the exhibition started. Word had already gone around that we were preparing something big and several artists had contacted us, wanting to join. We didn't ask for clear names. We just set a date, provided the paint and those who showed up were given a spot. Soon the walls looked more street-like. Many artists were astonished that we welcomed their contribution, given that usually only 'neat' street art gets displayed in museums (Fig 10).

5.3. Work in Progress

The rough charm of the DIY area also appealed to our Hall-of-Fame artists. Some of them left tags or small pieces—like Tabby, who makes subversive stencils with pop-cultural icons or politicians (Fig 11). Paul BUSK had the habit of adding his name on each visit. Stickers, throw-ups, tags and even a tiny sgraffito—it became a funny game. In the end, we got 'busked' 28 times.

Week by week the walls became more colourful. Visitors returned with markers and pens to leave their messages,




**Figure 10.** Skatepark by Spoff Parks with pieces by Drawvolution, Slayer, Jakob der Bruder, Kiwi, Fati and Lumen (from left to right), photo: Christoph Schlessmann.




**Figure 11.** Tabby charging the DIY-Area, photo: Christoph Schlessmann.




**Figure 12.** Wiener Wand in front of Wien Museum. Karus dedicated his piece to Franz Kratzer, the founder of "Wiener Wand" who had passed away in August 2019, photo: Stefan Wogrin/Spraycity.

groups of students met for painting sessions and the flow of artists seemed endless. Instagram served as the main communication tool. Not only for documentation and sharing souvenir pictures, but for people contacting us about creative possibilities. The usual dialogue: "Hi, I want to do a piece at the museum. Do you have a spot for me?"—"Sure. What do you want to do? Can you do it without cans?"

We soon ran out of clear spots and overpainted some walls for new interactions. Most people enjoyed the atmosphere and respected our Do's and Don'ts, which included a non-toleration policy for racist, anti-Semitic, or sexist content. There were fewer offensive marks than expected. Still, we had to erase several—mostly sexist comments—especially on the feminist artworks.
The 'Wiener Wand' outside changed almost daily, sometimes even twice a day when nighttime activists had gone to work (Fig 12).

**6. Collaborations and Events**

Many parts of Takeover were only possible thanks to collaborations. Particularly in the event programme: the open-air cinema Film Kaleidoskop created a programme dedicated to street art. The Wien Museum had always served as a location for Popfest Wien. This time it became the festival centre. The museum was also the festival centre for Calle Libre, which invited the Spanish collective Reskate Studio to do a mural outside. Music Res. Radio set up a DJ-Line in the former café, run by dasWERK, a club deeply connected with the scene. The shop space was covered in turn by Jan Arnold Gallery, Leap Art Prints and Oxymoron Gallery.

The FM4-radio station broadcasted live from the museum for the album release of Skero, a well-known Austrian hip-hop artist and member of the first generation of graffiti writers, in front of his wall. Shue, who has a long experience as a breakdancer, organised a breakdance battle. Speak-

er-23, who has a strong affiliation with techno, persuaded us to host a rave. He was so happy that he made his wall a huge flyer advertising the line-up. A video of the "Tek Over "-party can still be watched on YouTube (https://youtu.be/FbkhjLi_pWs). For the finissage, Dead Beat Hero organised an 'Artslam!' —a great art battle with live drawing sessions, artist booths, DJs, and drinks.

**7. Conclusion**

From the museum's point of view, the regular museum service ended on the 3rd of February 2019. "Takeover" was not considered a normal exhibition. Everything had to be thought of anew: guards, cleaning, guided tours, cafeteria and shop. An advantage this gave us was more flexibility with different opening hours fitting to our event programme, Thursday to Sunday from 2 pm to 10 pm, and free admission.

From the artists' point of view, it was the—long overdue—first museum exhibition about Viennese street art. Intrigued by the temporary character, they fully supported our adventure.

From the visitor's point of view, it was the chance to visit their beloved city museum once again before it closed for several years. They enjoyed the multiverse of street art and skateboarding and the many possibilities for participation. People lined up, waiting for the doors to open. Teenagers and young adults dragged their parents to the museum. Usually, it was the other way around. The museum became a meeting spot for visitors of all ages. Senior citizens, our usual audience, were also celebrating "Takeover". Many visited us several times. We heard: "Thank you. Now I recognise the artists of the murals I see on my walks in the city" and "You should keep the museum this way" and "When will you do this again?".

With more than 55,000 visitors and 123 events in 36 days, the exhibition was a huge success, ranking among the top 10 in the Wien Museum statistics. As a follow-up project, the construction fence became a canvas for street art during the summer of 2021 and 2022. Street Art continues to play a part in our museum work.

**Conflict of Interests**

The author declares no conflict of interest.

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Chiara Ricci is a conservation scientist at the Centre for Conservation and Restoration of Cultural Heritage "La Venaria Reale" (CCR). She currently also works as a laboratory technician at the University of Turin. She received a Master's degree in Science for Cultural Heritage in 2012 and Material Science for Cultural Heritage in 2016. She earned a PhD in Protection of Cultural Heritage in collaboration with the University of Vigo, Spain. After graduation, she had internship experiences at the Getty Conservation Institute (Los Angeles, USA) and the Instituto del Patrimonio Cultural de España (Madrid, Spain). She carries out scientific investigations on several heritage materials with a multi-analytical approach. In recent years, she has been focusing on the issues of graffiti removal from ornamental stones and street art conservation, participating in the European project CAPuS. Her research output can be found at https://orcid.org/0000-0002-5358-1932.

**NINA RICHARDS**

Nina Richards (born Nina Brundke, °1983) is an archaeologist and anthropologist involved in several projects within the scope of digital humanities. She received her Master's degree from Otto Friedrich University Bamberg (Germany) in 2009 (Archaeology of the Middle Ages and Modern Times). In 2014, she received a Bachelor of Sciences from the University of Vienna (Austria, Biology). Since 2006 she has been involved in different digital humanities projects such as Montelius, OpenAtlas, and RELEVEN. She is currently employed at the Austrian Centre of Digital Humanities and Cultural Heritage as well as at the Austrian Archaeological Institute and, together with Stefan Eichert, is PI of the THANADOS project (https://thanados.net).

**MICHELE RUSSO**

Michele Russo (°1977) is an Associate Professor in Representation at the Sapienza University of Rome. He received his Master's degree in Architecture from Ferrara University and PhD degrees from Politecnico di Milano

in 2002 and 2007, respectively. Since 2008, Michele has been working on many 3D acquisition, modelling and data visualisation topics at Politecnico di Milano and Sapienza, when he moved in 2016. He's actually involved in much research about 3D imaging, Augmented Reality, and Artificial Intelligence applied to the cultural heritage, architecture, and design domains. His research output can be found at https://www.researchgate.net/profile/Michele-Russo-5.

**DOMINIQUE SCALARONE**

Dominique Scalarone is an associate professor at the Chemistry Department of the University of Torino, where she gives lectures in Chemistry and the Conservation and Restoration of Cultural Heritage curricula. She received her Master's and PhD degrees from the University of Torino (Italy) in 1998 and 2001, respectively. Her research interests concern the chemical characterisation of organic artistic materials, the study of their degradation and the development of polymeric materials and protocols for conserving and protecting cultural heritage assets. Since 2018, she has been working on the conservation of street art, first as coordinator of the European project CAPuS, and now as a partner of the national project SuperStAr. Her research output can be found at https://orcid.org/0000-0002-0799-1690.

**ARIANNA SCARCELLA**

Arianna Scarcella is a conservator at the Centre for Conservation and Restoration of Cultural Heritage "La Venaria Reale" (CCR). She executed several conservation projects and interventions on wall paintings, stones and architectural surfaces in Pompei, on artworks from Museo Egizio of Turin and several sites in Piedmont. Arianna collaborates, as a lecturer, with the University of Turin, holding several internships, workshops and courses on wall painting conservation (2020-2021). In 2016-2018 she joined, as stone and wall paintings conservation trainer, the international cooperation project PMPS, in Jerusalem (archaeological site of Bethany Tomb). Since 2017 she has been involved as a researcher and trainer in different research projects on urban spaces and public art conservation, like the CAPuS project. In 2020, she joined the Advanced Training School of CCR, developing and managing international training programs on heritage conservation and capacity building with worldwide museums and international UN organisations.

**JONA SCHLEGEL**

Jona Schlegel (°1988) is doing a PhD at the University of Vienna (Austria) on archaeological stratigraphy and spatio-temporal reasoning. Furthermore, she is employed as a junior researcher at the Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology. She received her Master of Science in Landscape Archaeology at the University of Applied Science and the Free University (Berlin, Germany) in 2018. Since 2017, she has been working with geophysical prospection methods like geomagnetics and ground-penetrating radar. Starting in September 2021, she is part of project INDIGO, focusing on the graffiti thesaurus, spatio-temporal data structuring and web development. Her research can be found at: https://www.researchgate.net/profile/Jona-Schlegel

**SERT**

Despite growing up in a small village in western Austria with little graffiti, SERT has been a graffitist since 2009. SERT – now living in Vienna – considers the Danube Canal an important place for the Viennese graffiti culture. The urban surfaces along the channel are more than just a big canvas; they form a meeting point for old and new acquaintances. SERT's graffiti style can be described as semi-wildstyle.

**SAGITA MIRJAM SUNARA**

Sagita Mirjam Sunara is an associate professor at the Conservation Department of the Arts Academy, University of Split. She teaches preventive conservation, conservation documentation, history of conservation, and introduction to conservation of easel paintings and polychrome wood. She also teaches a course on artist interviews. She has a diploma in conservation from the University of Split and a PhD in art history (heritage preservation) from the University of Zagreb. In recent years her research has been focused on outdoor sculpture in general, and the Sisak Steelworks Sculpture Park in particular. She managed the CAPuS project on behalf of the University of Split, and coordinated the activities of the Croatian research group. One of her main project outputs was the CAPuS Digital

Repository. Her publications can be accessed here: https://umas.academia.edu/SagitaMirjamSunara.

**TONI TABAK**

Toni Tabak is an engineer and entrepreneur with more than twelve years of experience in software development. He started his career in 2010 as a freelance developer working on numerous projects involving 3D rendering pharm, governmental medical solutions, pipeline inspection/ reparation software and hardware, tourism booking engine and travel safety-centric solutions. Since 2019, he has been developing online learning platforms for prestigious colleges like Harward business school. In 2022 he decided it was time to focus entirely on resolving some crucial questions like liberalisation, freedom, and equality. He started working on zero knowledge L2 scaling solutions for the Ethereum decentralised financial system. He designed and developed the CAPuS digital repository as a searchable database application containing all research and resources produced during the project.

**GEERT J. VERHOEVEN**

Geert J. Verhoeven (°1978) is a senior researcher in archaeology at the LBI AchPro and is currently leading the academic graffiti project INDIGO. He received his Master's and PhD degrees from Ghent University (Belgium) in 2002 and 2009, respectively. Since 2010, Geert has been working on many 3D modelling, remote sensing and data visualisation topics at the LBI AchPro, a research institute of which he is currently the vice director. In September 2021, Geert took a deep dive into the colourful graffiti world through project INDIGO. His research output can be found at https://www.researchgate.net/profile/Geert-Verhoeven-2.

**ALEXANDER WATZINGER**

Alexander Watzinger (°1973) is a software developer with a special interest in data modelling and the use of web applications within scientific research. His favourite tools are Python, PostgreSQL, Linux, and open-source software in general. He is the lead developer of the OpenAtlas project (https://openatlas.eu). Since 2017, he has been working at the Austrian Centre for Digital Humanities and Cultural Heritage of the Austrian Academy of Sciences in Vienna. Within INDIGO, Alex will further adapt and develop OpenAtlas for the project's specific needs and requirements. His scientific research output can be found at https://oeaw.academia.edu/AlexanderWatzinger. His open-source code is available on GitHub: https://github.com/craws.

**MARTIN WIESER**

Martin Wieser (°1986) is an independent researcher in photogrammetry and remote sensing. He received his Master's degree from the Technical University of Vienna (TU Wien, Austria) in 2012. From 2010–2019, Martin worked on many photogrammetry, 3D modelling, remote sensing and data visualisation topics at the TU Wien as a project and university assistant. Since 2016, Martin has also been developing geospatial soft- and hardware prototypes for researchers worldwide (Historic England, University of Vienna, Murdoch University Perth).

**BENJAMIN WILD**

Benjamin Wild (°1996) is a PhD student and university assistant at the Photogrammetry unit at the Department for Geodesy and Geoinformation at Technische Universität Wien (TU Wien). He received his Master's degree from TU Wien in Geodesy and Geoinformation in 2021. Since then, he has been part of the graffiti-centred academic project INDIGO. Before investigating photogrammetric solutions in the context of graffiti research, Benjamin was working in the same department but in the field of environmental microwave remote sensing. What connects both experiences is the interest in understanding our environment better. Be it the amazon rainforest or the graffiti along Donaukanal. Benjamin's research output can be found at https://www.researchgate.net/profile/Benjamin-Wild-5.

**STEFAN WOGRIN**

Stefan Wogrin (°1989) is an art historian and graffiti documenter. In 2001 he founded the "Spraycity "graffiti writing archive (https://spraycity.at), which is also an online platform where 100.000 graffiti photos are accessible online. The archive is based in Vienna. He received his Bachelor of Arts in art history and European ethnology from the University of Vienna in 2017. Since 2001 Stefan is

also an active graffiti writer. Furthermore, he photographs graffiti from all different public surfaces in Vienna and the entire Europe. Since 2013, Stefan has also been researching the history of graffiti in Vienna, which is his main research interest. Stefan curated several exhibitions about graffiti, and he is the editor of the “Offline Graffiti Magazine “. The research Stefan is involved in can be found at https://spraycity.at/research.




goINDIGO 2022 has managed to bring various disciplines together. That is why the editors hope that the contributions in these proceedings can collectively be considered a proper methodological status quo on the inventorying and dissemination of graffiti records. Because most academic efforts focus on the analyses of graffiti, these proceedings also hope to kickstart further discussion and interdisciplinary scholarly action on the (need for) proper documentation and dissemination of graffiti. Critical, maybe even uncomfortable, reflections like those vented in this volume form an essential part of this discourse.

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