Cartographic Perspectives

The Journal of nacis

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MAPPING EMOTIONAL CARTOGRAPHY

Sébastien Caquard
Concordia University

Amy L. Griffin
RMIT University

INTRODUCTION

Maps are somehow shy. They tend to hide their emotional side behind their clear lines, precise points, minimalistic words, numerical data and informative purpose. But when we scratch the cartographic surface, maps appear to be impregnated with all sorts of emotions. The emotions associated with the topic mapped and the ones evoked through the cartographic design. The emotions felt by the mapmaker while drawing the map and the ones felt by the map user when discovering it. The anger and sadness triggered by social injustices revealed on a map, or the simple pleasure felt while admiring a beautiful cartographic design. The emotional experiences we clearly remember and the most common ones we hardly notice or we simply forget. Beneath the surface, maps and mapping teem with emotions of all sorts. In this introduction to the special issue on Maps and Emotions, we will reveal the multiple relationships that exist between maps, mapping, and emotions.

Before looking at these relationships, let's first clarify what we mean by "emotions" in the context of mapmaking. The term *emotion* is often used interchangeably with the term *affect*, since both are generally understood by scholars as embodied experiences. Beyond this commonality there are distinct differences between affect and emotion that vary depending on the disciplinary lens through which each is viewed. While both arise from our interaction with the environment, affects are generally conceived as arising from the body, while emotions are usually linked to the conscious mind and expressed through emotion concepts (e.g., fear, joy, embarrassment). One major disciplinary distinction lies in the relationship between affects, the body, and the mind. For affectual geographers, affects are non-cognitive (Pile 2010), while for neuroscientists affects are the mind's interpretation of the body's physiological state within the world (Feldman Barrett 2017). This differentiation is significant for cartography. For affectual geographers, because affects cannot be conscious, they can be neither expressed nor represented, while according to neuroscientists, affects can be both expressed and represented. On the other hand, both disciplines envision emotions not only as being conscious and representable, but also as being locatable within both bodies and the spatial contexts in which they are felt (Anderson and Smith 2001; Bondi 2005; Feldman

Barrett 2017). Geographical understandings of emotion acknowledge that place and context shape emotions, but also attend to how emotions shape space and place.

In this paper we review the relationships that exist between maps and emotions from a geographical perspective. This review is organized through three main themes: (1) the emotions that we place on maps; (2) the emotions that shape the mapping process and the map; and (3) the emotions people experience in response to maps. We conclude by identifying which of these aspects have been explored in the literature and more generally in this special issue, and which ones remain to be better studied to expand our understanding of the complex relations that exist between places, maps, and emotions.

1. THE EMOTIONS THAT WE PLACE ON MAPS

The placing of emotions on maps serves multiple interests. It can help urban planners to integrate citizens' perceptions into the planning process (Zeile et al. 2015; Resch et al. 2016; Fathullah and Willis 2018), it can serve to identify positive and negative hotspots such as places of fear in the city (Curtis et al. 2014), and it can be mobilized by marginalized groups and communities to resist unwelcomed development projects by demonstrating a specific and profound attachment to certain places (Graybill 2013). In more general terms, putting emotions on maps can inform social scientists—including geographers—about the kinds of relationships individuals have developed with places. In other words, mapping emotions can help us to better understand places and their relationships with our bodies and our minds.

Various attempts have been made to collect emotions connected to place, mainly in urban contexts. Already in the 1950s, psychogeographers were drifting in the streets of Paris to cross psychogeographic barriers while identifying and mapping "unité d'ambiance" based on their personal feelings (Debord 1957). The idea of drifting throughout the city to collect emotional data has been pushed further since then. In his famous "bio mapping" project, artist Christian Nold (2009) invited individuals to walk in their neighborhood equipped with a device combining a GPS receiver and a polygraph, which recorded the ups and downs of certain bodily reactions (such as the quantitative level of sweat) associated with locations. To refine what we can call "affect data," Nold organized debriefing sessions after each walk, during which participants would explain the reasons behind the bodily reactions measured by the device. These comments and personal stories gave some meaning to the polygraph's quantitative measurements of the body's reactions. In that sense, this device "functions as a total inversion of the lie-detector, which supposes that the body tells the truth, while we lie with our spoken words" (Nold 2009, 5).

In a later paper, Nold (2018) distinguishes his approach from what Peter Zeile and colleagues (2015) have called "Urban Emotion," which includes a range of methodologies dedicated to harvesting emotions as expressed in social media and through crowdsourcing approaches (see below). Building on Bruno Latour's argument that the modernist division between material objects and human subjects has created an artificial hierarchy in which human experiences and narratives have been systematically delegitimized because of their lack of precision in comparison to the scientific measurement of objects, Nold (2018) argues that only a combination of the measured and the perceived can enable an understanding of our emotional responses to places and situations, dismissing the capacity of systematic machine interpretation of emotions. In other words, mapping emotions requires more than what machines and lines of code can do: it requires some form of human unpacking of

affect data or emotional proxy measurements. This view is supported by the psychological theory of constructed emotion, which hypothesizes that producing emotional experiences requires emotion concepts to make meaning from bodily sensations in the world (Feldman Barrett 2017).

In addition, this critical positioning vis-à-vis the capacity of machines to properly interpret our emotions is part of a larger movement of resistance against the use of biometric technologies as a form of control and surveillance (see, for instance, Raqs Media Collective 2009). Nold recounts that in a workshop he led in Munich, "all the participants refused to be wired up with the sensing devices" because of the association of these devices with the Nazi regime, while in another workshop in London with an intergenerational Bangladeshi group, the device triggered a discussion about the use of technology for racial profiling (Nold 2018, 13).

These strong emotional reactions against using biometric technologies contrasts with the growing use of fitness apps that collect personal bodily data (such as heart rates), as well as with the use of social media to make public these data and their associated feelings and emotions. Social media have become a new El Dorado for researchers and companies looking to mine personal information, including emotions. Verbal expressions of joy, anger, fear, and sadness have been extracted from social media posts such as Tweets (Resch et al. 2015; 2016) and Flickr photo captions (Hauthal and Burghardt 2013) and then mapped. Other projects such as EmoMap (Ortag and Huang 2011) rely on a voluntary crowdsourcing approach to collect emotional spatial data over the Internet (see also Klettner et al. 2013). While Web 2.0 offers an extensive source of emotional spatial data, it is important to keep in mind that social media are highly performative in the sense that they are used extensively to perform, promote, and brand ourselves (Papacharissi 2012) rather than solely to communicate highly intimate and emotional information (Longhurst 2016; Shaw 2018). In other words, data available throughout social media likely reflect the emotions we *want* to be associated with, rather than the ones we feel most deeply; at times these may coincide, but they do not do so systematically. So when we claim to map emotions based on data mined from social media, what we more likely map is performed emotions or rather performed emotion proxies.

Emotions are extremely difficult to characterize and to circumscribe spatially. Mapping emotions involves mobilizing two types of proxies: those associated with the emotion itself (i.e., how can we identify and characterise an emotion?) and those related to their locations (i.e., what is the spatial extent of this identified emotion?). Emotion proxies can range from simple words identified in texts such as social media posts, to self-reflections about the emotional dimensions associated with measurements of our bodily reactions to the environment, as illustrated in Christian Nold's workshops. A major challenge here is that emotions do vary between people, clearly evidenced by the fact that some languages and cultures have no concept (and therefore word) for particular emotions (Pavlenko 2014). Thus a given proxy such as the words used or facial expressions displayed may not always represent the same emotion in the same way.

Spatial proxies have been developed to circumscribe these emotional proxies more or less precisely (see Bleisch and Hollenstein, this issue). These range from very specific point locations (for example, a geolocated Tweet that contains an identified emotion; Resch et al. 2015), to more personal and conceptual spatial expressions that respect as much as

possible the emotions themselves at the expense of precise geographical locations (Knowles, Westerveld, and Strom 2015; Westerveld and Knowles 2018; Caquard et al., forthcoming). The diversity of these approximations emphasizes the necessity of approaching the mapping of emotions through a combination of cartographic methods, of quantitative and qualitative data, and of conventional and creative ways of collecting and mapping them. It also highlights the importance of being extremely cautious and humble when making any final statements about the relationships between maps, places, and emotions.

2. THE EMOTIONS THAT SHAPE THE MAPPING PROCESS AND THE MAP

Just like writing and drawing, the practice of making maps can generate emotions. Davisi Boontharm (2019) emphasizes the pleasure she experiences while sketching maps of the cities she has visited or in which she lives. Jo Gerlach (2018) hypothesizes the possible "experiential jouissance" that might arise from being involved in collective mapping efforts such as OpenStreetMap. In the context of community mapping, Young and Gilmore (2013) describe how mapping together in a minga (a traditional communal work party) helped to generate an atmosphere in which participants could counter negative reminders of colonial mappings that erased their communities from official maps, and instead generated positive emotions by collectively imagining and mapping new futures for their traditional lands. But community mapping can also be a source of frustration if it does not not live up to the standards originally imagined by the participants (Sletto 2009), while online collaborative mapping can be frustrating because of the poor design of some map editing tools (Ballatore 2014). Frustration can also emerge from the lack of reliable data, from a shallow understanding of complex mapping software, and from the disappointing cartographic design quality of the map itself. In other words, mapmaking is a process that can be as painful as it can be joyful, but it is certainly not emotionless.

Throughout the entire mapping process, all of the individuals involved experience a series of emotions that arise in response to the topic mapped, to technological and practical hurdles, to the context of map production, to some personal life events, or to the more general context within which the map has been produced (see some examples of these emotions described at **acartographersstory.com**). How does a major political or humanitarian crisis affect the work of a cartographer mapping this topic? What if they were depressed or in love while working on this project? How do these emotions shape the mapping process?

Telling the story of the mapmaking process might contribute to partially addressing these questions and to helping better understand the meaning of a map through revealing some of the intentions and emotions of the mapmaker(s) (Caquard and Cartwright 2014). Building on this idea, Giada Peterle (2018) proposes the concept of "carto-fiction," which combines mapping with creative writing to enable the mapmaker to express their feelings about the mapping process through the mapping output. She argues for "the exploration of creative writing as a method of research in the field of cartographic theory [that] could stimulate the affective, emotional and embodied aspects related to maps as mapping experiences to emerge, making them readable through the telling of stories" (Peterle 2018, 7). This idea of combining mapping with creative writing to "give shape to cartographic emotions in their multiple nuances" is also explored by Tania Rossetto (forthcoming).

While Rossetto argues rightly that critical cartographers have often associated maps with a "negative mood" based on the assumption that maps control, assert, and command, she makes

the map tell a different story: its own life story. Under Tania Rossetto's pen, Fonteuropa—a large mosaic map sculpture located in the center of Padova (Italy)—becomes a narrator that tells its life story, echoing the story of the European project to which the map is intimately linked (Rossetto, forthcoming). From this perspective, making maps talk through creative writing can serve not only to "unmask" the Machiavellian plots of power and control that lay behind them, but also to reveal the larger historical, cultural, and social context in which they are embedded, as well as certain emotions associated with this context that resonate with our own experiences and lives.

Maps are indeed part of our lives. They contribute not only to revealing but also to activating "complex geographies of perception" (della Dora 2009, 348). These geographies of perception are affected by the map, by the context in which it was received, by the mood of the receiver, and by the way the map affects the receiver's mood. The narrative and emotional power of maps is not, as pointed out by Peterle (2018, 6), "merely confined to the creative effort made by the cartographer"; it is also "refracted in every moment map-users engage with maps, composing their emotional, affected, memorial and sensuous narrative trajectories to follow." For example, a map user may have difficulty reading a map when they are anxious or under great stress (Thoresen et al. 2016), as any driver who is trying to find their way in an unknown city will know. The emotions that affect the mapping process do not stop with the map's production but keep on evolving with the different contexts within which the map will be received, used, mobilized, and instrumentalized.

3. THE EMOTIONS EXPERIENCED IN RESPONSE TO MAPS

Maps have appeared in films, novels, and visual art not only to support the plot and the message but also to suggest, convey, and evoke emotions (see Bruno 2002; Conley 2007; Harmon 2009). Maps can evoke emotions based on their aesthetic properties, on the pleasure or nostalgia they arouse, on the information they convey, and the way they convey it. "When [maps] represent space well they also draw us in imaginatively and emotionally," as Craine and Aiken (2009, 152) point out. In other words, a map that "represents space well" is inherently a potentially unlimited source of emotions for its users, as long as the context of its reception is propitious. While this "good map" might evoke emotions unintentionally simply by "representing space well," cartographers and other mapmakers have developed techniques to provoke emotions deliberately, as epitomized in propaganda maps.

Propaganda maps—as well as other types of persuasive visual communication—harness the rhetorical power of emotional appeals in an attempt to shape opinions and beliefs (Tyner 2015). Although systematic empirical research on the design of persuasive maps and the efficacy of their emotional appeals is still relatively sparse (Griffin and McQuoid 2012), some interesting aspects have been unveiled. Keates (1996) wrote extensively on rhetoric and maps and noted that expert cartographers often make design choices that aim to persuade by evoking emotional responses among map readers. Emotional appeals may be direct and sharp, as in the case of a World War II propaganda map that deliberately oriented the map west-up, thereby showing the USSR weighing down on Nazi Germany (Jaeger 1942), or subtle, as in the modern-day visitor map to the Sachsenhausen concentration camp, which uses carefully modulated color choices to evoke the mood of a brutal landscape that is present only in remnants at that location today (L2M3 Kommunikationsdesign GmbH 2008). Although more openly propagandist cartographic styles might be more memorable,

they are also characterized by map users as less trustable, as demonstrated by Muehlenhaus (2012) in his study of different rhetorical cartographic styles.

Beyond the persuasive aims of cartographic design, evoking emotional responses in map readers can influence cognitive processes such as attention, working memory, and long-term memory (Fabrikant et al. 2012; Montello, Fabrikant, and Davies 2018). Several cartographic design decisions have been studied to assess their capacity to stimulate specific emotional responses among map readers, with different and sometimes contradictory results. For instance, Anderson (2018) found that affective incongruence (e.g., using bright cheery colors to map negative topics) confused map readers, and made the map unpleasant, while it was not clear in a study conducted by Fish (2018) if the use of vivid cartographic designs evoked specific emotions and were more persuasive than less vivid ones. On the other hand, researchers such as Field (2018) argue that subtle cartographic designs are more efficient to evoke emotions and increase the user's level of engagement with the map, while Kent (2012, 48) goes as far as arguing that "the absence of detail inherent to cartographic symbolization allows a free play of the imagination necessary for the development of emotions associated with that sense of place." The more minimalistic cartographic design would then be potentially more likely to arouse map users' emotions. However, Kent's later work seems to hint that more cartographic detail might prompt more flights of imagination among map users (Kent and Hopfstadt, this issue).

All these different arguments emphasize the complexity of assessing the real potential of cartographic design to evoke and convey emotion, especially when combined with different media such as video, senses such as smell (Lammes et al. 2018), and technologies such as sat nav (Speake and Axon 2012). It also illustrates the need for cartographers attempting to evoke and convey emotions with their maps to either collaborate with designers (Gardener, Cartwright, and Duxbury 2017), artists, filmmakers, journalists, or other individuals who have developed expertise in conveying emotions, or to simply focus on what they know best: designing maps that "represent space well."

4. MAPS AND EMOTIONS IN THIS SPECIAL ISSUE

In this last section, we will assess how the six papers that are part of this special issue address the three main aspects of the relationships between maps and emotions identified above: (1) the emotions that we place on maps; (2) the emotions that shape the mapping process and the map; and (3) the emotions experienced in response to maps. These papers were first presented as part of a two-day workshop on "Maps and Emotions" conducted in Washington, DC in July 2017, prior to the International Cartographic Conference. About fifty persons attended, including researchers and students of cartography, geographic information science, and design, alongside practicing artists.

Jiří Pánek's contribution critically discusses and reflects on his experiments with methodologies for locating perceptions and emotions in cities in the Czech Republic as part of a series of mapping exercises that supported participatory planning processes. In his mapping exercises, he iterated from crayons on paper to colorful (physical) pins placed on a paper map to a web application that allowed participants to use different spatial proxies (points, lines, and polygons). He eventually concluded that points allowed participants to most precisely locate where they remembered experiencing a particular emotion. Points also had the benefit of being easily aggregated and visualized through hexbins or heat maps. Pánek's focus is not

solely on the emotions being placed on maps. He argues that the process of participating in emotional mapping exercises (i.e., the mapping process itself) increases a participant's level of engagement with and sense of ownership of places and cities.

Susanne Bleisch and Daria Hollenstein present a cartographic method for mapping place-related emotion data. Like Pánek, they are interested in relationships between places, the design characteristics of places, and people's experiences of these places. Working with data from interviews with elderly women about their everyday experiences in a Swiss city, their mapping method visually represents the underlying valence of these expressions (positive or negative) rather than particular emotions themselves. Using these coarser emotional proxies avoids the challenges of inferring specific emotions, instead focusing on similarities in the experiences of these women at a less emotionally granular level. Bleisch and Hollenstein explore how emotion proxies can be covisualized with other information about the locale (e.g., the materials present in a place) to explore relationships between urban design and emotional experiences. Their mapping method also grapples with the issue of spatial proxies, in particular, vagueness in the location where emotions were and are felt. A final interesting point raised in this contribution relates to how emotions could affect the mapping process. Bleisch and Hollenstein's research was undertaken in an interdisciplinary context in collaboration with social scientists, so they made the decision to act as visualization guides, handling the manipulation of the interactive maps so that the social scientists could avoid the potential frustration of working with a new and complicated technology.

Hovig Ter Minassian's contribution explores how mental maps can be used to reveal emotions associated with experiences of virtual places in video games. He used a mental map methodology and a subsequent semi-structured interview to collect data on emotions and their relationships to experiences of virtual (and real/referential) places associated with playing video games. Like the women interviewed by Bleisch and Hollenstein, Ter Minassian's study participants often expressed emotions they remembered from the past (e.g., from playing a favorite game from childhood) instead of emotions they experience currently while playing games. The process of drawing their mental map(s) of these game environments evoked the emotion of nostalgia among some participants. Ter Minassian's study also demonstrates that accompanying stories are often needed to understand the emotions hidden in maps. He found that synecdochical mental maps were best able to express emotional attachments to places in video games.

Élise Olmedo and Mathilde Christmann demonstrate how the mapping process can reveal and capture emotional experiences in place. They present a mapping protocol, called the map-score, inspired by the landscape scores produced by Lawrence and Anna Halprin, a landscape architect and choreographer, respectively. Their map-scores provide intentions to guide the experience of people in a place and simultaneously allow the recording of these experiences. When a map-score is performed repeatedly, it could support investigation of how the context of a performance (e.g., weather, time of day or year, whom one is with, the emotions or mood of the performer at the start of the map-score) might alter the sensorial and emotional experience of a place. The map-scores themselves can in some cases capture some traces of the emotional state of their authors, though without accompanying stories, these emotions may remain somewhat mysterious.

Alex Kent and Anja Hopfstadt reflect on a creative activity that explored how different topographic maps mediated the experience of place, whether a specific map stimulated

distinct emotional responses to the place, and how these experiences and their accompanying emotional responses related to the map's design. They found some evidence that greater detail in topographic maps might be more stimulating, and that map users' perceptions of the map designer's intentions might have the greatest influence on the users' ranges of emotional experiences in response to the map. Their study was based on the analysis of a series of emotional proxies (photographs taken during the creative activity) and shared by the participants on an online platform. These photographs provide some hints that the performative nature of emotional expression that photography encourages, similar to those observed in other social media contexts, may also have produced some performance of emotions within the urban environment. They point out as well that photographs can be taken with the intent of evoking an emotion in the viewer rather than to reveal the emotion felt by the photographer. This conclusion reiterates the importance of triangulating sources of emotional data when investigating relationships between maps, emotions, and places.

In the final contribution to this special issue, Catherine Turk touches on all three aspects of the relationships between maps and emotion that we have outlined here. Her contribution explores the cartographic challenges of putting place-linked emotions on the map, through a participatory digital spatial database that recorded examples of emotional engagements with two rivers in Western Australia. Emotional engagements with place were recorded in the database when contributors uploaded objects that contained content that expressed emotions implicitly such as stories, images, video, and audio recordings. These objects could then also be given tags that identified emotions explicitly. Turk describes how the researchers chose to use a map as an organizing mechanism for the database in part because they believed it provided an emotionally neutral entry point to the database that (they believed) would not influence how or why people might contribute to the database. This raises the question of whether this was in fact true. Finally, Turk notes that context affects the interpretation of emotions, and thus connects to the third theme: the emotions experienced in response to maps. (How) does placing the emotion on the map instead of experiencing it where it was felt in the landscape change its interpretation? In her analysis, Turk questions the impact of the researchers' own emotional engagements with place, which were represented alongside those contributed by other participants. How did the process of curating the map affect what emotions might be found within it, and could telling that curation story reveal something more about emotional engagements with the places themselves?

CONCLUSION

The different papers that compose this special issue illustrate to some degree the main aspects of the way we currently approach the relationships between places, maps, and emotions. They illustrate the necessity of envisioning the mapping of emotions through emotional and spatial proxies. They recognize the importance of combining different data sources, methods, techniques, and designs to reduce, insofar as it is possible, the cartographic gap between places and emotions represented by these proxies. They acknowledge that the mapmaker should find ways to articulate what has been lost and gained in terms of emotional meaning and precision throughout the mapmaking process, suggesting that narratives might be a relevant form for telling the story of the decisions that have shaped these proxies. They also go beyond the unique aspect of placing emotional proxies on maps to suggest broadening the way we approach the relationships between maps, places, and emotions. They seem aware of the impact of the fluctuating emotional positionality of the data provider, of the mapmaker, and of the map receiver throughout the mapping process,

although this awareness is translated more through suggestions than through solutions. In fact, we don't really know *how* to link the emotional context of mapmaking to the map produced and the emotional context of map reception to the map use. Although there is growing recognition of the importance of better understanding these aspects of the mapping process, this might require some help from other domains such as artistic practice, storytelling, neuroscience, cognitive science, and geography to address this issue properly. The relationships between places and emotions are too complex to be properly captured solely by maps, but the mapping process is just too powerful not to play a central role in our attempt to better understand our emotional engagements with places. It is time to break through the impersonal reserve of maps to reveal their multiple emotional layers.

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PEER-REVIEWED ARTICLE

Emotional Maps: Participatory Crowdsourcing of Citizens´ Perceptions of Their Urban Environment

Jiří Pánek
Palacký University Olomouc
jirkapanek@gmail.com

Public participation and civic engagement in the urban planning process are societal trends that stretch across countries, cultures, and classes. After decades of communist regimes in the Eastern Bloc, where there was basically no civic participation, civic society in the Czech Republic began to engage in discussions with the authorities, and citizens became more active in local planning. In 1994 eleven municipalities started the Network of Healthy Cities of the Czech Republic as a platform for sharing good practices in sustainable development and local participation. In the last three years, members of the Network have used emotional mapping activities to facilitate and improve the process of participatory planning. This paper describes the timeline of development and the deployment of an emotional mapping methodology in various workshops in the Healthy Cities network. A total of forty-six emotional mapping workshops were organised in thirty-five municipalities of the Czech Republic. The paper presents the change from crayon-based maps to digital web-mapping platforms; and presents a case study of the Prague 12 district, where emotional mapping workshops were used to explore the perception of safety, among other issues.

KEYWORDS: emotional mapping; methodology; neocartography; public participation; Prague 12

INTRODUCTION

Internationally, democratic movements that encouraged and supported participatory activism involved community members in local planning and development decision-making as early as the 1930s (Guldi 2017), and in the 1940s Demerath (1947) suggested that social scientists could help city planners to increase community participation in the planning process. The United States Economic Opportunity Act of 1964 urged "maximum feasible participation" in state-funded urban and rural community programmes (Economic Opportunity Act of 1964), and in 1965, the Planning Advisory Group in the United Kingdom presented a directive calling for public participation in plans issued under the Town and Country Planning Act (Taylor 1998). However, probably one of the most influential statements from that era was an essay by Sherry Arnstein (1969), "A Ladder of Citizen Participation," in which the Californian social worker argued that "participation without redistribution of power is just an empty and frustrating process for the powerless" (216). Similarly, students protesting in Paris in 1968[1] understood that participation does not guarantee change (Figure 1) if it is not supported and implemented by those in power (Arnstein 1969). By the 1970s and 1980s participatory mapping projects were used by poor and indigenous peoples in Asia, Africa, and North and South America to advocate for their right to water, land, and culture (Chambers 1994a; Tulloch 2007; Pánek 2016).

All of these processes took place outside the former Eastern Bloc, so the Czech Republic does not share a history of public participation in urban planning and decision-making processes. It was only after the Velvet Revolution in

1. 1968 was the same year as the Prague Spring and the Warsaw Pact invasion of Czechoslovakia.

1989, when civil society in the former Czechoslovakia re-emerged, that citizens became more active in shaping the shared places in which they lived.

The Network of Healthy Cities of the Czech Republic (HCCZ) was created in 1994, and its mission is to encourage Czech municipalities to stipulate in their statutes that they will consistently work towards sustainable development, health, and quality of life in cities and regions of the Czech Republic. Among the first steps in increasing citizens' quality of life were the publication of the booklet *Methodology of Sustainable Development* and the holding of annual *Forum of the Healthy City* events. Both of these were implemented in order to engage citizens in local planning, but it was only with the rise of the Internet and crowdsourcing that the "democratisation of cartography" (Rød, Ormeling, and van Elzakker 2001) could start. OpenStreetMap in 2004, followed by Google Maps in 2005, opened the vast world of mapping to the general population, and it was no longer necessary to have a formal education related to cartography or planning to add points/lines/polygons to a world map. Participatory planning support systems such as FixMyStreet, CitySourced, and Maptionnaire opened new opportunities for citizens to become involved in planning processes.

In 2014 HCCZ implemented emotional mapping workshops in their *Forum of the Healthy City* workshop, which is the first contact and also the annual meeting between the local administration and citizens. I coordinated the emotional mapping workshops at HCCZ; this paper combines my personal experience with a descriptive analysis of the process involved in developing a methodology for the collection and visualisation of citizens´ perceptions of how they experience the city. This paper describes (1) past experiences with different modes of collecting the emotional data during the workshops, (2) the various methods tested for the visualisation of the results, and (3) the current version of my web app for the participatory crowdsourcing of citizens´ perceptions of their urban environment. As the over-reporting of successes is considered to be one of the plagues of community development (Botes and van Rensburg 2000), I will also focus on failures in my research and methodologies in order to broaden the current state-of-the-art in the area of emotional mapping.

Figure 1. *French student poster from 1968 created at Atélier Populaire. In English it reads, "I participate / you participate / he participates / we participate / you participate / they profit."*

WHAT ARE EMOTIONAL MAPS?

Emotional mapping, as understood in the field of participatory planning, is a method that allows citizens and municipalities to initiate a map-based dialogue concerning the current and future state of public space, drawing upon their experiences of that place. The method can be considered to be a subgroup of Public Participation GIS (PPGIS) methods (Brown and Kyttä 2014) and at the same time as a tool of GeoParticipation (Pánek 2016). GeoParticipation, which is the use of spatial tools in order to involve citizens in community participation, further

develops PPGIS as it provides an easy-to-use environment for social engagement while creating a feeling of belonging to a certain social group or community (Pánek 2016).

One of the first examples of emotional mapping in urban visualisation comes from a book of essays entitled *Emotional Cartography: Technologies of the Self* (Nold 2009). The book was described by Nold as "a collection of essays by artists, designers, psychogeographers, cultural researchers, futurologists and neuroscientists, brought together by Christian Nold to explore the political, social and cultural implications of using technology to visualise intimate biometric data and emotional experiences" (3). Surprisingly, the publication has no essays by cartographers or city planners, although emotions have a strong influence on how the (urban) environment is perceived and on how people perceive a spatial layout (Zadra and Clore 2011). Emotions are the crucial part of every human being and yet their presence on maps and in spatial data is rare (Griffin and McQuoid 2012).

Emotional mapping has the tools to support the ideas of Mody, Willis, and Kerstein (2009), who believe that emotions, spaces, and places are interconnected and that every location can evoke an emotion. As Korpela (2002, 363–373) says, places can be seen as attractive, boring, dangerous, or scary, among other perceptions. Not only can basic emotions—as defined by Ekman (1992)—be mapped, but also more specific perceptions and ideas about the utilisation of public space can be placed on the map. It's possible to argue that emotional mapping is not the correct term, because emotions are not the only things that are mapped; the maps also include people's perceptions of and experiences in a place. Questions related to the lack of parking spaces and issues such as where to place a new statue can be examples of non-emotional spatial questions.

Creating a map within a community has an empowering effect because members of the community have the opportunity to think spatially about their environment and literally put their community, their perceptions, and their emotions on the map. The process of creating the data triggers feelings of belonging to the community and ownership of the future. With ownership comes the onset of empowerment, leading to sustainable development, driven and run by the community itself (Vlok and Pánek 2012). This has been observed in various communities and it is also the reason that incorporating emotions in community planning has its proponents (Bergner et al. 2011; Raslan, Al-Hagla, and Bakr 2014; Curtis 2012).

Participation has become an integral part of geographical research since behavioural geographers started working with place perception and Kevin Lynch (1960), along with Peter Gould and Rodney White (1974), used the concept of mental maps to explore urban visualisation and spatial preferences. Later, when Robert Chambers (1994a; 1994b; 1994c) and others introduced maps into Participatory Rural Appraisal, Participatory GIS and PPGIS were also recognised by quantitative geographers as research methods and visualisation tools. With the rise of participatory approaches to GIS, sketch maps have appeared as an alternative form of data collection to mental maps. Unlike mental maps, which are often free-form drawings from memory, sketch maps are more likely to be georeferenced and to represent the actual experiences of the participants (Boschmann and Cubbon 2014).

Emotional mapping combines the mental mapping heritage of behavioural geography with sketch maps´ integration of GIS in order to visualise, overlay, and analyse results that are voluminous in the number of respondents as well as in the representations collected. These emotional maps, in contrast to mental maps, are a spatially accurate mode of data collection and use a base map as a background for respondents´ drawings. Unlike sketch maps, which are often used as an additional data source in surveys and interviews (D'Antona, Cak, and VanWey 2008), emotional maps are usually the sole data source used in the research.

Emotional maps, as implemented in the research described here, work with people's perceptions of their spatial environment and are used to understand and explain participants' decision-making and behaviour in an urban space (Kitchin, Blades, and Golledge 1997; Spencer and Dixon 1983). In the HCCZ workshops, the primary source of the experiences presented in this paper, users are often asked to identify places on the map where they feel afraid (mapping of safety), where they "like it" (positive emotional responses), where they spend their free time (planning leisure-time activities), and where it is "dirty" (environmental pollution, etc.). The answers to this variety of spatial perception questions can hardly be considered to be the totality of emotional responses to the place, but could fit under the umbrella term *emotional mapping*.

Some authors use terms such as sentiment mapping (Caragea et al. 2014; Kocich 2018), hedonic mapping (Ennis and Ennis 2013), ephemeral mapping (Art & Cartography Commission of ICA 2014), perceptual mapping (Doran and Burgess 2011), or sketch mapping (Boschmann and Cubbon 2014), among many others to describe people's experience of places. The theoretical discussions and uncertainty about the terminology show that emotional mapping research and practice is neither clearly defined nor anchored in its respective disciplines. Nevertheless, I will use the term emotional mapping, mainly based on the argument of Perkins (2009, 130), who states that "emotional maps which chart human feelings onto a cartographical landscape . . . and allow users to devise and customise their own emotional landscape, to choose what kinds of thoughts and experiences, feelings and passions, to map"; but also as nod to the a legacy of Nold's *Emotional Cartography* (2009).

METHODOLOGY DEVELOPMENT

During the process of testing, developing, and deploying the emotional mapping workshops, I tried various mapping techniques and achieved diverse results. The first map was created using six large crayons and one A1-sized map (Figure 2) of the city Třebíč at a meeting of the municipality with the citizens. A total of 65 people participated in the workshop. The idea of using crayons came from the influential book by Robert Chambers *Whose Reality Counts? Putting the First Last* (2003), in which Chambers argues that (community) development experts should "hand over the stick" to let people draw their own maps. While it may be easy for a facilitator to hand over the stick to the participants, it is not so easy to share the crayon among the participants. There is always somebody who wants to take control of the tool and effectively take control of the map. As there were usually only two pieces of the same colour crayons, participation was not equal and some citizens may have felt excluded. The second disadvantage of this method was that, if three or more colours were overlaid, it was impossible to identify the original colours as they all became shades of grey.

Figure 2. *Example of the analogue emotional map created at the first emotional mapping workshop in 2014.*

With the first attempt of emotional mapping (Figure 2) being unsuccessful and useless, it was necessary to develop a method where all citizens had an equal opportunity to participate in the creation of the map and to ensure that the visual outcome was also readable. Using crayons may have been creative and useful while working with children, but as a serious tool for participatory mapping it lacks accuracy and is difficult to digitize.

The second version of analogue emotional mapping involved coloured pins (Figure 3), which the participants pinned onto a map on a corkboard. This solved the overlay issue (as opposed to using coloured stickers that overlay

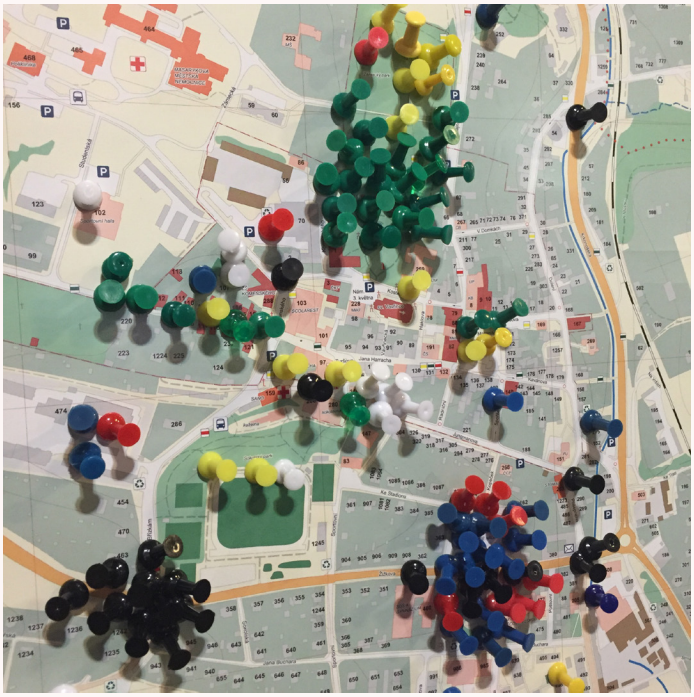

Figure 3. *Example of using colourful pins for creating an emotional map in 2016.*

Figure 4. *Colourful pins with numbers used to identify the authors and link them with respective complaints.*

each other) as well as the *hand over the stick* problem, as there were always more than one hundred pins of each colour. Participants could use as many pins as they wished, and several pins in the same location created easily visible hotspots and also produced a 3D effect on the map. When pins are used, each colour represents a different emotion, and when the results are digitised, each pin is represented as a single point, as opposed to the first mapping attempt, which required combinations of points, lines, and polygons. The change from multiple geometries towards points only was due to difficulties in combining multi-feature datasets in GIS and the experience of other authors´ research: up to now the predominant methods for spatially-explicit preference mapping have been marking points for locations or sketching polygons annotated with expressions of preference (Jankowski et al. 2016). Furthermore, Brown and Pullar (2012) suggested that points instead of polygons be used in future PPGIS applications, although their study was focused on mapping large-scale landscape values. Huck, Whyatt, and Coulton (2014) suggested using a fuzzy, multi-point feature called a Spraycan to collect the information, but I decided to only use single points as, in my experience, I have found that points are often more specific and place-related than polygons or multipoint features. Also it would be technically very complicated to recreate fuzzy collections of multiple points with pins in the analogue version of the workshop. Nevertheless, with specific topics (bike lanes, air pollution, perceptions of city centre boundaries), different feature types may prove to be more convenient.

A further improvement in the emotional mapping workshops organised by the HCCZ was made by linking each pin with its author´s demographic profile via numbers on the pins (Figure 4). Comments were also written with the same number code on the side. Thanks to this approach, the data gathered later via an online tool and the data from participatory mapping meetings were almost totally comparable and hence could be integrated into one large dataset. The ability to combine the datasets also allowed me to combine various target groups, as some respondents tended to prefer face-to-face meetings and communal gatherings, while others preferred the anonymous online form of participation. Information from the demographic profiles

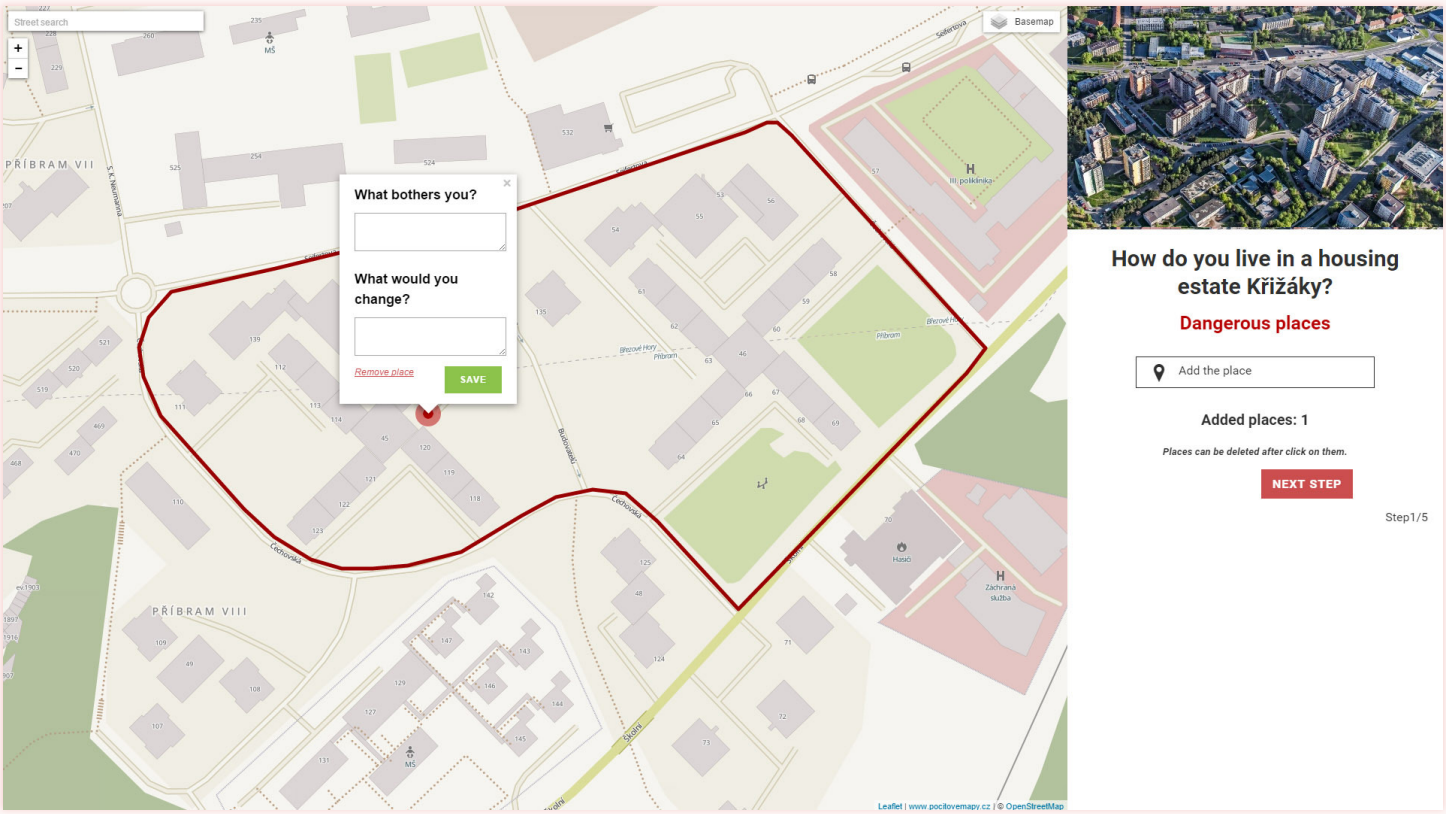

Figure 5. *The web application created for participatory consultation on a neighbourhood revitalisation plan in Příbram, the Czech Republic, in 2015.*

was later used to better filter the results and to create a series of maps of the same topic based on the respondents' profiles (gender, age, income, etc.).

Besides organizing participatory emotional mapping workshops, I also co-created **PocitoveMapy.cz** (Figure 5), a single-page web application that uses two open-source JavaScript libraries: jQuery for basic user interactions and app control, and Leaflet for map interactions. The results from the front end are sent asynchronously to the back end, which uses a simple Model–View–Controller framework written in the PHP scripting language. A MySQL database is used for storing metadata from users, and geodata are stored in GeoJSON format. The collection of emotional mapping data is also made possible with the help of a CSS framework and Bootstrap, and administrators are allowed to download the full metadata from MySQL, concatenated with GeoJSONs.

The gradual development of the analogue methodology was complemented by increasing the functionality of the web interface used for both collecting and visualising the data. As mentioned previously, combining feature types is undesirable and this was proved not only by the inability of GIS to perform advanced analyses on multiple feature types stored in one file, but also during attempts at visualisation (see Figure 6), when large polygons often covered the whole study area and thus decreased the utility of collected data and made it more difficult to analyse such datasets. Although the multiple feature types could be converted to raster as tested by Šerý and Šimáček (2012), the overwhelming area of large polygons still dominated

Figure 6. *A failed attempt at using three feature types (points, lines, and polygons) to collect data about air pollution in Olomouc, Czech Republic.*

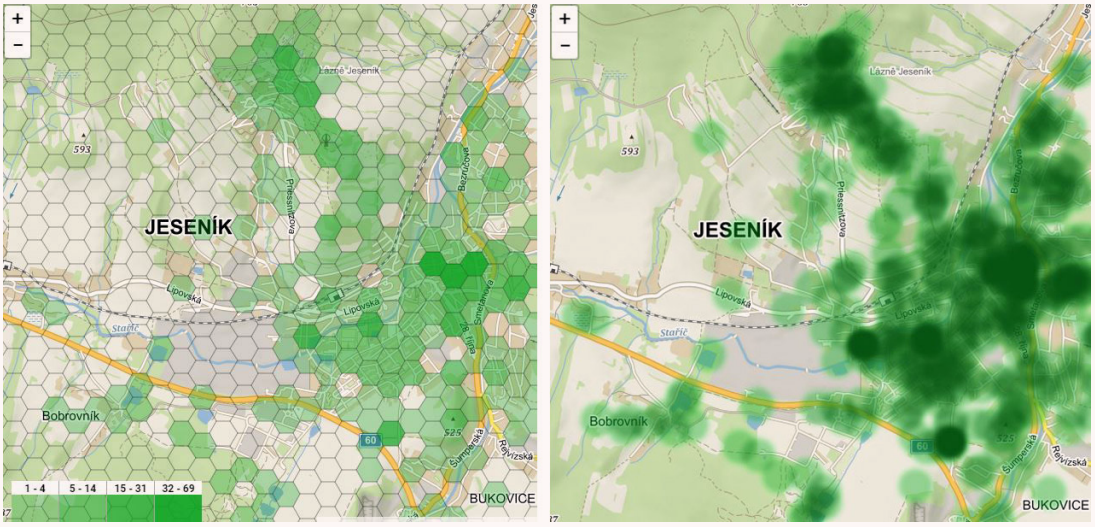

Figure 7. Left: hexagons (side = 200m) used to visualise the collected data. Right: a heatmap visualisation of the same data.

and affected the final results. Therefore, the application's original functionality, which allowed respondents to choose from points, lines, and polygons (clicking or hand-drawn) was usually limited to one feature type only. With the growing ability of Czech municipalities to attract people to participatory mapping activities, local political representatives realised that it was not only necessary to ask spatial questions, but that it might also be possible, via the web app, to create questionnaires with complex questions and embedded maps. Therefore, functionality to create non-spatial questions was added in 2016.

As the platform is also used to visualise the results, the original *points only* visualisation was soon complemented with two other visualisation methods: (1) a hexagonal grid (Figure 7, left) formed from the aggregation of points, and (2) a heat map (Figure 7, right) visualisation.

Hexagons are used as they were identified as the optimal shape for delimiting urban areas in previous research (Burian, Pászto, and Langrová 2014). They are also used in ecological modelling (Birch, Oom, and Beecham 2007) as well as in self-organising maps (Jiang and Harrie 2004). Furthermore, conducting a nearest neighbourhood analysis is simpler and less ambiguous when using a hexagonal grid. Hexagons also have a shorter perimeter than a square of equal area, which potentially reduces bias due to edge effects (Krebs 1989). A square with unit area has a perimeter of length 4, whereas the perimeter of a hexagon with unit area is 3.722, so the edge-to-area ratio of a hexagon matches that of a square with 15.5% more area. Also, some parts of a square are farther from its centre than any part of a hexagon of equal area, so the average distance from the centre of a square with unit area is 0.3826, whereas the average distance from the centre of a hexagon with the same area is 0.3772 (Birch, Oom, and Beecham 2007).

With a large quantity of data collected—some emotional mapping activities had over 2,000 respondents and gathered over 40,000 features—it was necessary to code new functionality in order to filter the data based on the respondents' gender, age, education, etc. A further improvement was the ability to compare data across time through simple swipe visualisation inspired by the Esri StoryMap platform. This is often used when, after a year's break, a municipality runs a workshop with the same questions. The swipe allows the public to compare the results easily without the need for any programming or GIS skills. At the time of this writing, the current version of the app allows for the collection and visualisation of vector data (points, lines, and polygons), and furthermore it is possible to add complex questions to the map and to assign values to collected features. The visualisation consists of heat map options, a filtering option, simple features with an optional swipe function, and hexagons.

REAL LIFE DEPLOYMENT

Since 2014, thirty-five member municipalities of the HCCZ network have conducted forty-six emotional mapping workshops. They all implemented the analogue map workshop and most of them (n=29) used the digital version in order to broaden data collection and engage various types of respondents. Each city had its own range of questions, usually between five and seven in number, and these reflected the planning ideas and what was needed in

the city. The questions ranged from the generic, "Where do you like it?" and "Where is it ugly?", to the quite specific, "Where do you have problems with parking?" and, "Where should the city place the new Edison statue?". The most common questions were related to the perception of safety, both during the day and at night, regarding walking, cycling, and driving. There were also positive questions: the most common ones were about pleasant places, about how people spent their free time, and their pride in the city (important landmarks, etc.). As the answers and quantitative involvement of the citizens vary, the results are used differently.

The most common use of the results is in the confirmation of what is already known, because civil servants often lack time as well as support from the government to draw any long-term conclusions from the mapping. Nevertheless, some municipalities used the results of the mapping workshops as a preliminary study and employed the data in SWOT analysis, strategic planning analysis, and other applications. If the workshop subject was more specific, such as safety mapping (Pánek, Pászto, and Marek 2017; Pánek, Pászto, and Šimáček 2018), neighbourhood revitalisation (Pánek and Pászto 2017), air pollution (Pánek et al. 2017), or bicycle infrastructure (Pánek and Benediktsson 2017), the results were often used for white papers, policy papers, or urban studies.

Often the emotional mapping workshops are connected with public events such as Earth Day or neighbourhood festivals. In such cases, non-profit organisations usually create emotional maps of smaller areas (neighbourhoods, squares) in order to draw public attention to planning issues and the use of public spaces. These attempts strongly depend on collaboration with the municipality, as there is sometimes a lack of willingness to participate as a result of past experiences where expectations were not fulfilled (Botes and van Rensburg 2000).

RESULTS

This paper is intended to show how I developed an emotional mapping methodology and participatory mapping platform, while reflecting on my failures in order to help others not make such mistakes. So in this results section, I will present only one case study. The case study was implemented in the Prague 12 district (approx. 55,000 inhabitants) from September 2016 to November 2017 and it consisted of three mapping activities: a workshop at a community meeting (Figure 8) with an online emotional mapping extension, the creation of maps for use by the local police force (LPF), and a specialised school-surroundings safety mapping.

On the 22nd of September 2016, 92 citizens participated in a *Forum of the Healthy City* meeting held in Prague 12, and this was where the paper-based emotional map of the district was created. This was followed by the participation of 233 respondents who completed the online emotional map between September and December 2016. The results from two collections included 2,696 points from six spatial questions. The questions were:

- Where is it dangerous? (point + comment)
- Where is it interesting? (point + comment)
- Where do you relax? (point + comment)
- Where do you miss something? (point + comment)
- Where is there an obstruction? (point + comment)
- Where do you meet with friends? (point + comment)

The results were presented in an emotional mapping report with maps and web visualisations, and the Prague 12 municipality requested a specialised map based on answers to the "Where is it dangerous?" question for internal use by

Figure 8. Emotional mapping workshop at the community meeting in the Prague 12 municipality.

the local police. Based on the respondents´ comments, the police representative divided points from this question into six categories (homeless; alcohol and drugs; traffic that can be solved by LPF; traffic that cannot be solved by LPF; other; not specified), and each police patrol received a map with designated places they were instructed to visit at least twice a month in order to monitor the issues reported by the citizens.

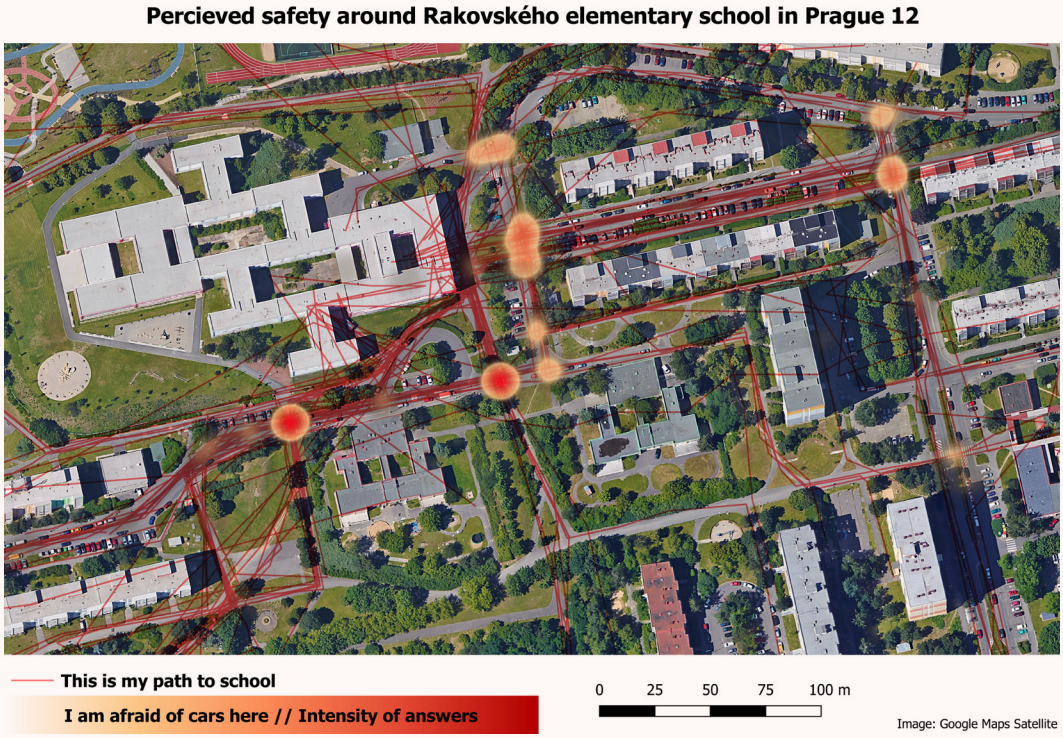

Figure 9. Example of a perception of safety map given to the school principals.

Based on the experience of using the emotional mapping workshop to improve the perception of safety in the district, the municipality decided to organize a large-scale safety mapping exercise among the grammar school pupils in the district. An online map was created with five spatial questions related to the perception of safety around local grammar schools. The questions, prepared in cooperation with teachers, police, and the district representatives were:

- This is my path to school (line)
- I am afraid of cars here (point + comment)
- It is uncomfortable here (point + comment)
- I like it here (point + comment)
- I spend my free time here (point + comment)

Besides the spatial information and comments, information was also collected about school, gender, grade, and how pupils annotated the map (alone, at school, with parents). Each school had its own access code, so only pupils from that specific school could annotate the map. Once the code was entered, the map centred and zoomed in on the school surroundings and pupils could start entering their answers. A total of 990 pupils from eight schools took part in the mapping activity. While the gender balance of the pupils was quite even, age was unevenly distributed. The map was mainly completed by pupils between the 4th and 9th grades, and this was generally because the younger pupils do not walk as independently and freely around their schools as the older ones and they are more often driven to school by parents, while the older pupils usually use public transport or walk alone. The majority (81%) of the maps were made at schools and the final results, including maps (Figure 9), reports, and statistics, were delivered to city representatives as well as school principals and local police forces.

DISCUSSION AND CONCLUSIONS

Although it can be argued that the emotional mapping workshops are only an extension of the inequitable and preferential participation for those with skills, knowledge, and opportunities, it also has to be noted that in 29 electronic emotional maps, 6,343 people expressed ideas about their community, and furthermore several hundred citizens took part in the emotional mapping workshops at community meetings in their cities. The utilisation of

online methods for community participation definitely carries the burden of the digital divide, where some people have easier and more comfortable access to the internet while others, especially the elderly, still lack opportunities to participate. Nevertheless, I see an opportunity in combining both offline and online data collection methods in order to open the participation process to as many citizens as possible.

Cities are complex systems with several social, cultural, and spatial processes, so it is difficult to use only one participatory mapping approach to address all the issues and contact the necessary target groups. Across the discipline, participatory mapping platforms struggle to achieve a critical mass of respondents in order to justify their deployment and the representativeness of the results. The emotional mapping workshop methodology presented in this paper, based on a combination of paper maps at local meetings and a modern web-mapping application, can further contribute to our understanding of how public participation and PPGIS can help build stronger and more resilient communities, while climbing the ladder of participation (Arnstein 1969).

The engaged municipalities agreed that participatory mapping workshops such as the one presented in this paper have value and the results often bring interesting insights. Nevertheless, the main contribution of emotional mapping workshops was seen in the creation of the notion of engagement. Over the past three years various methods for the collection and visualisation of urban perceptions have been tested. I am aware that there is still room for further development and improvement, and that it is also necessary to share the continuous challenges and failures. But, based on experience gained from the emotional mapping workshops, I can confidently say that emotional maps, as a tool for the participatory crowdsourcing of citizens´ perceptions of their urban environment, have the potential to attract citizens' attention and to deliver tangible results that are readable and acceptable to municipality representatives. Further testing and comparison with similar platforms that already exist (Maptionnaire, GeoLive, GeoCitizen, etc.) is still needed. Therefore, this paper is also an open invitation for further collaboration in the area of emotional mapping, and it is also a contribution to discussions concerning the terminology and definitions of *emotional mapping*.

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PEER-REVIEWED ARTICLE

Exploratory Geovisualizations for Supporting the Qualitative Analysis and Synthesis of Place-Related Emotion Data

Susanne Bleisch
Fachhochschule Nordwestschweiz
susanne.bleisch@fhnw.ch

Daria Hollenstein
Fachhochschule Nordwestschweiz
daria.hollenstein@fhnw.ch

Locations become places through personal significance and experience. While place data are not emotion data, per se, personal significance and experience are often emotional. In this paper, we explore the potential of using visual data exploration to support the qualitative analysis of place-related emotion data. To do so, we draw upon Creswell's (2009) definition of place to define a generic data model that contains emotion data for a given location and its locale. For each data dimension in our model, we present symbolization options that can be combined to create a range of interactive visualizations, specifically supporting re-expression. We discuss the usefulness of example visualizations, created based on a data set from a pilot study on how elderly women experience their neighborhood. We find that the visualizations support four broad qualitative data analysis tasks: revising categorizations, making connections and relationships, aggregating for synthesis, and corroborating evidence by combining sense of place with locale information to support a holistic interpretation of place data. In conclusion, the paper contributes to the literature in three ways. It provides a generic data model and associated symbolization options, and uses examples to show how place-related emotion data can be visualized. Further, the example visualizations make explicit how re-expression, the combination of emotion data with locale information, and visualization of vagueness and linked data support the analysis of emotion data. Finally, we advocate for visualization-supported qualitative data analysis in interdisciplinary teams so that more suitable maps are used and so that cartographers can better understand and support qualitative data analysis.

KEYWORDS: emotion data; place; visual data exploration; qualitative data analysis; QDA, qualitative analysis tasks; interdisciplinary, re-expression; geovisualization

1. INTRODUCTION

1.1 MOTIVATION AND BACKGROUND

People live in *places*, which are "locations imbued with meaning" and "sites of everyday practice" (Cresswell 2009, 9). These are not new concepts: at least as far back as the Greek philosophers, we have been thinking about places and our relationships with them. Tuan (1979) defined the concept of place as a space endowed with meaning, in which experience is a central notion. Places are not only located somewhere on Earth, but they are also connected to personal or shared significance, experience, emotion, or understanding (Lengen 2016). While people live in and interact with places, those places themselves also are important for people's wellbeing (Gebhard and Kistemann 2016), which is another dimension connected to emotions (e.g., Berrios et al. 2018).

In a range of application areas, analyzing the thoughts, emotions, and relationships associated with locations has been important, for example, both for understanding the quality of urban spaces and for transforming them. Examples of such analyses include studying pedestrian friendliness (Ferreira et al. 2016), judging the importance of reported city maintenance issues (Masdeval and Veloso 2015), or learning about the effect of greenness of places on wellbeing (Han 2017). In another specific example, elderly women reported that their ability (or inability) to engage in physical activities related to places (such as dancing, gardening, or walking) was the source of a range of emotions from fear and frustration to satisfaction and pleasure (Bennett et al. 2017). To form the basis of such

analyses, different methods can be used to capture data on the relationship between places and emotions. In our own project, discussed below, we made use of data collected from "walking interviews," in which informants are accompanied and asked questions as they move through an area. Jones et al. point out that this method "has great potential to shed light on how participants use and understand different spaces" (2008, 7).

Once data have been collected about the spatial relationships between places and emotions, it may seem obvious for cartographers to map them. However, Jones et al. (2008) list a surprising number of projects that made little or no use of maps for exploring data captured through walking interviews. Furthermore, mapping poses some challenges. We tend naturally to believe that what is presented on a map is the reality (Wood 1992), but all mapped data have some degree of uncertainty, as is found in any knowledge production process (Couclelis 2003). The challenge of representing the uncertainty or vagueness associated with data has been an active research area (e.g., MacEachren 1992; Kinkeldey et al. 2017; Smith Mason et al. 2016). The difficulty lies not only in finding a suitable technique for displaying uncertainty, but also, or maybe even more so, in communicating its variability or ultimately assigning it a value or a quality that supports the purpose of the visualization. Additionally, maps often only depict snapshots of specific times (Barclay 2013). However, technological advances have now made it possible to create interactive visualizations of temporal data. While doing so remains challenging (Çöltekin et al. 2017), depicting temporal data can be useful for understanding changes over time. Time and the analysis of changes over time is important with respect to emotion data, as emotions may be related to memories and evolve over time (Jager 2016).

Traditionally, cartographers have paid little attention to the mapping of emotions. Griffin and McQuoid (2012) give an overview of how emotions are represented on maps and observe that emotion, contrary to the inter-related topic of cognition, has received little attention in the cartographic literature. With new data sources (e.g., from directed or undirected online activities), sentiment or emotion analysis has become a research topic in many areas (e.g., urban issues: Masdeval and Veloso 2015), but uses surprisingly few maps. The *Literature Atlas*—a project which aims to map the geographies of fiction—does not specifically map emotions, but deals with similar challenges in localizing and symbolizing information (Piatti and Hurni 2009; Piatti, Reuschel, and Hurni 2013).

1.2 GOALS

The work we report here is intended to support researchers analyzing place-related emotion data, by offering them exploratory geovisualizations that are able to include all relevant aspects of the data: topic, space, and time. To do so, we defined, from a geovisualization perspective, and refined, from a social science perspective, a generic data model as well as a set of multivariate interactive symbolization options for representing the dimensions of the data model. We created visualizations based on the symbolization options with the aim of supporting and enhancing the different stages of qualitative data analysis (QDA) from data description to synthesis and sensemaking. To create example visualizations, we employed a data set from a pilot study that aimed to understand the different dimensions of walkability and the social interaction potential of the neighborhoods of elderly women (Bachmann et al. 2016; Süsstrunk et al. 2018). However, we based our exploration of visualization options on a generic data model, its associated symbolization options, and general stages and principles of data analysis, and only exemplify the visualization options with the data from the case study. We present the examples to support understanding of the transferability of the described visualization approaches options to other application areas and data sets that contain place-related emotion data.

2. EMOTIONS AND PLACES

2.1 EMOTIONS AND THEIR REFLECTIONS IN EXPRESSIONS

Emotions are important parts of all our lives, and we can even become emotional when talking about emotion (Coppin and Sander 2016). Still, we have difficulties giving a definition for the concept of emotion (Fehr and Russell 1984). Acknowledging the difficulty of defining the concept of emotion, Ekman (1984) proposed ten characteristics that allow distinguishing emotions from moods, reflexes, or attitudes. Studies confirmed that six basic emotions (fear, anger, surprise, disgust, sadness, and happiness) are experienced across cultures and can be conveyed through facial expressions when not suppressed or changed through social display rules (Ekman 1984).

Empirical data show that emotion can impact human cognition and behavior, for example, by guiding attention, memory, decision-making, and action (Coppin and Sander 2016).

Recent research has used detailed categorizations to measure emotions through self-reporting (e.g., Kremer and den Uijl 2016). Importantly, emotions are not static, but evolve continuously (Kuppens and Verduyn 2017). The older people become, the more they shift their focus to more positive experiences and emotions (Charles and Leger 2016; Kremer and den Uijl 2016). Measuring explicit emotions, (i.e., conscious feelings), is challenging in itself, but especially with older persons, who are more heterogeneous in their personal characteristics than the young (Moschis 2003; Hayden et al. 2011), and who potentially experience various forms of decline that limit their abilities to focus and to express themselves (Kremer and den Uijl 2016). Explicit measurement tools, such as rating scales, may miss unconscious or implicit emotions. To capture implicit emotions, indirect approaches are required, such as text or sentiment analysis (Kremer and den Uijl 2016).

Sentiment analysis is an active research area in natural language processing. **Merriam-Webster.com** defines sentiment as "an attitude, thought, or judgment prompted by feeling" or "the emotional significance of a passage or expression as distinguished from its verbal context." Most commonly, sentiment analysis refers to the evaluation of the valence (i.e., positive, negative, or neutral) of statements or other pieces of text (Mohammad 2016). In addition to the categorization of valence, more complex descriptions and categorizations of sentiment with respect to different purposes such as market research exist. However, those are, with few exceptions, often developed by companies and organizations and are not publicly available (Iglesias et al. 2017).

2.2 EMOTIONS AND THEIR RELATION TO LOCATIONS

As we mentioned in our introduction, a person's environment is not just a specific part of the Earth's surface, but rather a multitude of places of significance and importance to the person. Cresswell (2009, 1) usefully summarized earlier conceptualizations of space and place (e.g., Tuan 1979) to define place as being tripartite.

> The word "place" has been . . . conceptualized as a particular location that has acquired a set of meanings and attachments. Place is a meaningful site that combines locations, locale, and sense of place. Location refers to an absolute point in space with a specific set of coordinates and measurable distances from other locations. Location refers to the "where" of place. Locale refers to the material setting for social relations—the way a place looks. Locale includes the buildings, streets, parks, and other visible and tangible aspects of a place. Sense of place refers to the more nebulous meanings associated with a place: the feelings and emotions a place evokes. These meanings can be individual and based on personal biography or they can be shared. Shared senses of place are based on mediation and representation. (Cresswell, 2009, 1)

Cresswell's definition allows combining people's expressions and emotions (the sense of place) with a specific locale (the available infrastructure at a location that can be defined through coordinates). This definition supports the combination of subjective and objective data at a location. Any framework for representing and analyzing places needs to account for its multiplicity. Additionally, unless a shared sense of place is the focus, the sense of place varies from person to person and it can, in any case, change over time and depending on the context. Therefore, sense of place categorizations are typically non-comprehensive but focused on specific aspects that are relevant within a certain context. For example, Deutsch, Yoon, and Goulias (2013) derived six categories of sense of place from surveys to explain travel behavior: attachment, association, identity, satisfaction, atmosphere, and community. Jenkins et al. (2016) tried to characterize locations through emerging themes. They aimed to derive a shared sense of place from crowd-sourced data using the categories of politics, sports, recreation, education, entertainment, and business.

3. CASE STUDY FOR EXAMPLE VISUALIZATIONS

The MABF (Mit Den Augen Betagter Frauen: "With the Eyes of Elderly Women") pilot study (Bachmann et al. 2016; Süsstrunk et al. 2018) developed an age- and gender-relevant method for capturing, analyzing, and

discussing the physical and social environment of elderly women. For data collection, the study employed the "go-along" variant (Carpiano 2009) of a walking interview (Jones et al. 2008). Social scientists accompanied seven elderly women on a route through their daily routines to learn about different dimensions of walkability and the social interaction potential of the neighborhoods that they use actively. Audio recordings were made of the women's comments during the route, and were analyzed using qualitative content analysis (Bachmann et al. 2016). The results were compared to a GIS-based quantitative analysis of the locale such as footpath slope, numbers of benches for resting, and density of street lighting. This information was used to derive and visualize different walkability indices (Hollenstein and Bleisch 2016; Bleisch and Hollenstein 2017). The pilot study demonstrated the utility of the implemented research methods and identified important factors that support daily activities, independence, and social integration of elderly women in their living spaces.

The data collected and analyzed in the MABF pilot study, especially the statements that included emotional content like memories and personal experiences of a locale, were used to explore visualization options, below, that could support qualitative data analysis tasks for relating emotions and places. The social scientists who designed and led the MABF study were involved in discussing the visualization options and provided their perspective and general data analysis knowledge for focusing and refining the data model, the symbolization, and the visualizations proposed here. Below, the case study data are described in as much detail as is needed to understand the visualization methods and examples presented in this paper. However, during the MABF study, the data were not analyzed using all the methods proposed, nor do we comprehensively (re-) analyze the data, nor do we draw social scientific conclusions based on the examples in this paper.

3.1 APPROXIMATING A SENSE OF PLACE

Using Cresswell's (2009) tripartite place definition, we reconsidered the MABF data. All the data were related to the space the elderly women used, thus, they had a *location*. The GIS-based walkability analysis described the *locale* of each place, for example the density of lighting posts along a street. In the QDA portion of the study, the women's comments (for example, about their experience of the lighting: avoiding a street at night for its gloominess) were categorized in two dimensions: by their valence, and by their sense of place—the participants' relationship to or experience of aspects of the locale (Bachmann et al. 2016). The entire categorization was derived from an inductive-deductive process (Mayring 2014) based on existing literature and based on the walking interview data itself.

Seven sense of place categories resulted from this process:

- aesthetics (e.g., greenness, cleanliness, including aspects of wellbeing),
- walking comfort (e.g., experience of slope of pedestrian walkways),
- safety (e.g., experience of lighting, pedestrian crossings),
- facilities (e.g., relevance of shopping, restaurants),
- accessibility (e.g., experience of public transport options, judged distances to facilities),
- interaction (e.g., social contacts, comfort of benches or their quality of inviting resting and chatting), and
- memories (e.g., nostalgia, discrepancy).

Each of these seven sense of place categories contained participants' qualitative expressions that were rated for their valence. The dimensions of locale (from the walkability indices based on quantitative GIS analysis) and sense of place (categorized qualitative expressions rated for valence) may seem overlapping. However, they are distinguishable. For example, a shopping facility is a destination, and its availability and distance from another location is part of the locale. However, a participant's comment about using that shopping facility (desired destination with positive valence) and the difficulty of accessing the facility with limited mobility (negative valence of accessibility) conveys a sense of place as it relates the locale to personal experience and relevance. The same locale may have a different sense of place for another participant: he or she might not use that shopping facility (negative or neutral valence, if mentioned at all) or—with full mobility—may not have difficulties in accessing it. While almost all statements conveyed either a positive or negative valence, statements in the category "memories" were frequently highly emotional. This may have resulted from some participants leading the interviewer along and talking about a route of personal significance, rather than one of a daily errand.

Each expression in the study data set was assigned to one of the seven sense of place categories, and assigned a

valence. Some expressions, such as those that include references to different times of the day, relate to more than one category or valence. For example, a park may be a preferred destination during the day (to enjoy the greenery) but may be avoided at night (for fear about safety). Rather than splitting these comments into multiple expressions for separate categorization, we kept them together and assigned them to two or more categories.

3.2 MAPPING SENSE OF PLACE TO LOCATIONS

To represent a feature on a map, the cartographer must first locate it. The expressions collected during the walking interviews were initially mapped to the positions along the routes where they were made. However, we also attempted to identify locations that each expression referred to. Doing so was challenging, as the spatial references could be vague or might refer to an ill-defined area, or even to a shape that varies depending on the context. For example, a comment about the benches along street X might refer not to the common geographic definition and length of the whole street, but only to the part of the street that offers a specific type of resting opportunity. For the MABF study data, we assigned expressions a location and an extent based on explicit references to locations when available, and made assumptions based on the content of the expression when explicit references were missing. Expressions that related to small features were mapped to a point and assigned an "uncertainty size" to reflect the area that might possibly be covered by the expression. Expressions referring to larger, identifiable features (for example, a street, a park, or the historic center of a city) we mapped to points at representative locations within or along those features, and assigned an "uncertainty size."

4. DIMENSIONS OF AND APPROACHES TO VISUALLY-SUPPORTED DATA ANALYSIS

To visually support QDA, different aspects of the analytical process need to be considered: the specific tasks to be completed, the data and their dimensions, and how those data dimensions map to visual variables, in order to define symbolization options.

4.1 QDA TASKS

QDA requires conceptualization and sense-making, and its core principles include describing or categorizing data, and making connections between categories (Dey 1993). Visual representations can support QDA by contributing "to conceptual clarification which can encourage us to think about the data in new ways" (Dey 1993, 218). When the qualitative data are spatial, maps or geovisualizations can be helpful by supporting typical spatial analysis tasks, such as evaluating the spatial distribution and extent of objects, the existence or absence of elements in locations, the closeness or distance of objects, or the density of space occupation.

QDA options are manifold. After discussion with the social scientists involved in the pilot study, we focused on four tasks as we explored options for visually supporting QDA. They are listed in order of a typical potential sequence for undertaking visually supported QDA, but may be revisited iteratively or even approached concurrently.

- *Revising and refining categorization* of sense of place. This could involve examining the spatial distribution of all data, certain data categories, or an individual participant's data (including areas covered/not covered by data), and accessing the original data chunks (i.e., the expressions) through the visualizations.

- *Making connections and establishing relationships* between categories or participants. By showing spatial overviews of categorized data, we can relate categories spatially and topically, finding both clusters and outliers, which leads us to consider the meaning and importance of those findings.

- *Aggregating (filtered) data for focus and synthesis*. For example, density overviews of selected data dimensions could be inspected, and decisions made about which data should be aggregated.

- *Corroborating evidence* by combining sense of place data through comparison with quantitative locale data. Additionally, corroboration might include comparing different places based on their similarity in one

or two of Cresswell's (2009) place dimensions with regard to the other(s).

4.2 MODELING THE DATA DIMENSIONS

For interactive and visual data exploration, the data need a structure that allows querying and provides query results that can be transformed into visualizations. Creating a data model that includes the properties of tripartite place data and also supports data queries is a key prerequisite for creating a range of visualizations or interactive visual re-expressions. The data model needs to store the sense of place categorization and the associated qualitative data chunks (i.e., the expressions) as well as the spatial reference and its associated uncertainty. To model all aspects of sense of place, including emotions and memories, we also needed to include dimensions for associations, valence, and time. Thus, we assigned "origin," "valence," and "time" fields to each data element. Data chunks that belonged to more than one category, or that had multiple valences, were duplicated. Splitting was only used in cases when the contents were clearly separable and no holistic statements were broken up. The value of "self" in the origin field identified data chunks relating to the current location. Additional values denoted other locations containing expressions referring to the current location. The duplication or splitting of data chunks allowed us to assign multiple locations to one expression. This was useful in situations where different parts of a place were judged differently (e.g., a participant referred to a nice street but also lamented the uncomfortable benches along one stretch of the street). Temporal references were grouped into three broad categories ("distant past," "past," and "future") in order to avoid uncertainty and granularity issues such as those discussed for the spatial references.

The symbolization options we offer below (see 4.4) can be used to visualize other place-related emotion data, provided that those data conform to the generic data model described above. In sum, for our visualization options to be applicable, we assume that spatially-related emotion data are assigned a set of sense of place categories and that each categorized data chunk has a spatial reference. Additionally, to understand topical associations, the origin location needs to be available. Optional data for all data elements include the original data chunks, the uncertainty size assigned to the spatial location, a valence judgment, and an indication of time. To make use of the tripartite place definition, data about the locale dimension, for example walkability indices (see Bleisch and Hollenstein [2017] for a visual representation), may be used in combination with the sense of place dimension.

4.3 EXPLORATORY DATA VISUALIZATION

While some visualizations are aimed at communicating selected information, others are intended instead for visual exploration, allowing data experts to gain insight into the data using different kinds of reasoning (Gahegan 2005). Plaisant, Fekete, and Grinstein (2008) define an insight as a "nontrivial discovery" resulting from the data. Gaining insight and learning from the data through exploratory data visualization thus directly supports the main aims of QDA: sense-making and understanding (Dey 1993). Gahegan (2005) argues strongly for visualization approaches that put reasoning tasks in focus rather than concentrating on tools and accommodating data variations. Nevertheless, visual data exploration requires interactive rather than static views, thus tools allowing for data manipulation, re-expression, or viewpoint change are needed (Slocum et al. 2009).

All visual data exploration requires attention and a conscious effort to overcome innate human biases, such as cognitive inertia or confirmation bias, which can influence or potentially hinder visual data exploration. Hartwig and Dearing (1979) argue that exploratory data analysis requires openness and skepticism. From our experience, these characteristics are still strongly required but neither always present nor reported on. One option for supporting openness is re-expression—representing the data in more than one way—thus offering different perspectives on the data (Slocum et al. 2009; Hartwig and Dearing 1979). Those perspectives may be of varying usefulness for generating insight and stimulating hypotheses during exploratory visual analysis. However, adhering to the re-expression principle is essential, especially when experts who have already worked with the data set and want to look at it with fresh eyes are involved (Bleisch, Duckham, and Pettit 2017), as was the case here.

Exploratory visualizations can be implemented in a range of existing tools, or customized tools can be developed for a specific application area. We implemented our visualizations in QGIS, which allows the implementation of a wide range of symbolizations. It also offers opportunities to import data from various formats, a range of options for interacting with the data display (e.g., zooming and

panning), and options for data filtering without requiring additional software development.

4.4 MAPPING DATA DIMENSIONS TO VISUAL VARIABLES

It is important to map data dimensions to the visual variables that most effectively represent them and that evoke the correct visual impression. In Table 1, we suggest a series of appropriate pairings of visual variables with sense of place data (categorized according to the model described above). These pairings are useful for the visual analysis of the data, especially as detailed above in 4.1. Below, we break down the choices involved in creating visual variable schemes for each data dimension.

Sense of place and valence: The seven categories, combined with the expression's valence, are mapped to a 7×2 diverging color scheme (Table 1, rows 1–2, left column). We chose complementary hues to represent opposite valences, to facilitate a natural interpretation of the valences. This choice is supported by recent findings on common color-affect associations (Bartram et al. 2017). Further, we designed the scheme so that similar sense of place categories were represented by similar hues. For example, the "safety" category often refers to infrastructure that is closely related to features that facilitate comfortable walking ("comfort"). Meanwhile, feeling safe is closely connected to the number of people who frequent a location, which in turn is related to the opportunity for social contact ("interaction"). In this way, the scheme's design follows a color circle: each color is similar in hue to its neighbors, as are the colors at the left and right ends of the rows. This is true for both the positive and negative valences. To allow the aggregation of several expressions, the scheme was extended to a 7×4 bivariate diverging color scheme (Table 1, rows 1–2, right column).

Spatial entity and extent: Given that the visual variable of size can have such an impact, careful consideration of how the spatial extent of an expression is represented is necessary (see 3.2). Larger features easily create an impression of greater importance compared to smaller features. In many cases, there was no clear argument for what size of symbol to use, especially for references to uncertain or ill-defined areas. Both large and small representations are sensible, but each may lead a reader to generate different hypotheses. To support fast re-expression, we have used points with different circle or ray sizes assigned for differently-sized spatial references in our visualization of the pilot study data (Table 1, row 3; we were inspired by Piatti, Reuschel, and Hurni [2013], who mainly used circular symbols to visualize similarly ill-defined places). While we ensure that the representation options adhere to visualization standards (e.g., Slocum et al. 2009; Munzner 2014), we did not optimize our choices to create the single best symbol for showing the data (as we would when mapping for communication purposes); instead, we produced a series of different options that help in developing different perspectives on the data.

Temporal and topical associations: "Memories" contained the most emotion data of any of the sense of place categories, often as associations. We differentiate two types of associations: temporal and topical associations. Memory expressions made during the walking interviews were generally evoked by the location that was passed, and link different times; we call them temporal associations. For example, passing a church may trigger memories of a wedding that took place in that church decades ago. Topical associations are triggered by characteristics and qualities of the present location, but refer to other locations and/or times with similar or opposite characteristics or qualities. For example, a participant might refer to the quality of the lighting in the current location, which they deem better than the lighting in the park at the end of the road. We used simple arrows with an origin and a pointer to represent topical associations linking different locations. The categorization of the content itself was represented through points at both ends of the associations, symbolized as discussed above.

Temporal data were not explicitly represented but instead queried through filtering—for example, by displaying information relating only to the past. In our case study data set, temporal associations or memories that link places through time often referred to the same place with different or even opposite valences. We found that interviewees' memories often involved positive perceptions of locations in the past, alongside ambivalent situations in the present, such as a loss of social contact because of deaths. As older people tend to shift their focus to more positive emotions (Charles and Leger 2016), this may be unsurprising. Nevertheless, it is interesting to analyze these circumstances with respect to the topic, place, and time dimensions concerned.

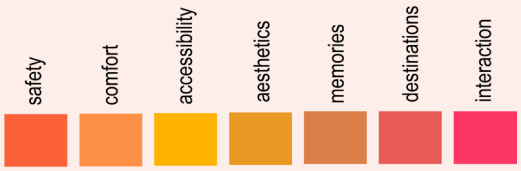
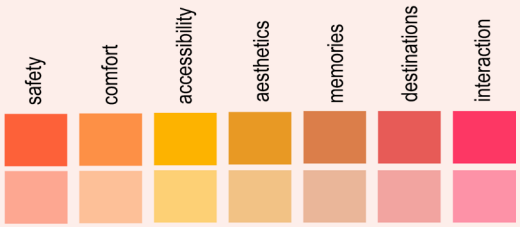
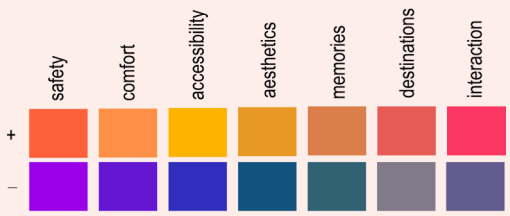
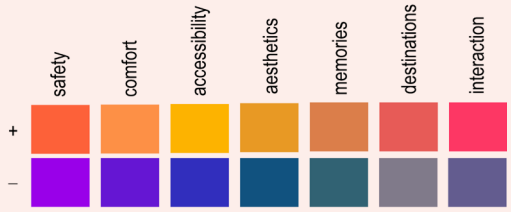
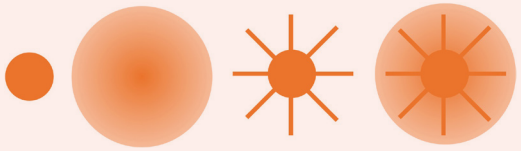
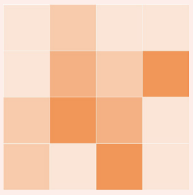
Data Dimensions	Aggregation Level: Filtered (one participant or a selected category)	Aggregation Level: Aggregated (all participants or categories)
Sense of place categories	Color hues, chosen for similarity  *A categorical visual variable is used for categorical data (Slocum et al. 2009)*	Semi-transparent colors; overlapping content creates more opacity  *We created a bivariate color scheme by adding a numerical dimension (transparency) to the categorical dimension (Munzner 2014)*
Valence	Complementary color hues  *A diverging color scheme represents positive/ negative valence (Munzner 2014)*	 *A combination of the concepts above and left, to create a bivariate diverging color scheme (Munzner 2014)*
Spatial reference and associated uncertainties	 *Uncertainty representation options: size and fuzziness (MacEachren et al. 2012), and radiating from a central point, inspired by Piatti, Reuschel, and Hurni (2013)*	 *An aggregated grid view partly removes size impressions, inspired by Wood, Dykes, and Slingsby (2010)*
Associations: topic	 Link symbol with a defined start (short perpendicular line) and pointing end, such as an arrow *Linear symbols visualize flows or links (Munzner 2014)*	
Associations: time	Time could be symbolized. However, for the example visualizations presented in this study, time was only demonstrated through interactive filtering, or through the sense of place category "memories."	

Table 1. *Overview of visual variables for the different data dimensions. Their use is illustrated in section 5. In italics, we provide the rationale for and/or references supporting choosing the respective visual variable.*

The list of visual variables and symbolization options we present here is by no means exhaustive and was condensed and selected through discussions with social scientists about the data and visualizations. They support a wide range of different visualizations, including the QDA tasks discussed in the next section. Additionally, interaction options, such as re-expression, data selection, or filtering of the listed data dimensions, can be employed through QGIS functionality. Filtering the data dimensions allows a user, for example, to focus on one or more sense of place dimensions, exclude expressions with negative valences, or display only those topical associations that refer to the past.

However when the data are eventually represented, it is important that the original data chunks are accessible through the visual representations. Accessing the original data allows the user to revise and refine the categorization as well as to validate findings and evaluate hypotheses that are formed based on the visualization.

5. VISUALIZATIONS SUPPORTING QDA TASKS

Based on the data structure and symbolization options described above, we created a range of visualizations for the MABF study data set and discussed them interactively in joint sessions with the social scientists to consider the visualizations' potential and limitations for supporting QDA. Interactive joint sessions spared the social scientists from the need to handle the visualization and interaction options in QGIS. The following sections discuss some example static views from our discussion sessions, including the input from social scientists. Where helpful for understanding the potential utility of the visualizations, we highlight the dataset's contents and analysis results, as well as interaction opportunities.

5.1 REVISING AND REFINING CATEGORIZATION

Figure 1 shows a part of an overview visualization in which all expressions are symbolized by sense of place category and valence, according to the principles detailed in section 4.4 and Table 1. Additionally, the background map is emphasized within a buffer of 20 meters around the different routes the participants walked (darker grey background map elements within the buffer area), to show the areas covered or not covered during the walking interviews. The visualization allows a first assessment of the spatial distribution and clustering of different categories, as well as positive and negative expressions. The social

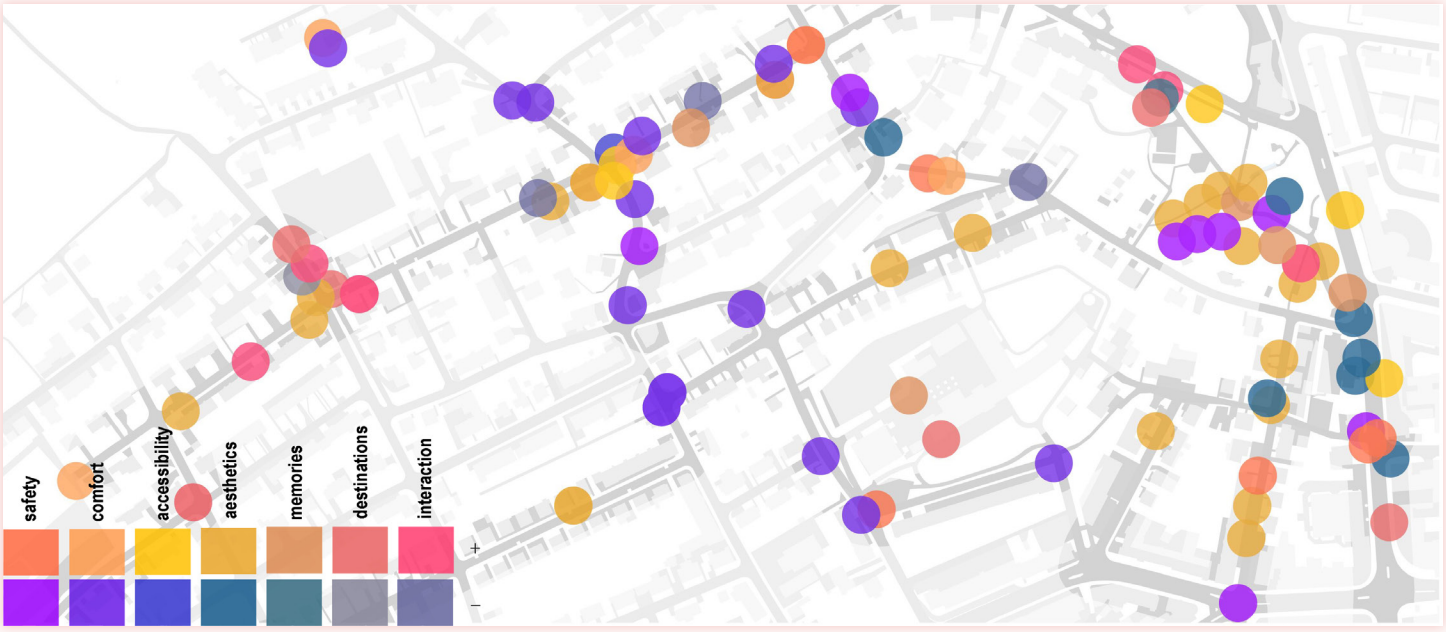


Figure 1. *An extract of an overview visualization showing all localized data chunks, their categorization, and valence. The background map is subtly emphasized within a buffer of 20 meters around the routes, to show the area covered by the walking interviews. Clicking the points allows the user to view the original data chunks.*

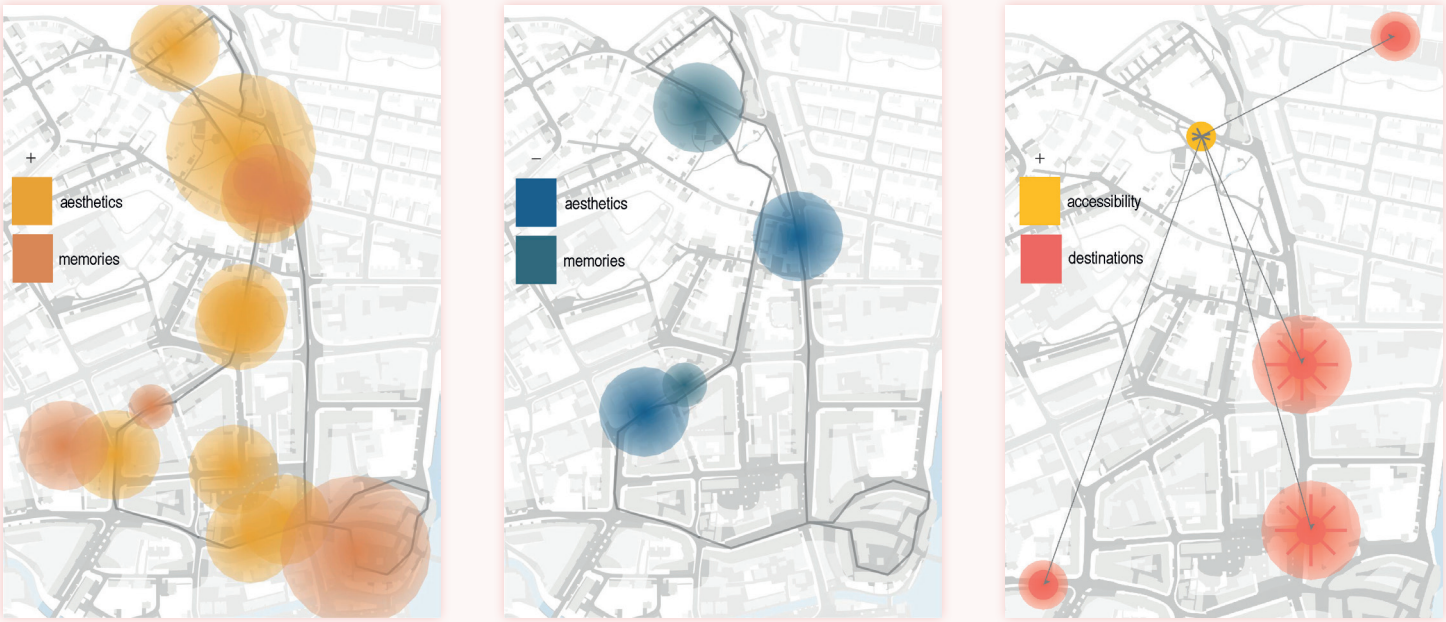


Figure 2. *Filtered views of selected sense of place data. Left: Route of a single participant and their expressions of positive valence in the categories of memories and aesthetics. Circle size approximates place extent. Center: The same participant and categories as on the left, now showing negative valences. Right: Accessible destinations (red circles) referred to by a participant while standing at the location marked with a yellow circle (topical associations). The circles are used to approximate the place's location, while the overlaid opaque large dot and the rays indicate an uncertain extent associated with the location.*

scientists pointed out that in QDA that does not use spatial displays, they more often think about the data semantically than spatially. The original text of the qualitative data chunks can be accessed through the point symbols to reconsider the sense of place categorization or the valence judgment, as well as to get a more detailed impression of the spatial distribution and of distance between specific statements and associations.

5.2 MAKING CONNECTIONS AND ESTABLISHING RELATIONSHIPS

In addition to the simple data display in Figure 1, the example visualizations in Figure 2 show filtered views of sense of place categories and expressions from a single participant, making use of the assigned uncertainty range of the spatial reference. Such visualizations clarify where along the route data were collected and where they were not (Figure 2, left and center). Caution is needed here: to some degree, these visualizations imply that locations with expressions are more important than locations that were not commented on. Likewise, the distribution of the locations, as well as the varying sizes of the circles (approximating the dimension of the mentioned places) give an impression of varying density and importance that may not accurately reflect the significance of the expressions. Using the principle of re-expression, we can vary the extent assigned to a participant's expression, or how that extent is symbolized, in order to provide varying perspectives on the data for hypothesis generation.

Discussing the filtered views, we found that looking at the expressions in the form of symbols on a map offers a different perspective on their spatiality than thinking about space only implicitly and sporadically when qualitatively analyzing text data. Specifically, Figure 2, right, revealed that the destinations (shown in red, connected by grey arrows), which the participant referred to as being within close reach, are actually located at a substantial distance from the position where the expression was made (marked with a yellow circle). Another discussion related to the negative associations of a seemingly nice area with a pond. Accessing the original expressions, we learn that while the area is nice, there are no benches upon which to rest and enjoy the view—a joyful aspect commented upon with regret. The color schemes that included very similar hues worked well in our discussion group, but one researcher

could not see all the differences between the chosen color hues.

5.3 AGGREGATING (FILTERED) DATA FOR FOCUS AND SYNTHESIS

Aggregated views potentially allow the visual analysis of all data in one display. However, it is often more useful not to look at all data at once. For example, aggregation of all participants' expressions of just one category allows focusing, while looking at aggregations of several selected categories side by side may allow synthesizing findings across categories. Generally, aggregated visualizations support the same spatial analysis tasks as other representations, for example, analyzing spatial coverage and extent. With gridded aggregated visualizations (Figure 3, left), it becomes even more important to consider context information. For example, an empty area in the visualization means no data. However, there might be no data either because the area is not interesting or because a participant did not make reference to it. This is true for displays of data from single participants, but needs even more attention when data from several participants are combined.

Being able to crosscheck findings and hypotheses with the original expressions is also crucial for aggregated views. Grid-based aggregated visualizations, such as the one shown in Figure 3, left, have the advantage of not implying that the place size corresponds exactly to the area covered by the grid cells. On the other hand, the spatial extent initially assigned to the place directly influences the number of grid cells that are filled. For grid-based aggregated views, more opaque fills are created by multiple expressions that refer to the same location or overlapping place extents. Visual aggregation of expressions is achieved through the symbolization of the associated spatial uncertainty of locations with semi-transparent circles or stars in point-based displays (Figure 3, right). Importantly, interactively discussing visualizations based on different area and uncertainty assignments (employing the concept of re-expression) did stimulate different views on the data and the generation of different hypotheses. For larger areas or for larger spatial entities (for example a park or the city center), or for the identification of "hot spots," we found that grid-based aggregation of uncertainty sizes and suitably large grid cells better support topical and quantitative comparisons—a general impression of a shared sense of place—than the point-based visual aggregations of uncertainty sizes. Point based visual aggregations, especially with smaller symbol sizes, leave the single expressions discernible and support, for example, the typification of participants such as "open," "mobile," or "anxious."

5.4 CORROBORATING EVIDENCE BY COMBINING AND EXTENDING SENSE OF PLACE WITH LOCALE

Figure 4 shows a visualization of sense of place valence in combination with attributes of the locale. The background shows the valence of all participants' expressions that fell into the "aesthetics" sense of place category, aggregated using a grid. The grid size can be varied, but should allow

Figure 3. *Overviews of selected data aggregated across all participants. Left: Grid-based aggregation of negative valence in the category "comfort" from expressions of all participants. Right: Topical associations with a negative valence, across all participants. Note: the place of origin of the association may be perceived positively.*

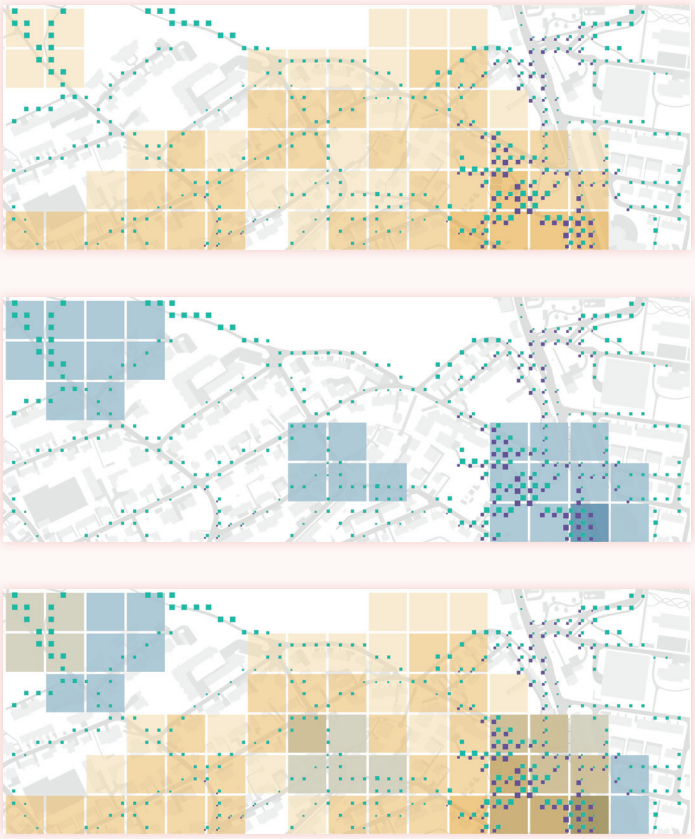


Figure 4. *Gridded density overviews of the category "aesthetics," overlaid with bivariate squares symbolizing the green space index (green) and bench index (purple), calculated for short road segments (Bleisch and Hollenstein 2017). The background features expressions with a positive valence (top), negative valence (middle), or both valences (bottom).*

for some aggregation of the data. The top, middle, and bottom of the figure show, in the background, aggregations of positive, negative, or both valences, respectively. While the bottom one mixes colors, this could be avoided by coloring the grid cells using the majority valence. Green space (green) and bench availability (purple) indices that were calculated along short road segments (data about the locale) are overlaid on the grids. Bigger squares indicate higher index values: i.e., more greenery or higher bench density around the road segment (see Bleisch and Hollenstein [2017] for more detail on the index visualizations). This allows the direct visual comparison of sense of place with the locale. As expected, green space is not the only contributing factor to aesthetic appeal. In the upper left corner of each of the visualizations in Figure 4, we find high green space index values, but aesthetics expressions have a predominately negative valence because of unappealing buildings in the area. Additionally, we need to consider that while the green space index is calculated along all roads, sense of place data are only available for locations that were visited or commented on. The use of the visualizations to generate hypotheses requires knowledge about the data collection procedures and evidence verification using the original data chunks.

Discussing these combined visualizations with social scientists, we find that data-dense displays are challenging, but valuable once they are understood. There is great potential to combine different aspects of the datasets and visually analyze them concurrently. In another example, pathway slope was combined with shop accessibility. The potential closing of a local shop resulted in not only some expressions discussing the loss of social contact and longer routes, but also showed concretely the much longer and steeper routes required to access alternative shopping facilities. Contrasting location characteristics with emotion data allows for a more holistic view of the affordances of an environment.

6. CONCLUSIONS AND OUTLOOK

We have explored how visual representations can be used to support selected tasks in the qualitative analysis of place-related emotion data. We identified symbolization opportunities for all modeled data dimensions, and exemplified them using different visualizations created with an example data set from an existing case study. We discussed these visualizations with social scientists from the original study to include their perspectives and to benefit from their data analysis knowledge. We reported insights from these discussions that we think are interesting and important for the future implementation and evaluation of the proposed visualizations for place-related emotion data in different application areas.

To conclude, we identify three areas, below, to which the findings of this study contribute. The first is that it provides specific examples of how place-related emotion data can be visualized to support QDA tasks. The second is that it makes explicit some of the benefits of the described symbolization options and how they were used in visualizations: re-expression; combinations of sense of place and locale; and visualizations of vagueness as well as topical

associations through arrows. Finally, it advocates for visualization-supported data analysis in interdisciplinary teams.

The aspects discussed in this paper, the tripartite place definition (Cresswell 2009), the derived sense of place categories for the example data, and their inclusion in a data model, as well as the visualization options supporting selected QDA tasks and the resulting visualization, all support the analysis of emotion data related to place. While traditional QDA often only semantically considers spatial aspects of data, the options discussed here emphasize the spatial analysis of emotion data. Specifically, we find that the visualizations combining the categorized and valence-rated sense of place expressions with the locale at one location or across an area are useful for a more holistic understanding of emotion data related to place. While the individual researcher often has good knowledge of the study area to relate the collected emotion data to it, the systematic and comprehensive visual comparison of sense of place with locale was interesting and will be used more in future projects.

6.1 SUPPORTING QDA

Qualitative analysis is generally time consuming, and adding another exploratory method for hypothesis generation, hypothesis testing, and triangulation may only be worth the time required when significantly more or different findings are to be expected. By presenting specific examples that operationalize a generic data model for place-related emotion data based on Cresswell's (2009) tripartite place definition (section 4.2), the associated symbolization options (section 4.4), and their implementation in example visualizations, we hope to demonstrate the value of the effort required to add spatial representations to an analysis. We believe this approach should be generally applicable to data generated through walking interviews. Our discussions with our social scientist collaborators showed that the map-based visualizations, specifically the range of different visualizations offered through re-expression, provided different perspectives and triggered spatial thinking and insights. Additionally, working with the different visualizations, the social scientists found that looking at the data in a more abstract but spatially organized way—in the form of symbols on a map—offered them a different perspective on the spatiality of the data than thinking about space only implicitly and sporadically when qualitatively analyzing text data.

6.2 SELECTED VISUALIZATION BENEFITS

Re-expression is a basic concept in geovisualization (Slocum et al. 2009). However, it is our impression that it is rarely used extensively. One reason for this may be the time and effort needed to do so. With the generic data model and associated symbolization options, we provide a range of options that encourage active re-expression, specifically through their simplicity. In our approach, the range of visualization options is limited to point-based object representations. However, after working with the visualizations, we believe that the benefits of fast and simple re-expression outweigh this limitation. When including uncertainty information through the size of points, the visualizations give different hints and inputs for preliminary hypothesis generation, which then need evaluation by either accessing the original data chunks or yet other visualization types. Varying uncertainty—thus also varying the visual impact of the symbols—as well as making associations and their distances explicit (e.g., something some distance away is mentioned as being felt to be close) were important aspects of the implemented visualizations for analysis of this qualitative emotion data and hypothesis generation.

The combination of sense of place and locale in the same representation results in complex but insightful displays: they offer opportunities to combine subjective place impressions with the physical properties of the location, thus, supporting a more holistic assessment of the location. When crosschecking hypotheses generated about the emotion data, it was interesting to relate these data to the locale information. This also showed that participants may compare or relate locations to each other (e.g., *here* it now feels like it felt *there* some years ago) based on the characteristics of the locale and sense of place dimensions of the tripartite place definition. Such knowledge may be useful when comparing different locations from a personal perspective—for example, for a relocation. Additionally, comparing expressions of walking comfort to footpath slope allowed us to learn that a certain environmental characteristic (steepness) does foster certain expressions (of discomfort or contentment). However, a steep section of a footpath may not always be seen negatively. Perhaps, due

to a participant's personal preference, it is not a reason for discomfort but rather an element of their personal fitness training.

Capturing more precise and/or consistent spatial relations and spatial extents of interview expressions would be interesting but may pose challenges. A persistent challenge (Çöltekin et al. 2017) is the relevant, but not necessarily precise, definition of the location and extent that is indicated by an expression, as well as specifying the temporal aspects of experience in more detail.

6.3 INTERDISCIPLINARY ANALYSIS SETTINGS

Discussions with colleagues in the social sciences helped us to better understand their concerns, a task which is crucial but often time-constrained in interdisciplinary research projects. We and the social scientists both benefitted greatly from working together. While QDA is generally time consuming, social scientists did not need to spend extra time on learning to handle an additional method, as we handled the re-expressions. In the team, their time was spent thinking about the visualizations and visually analyzing the example data. On the other hand, we benefited from discussions and explanations concerning, for example, the context of data collection or theoretical considerations regarding data categorization. Insights from this dialogue helped to refine the underlying data model, so that it may be transferred and applied to the visualization of similar data sets from other projects. Additionally, it helped us to define which of the many visualization options we created were most useful for which QDA tasks. Thus, the discussions shaped the content and presentation of this paper, allowing us to focus on the presentation of tasks and visualizations that have most potential for further use and evaluation in other studies, as well as for transferability to other application areas.

6.4 OUTLOOK AND FUTURE WORK

As we did not fully analyze data using the proposed symbolizations and visualizations, we plan to do so in a future project in the same or in a related application area with similar data sets, but with potentially different categorizations of sense of place as relevant to the application. The ideas and conclusions presented here will benefit from a more thorough evaluation and testing of the transferability of the visualization approach, an identified research area (Griffin et al. 2017). Additionally, as presented here, the data model, symbolizations, and visualizations provide some options for supporting the analysis of qualitative data, but they are by no means complete or exhaustive. To supplement the symbolization options, we suggest that abstract symbols—potentially better understood than color hues—could be added. They could be combined with the color hues or be used by themselves.

While the spatial reference or extent of emotion data seems vague, it is often the case that the expression itself is vague and/or of varying complexity. Adding more symbolization options for representing vagueness or uncertainty would further broaden the set of options for re-expression. Just as re-expression using different symbols for spatial uncertainty seemed to trigger reconsideration of data and relationships in our discussions with the social scientists, showing vagueness on the part of the participant might be worth considering in more detail in future work.

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PEER-REVIEWED ARTICLE

Drawing Video Game Mental Maps: From Emotional Games to Emotions of Play

Hovig Ter Minassian
University François-Rabelais
hovig.terminassian@univ-tours.fr

By exploring emotions at play in video game experiences, we sought to analyze how people interact with digital spaces in everyday life. Taking a somewhat different view than much of the literature in the field of video game studies, we examined emotions that were created from users' experience of games, rather than focusing on game design and gameplay. To that end, we based our analysis on 38 video game mental maps drawn by 26 people. We successively analyzed the topic, the structure, and the experiential and emotional meaning of each of the mental maps. Thus, we explored the diversity of emotions that participants linked to video games, and examined the mental maps in relation to what the respondents said about how and why they chose to draw a particular video game. Our work shows the importance of looking beyond the analysis of affects and gameplay, and of examining the emotions produced by the video game experience, along with what they can tell us about the role of games in individual and collective spatial experiences and sociability. Everything doesn't happen on the screen, and what is lived within the game also depends on what is lived in the physical space of the player. In other words, video games aren't emotional in themselves, but there are significant video game experiences that contribute to the structuration of individuals.

KEYWORDS: video games; computer games; mental maps; digital space; digital geography; emotions; cultural practices

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INTRODUCTION

Since the term "cyberspace" was coined by William Gibson in 1984, digital tools have extensively infiltrated our everyday space, from augmented reality games to interactive road maps. This increasing digital influence on our experience of space has led researchers to argue that it is now necessary to erase the distinction between the real and the virtual, and they consequently speak of geo-cyberspace (Bakis 1997), code/space (Dodge and Kitchin 2005), hybrid space (de Souza e Silva 2006), or augmented reality (Graham and Zook 2013).

Video games, as a cultural activity strongly supported by the development of digital technologies and mobile media, seem a relevant starting point to observe the nature of those spaces. As stated by Shaw and Warf, "simple dichotomies like player and game, or real and virtual space, fail to do justice to the depth and extent to which digital technologies have penetrated minds and bodies in contemporary capitalism" (2009, 1339). With growing media coverage and the success of augmented reality games such as *Pokémon Go*, video games are now particularly well

established as a cultural activity in society. According to the CEO of Niantic, the studio behind the game, the number of *Pokémon Go* players worldwide was estimated to have exceeded 65 million in the spring of 2017 (**www.businessinsider.fr/us/pokemon-go-65-million-monthly-active-players-2017-4**). The international analysis firm Newzoo estimated that the global turnover of the video game industry in 2018 will reach almost $138 billion USD (**newzoo.com/wp-content/uploads/2018/08/Global_Games_Market_2018.png**). But despite their widespread use, there have been very few studies on the geographies of video games; geographers have mostly focused on spatial representations within games (e.g., Magnet 2006; Shaw 2010), their potential educational uses (e.g., Adams 1998; Gaber 2007), or, more rarely, the video game industry itself (Aoyama and Izuchi 2003; 2006; Johns 2006). There is therefore a need to study the geographies "produced by the digital" (Ash, Kitchin, and Leszczynski 2018, 35) in video games, by looking beyond the analysis of devices and technologies and their design, and examining how they are actually used and domesticated (Berker et al. 2006).

As Ash and Gallacher point out regarding the study of video games, "there is a need for continued methodological innovation in order to capture and document the complex interrelations between gestures, discourses, feelings, affects, among other categories and frames of sense" (2011, 363). The aim of this paper is to respond to this need, both theoretically and methodologically. We aim to show the value in analyzing the way digital spaces are actually produced and experienced by their users. To that end, studying the *emotions* involved in the video game experience seems to us a relevant starting point. It allows us to focus on the *players*, rather than analyzing game design or gaming devices as previous researchers have done. At the same time, our approach also takes into account the context in which these emotions occur, and their effects on individuals. In other words, by tackling the issue from an emotional perspective, it is possible to situate video game practices socially and spatially, and to examine how a particular geographical experience emerges, conjointly produced by the in-game space and the space of the player. To achieve this aim, we used a "mental maps" methodology developed in a research program on video game users and practices in France. The first part of this article presents the theoretical framework of the study, emphasizing the importance of taking into account the diversity of experiences when examining the geography of digital spaces. The second part covers the survey methodology, based on mental maps and semi-structured interviews, used to analyze the emotions produced by playing video games, and the socio-spatial context of the experiences related to them. The final sections discuss the results of the study and the main findings.

EMOTIONS IN GAMES OR EMOTIONS AT PLAY?

Ian Shaw claims that "play is relatively under-theorized in cultural studies" (2010, 791). Instead, content analysis has long dominated the study of video games. Geographers and other researchers have focused mostly on spatial representations or game design, while pointing out the need to take into account the player's experience. Our work follows the latter line, by taking the players' emotions as a starting point to analyze the geographical experience of video games.

FROM GAME STUDIES TO PLAY STUDIES

The field of "Video Game Studies" has historically been dominated by internalist approaches, favoring the study of content and taking either a *narratology* or a *ludology* view. Narratologists have focused on the discourse and representations produced by video games, whether through text or images (Fuller and Jenkins 1995; Aaserth 1997; Salter 2011). By contrast, ludologists have focused on analysis of game mechanics and gameplay, arguing that what distinguishes video games from other media or cultural products is the nature of the human/machine interaction (see, for instance, Frasca 1999; Stockburger 2006). This debate is still significant, and above all testifies to the importance given to the analysis of the medium itself rather than to the way it is used.[1] However, neither of these approaches say much about the way this cultural medium is received or about the experiences of the players. Of course, the latter are mentioned, but often independently of their individual, social, or geographical characteristics. Even when talking about immersion or the emotions produced by video games, researchers usually focus on either

1. See, for instance, the theme of the international conference of the Digital Games Research Association (DiGRA) in 2018: "The Game is the Message."

very personal analyses (Krzywinska 2015; Gong, Hassink, and Maus 2017), or techniques for producing emotions and commitment (Frome 2007; Juul 2007). However, some authors acknowledge that "elements such as the physical qualities of the gaming device as well as the social space surrounding the game are part of the game space" (Stockburger 2006, 87), but do not necessarily describe them.

In contrast to these internalist approaches, other studies, first appearing in the early 2000s, showed that video games are played in a variety of contexts, and by players with varying levels of commitment; hence there is a diversity of gaming experiences. These include works by Taylor (2006) and Berry (2012) on massively multiplayer online role-playing games (MMORPGs), ethnographies of *Second Life* (Boellstorff 2008; Lucas 2013), research on e-sports (Taylor 2012), and work on cheating in games (Consalvo 2007). In the case of online multiplayer games such as *Lineage* and *World of Warcraft*, for instance, Steinkuehler (2006) observes how different communities of players interpret the rules and game framework differently. Dyer-Witheford and de Peuter (2009) also describe how digital workers, usually based in Asian-Pacific countries, are paid to play games in order to accumulate in-game resources that will then be resold to other players for real money, and whose experiences of virtual worlds are radically different from the consumer-players of the European and North American markets. Similarly, both Boellstorff (2008) and Lucas (2013) have shown the variations in users' experiences of digital spaces in the online game *Second Life*, and the different ways they have of "inhabiting" virtual worlds. Thus, because video game practices can vary widely from one individual to another, and because they are geographically and socially situated in the individual's way of living and social space (Rufat, Ter Minassian, and Coavoux 2014; Coavoux and Gerber 2016), Mathieu Triclot (2013) argues for the development of a field of "Play Studies." Video games are, above all, *experiences*, which depend as much on the socio-spatial context in which they take place (Boutet 2012) as on the players' biographical trajectories (Coavoux and Gerber 2016).

Thus, as observed by Ash, there are no pre-determined meanings of the images and representations in a video game, but rather actualized meanings that occur in the context of their use: "Experiencing an image is an embodied event. The signification of the image is not determined in advance of it being viewed, but is made performatively in the singular moment of this or that viewing by differently located and contextualised bodies" (2009, 2107). Ash therefore recommends that video games should be considered based not only on how they represent reality, but also on their geographical function and their capacity to produce space. Shaw (2010) thus borrows from the psychoanalyst Donald Winnicott the notion of "transitional space" to characterize these video game spaces: a place of transition and encounter between oneself and the real world, a place in which the subjectivity of the former meets the political and social organization of the latter. For instance, Shaw looks at how war-themed video games bear the imprint of the American military-industrial complex. But while he questions the nature of digital spaces as transitional spaces (by looking at their aesthetics and narrative content), we look at *what is happening* in these digital spaces. This involves not only being attentive to user/screen interactions—whether through messages, feedback, or affects that circulate from one to the other—but also to the context of video game practices, what we have called elsewhere the "space of the player" (Rufat and Ter Minassian 2011), by studying the emotions that come into play during these experiences.

EMOTIONS AT PLAY IN VIDEO GAMES

Video games produce many *affects*, that is, "precognitive and embodied (re)actions" that structure the geographical experience of video games (Shaw and Warf 2009, 1333). As Ash (2009) points out, the player is affected by a game's audio, visual, and sometimes tactile stimuli (the vibrating motors in the game controllers). In addition, some living-room devices such as the Kinect or Wii have popularized dance, music, or sports video games that force players to use their own moving bodies (and not just their hands) to control activity on the screen. At the same time, some major video game studios have put considerable effort into the scriptwriting of their games, and called upon real actors to portray game characters to reinforce the realism of the dialogues. In 2018, the second Emotional Games Awards took place in France. What kinds of emotions are produced by these affects and realistic game narratives?

While it may seem relevant to study the affects of a game session, the concept of emotion is necessary to characterize this geographical experience from the point of view of the players and to understand how they incorporate it in

their biography. It is insufficient to simply describe a player's experiences; we must also look at how these experiences arise and structure players' sociability and practices. For instance, for Fiske (1989), pleasure is not only an act of passive consumption, it is also a form of activity that engages the individual in their environment. Emotions are thus part of the process of construction and interpretation of the world and our spatial experiences. As described in *Emotional Geographies* (Davidson, Bondi, and Smith 2007), they contribute to the way we structure our spatial practices and represent and categorize the world. Individuals do not *have* emotions; they *produce* them in situations of social and spatial interaction (Bareither 2017). In this way, emotions are not just about the feeling that is experienced: they also concern the context in which they were experienced and made possible. As observed by Davidson and Milligan, "While we attribute emotional agency or capacity to a surprising range of external sources—saying, for example, that low clouds make us gloomy, while blue skies raise our spirits—our heart-felt articulations of emotion, themselves, acknowledge their interactional quality" (2007, 524).

Our hypothesis is therefore that the analysis of emotions related to playing video games cannot be reduced to the study of activities and affects that occur during a video game session, but must also take into account the attachments developed by the player, during their life, towards the many items related to playing video games—not only objects and devices, but also digital spaces or particularly striking events. As stated by Owain Jones, "emotions are systemic and interact constantly with our conscious and unconscious selves, memories and environment" (2007, 205). Hence, to understand the emotions related to video games, we should study games as a leisure activity that can be embodied in various situations and that can be given many different meanings according to the player's motives and biography. In other words, emotion in a video game is not just about activation of a few gameplay mechanisms; it arises from the geographical experience in which the activity takes place, while contributing to its particular meaning.

MAPPING THE GAME, MAPPING THE EXPERIENCE

For many categories of video games, the map is a crucial element. For example, in adventure games, role-playing games, and shooting games, the player uses it to navigate through virtual spaces. In city-builder games and war games, maps support planning or conquest. Players sometimes create their own maps to facilitate navigation, to help other players, or to produce personal artistic works.[2] The widespread involvement of maps in video gaming suggested to us that maps would be a good medium for examining the geographical experiences of players. Griffin and McQuoid (2012) identify three main uses of cartography in understanding human emotions: maps can be used to represent emotions (e.g., a map of world happiness); they can elicit emotions during reading; and they can be used to collect emotional data and show "emotional associations individuals have with certain places" (2012, 297). Our work is in line with the latter, as we used video game mental maps to interview players about their experiences and the socio-spatial context in which those experiences happened.

MENTAL MAPS AS "GRAPHICAL AUTOBIOGRAPHIES"

Mental map methodology has been recognized in geography since the pioneering work of Lynch (1960) and of Gould and White (1974), although it has seldom been applied in the field of video games and digital worlds. However, mental maps enable interviewees to tell a story, or to relate a geographical experience.[3] Thus, a map offers more than a simple description of the digital space, instead "shaping it with meaning," in the words of Pearce (2008, 21). According to Antoine Bailly, mental maps are "graphical autobiographies" (quoted in Avry 2012); in other words, when people draw a place, they are not only describing it, they are also saying something about themselves. They are expressing a spatial experience, and their attachment to places and emotions.

Thus, we believe that mental maps can complement semi-structured interviews, helping respondents describe particular experiences and emotions aroused by certain

2. Some can be found on the Internet, for instance at **mapstalgia.tumblr.com**.

3. For a general discussion of theoretical and methodological issues of mental maps see Avry (2012).

activities (or specific moments) of their life as a video game player. As observed by Gould and White, "Our memory, far from holding every sensory impression from our environment, selects and retains only a small portion" (1974, 43). For this reason, we looked for a method that could activate respondents' memories and lead them to describe their relationship with a particular game or their memory of a particular experience, without any preconceived ideas about the type of emotions that these virtual experiences may arouse. We aimed to achieve a balance in how the players described their digital space experience between "involvement in" and "detachment from" space (Pearce 2008, 21), encouraging them to focus on relating their experience of the space rather than on accuracy and precision of the drawing. Hence, the aim of our video game mental maps was not for interviewees to give an accurate account of the characteristics of a video game space, but rather to describe how they experienced it. In this way, the mental maps brought out memories, emotions, and thoughts linked to specific moments or experiences in particular social or spatial contexts, which would have escaped us in conversations about other aspects of game activities.

VIDEO GAME MENTAL MAPS METHODOLOGY

We employed our mental maps methodology in LUDESPACE, a collective research program on video game users and practices in France, funded by the French National Research Agency (2011–2014).[4] Our project involved interviews with 26 people (11 women and 15 men),[5] conducted in 2013 and 2014. The age of the respondents ranged from 17 to 56 years, and their profiles varied: some were not employed (two retired, one university student, one high-school student), while others were, with a diversity of professions and levels of qualification (civil servant, police officer, doctoral student, teacher, real estate agent, programmer, architect, etc.).

The LUDESPACE research program included: (1) a population-wide quantitative survey on video game uses (2,042 adults aged 18+ and 500 teenagers aged 11 to 17); (2) about 30 semi-structured interviews with players about their past, present and future video game practices; (3) audio/video recordings of nine video game sessions at players' home. Since the LUDESPACE research focused on video game users in general, and not only on intensive video game players, our sample also included respondents with varied levels of commitment. While some of them claimed to be experienced players (like Jeanne,[6] a 22-year-old student, or Michel, a 34-year-old programmer), others described themselves as "former" intensive players (Dominique, a 34-year-old sales representative), or as casual players (Guy, a 33-year-old senior civil servant), or even non-players (Chantal, a 47-year-old retired teacher).

During the semi-structured interviews, respondents were asked to draw one or more video game spaces of their choice. Their hands were filmed while drawing, and they were encouraged to talk about what they were doing, so that we could analyze not only the topic but also the structure of the drawing and the discourse. Our approach was guided by the example of Avry (2012): namely, that the analysis of mental maps is not about accuracy (they are not a test) or aesthetics, but about examining the topic of the map, the structure of the map, and its experiential and emotional meaning. Our analysis of each mental map's **topic** focused on the interviewee's choice of video game (*what did they draw?*). The analysis of the **structure of the mental map** focused on the way the mental map was drawn (*how did they draw it?):* what was depicted, in what order, and the elements (characters, landscape, on-screen directions, etc.) that the participant considered relevant to explain the geographical experience and emotions related to the drawn space. Finally, our examination of the **experiential and emotional meaning of the mental map** focused on the motivations, justifications, and explanations given by the respondent for choosing a particular drawing or game (*why did they draw it?*). Our project ultimately included 38 mental maps drawn by 26 people. Two people did not participate in the mental map exercise; the reasons for their refusal are discussed below. Some of the maps were very different than what a map, even a mental map, is normally expected to be. We decided to keep them in the corpus, not based on objective criteria (scale, orientation, etc.), but because they are the way some of our respondents

4. For more details, see: **citeres.univ-tours.fr/spip.php?article1267**. I would particularly like to thank Manuel Boutet and David Gerber, who contributed significantly to the qualitative part of the fieldwork and its analysis.

5. The respondents were selected according to their participation in either the quantitative survey or the recordings of video game sessions, or according to their specific background as players (since we were looking for diversity).

6. For ethical reasons, all interviewees are anonymized in this paper.

understood the instructions they were given to draw a video game space.

PITFALLS AND LIMITATIONS

One could argue that drawing a space is not necessary in order to talk about it. In fact, most of our interviewees found the instructions difficult to understand at first: what does it mean to "draw" a video game space? What space should they draw? Should be it the map of the virtual world, one place in particular, the character's environment, or even the interface that appears on their TV, smartphone, or computer screen (as in Figure 1)? Nonetheless, we asked them to create mental maps because we considered that it would likewise be very difficult for our interviewees to answer questions such as "tell me about your emotions when you played that game or when you played with your siblings or your friends."

Still, our choice of approach led two interviewees refusing to draw video game mental maps. From what we learned in their interviews, it appears that their refusal was due less to their inability to draw maps by hand, than to the fact that they didn't feel committed to video games as a leisure activity. For example, Lionel acknowledged that he spent some time playing video games as a child, but that he was no longer very interested, even if he sometimes played with his two daughters or during long journeys. He now preferred car races, comic books, and superhero movies. The other, Chantal, considered that video games were overall a waste of time, although she did play *Sudoku* on her smartphone. Hence, for both of them, drawing video game mental maps did not seem relevant, because they have little experience to call upon, or because they didn't consider that video games to be an important part of their cultural practices or social activities. By contrast, the other interviewees were very keen to do so. These different attitudes towards the mental map exercise are in themselves an objective indicator of the importance of video games in some people's lives, in terms of their leisure and cultural activities, their social networks, and their everyday experience of digital spaces.

Figure 1. *Georges's view of the space in the game and the space of the interface.*

EMOTIONS AT PLAY IN VIDEO GAMES

An overall analysis of the corpus shows a great diversity of subjects drawn in the mental maps (29 different titles or video game categories across the 38 maps), including both well-known and obscure titles, generic categories (basketball games, strategy games), and even one personal creation by a respondent who studied game design and programming. It also shows that the most commonly depicted genres in our corpus, such as "platform games" (10 out of 38) and "puzzles and solitaire games" (6 out of 38), are those with the poorest virtual space. In the former, digital space is usually a network of discontinuous "levels" or "stages," sometimes without transition zones. The latter include games such as *Solitaire*, *Sudoku*, or *Crosswords*, which usually have no geographical space other than the screen of the device on which they are played.

ABOUT MENTAL MAP TOPICS: WHAT PEOPLE DREW AND WHY

Having looked above at which video games our interviewees chose to draw, we turned next to how they explained their choices during their interviews. Interviewees identified five main reasons for their choices, some of which were directly related to emotions (Figure 2).

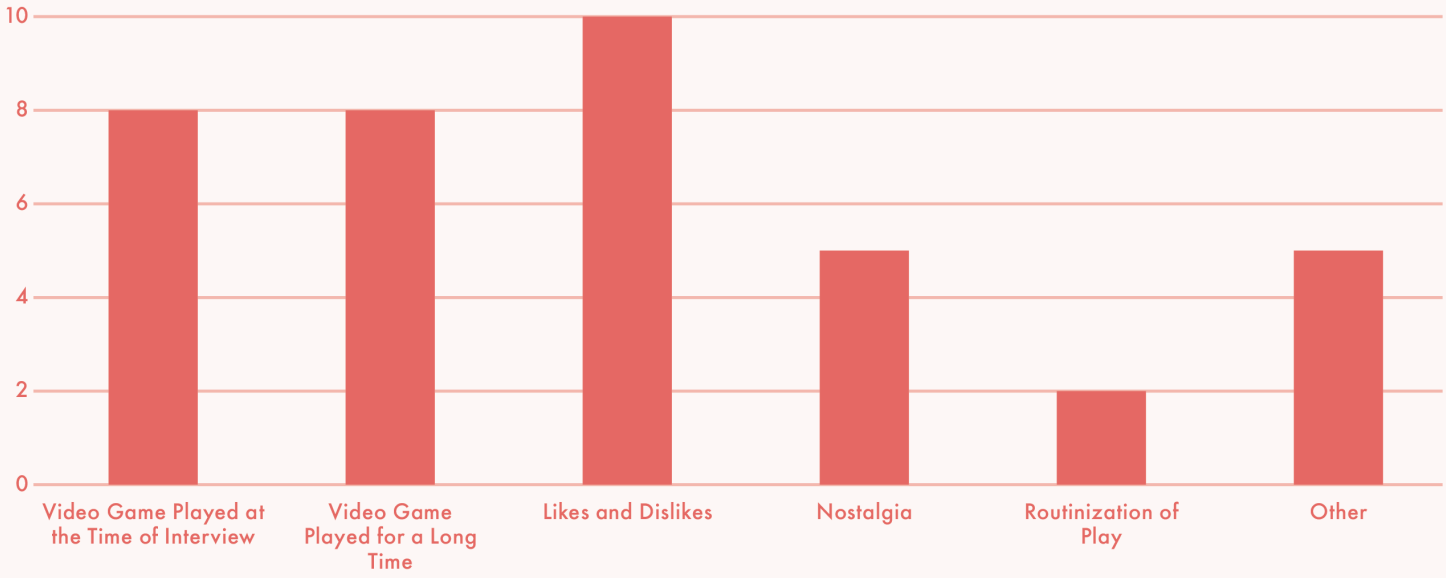

Figure 2. *Reasons interviewees chose certain video games for their mental maps.*

The first reason for drawing one game in particular was that it was *the game the interviewee had been playing around the time of the interview*. Not surprisingly, when asked to draw a video game mental map, some of the players drew the one that immediately came to mind because they had just been playing it. For instance, Guy, who is a casual video game player, drew a "runner" game that he had been playing the day before the interview (although he could not remember its name). However, as shown in Figure 2, most people preferred to draw a game that had more emotional significance for them (aggregating the "video games played a long time," "likes and dislikes," and "nostalgia" categories).

The second reason was *that it was a game that the interviewee had played for a long time*. Drawing it thus underlines the fact that it had particular significance in their experience as a video game player. For example, Patrick drew a map of *CounterStrike* (Figure 3), even if he now plays it less than soccer video games, because he had played it for a long time and had significant social and spatial experiences related to it. He managed

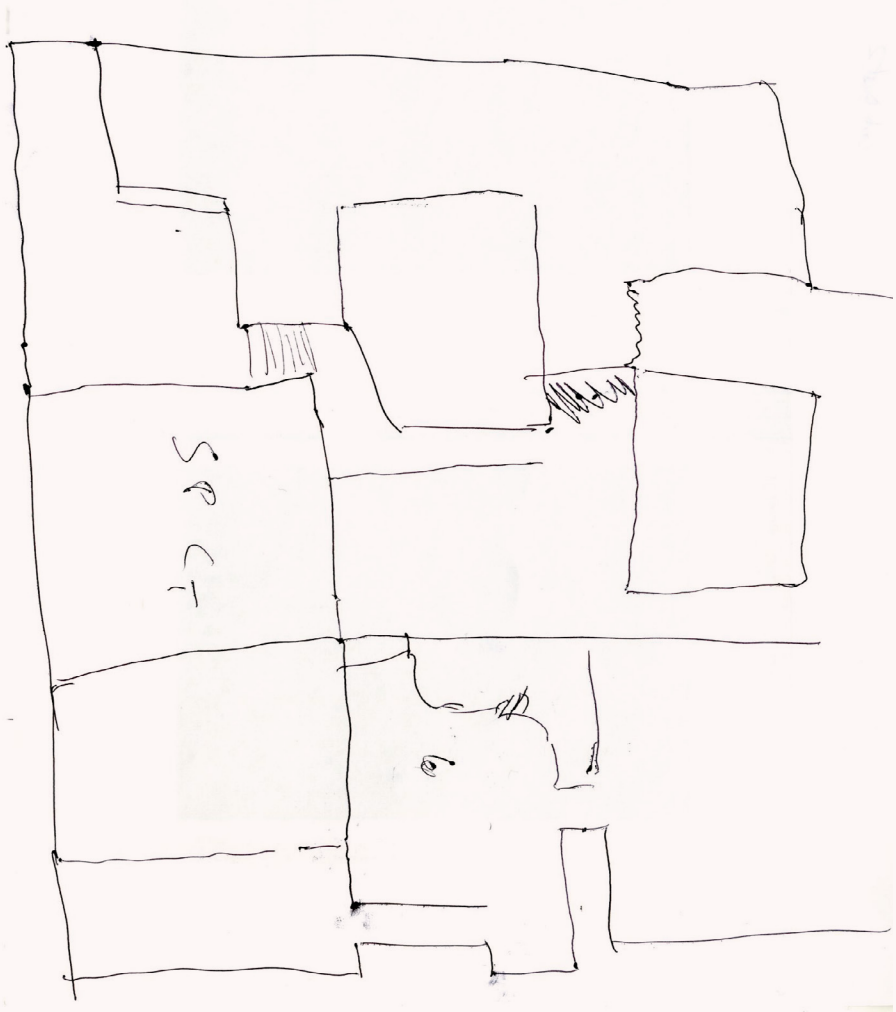

Figure 3. *Patrick chose to draw "Dust2" in* CounterStrike.

his own team and had taken part in several meetings and competitions (sometimes involving more than 50 players) in different cities.

The third motivation was related to *likes and dislikes* of a video game genre, which appeared 10 times out of 38. Of course, most of the players drew games they liked. Some of them chose to draw not one game in particular, but a genre: for example a platform game, a car racing game (see Figure 4), or a strategy game (Figure 5).

The fourth motivation was *nostalgia*. Here again, the video games chosen were those with special significance for the player, not necessarily because of the amount of time spent playing them, but because they were played under very specific circumstances. For example, they were the games played during childhood, or played with brothers or sisters, or with a tournament team, etc. Thus, Céleste decided to draw a video game from the *Legend of Zelda* franchise, because she still had fond memories of playing it when she was a child.

By contrast, the fifth motivation concerned *video games that were played in a very routinized way*. These are the games that people play not because they particularly like them or because they are emotionally attached to them, but because they play them often, and in very specific situations: for example during journeys, or in the evening while watching TV, or while walking the dog, which was the case of Claude. He was not an intensive video game player, but he plays *Solitaire* a lot, not because he particularly likes it (actually, he prefers car racing games), but simply because it fits conveniently in his time-space of video game activity. Thus, video games do not always produce emotions, and they are not always played because they resonate with the player's biography. Nevertheless, the mental maps drawn by our respondents show that the majority of experiences they related had emotional significance.

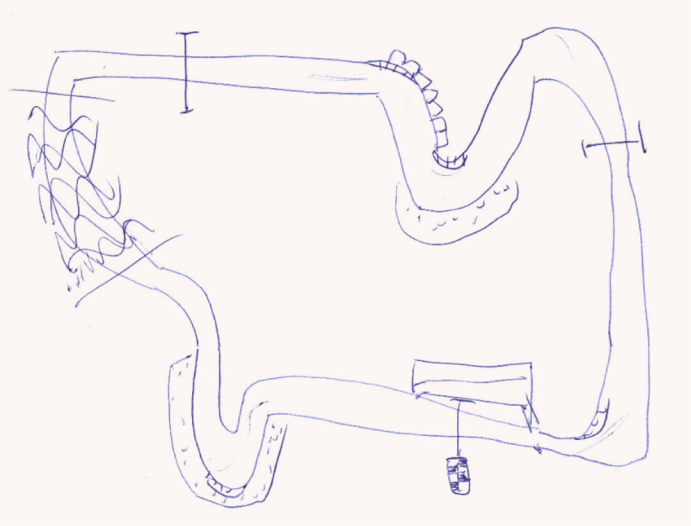

Figure 4. *Lucas likes to play car racing games.*

Figure 5. *Marc's personal taste for strategy games, like* Civilization.

POSITIVE AND NEGATIVE EMOTIONS AT PLAY

A closer look at the emotions produced by playing video games reveals their diversity. Using the video game mental maps and what participants told us about them while drawing, we identified seven different emotional relationships between people and games in our corpus, three positive and four negative. The first is *pleasure*: obviously, people who like video games take pleasure in playing, and when asked, many people (e.g., Dominique and Michel) told us that they could not imagine stopping playing video games in the near future because the games and their related culture were an important part of their leisure and social life. For example, even if Dominique describes himself as a "former" intensive player, he still continues to visit and read specialized websites and magazines, staying informed of releases and news of the industry.

Another emotion linked to pleasure is *joy*, but whereas pleasure describes the activity as a whole (one does or does not like playing video games), joy describes a sense of elation evoked by significant or unique experiences. This is illustrated best by Nelly, who drew a mental map of one particular place in the virtual world of *The Legend of Zelda: Ocarina of Time* (Figure 6). While drawing the main character of the game with a staff in front of a closed door surrounded by pillars and torches, she recalled very precisely the moment during her childhood when she managed to open that particular door she was struggling with: "I found myself stuck in the first room of the dungeon and you had to use a stick to light a torch in order to open the door. I talked about how I found out how to do it all through dinner!" Here, the drawing itself is less important than what Nelly says about it. It could be any character or any door from numerous roleplaying or adventure games. Nevertheless, this mental map had a special meaning for Nelly because it reminded her of a positive emotion she experienced through this game; she even said, "For me, it was really a new world. . . . That's when my life changed." Her statement could make us smile, but we could also take it seriously and acknowledge that playing video games can be an opportunity to experience new worlds, widen cultural horizons, and possibly be the source of rich experiences.

In our context, *nostalgia* is also a positive emotion, in that it allows players to relive intense video game experiences, and may motivate them to continue playing. Thus, Laurence remembered playing Aladdin during childhood: "I used to play it with my sister, otherwise she couldn't finish the game." In her case, playing video games was connected to her relationship with her sibling, and to their shared leisure activities when they were children.

Figure 6. *Nelly struggling to solve a problem in* The Legend of Zelda: Ocarina of Time.

However, the range of emotions and geographical experiences related to video games is not limited to positive ones. Respondents' discourses about the maps they drew also revealed negative emotions, beginning with *fear*. For instance, Céleste told us that she was afraid of spiders, even digital ones: "I'm also scared in Zelda when there are spiders. I jump up, I scream. And I run away. But . . . but I run away screaming. . . . In Zelda, generally I used to play alone, and when all of a sudden they would come out, like that, usually I would jump a good nine feet in the air before fighting." In her case, the emotional experience of fear in a virtual world is seemingly just as strong as what she would have experienced in the physical world. While she described *The Legend of Zelda* as her "fetish game," she was still able to talk about a negative experience she had had many years before, which she probably wouldn't have mentioned during the interview without the use of the video game mental map.

Anxiety is another negative emotion we identified in relation to video game experiences, occurring, for instance, when a player gets lost. This was the case of Yann, a high-school student who told us about his feeling of loneliness and loss in the roleplaying video game *Skyrim*, because the in-game space was too huge and because he struggled with the in-game map: "At the beginning, I didn't know what it pictured, but generally it was the nearest dungeon. But besides that, to find one's way . . . as soon as you move, it spins around. I couldn't understand where I was. I looked for the map every time." Interestingly, he did not produce a mental map of that video game, but chose to draw a different one, with which he had more positive emotions.

Contrary to what advertisements and video game producers tell us, *boredom* can also be quite common. Among our interviewees, many, like Amelie, played some games because they had to (for example to spend time with a friend, brother or sister, etc.) but without enjoying it: "I'm completely lost, I mean, I'm going round in circles in the level. And my character he will . . . he can't do anything because he just keeps going round in circles. Well, it's . . . it's tragic. He's supposed to climb on the roofs, but he always kills himself. And that's it. I can't master it. I don't like it." It confirms the observations of Coavoux and Gerber (2016) that in some cultural activities, sociability comes before taste. Some people do not necessarily play video games

because they like them, but because they want to be with their friends or family.

Finally, *guilt* was also experienced by a couple of our interviewees. For example, Chantal, a housewife with three children, did not like video games very much (unlike her children). As we mentioned earlier, she considered video games as a waste of time, unlike reading books or singing with a choir (leisure activities she enjoyed on a regular basis). But, at the same time, she revealed that she played *Sudoku* on her smartphone every morning for about twenty minutes, after her husband left the house to go to work, and before doing the housework. She explained that that this short video game session was the only time in the day she could take for herself (rather than taking care of the family and their home), but she still did not permit herself to play too long.

VIDEO GAME PLAY: A SYNECDOCHICAL EXPERIENCE?

Finally, our analysis of the structure of the mental maps shows that they can be grouped into two broad families. In the first, the respondents mainly drew specific "operationable" features in the video game space: items, characters, and elements of the game with which the player can interact. Interaction with these items makes the action possible, but they are not themselves necessarily representative of the overall setting, landscape, or story. In the second group, by contrast, the players drew items, characters, or parts of the set that represent larger portions of the game, using a few example elements to demonstrate the whole. Thus, one player drew a monster to symbolize all the enemies the character has to confront; another drew a tree to represent the forest and natural environment (Figure 7).

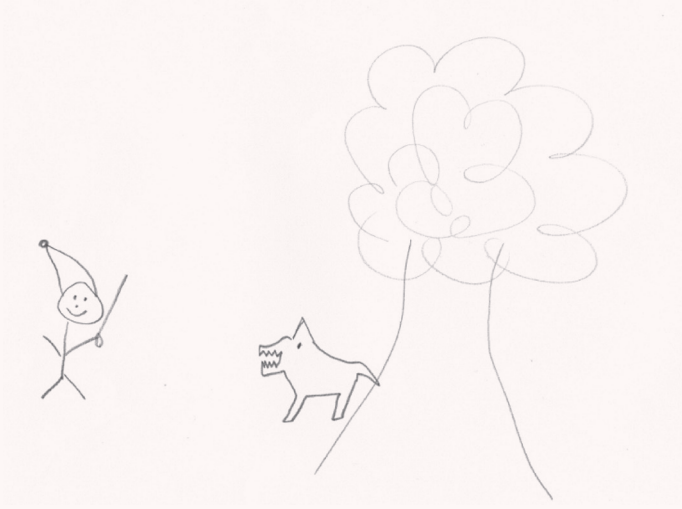

Figure 7. *"I'll draw a tree on the side, to represent the world, so to speak" (Céleste drawing* The Legend of Zelda*).*

In our view, the mental maps of this second category express a "synecdochical" approach. A synecdoche is a figure of speech that allows the whole to be expressed through the part. Thus, a sail seen on the horizon is not just a sail, it is a boat. According to Détrie, the synecdoche involves interpretation, whereby "experience takes precedence over content" (2006, 795). It is because I know that a boat has a sail that I can say that a sail on the horizon indicates the presence of a boat. Hence, the synecdoche engages the speaker to represent the world as they experience it from their own perspective (Détrie 2006, 796). In the case of our participants, these synecdochical maps show how the player experiences virtual space.

The mental map thus gives players the opportunity to express a certain perspective on the video game space, based on their particular experience. Unlike mental maps that highlight the operationable, the synecdochical mental map is an opportunity for the respondent to express emotions, feelings, or judgments about the aesthetic aspect of virtual spaces. They can share their opinions on the quality of the game experience, whether environments are beautiful, poetic, or enchanting, or on the contrary too vast or too oppressive. While the operationable map thus places the video game experience within a utilitarian or pragmatic relationship to virtual space, the synecdochical one places it within an emotional or aesthetic relationship. In the words of Silas, one of our younger respondents, "You can't rely on drawing. It's much more beautiful." Moreover, for respondents who believed that they couldn't draw very well, the synecdochical property of the mental map can have a compensatory function. Céleste, for example, drew only one sketch of a tree instead of drawing a whole forest, claiming that the latter was beyond her drawing skills.

However, it is not always possible to reduce each respondent to a single attitude or a single map category, since some, like Lucas, made mental maps that fall within both of the above-mentioned categories. In those cases, we believe that the players most involved in playing video games navigate more easily from one category to another, and can draw on a greater diversity of geographical experiences of virtual spaces.

VIDEO GAME EXPERIENCES WITHIN BIOGRAPHICAL TRAJECTORIES OF PLAYERS

We aimed to show how mental maps could be a useful tool to encourage people to express emotional experiences linked to their past or present involvement in cultural activities and social relationships related to digital spaces. One limitation of our method is that the mental maps thus produced are not easy to understand without the comments of the people drawing them. In other words, "stories don't come from the map," as Mark Denil puts it (2016, 7). All maps require interpretation, and in our case, we sometimes needed to know which digital space (or which part of it) had been drawn, or even which video game had been chosen, particularly as some of them were not immediately recognizable. As Avry (2012) points out, a mental map does not show space as it is, but space as it is perceived. For instance, Françoise's mental map of the video game *World of Warcraft* can seem very puzzling. This online role-playing game depicts a fantasy world where players explore dungeons, slay monsters, and collect treasures. Françoise decided to draw not the map of the in-game world (or a portion of it), but rather a portrait of a witch, recognizable by her pointy hat and her broom, items associated with witches in folk culture (see Figure 8).

Françoise is a 56 year-old housewife with three children, with whom she likes to play video games. But she particularly likes drawing and painting, and she is very attracted to fantasy worlds and local folk tales, in which she finds inspiration for her artwork. She always likes to play a witch "avatar" whenever possible, including in *World of Warcraft*, because the game provides a narrative background (a folk tale) which matches her tastes and can be a source of creativity. Thus, her portrait of a witch is as much a self-portrait of her avatar in *World of Warcraft* as a way of encapsulating her enjoyment of video games and of drawing fantasy figures, which gives the drawing its synechdochical property. It is a mental map not of one game in particular but of Françoise's "interior world," made up of emotions (attachment to her in-game avatar), culture (fantasy books, folk tales), tastes (drawing, painting, playing video games), and social activities (playing with her sons and friends).

This example shows that, like all other activities, digital activities and spaces can be enmeshed in what the anthropologist Amos Rapoport calls "systems of activities" (1990). That is, that video games hold meaning for individuals in relation to other activities, whether professional or leisure. Thus, Michel is a programmer and draws the game he would like to create, Emma is an architect and draws a city builder game, Etienne plays basketball and draws a basketball game, and Mika likes *Solitaire* and sometimes plays with traditional cards (in addition to digital ones). Playing video games thus forms a "system" with other activities and contributes to the production of meaningful experiences, and to situating the player both socially and emotionally. In this way, the in-game space and the space of the player conjointly define the place of each singular video game experience in the player's biography and practices. More generally, one way to capture the domestication of a digital technology (Berker et al. 2006) could be to observe its interpenetration with other more established social or cultural practices.

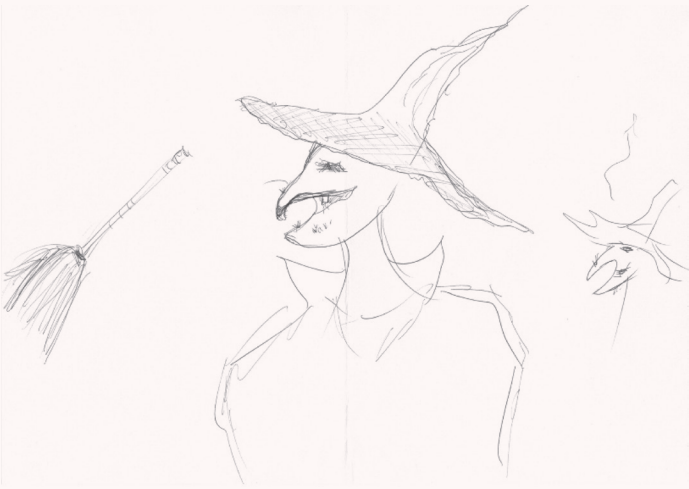

Figure 8. *How Françoise depicts herself in* World of Warcraft.

Also, as seen above, playing video games is an experience that can be emotional (producing nostalgia, fear, pleasure, boredom, etc.) under certain conditions linked to the socio-spatial context, but that no game is emotional in itself. Here we fully agree with Bareither's (2017) ethnographic analysis, in which he clearly shows that the pleasure resulting from playing violent games is not inherent to the device or the game itself. It is a production of meaning (guilt or, on the contrary, the pleasure of transgression) partly linked to the game environment, whether online through a video channel or side-by-side with a friend in the same room. The emotion arises not only from the game device but also from the environment of its use, the space of the player. One can thus assume that the same game will not produce the same emotions for each individual, but that they will depend on the time-space in

which it is played. An analogy can be made here with the movie experience, which varies not only from one individual to another but also according to the expectations of the same movie watched in different contexts. Thus, for Jullier, a "good movie" is one that has "fulfilled its role," which varies in different situations (2012, 39). This also shows the importance of going beyond the basic analysis of affects and of looking at the emotions an experience produces, along with what they reveal about the place of video games in systems of activities, social relations, and personal or collective experiences.

Thus, in one-third of the cases studied in our work, the geographical experiences described are constitutive of "player trajectories" (Coavoux 2008), showing that the latter are based on both capitalization of experiences in certain video game genres, and on opportunities offered by particular occasions or events in the players' lives. As pointed out by Hockey, Penhale, and Sibley (2007), objects, images, and sounds of the past are not simple stimuli; they are constitutive of the social time and space of the present. Thus, memory, nostalgia, and even regret or frustration, were common themes in the discourse of our interviewees. This could be a bias of the survey, as the interviews encouraged a retrospective account of players' backgrounds, sometimes leading them to choose and draw games that had been discussed earlier.

However, a dozen other cases also show that these video game experiences involve sociability through play, whether with family members or friends. Coavoux and Gerber (2016) highlighted the importance of this aspect in the way the activity is shared and constructed, which cannot always be seen solely in terms of taste or affinity for a particular game genre. This is confirmed by our findings, namely that people can enjoy playing a video game not only for its intrinsic qualities, but also because it is an opportunity to spend a pleasant evening with people they like. This was the case for Yann, a 19-year-old high-school student, who played or had played games (*Dofus*, *League of Legends*) because his friends played, while his personal tastes (especially for manga and Japanese roleplaying games) would lead him to prefer other types of games, which he played on his mobile phone. Analysis of the features (Krzywinska 2015) or the affective design (Ash 2012) of video games is clearly essential to understanding the techniques used by developers and publishers to design objects producing affect, in order to capture the attention of their public and to boost consumption. But at the same time, as pointed out by Nemorin (2017), affects should no longer be considered as simple expressions of individual emotion; their meaning is co-constructed by the individual and the social context in which they take place. In the case of Yann, pleasure, an emotion aroused by video games, was not a result of these player/machine affects and interactions; for him, video games were only a pretext for a shared social experience with his friends.

CONCLUSION

The aim of this study was to investigate geographical experiences of video games, by focusing on the emotions produced in relation to playing them. To that end, we used mental maps of digital spaces to get our respondents to describe their emotional relationship with certain video games, and to place those in the more general context of their other activities. Drawing maps was a way to make people talk about the uniqueness of their experience, which means that the discourse related to the mental map was as important in our analysis as the mental map itself. The fact that individuals agreed to draw a mental map of a video game reflects their high involvement in gaming (even for respondents who now spend less time playing). Thus, the geographical experience of video games here is the product of the convergence between a certain type of commitment to playing video games and certain categories of games.

Our study has three main results. First, it demonstrated that spatial experiences of video game play are diverse. This is an important contribution to the field of video game studies, which until now mainly focused, as seen in the first part of this article, on the analysis of human/machine interactions and gameplay. We invite others to better take into account the spatial contexts of use, which do participate in the emotional reception and the quality of the spatial experience of a video game. Everything doesn't happen on the screen, and what is lived within the game also depends on what is lived in the physical space of the player. Thus, the geography of video games should

not be limited to content analysis (which places and spaces are represented in video games and how they are represented) but should also include the analysis of the different spaces of play, whether physical, digital, or hybrid, looking at them in terms of continuity and interpenetration (de Souza e Silva 2006; Graham and Zook 2013) rather than in terms of discontinuity. Further investigation could be conducted to document these relations between the in-game space and the space of the player and how they contribute conjointly to produce singular spatial experiences (Stockburger 2006).

Secondly, our study highlights the quality and diversity of emotions produced by video game practices, underlining their individual and collective dimensions. Digital spaces can produce strong emotions, seemingly as much as physical spaces. These emotions, and the geographical experience that arouses them, contribute to the individualization of digital practices and their inscription into individuals' biographical trajectories, sociability, taste, and activities. At the same time, they are embedded into collective relationships to video game culture and practices, be it with a group of friends with whom one shares certain practices, or a generation of people who grew up with a video game culture and have appropriated some of its icons (as we can see with the numerous mental maps of major characters from video game history, such as Mario or Sonic). Our study shows that the emotions associated with video games can lead to different forms of appropriation of space (embellishing one's home with video game merchandise), sociability (creating or maintaining relationships with friends), or other cultural practices (drawing). In other words, video games aren't emotional in themselves, but there are significant video game experiences that contribute to the structuration of individuals.

Thirdly, the experience of video game spaces is not only about success, performance, or mastering. On the contrary, the spatial experiences described by our interviewees include contemplative experiences, "just-for-fun" exploration (like Nelly, for whom *The Legend of Zelda* video game series stood out of the crowd because it made possible this kind of playing style), and even sometimes a sense of disorientation or loneliness (like Yann with the roleplaying video game *Skyrim,* mentioned above). There again is an invitation to go beyond content and gameplay analysis which assume that players' behavior is determined by the gameplay and the device, and to anchor the study of digital worlds in empirical, comprehensive studies of their users (Shaw 2010), beyond the scope of MMORPGs and digital worlds such as *Second Life*, on which, until recently, most of the research has been focused (Coavoux, Boutet, and Zabban 2016).

Of course, our work doesn't address larger concerns about the risks of everyday life being dehumanized by the digital world, or about its control by digital governmentality (Gardin, Didier and Quentin 2016). But it also helps put these arguments into perspective by exposing the great diversity of actual digital practices of users. In the end, for the people we met, video games produce emotions and geographical experiences, but probably no more or less than other activities. Our analysis highlights the potential diversity of the geographical experiences of virtual worlds, varying between individuals, their practices, and their biographical trajectories, even if this raises the issue of digital divide. In a world increasingly governed by numbers and technology, these diverse experiences and player trajectories show that there is still room for individual agency in regards to what video games and game publishers expect of users; the players can, to a certain extent, produce their own meaning for their digital activities.

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PEER-REVIEWED ARTICLE

Perform the Map: Using Map-Score Experiences to Write and Reenact Places

Élise Olmedo
Aix-Marseille Université
elise.olmedo@gmail.com

Mathilde Christmann
Independent Researcher
mathilde.christmann@yahoo.fr

In this article, we aim to show the implementation of a kind of mapping that combines spatial experience, sensitive cartography, and choreographic scores. We explore this approach through an experiment led in the city of Washington, DC, in and around the Franklin Delano Roosevelt (FDR) Memorial, in July 2017. Showing how research and creation can support each other, such an experiment locates the map in the sensory and emotional side of cartographic practices, which leads us to reconsider how the spatialized and temporalized language of an experience might be reconstructed with drawings and writings. In other words, the map-score methodology allows us to observe how the experience of a place may be recorded during fieldwork (memory, drawings, notebooks) to create an archive that extends and enhances our knowledge of sensory perceptions, emotions, and points of view. This kind of experiment allows another regime of reflective cartographic practice, one that reconsiders its spatial and temporal dimensions and its modes of creation.

KEYWORDS: mapping experiment; sensibility mapping; performance; time-maps; map-score; post-representational theories; research-creation; art; geography; landscape

INTRODUCTION

Historically, there has been a lack of attention to subjective experience in map production, and the important role that sensations and emotions can play in the representation of spaces is frequently underestimated. Sensory and emotional maps can offer crucial expressions of what people perceive and how they feel when they experience places (Pink 2009; Nold 2009; O'Rourke 2013; Rekacewicz and Tratnjek 2016; Kitchin, Gleeson, and Dodge 2013). Such maps link to a tradition of work that has long emphasized awareness of individual knowledge of urban places and how these knowledges are expressed, beginning with research from urban psychology and with Lynch's *The Image of the City* (1960). While sensory cartography can offer us a detailed understanding of individuals' spatial practices, it is also important to consider how it could also enrich the *production* of maps, in terms of understanding the forms, constructions, and relations of places represented on the map.

In this article, we will explore the domain of *cartographie sensible* (in English, "sensibility mapping"), a research-creation approach developed in France (Olmedo 2015) that combines urban walking itineraries with a "processual approach" of hand-drawn maps and oral narratives. In particular, we will present the results of an experiment conducted at the Franklin Delano Roosevelt (FDR) Memorial in Washington, DC, in which we used a hybrid art-science approach that blends creation and research through an exploratory protocol of experimentation and performance. We employed a protocol that we refer to as "map-scores" (Christmann and Olmedo 2016), in which participants create hand-drawn "cartographic traces" that represent their itineraries through the environment, their sensory experiences, and their actions, intentional and unintentional, related to those experiences. Our method was inspired by a creative process known as RSVP Cycles, developed by Lawrence and Anna Halprin, which we

describe in more detail below (Hirsch 2016). The map-score methodology allows us to observe how someone records their experience of a place during fieldwork, and creates an archive that extends and enhances our knowledge of sensory perceptions, emotions, and points of view about spatial experiences in place.

Although participants' cartographic traces were a product of this experiment, the mapping process itself was just as important, situating our project within a post-representational cartographic framework (Kitchin 2010; Rossetto 2015; Caquard 2014). Our "map-score" experiments focus not on maps as end products, but on the immediate experience of places, emphasizing the importance of the body in exploring, mapping, and gaining a sensorial understanding of a place. They are highly inspired by the world of performance, particularly dance and relational art (Bourriaud 1998; Louppe 2004; O'Rourke 2013; Wood 2010), and we believe the method could contribute to developing new scientific ways of mapping. This project also references heterogeneous mapping methods, such as "deep mapping" (Bodenhamer 2015) and the emotional cartographic apparatus developed by artists such as Christian Nold to map physical arousal (Nold 2009). In France, artist-cartographers such as Mathias Poisson, Amandine Maria, and Till Roesken are currently revisiting mapping practices that use the body as a subjective tool to understand and represent places. The concept of "sensibility mapping" presented throughout this article offers a new way of understanding geography, by combining choreographical walking itineraries with oral narratives and hand-drawn maps.

The experiment presented in this paper, entitled "Exploration of the Sensibility to the Environment: Maps and Scores," merged cartographic and choreographic tools, including scores. The experiment's 27 participants (many of whom were cartographers) were drawn from the 2017 ICC "Maps & Emotions" workshop. These participants walked blindfolded around the FDR Memorial, and then documented their remembered experiences in a map-score. Their creative cartographies were constructed by hand, without the aid of digital technologies, and were the products of collaboration and connection between participants. By approaching the map as a performance, we seek to question the dualism between map and experience.

RESEARCH AND CREATION CROSSOVERS: MAPPING THE MEMORY OF EXPERIENCE

THE MAP AS AN ACT

Lawrence Halprin, the landscape architect who designed the FDR Memorial, often sought new methodological approaches on which to build his urban planning projects. His wife, Anna Halprin, was an innovator in the field of postmodern dance for forty years, recognized for experimenting with new choreographic tools (Ross 2007; Merriman 2014; Hirsch 2016; Perrin, forthcoming). Together they invented the "Take Part Workshops," which combined bodily actions and graphical productions in a quest to discover a place with all its sensibility aspects—whether it was a square for Anna's group to dance in, or the streets of a little American town that Lawrence had committed to design.

Together, the Halprins developed a practice-based theory called RSVP Cycles, which summarized all the steps of their creative process and that is transposable to all kinds of creative activities that draw upon experience.

> The RSVP cycles is a balanced scheme in which all the parts are mutually related and constantly interacting. It functions best when all parts are operating. Its purpose is to make procedures and processes visible, to allow for constant communication and ultimately to ensure the diversity and pluralism necessary for change and growth. (Halprin 1969, 5)

Each letter of the RSVP theory represents an important step in the process. The letter "R" stands for *Resources*: a project must gather all kinds of resources, documents, people, field notes, and so much more, especially when we take the theory outside of a landscape design context. The letter "S" represents *Scores*, the core of the Halprins' theory. Each person's unique experience of a place could be a score—a set of movements and actions and sensory perceptions—and each participant in a project is invited to express their scores through text and/or drawings. These

records become planning documents for future actions, just like a written musical score. The letter "V" represents *Valuaction* (a contraction of "Values" and "Actions"), a step of reflection on how the project gets enacted. Valuaction renews the process at every stage because it combines the aims of the group and the actions generated by the scores. Lastly, the letter "P" is for *Performance*, which is the execution of the score, such as an artistic performance, dance, or musical composition. The performance is not an end in itself, and in this way, the four letters represent a cycle of interchangeable and re-orderable phases.

Our map-score methodology is inspired by the Halprins' RSVP theory. Creating a map-score involves the combination of choreographies derived from personal experiences (a score) and geographical representation (a map). A participant draws symbols that graphically represent their personal score, alongside verbal descriptions of their actions and sensations (e.g., walking in a given area, touching a tree, listening to sounds). One person can perform a map-score, and then, in turn, record their own map-score that describes their performance/experience of another's original map-score. Our use of the Halprins' practice-based theory as a research methodology broadens the conception of documents that can be performed and reused during and after the design of a site, according to the theory of the RSVP cycle. Scores can be used to keep a record of the research process as well as to investigate places or even communicate about them, and can also play a role in planning a spatial experience. While designing the FDR Memorial in 1975 (Rainey 2012; Halprin 1997), Lawrence Halprin applied maps and scores to anticipate and imagine the site visitor's sensorial experience in the future monument, considering their movement and sounds that they might hear (Figure 1).

The protocol that we tested in Washington, DC owes a lot to the experiments that the Halprins used to lead, planning projects several decades ago in various places. Very few studies have focused on the *process* of performance drawing in landscape planning (Tiberghien 2007; van Dooren 2017), though landscape architects and choreographers, such as Lawrence and Anna Halprin, have used graphical tools in their workshops for many years. The aim of this experiment, then, is to introduce this little-known theoretical framework and practice, based on the combination of drawing and performance, to the field of cartography. Our notion of a mapping performance, by which we mean spatial and temporal movement, reinvigorates the idea of self-expression when developing and describing a conception of an environment.

Figure 1. *Left: "Motation Scores for FDR Experience," Lawrence Halprin, July 1975. A score for the Franklin Delano Roosevelt Memorial. Credit: University of Pennsylvania Press, Philadelphia. Right: Visitors walking through the FDR Memorial. Credit: M. Christmann, 2013.*

THE MAP-SCORE AS A NAVIGATION TOOL

The map-score experiment that we led during the Maps and Emotions workshop thrived on artistic-scientific crossovers in mapping (Wood 2006), more specifically between choreographic and cartographic approaches to the environment in the field. This experiment investigated the southeast portion of the National Mall, a famous park in DC that is known for its many American memorials—including the FDR Memorial, designed by Lawrence Halprin. Our experiment offers an original conception of being within a space, one that is between the drawing of planned actions which build the intention of experience (scores) and the drawing of that experience (maps), made possible by combining urban walks and writing. Our protocol was borrowed from the different skills that the Halprins developed, with a unique blend of theory and practice that follows Lawrence Halprin's original study of the relationships between feelings, drawing, and walking. From the 1970s to the end of the 1990s, he observed that in most of the projects he and his wife led, participants built a collective, subjective language relating to their environment (Halprin, Hester, and Mullen 1999)[1]. Anna and Lawrence Halprin's archive includes writings, sketches, and maps of their performed experiences. Using their collection as source material, we aimed to explore the possibilities of their artistic-choreographic processes in the social sciences, resulting in merging of landscape planning, dance, and sensibility mapping.

This experiment tested the map-score research-creation tool to produce maps, based on the work of Mathilde Christmann, Mathias Poisson, and Élise Olmedo. These map-scores capture the participants' sense of orientation or disorientation, understood as their internal feelings of navigation and spatial movement (O'Rourke 2013), and show landmarks visible during the conscious experience of a walk. Derived from the experience of the city, this experiment sets up the mapping of human actions as a performative way to produce sensorial and emotional representations of places. The act of mapping materializes an itinerary. The work we present in this article also contributes to the exploration of epistemological questions about a hodological (derived from the Greek *hodos*, meaning "path") mode of map construction (Tiberghien 2007). In her 2013 book *Walking and Mapping*, Karen O' Rourke explains how the practice of walking and mapping offers "a way to locate ourselves in the world, allowing us to make sense of our situation and to act on it" (2013, 18). She also describes how it served as an artistic medium for the work of Guy Debord and other psycho-geographers. In our project, maps are produced through experiments, grounded by itineraries. It is intended to explore new ways of collecting and mapping the emotions and spatial sensations experienced while walking, and to revisit one aspect of cognitive mapping through reintroducing subjective itinerary methods to cartography (O'Rourke 2013). Unlike stand-alone maps, performative map-scores, produced by participants right after their walk, depend on context. Relying on short-term memories, these records of walking experiences, in a sense, reactivate the conscious and unconscious (or pre-conscious) sensations of places, and can be questioned by researchers and participants together. This process, in which a participant could literally write and re-enact their relationship to an environment, leads us to question the presence and involvement of the participant in the collaborative process, and to reconsider the place of citizen in the conception of urban projects.

THE MAP-SCORE EXPERIMENT

Our experiment was mainly focused on the complex link between an action—wandering through a new place while concentrating on sensations and emotions—and its graphical interpretation, provided by memory. What does the product of the graphical interpretation tell us about a participant's bodily experiences? How is memory transformed into a representation of movement in the graphical output, and what does it say about the experiment itself? To answer these questions, we implemented a protocol for this workshop that drew upon other experiments we have led over the past several years,[2] and which was adapted to the spatial context and the specific aim of this workshop.

1. In Halprin's approach, being sensitive to environments was essential. He committed himself to ecological and holistic approaches, and developed his work in the context of the Californian hippie movement, in the 1960s and 1970s. His productions, scores, maps, and projects were always located in situ. His extensive vision of the "environment" in which we live included all of the living beings around us, which pushed him to be fascinated by the movement present in every shape and form.

2. Our team has been working together for many years and has developed both theoretical (Christmann and Olmedo 2016) and practical experiments. For example, in 2016 we conducted an experiment with the "Writing Sensibility to Environments: Wandering Laboratory of Research-creation" research group, led by Aline Jaulin and Élise Olmedo, to promote interdisciplinary collaboration between artists and researchers. We also worked in 2018 with the "Urban Pedestrian Mobilities" group, directed by Jérôme Monnet and Hélène Charreire of Paris East University.

Figure 2. *Left: Participants during the silent walk activity. Right: Participants creating individual maps of their experience. Credit: Julia Mia Stirnemann.*

Participants in our experiment were attendees of the 2017 Maps and Emotions workshop in DC. The experiment was conducted in three progressive stages over two hours, in and around the area of the FDR Memorial. Each stage was composed of two primary activities: (1) a short, silent walk conducted in pairs, with the aim of silently exploring the environment and focusing on the senses without speaking; and (2) a graphical transcription of the walk, through writing a map-score (Figure 2). The first and the second stages of the experiment were based on the artistic practice of Mathias Poisson and Alain Michard and the performance artwork they created entitled "Promenades Blanches" ("White Walks"; Poisson and Michard 2018). In this approach, one person in each pair was blindfolded (the "guided") and the other guided them (the "guide"). The guide took the arm of the blindfolded person during the walk, following a path that was designed previously by us to offer a sensory experience at the site. In the second stage, the members of the pair exchanged their roles and repeated the process. The two roles have equal importance: each must be aware of the sensations, emotions, and feelings that their walk can provide. These first two stages were intended to familiarize participants with the map-score protocol. Each walk took about ten minutes to complete, with the first going from the Jefferson Memorial to the George Mason Memorial and the second from the George Mason Memorial to the FDR Memorial. After each guide/guided walk, each participant took a few moments to graphically transcribe their experience, producing a map-score. This map-score consisted of a tracing of their recollection of the path they followed, along with

Figure 3. *Collective discussion after the first stage, at the George Mason Memorial. Credit: Mark Denil.*

the emotions and sensations they experienced at different moments during the walk. Finally, there was a period of time for pairs to share their outcomes with the group, a reflexive and collective time of exchange during the process (Figure 3).

The third stage (Figure 4), conducted inside the FDR Memorial, asked each pair of participants to create a map-score to give to another pair to perform, with the aim of designing a sensory walk in the FDR Memorial. Before they began the third stage, we briefed the teams on a protocol to follow:

1. Chose two or three actions (e.g., climbing, running, etc.) inspired by the previous walks, and the

current place, and decide on an order in which to do these actions. You can add timing elements.

2. Follow your proposed path through a guide-guided walk, following the actions and time values in whatever part of this space seems attractive to you for each action.

3. Write and draw a 5-minute map-score of what you have performed in order to allow other people to perform it on their own. Link the place, time and actions in the graphic map-score to propose a sensory walk to another team.

4. Perform another team's map-score.

RESULTS OF THE PARTICIPATORY EMOTIONAL METHOD

MEMORIES IN MAP-SCORE: BUILDING REFLEXIVE EXPERIENCE PROCESSES

Lawrence Halprin tried to figure out the shape of the process of building a score for an environment, and how time was seen in the process. According to the theory of RSVP Cycles, the process is constituted from written documents, visible traces located in time, and immaterial moments of experience that have no equivalent in the "writing" world. We are able to look back and remember the process thanks to these documents. Looking at the map-scores drawn by one of the participants, Travis, shows how some participants developed their own process to draw upon their memories of the environment (Figure 5). Though Travis acted as a guide during the first stage and thus had his eyes open during the experience, he felt compelled to first draw a map-score with his eyes closed, before drawing one with his eyes open. Travis explained that this choice let him be closer to his feelings while drawing the path and the environmental characteristics of the space. The second map is clearly influenced by the first, and also features a clearer representation: elements are no longer superimposed, and different symbols depict the succession of environments along the path (including the Tidal Basin, a field, the Potomac River, and Interstate 395). Both maps show the process of how attention becomes immediate memory. During the experiment, everyone is aware that they are participating in an experiment

Figure 4. *Drawing and discussion after the third stage, at the FDR Memorial. Credit: Élise Olmedo.*

and acts accordingly: participants walk around the area together as a group, focused together on the experiment. Participants' attention and their memories are very active during the walk if they know they will need to create a graphical representation later. But Travis's mappings also show how memories formed during the walking/feeling phase evolve when drawing a map-score. Our experiment's two phases form a cycle that links the senses with an immediate tracing of memory of an experience.

More than 60 map-scores were produced during the experiment. After each walk, participants were instructed to draw a line that started at the point of departure and ended at the point of arrival. This line could be enriched with representations of whatever actions, sensations, and feelings regarding the environment that the participant could remember from the walk. No specific way to "note" these additions was prescribed, and both text and illustrations were permitted. This creative freedom produced very

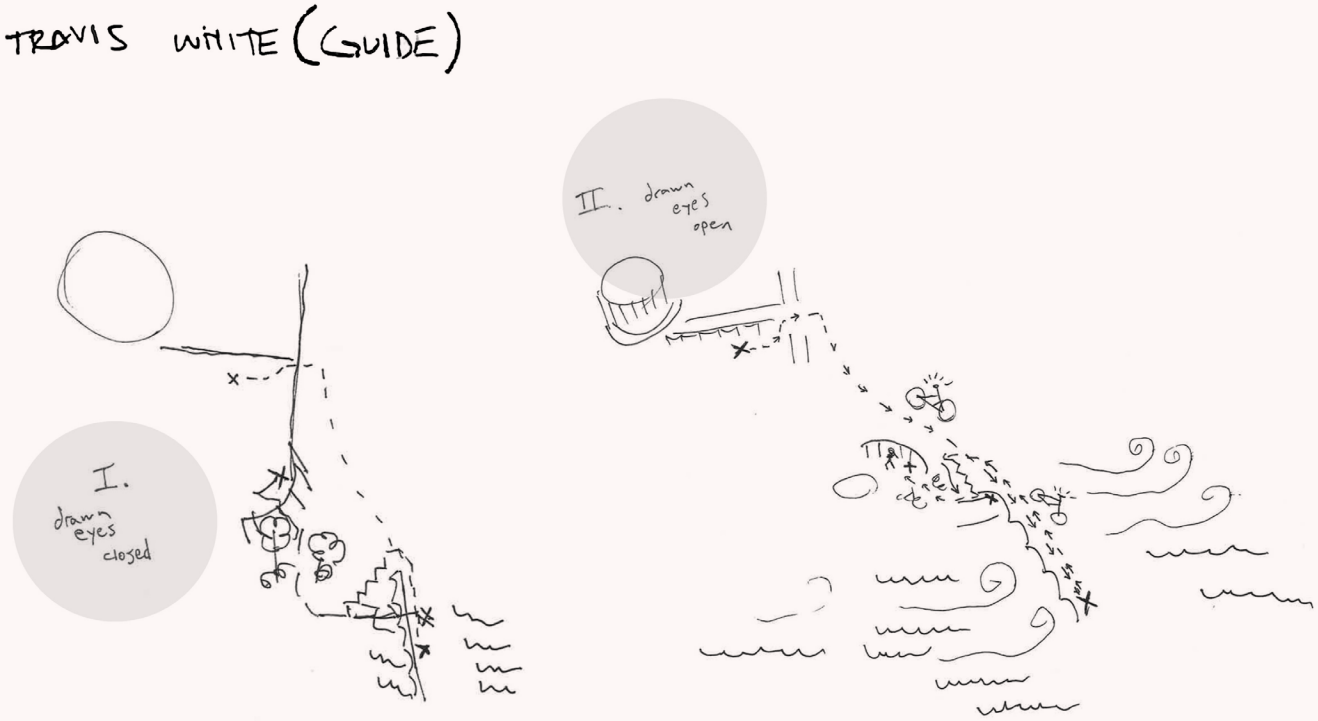

Figure 5. *Travis's first map-score, of his experience walking from the Jefferson Memorial to the George Mason Memorial. Annotations added by the authors.*

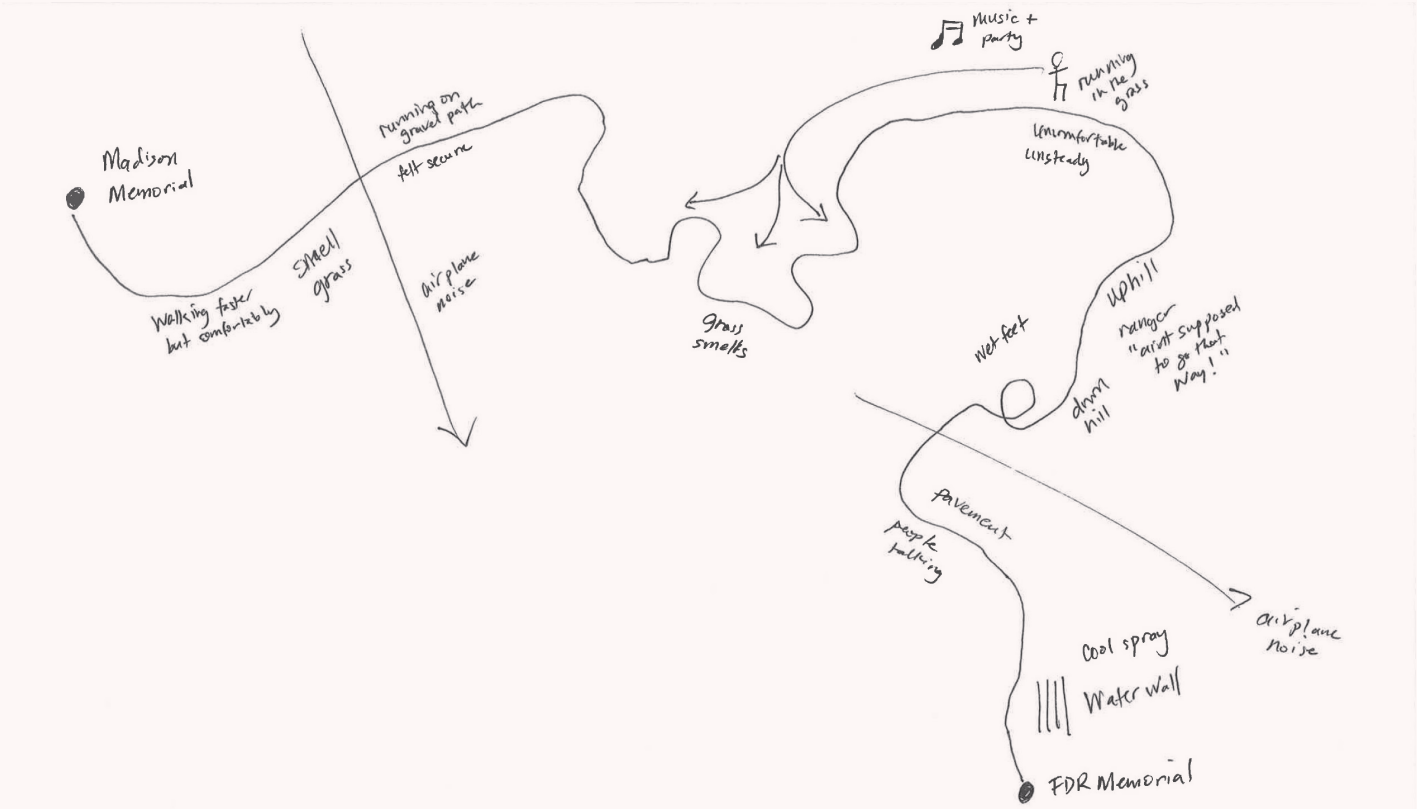

Figure 6. *Amy's first map-score, of the experience from the Jefferson Memorial to the George Mason Memorial.*

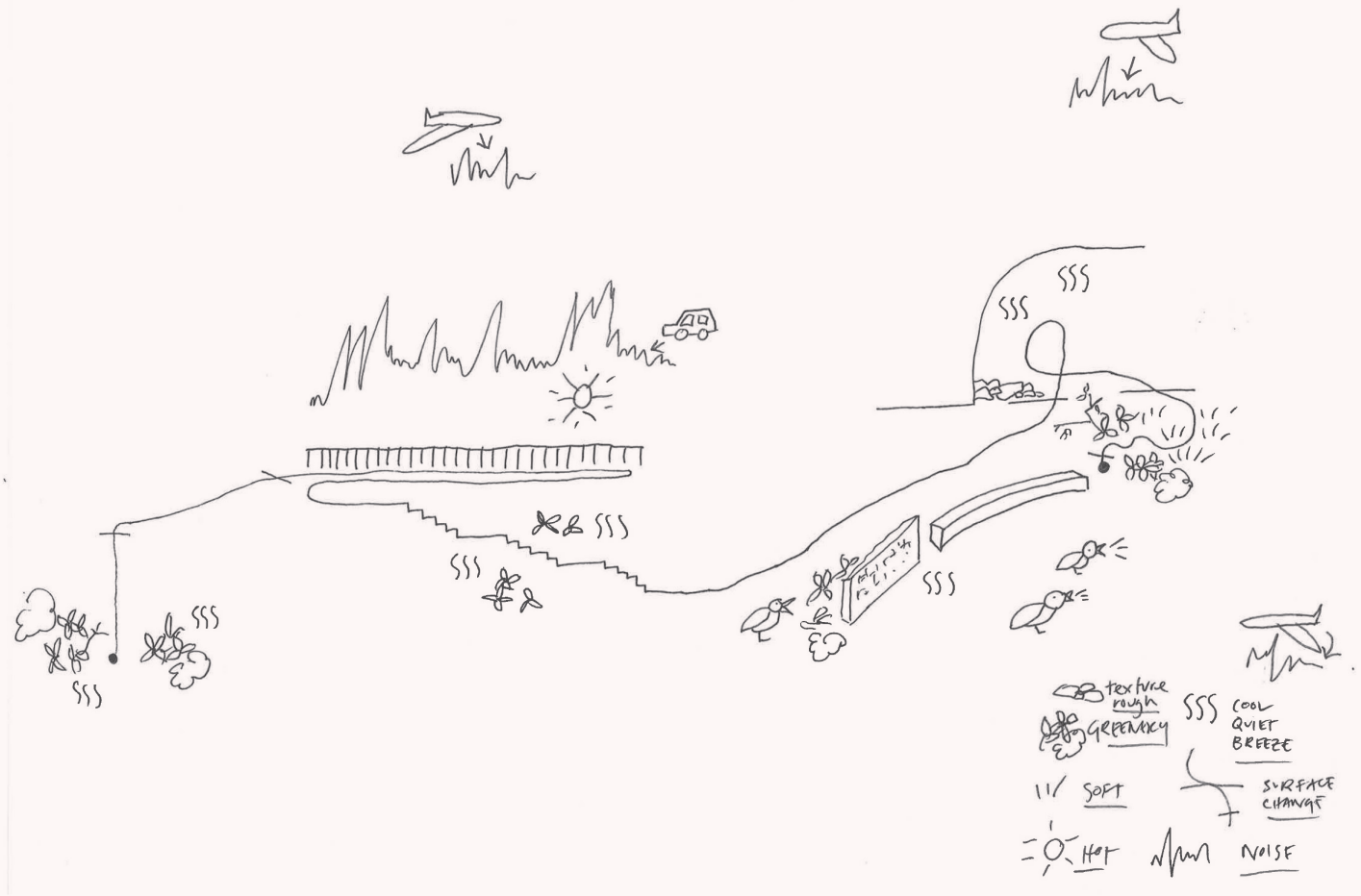

Figure 7. *Joanna's first map-score, of the experience from the Jefferson Memorial to the George Mason Memorial.*

different results and processes, from precise drawings to enigmatic ones, revealing the variety of ways participants conceived of the surroundings and spatial affect.

Some people focused strictly on their itinerary, drawing each curve from memory as accurately as possible in order to facilitate the comprehension by the other participants. The map-score traced by Amy in Figure 6, made while blindfolded, reflects the way she felt about her sense of orientation and surroundings, according to the different senses she perceived (odor and touch). She expressed her directional experience using her geographical and cartographical skills. In their quest to be as "cartographic" as possible, some people even added a legend to their path, as Joanna did (Figure 7). Her legend shows the many sensations she experienced in the environment: hot, soft, greenery, noise, and more.

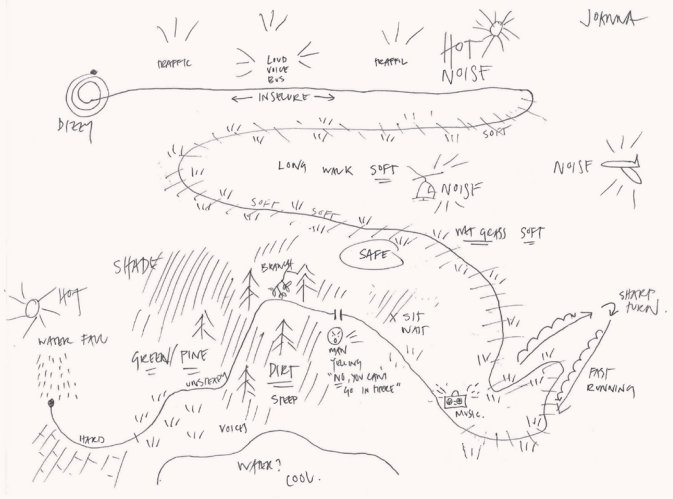

Figure 8. *Joanna's second map-score, from the George Mason Memorial to the FDR Memorial.*

However, after being blindfolded in her next journey, Joanna abandoned the use of a legend for her second map-score (Figure 8). Instead, she chose to express her experiences on the map by writing the same descriptive words, such as "soft," "noise," or "green," directly along her path. The line of the path itself is also enhanced with

small lines that create a texture for representing soft or rough surfaces. This second map-score reflects a deeper immersion in the environment: each kind of material encountered during the walk was represented in much more detail and at precise locations along the path. Here memory plays an important role. Without the sense of sight—which for most people is the most commonly used sense—participants cannot use visual landmarks to recall the position of their experiences. Instead, they must use non-visual points of references. The concordance in time and space between different sensations and emotions (from various sounds to the feeling of the shade and the sun) must be determined by their memory of their body's position along the itinerary. Choosing to mix words and graphical symbols on the path more directly evokes personal experience—in contrast to the established cartographic legend—and can also be used to attenuate or exacerbate the boundaries between the different sensations experienced during the walk. The map communicates the fact that sensations interact with each other. Sometimes they are present together, such as in Joanna's map, which shows the co-presence of light and sound perception (noises are represented in the same way as shade). Other times a participant's attention could be more focused on one sensation or another.

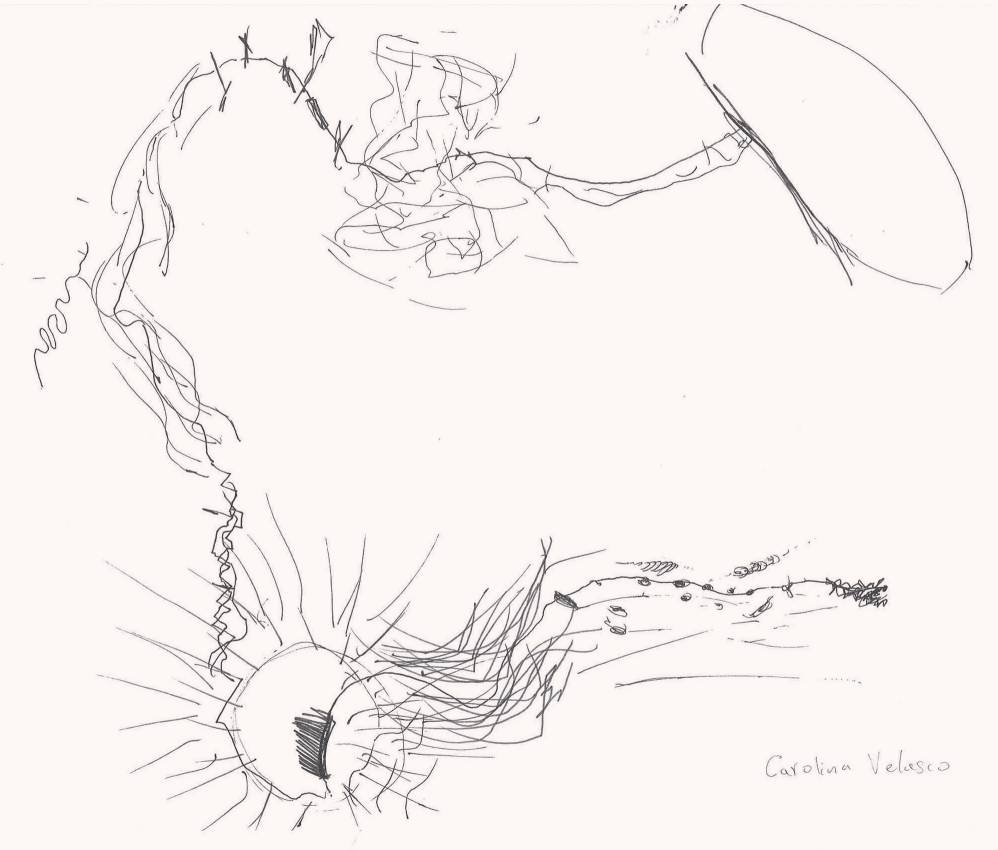

Figure 9. *Carolina's first map-score, from the Jefferson Memorial to the George Mason Memorial.*

THE INSTABILITY OF SENSING

Some participants drew very abstract paths that were more artistically expressive than a simple line proceeding from departure to arrival. These more expressive paths bring to mind the anthropological "route" line described by Tim Ingold in *Lines: a Brief History* (2007) or Michel de Certeau (1984). Ingold considers the line to be an expression of human beings, a medium of sensibility to express their realities. In Figure 9, the line describes the path followed by Carolina from her point of view, using a personal sense of orientation, informed by her own feelings and perceptions. Her drawing shows a curious path made of many of lines, mostly with curved and serpentine textures. Carolina was guided during this walk and here, one can see the fuzziness that occurs as all her remaining senses are mixed together: the use of textures without any words renders the map-score very expressive. Moments of rest (for example, at the beginning of the walk, seen on the lower right) as well as very energetic moments (the sunburst-looking area at the bottom, which probably corresponds to the passage up to the highway) can be identified. Light is also represented on this map because her eyes could perceive lightness and darkness through the blindfold. Although expressive of her emotions, Carolina's map-score shows neither where the beginning nor the end of the walk is.

Carolina and Cristina were paired together. It is interesting to note that Cristina, who walked with her eyes open, drew another kind of very abstract map-score for the same

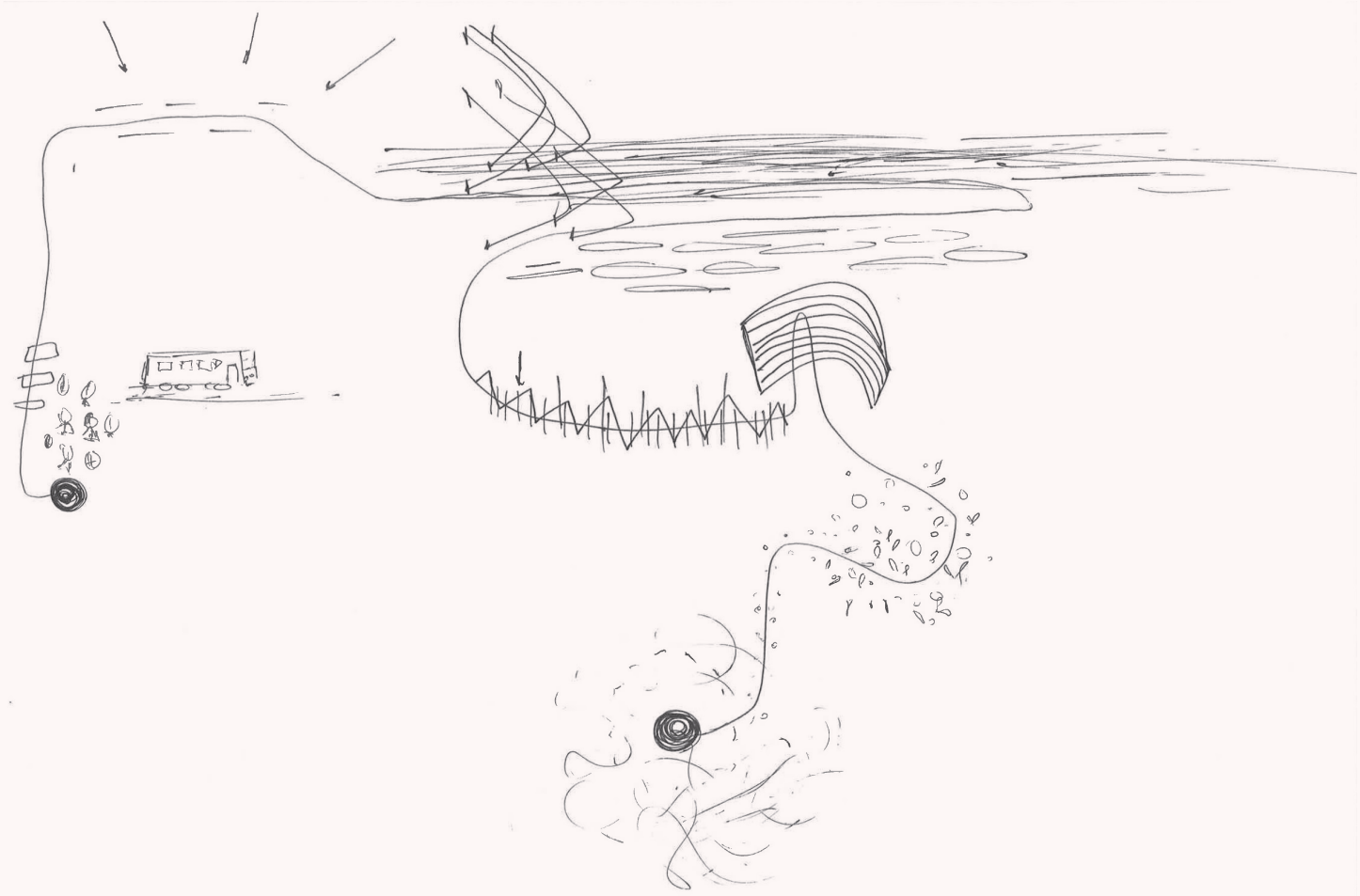

Figure 10. *Cristina's first map-score, from the Jefferson Memorial to the George Mason Memorial.*

path (Figure 10)[3]. Here again, a linear path enriched with more or less straight lines of intensity, was considered sufficient to convey her perceptions. Although Cristina could see, she drew a map-score that seems to be related to the general state of energy that she felt at different times during the walk.

FROM THE INTERPRETER TO THE COMPOSER: USING MAP-SCORES FOR A COLLECTIVE PERFORMANCE

The third map-score drawn by Carolina and Cristina consisted of two documents (Figure 11), and reflects their openness to the environment that was chosen for the experience, the FDR Memorial. This map-score uses elements that are present at the site of the memorial: some trees, a bench, and a "border"—referring to the edge of the park adjoining the Tidal Basin. Carolina and Cristina propose, to the participants in their map-score, different kinds of activities that have to be done in silence, to enhance their sensitivity to the environment: "feel the texture slowly with your feet," "walk fast with your arms up, feeling the trees," "feel the changes in the light," "lay down on the bench and listen," and "sit on the edge of the path." The words they used here are relatively precise, but the graphics associated with those words showed a "moving" path and an extensive time. Time duration was added to some actions, such as "1 minute" for the action of lying on the bench, but the order of the actions was left relatively open. One performer could begin with sitting on the edge of the path, while another could choose to "[feel] the trees." The action of feeling the trees is not connected to a specific place: one could choose to incorporate it whenever the sensory environment seemed interesting for that activity. Their map-score proposes a series of actions that the participants have to memorize, and which they can

3. Her score could be linked to contemporary abstract music scores, such as those of the British composer Cornelius Cardew. See: **socks-studio.com/2015/10/05/the-beauty-of-indeterminacy-graphic-scores-from-treatise-by-cornelius-cardew**.

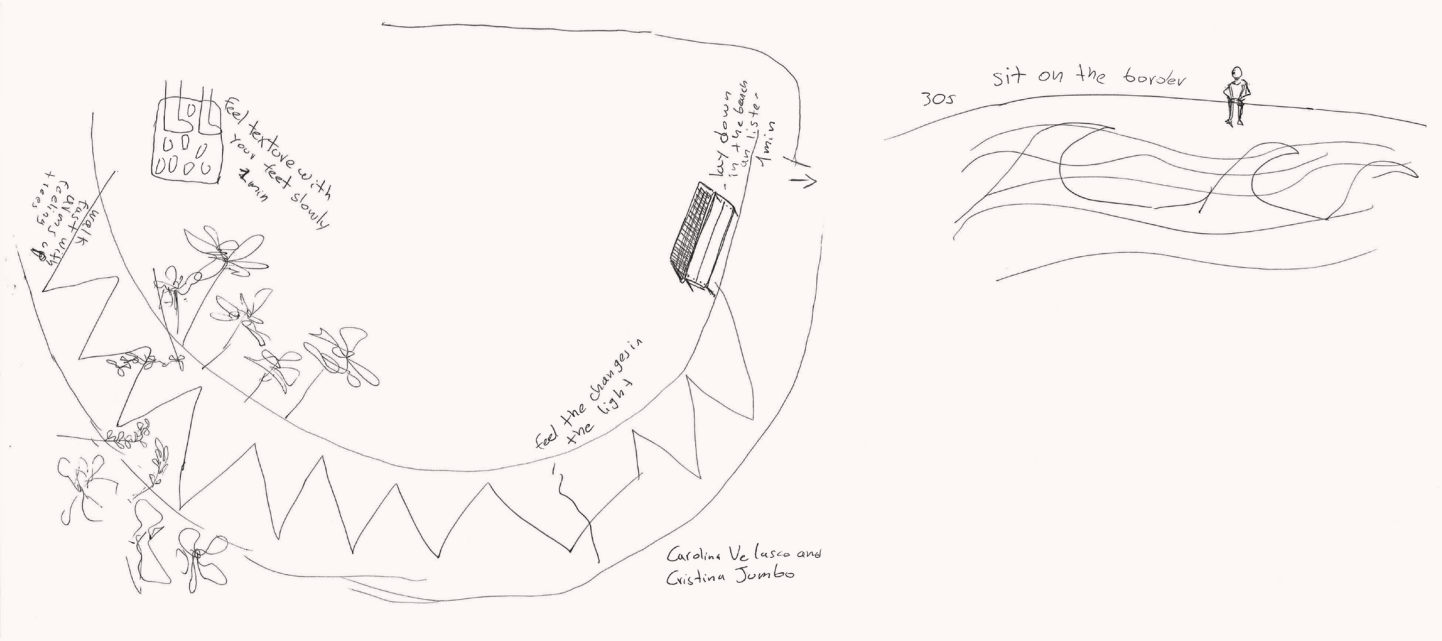

Figure 11. *Carolina's (left) and Cristina's (right) contributions to their third map-score, for an experience at the FDR Memorial.*

then freely enact, in silence, wherever they wish in the site. After the performance, participants were asked to draw a new map-score, based on and inspired by the map-score that they performed. A map-score isn't an end result, but instead is always a part of an ongoing process of writing and performance. By emphasizing the importance of sensations, our work highlights the power of non-verbal experiences to create relationships between human beings and between humans and their environment.

Participants such as Carolina and Cristina can only create a map-score after they have first discovered the environment themselves, with bodily action and writing. Their work is then handed over to others who will freely interpret the site, experiencing their own sensations and emotions. The whole process points to the particularity of the map-score: it is a graphical tool for both the creation of an experience (by the team), and for its interpretation (by the performers). It acts as a record, an invitation to experimentation, and the beginning of a process with others and the environment.

The graphical production process comprises many elements. While we clearly see three finished map-scores—one for each experience—what is hiding between those production steps? The whole process cannot be understood just by looking at the final graphic. Although these maps include elements that can be used to understand each experience, the graphics themselves represent only specific moments within the whole process.

The importance of the map-score protocol for creating and performing a map-score process, and what memory can activate from it, is visible in the way the protocol leads to something different from where it began. The process starts with a quiet walk, with eyes open or blindfolded, and ends with the graphical creation of a walk for another participant to perform. Each person begins as a sensory and emotional "receiver" of the environment, and then during the process develops the capacity to transmit that sensory experience to someone else, teaching them how to be a "receiver" as well. Our method demonstrates the idea that drawings related to places, such as maps, are already a process, guiding everyone toward sensitivity to environments. The map-score process starts with a situation that generates a relationship with oneself, the others, and the environment. Not only spatial, but temporal dimensions also have to be considered when thinking about and creating maps of a sensory world, and the link between time and the individual is the process: that is what we experience in the map-scores. As in Halprin's work, this project enriches the use of creative graphical objects, especially maps, to complement our knowledge of spaces.

REALIZING A MAP-SCORE: APPROPRIATION OF PLACES BY SCORING AND MAPPING

The third map-score also includes the idea of reflexive self-consciousness and also the potential reappropriation of the whole mapping process. This protocol insists on inclusion of sensibility in research and calls to ethical inclusive research, even though the great diversity of participants means that each might adapt it differently. For example, two participants mentioned that they attempted to link the experiment with their particular domain of research when adding their personal inputs to their map-score. This stage of reappropriation is the end of the process, though it was difficult to reach this point during the allocated time for our experiment. Therefore, it's important to understand that our third stage results are more exploratory than the previous two because it is based more on immediate reflexivity engaged during the lived experience of fieldwork. On the one hand, Joanna and Julia Mia focused on the trees at the FDR Memorial, known for its old Japanese cherries along the Tidal Basin (Figure 12). They paid attention to the memorial's vegetation and proposed unusual actions to feel, and, in a way, to relate to the trees ("feel the tree," "cling to a branch," "listen to the leaves' sound"). Their intention was to propose a careful selection of different paths, in which nature is the core of the experience. Their map-score does not indicate particular locations for actions: a performer could "feel a tree" anywhere along their route. And although their map-score is not very specific to the FDR Memorial, the proposed actions fit well within the site's characteristics, and attest

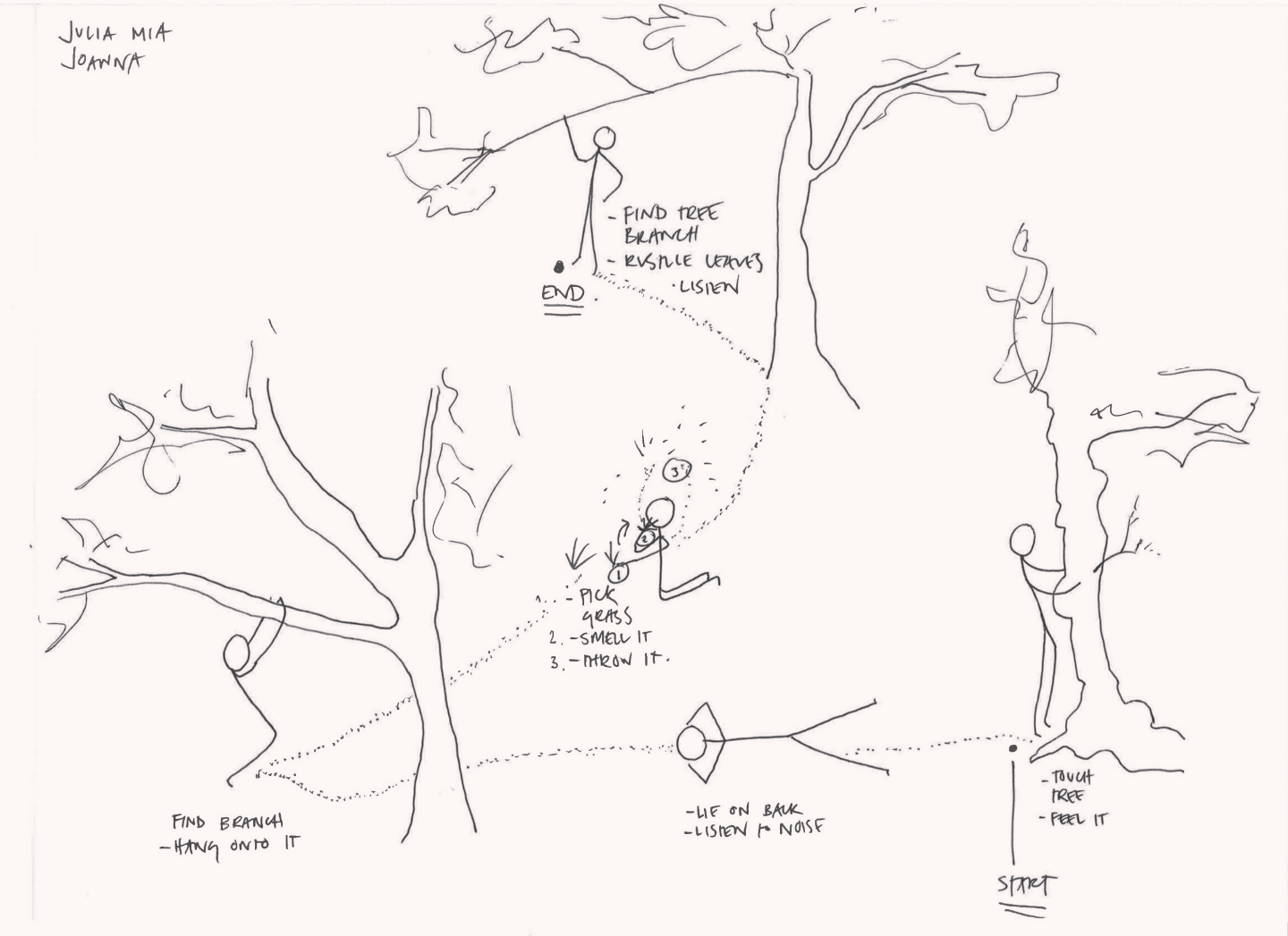

Figure 12. *Joanna and Julia Mia's third map-score, of their experience at the FDR Memorial.*

Figure 13. *Irma and Sébastien's third map-score.*

to its environmental possibilities. On the other hand, Irma and Sébastien chose to use specific elements of the Memorial, such as sculptures (Figure 13). Their map-score gives specific, precise instructions to performers. For example, they direct performers to "go behind the sculptured wall and walk along it with your left hand on it." However, their score does not specify a precise path between these specific actions. Cate and Hovig's map-score is less focused on the actions themselves—the ones they specify are actually not very precise (e.g., "touch me," "read me")—and more on being in the place, as a performative act (Figure 14). Their map-score reads as though it were a personal notebook that symbolizes the knowledge of the authors themselves. This map-score would be very difficult to read for those people who don't have any knowledge about the FDR Memorial. Just as a notebook, this document is more understandable to its authors than to other readers. Irma and Sébastien's map-score, like Cate and Hovig's, is more contextualized in the memorial than Joanna and Julia Mia's map-score.

The map-scores described above vary considerably in their content and style, with each pair choosing a different level of level of detail to give to the performer, and each map-score having a different level of legibility depending on its writers' intentions. The open-ended nature of the map-score protocol makes this variety possible, and is based on Haprin's idea of "openness" (1969). Participants can make different choices according to their experience each time, expressing their intention more or less precisely, and in whatever form they feel is appropriate.

Our approach considers the mapping process in a post-representational way: cartography does not merely represent what is there, but rather generates intentions from the people involved in the mapping. Irma and Sébastien's

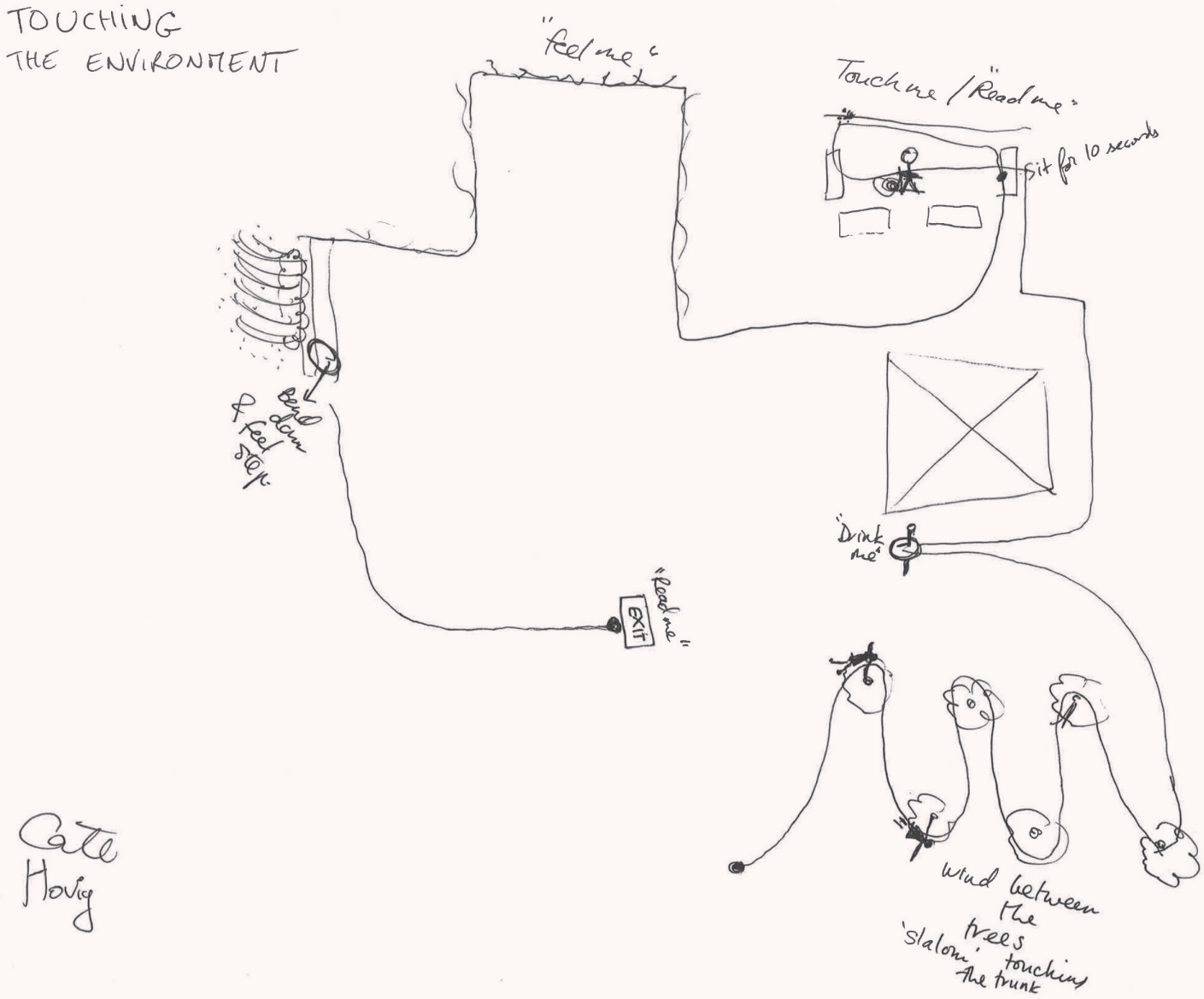

Figure 14. *Cate and Hovig's third map-score.*

map-score truly refers to the FDR Memorial: the waterfall, stone walls, banks, fountains, and the "exit" sign can all be recognized. The act of physically being at *this particular* historical monument is also clear in their map-score, which describes the Memorial as place that allows open movement, and where the performer's attention can focus on different micro-places such as the waterfall or the bushes. This interpretation is consistent with Halprin's intentions: he wanted those who read his plan for the Memorial to accurately imagine what it would be like to walk through the site once it was complete, including the sensory experience (Figure 1).

Each of the participants' map-scores materializes a subjective experience of the Memorial and reveals its sensory potentials. This record of the intentions of all these authors shows that a map-score is a way to really *interpret* a place, to give it a specific sensibility. The graphical transcription reflects its creators' particular feeling about the place and their intentions, which is the principle aim of a score: giving the participant an intention that they have to work with. The graphical production reflects how relationships to the environment are simultaneously both experienced and interpreted, which allows further discussions, exchanges, and points of view, since a map-score is specific to the relationship between one person (or here, a team of two) and a particular environment.

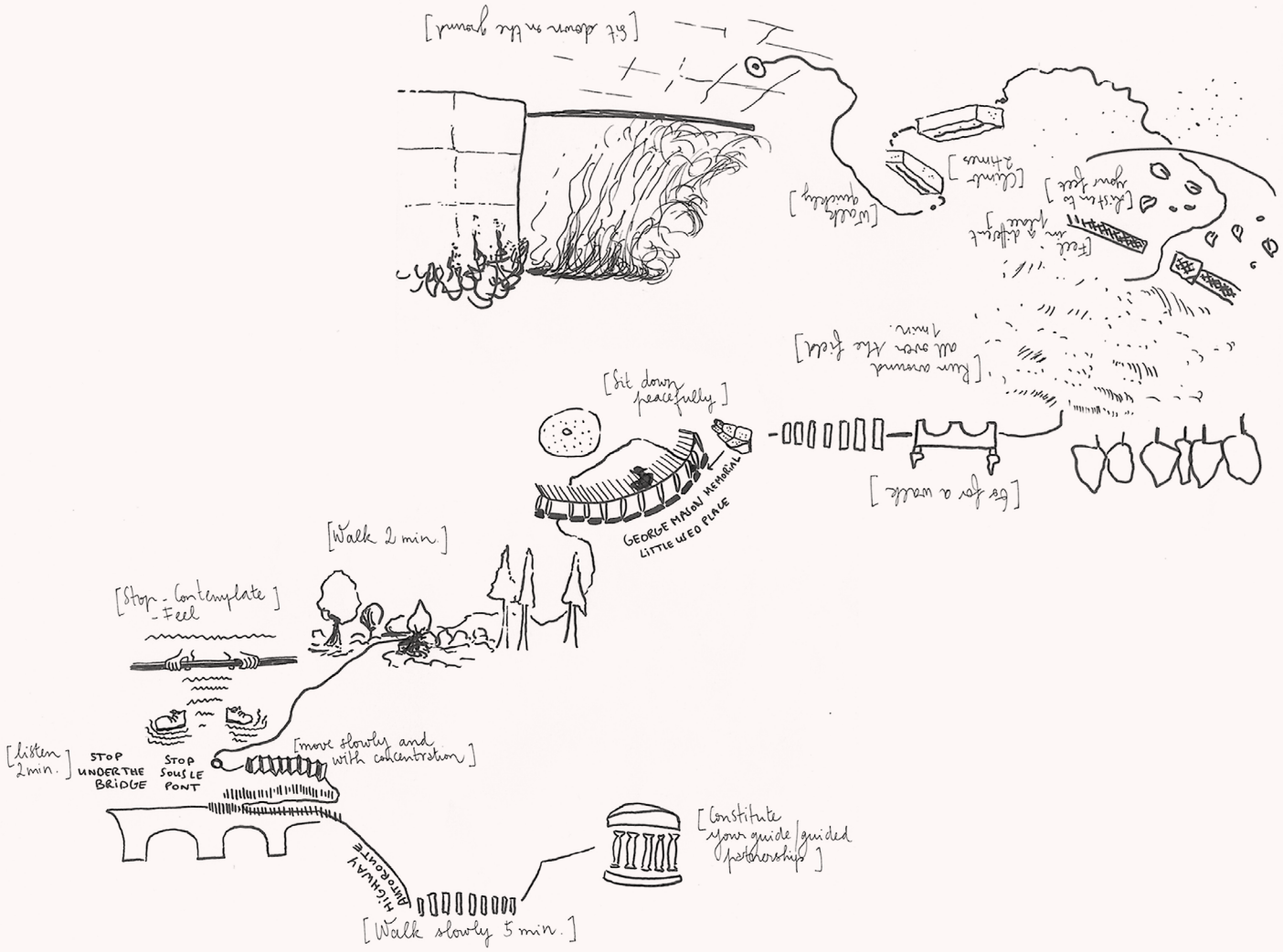

Figure 15. *Our map-score of the entire path from the Jefferson Memorial to the FDR Memorial. Preparatory sketch for the experiment. Digitally retouched by Élise Olmedo.*

USING THE MAP-SCORE TO REVEAL INTENTIONS

There is a methodological difficulty with research that involves *in situ* improvised performances. As researchers, we want to analyze not only the graphical output of the experiments, but the performances themselves. Map-scores can be archived for later, but we want to consider them beyond the inscriptive moment; a map-score also includes all the immaterial moments of the process. However, we must accept that some parts of the experiment cannot be saved forever: a lot of things are left behind when one tries to fix a reality within a map-score, as discussed by others in the context of mapping stories (Knowles et al. 2015; Caquard and Dimitrovas 2017).

The map-scores experience offers a way to approach the complex reality of sensibility, which is composed of multiple points of view based on the positions of each individual in space and time. The research-creation process, through the structure of an experiment, reveals not only points of view on environments but also the clear intentions of participants. In this light, the map-score is a broader part of a collective process. By materializing participants' intentions and experiences in an environment, it offers a basis for exchange between them. The map-score seen in Figure 15, which synthesizes the paths of the two first stages, was shown to participants at the beginning of the experiment in order to prompt a discussion about the idea of intention in experience. Beyond the instructions given to participants before their experience (see "The Map-Score Experiment," above), this document presented three complementary elements of intention that would have been

difficult to explain with words: (1) an itinerary from the Jefferson Memorial to the FDR Memorial, depicted by a black line; (2) some proposed actions along the path; and (3) some environmental elements near the path observed by the authors of the map-score (Élise & Mathilde) such as stairs, fences, a field, a highway, and architectural elements of memorials like a cascade or some columns.

Our preparatory map-score in Figure 15 laid out our initial intentions for the path, which evolved constantly during the experiment as participants became involved. In the first and second stages of the experiment, participants engaged with our map-score through their own performances, and through co-creating their own map-score based upon their interpretation of their performance of ours, rather than via their own self-determined path (as they developed in the third stage). Every participant shared their experience with others, revealing the many ways they had interpreted the initial proposition of walking.

CONCLUSIONS

This research project contributes to discussion in the field of deep, emotional, and sensibility mapping. Our experiment focused on the use of immediate experience, creating a shared research environment with our participants. The value of our particular research process is revealed in the map-score's articulation, which allows both a description of past experiences and an anticipation of forthcoming experiences. Our protocol does not focus on the specific representation of space, but instead yields a written/drawn *performance* of spatial experience, one that reenacts the physical presence of an individual in an environment. In a post-representational way, our experiment shows a way to bridge the gap between space and its representations.

Theoretically framed, the embodying process of mapping, and the production and epistemological status of emotional writings, are questioned together. The mapping process plays an important role in this perspective: space doesn't exist without the performance of individuals, who activate an evolving perception of environment, including sensory and emotional constructions. The practice of inscribing immediate memories appears to provide access to the capacity of consciousness. It shapes intentional and non-intentional images and interpretations of the experience. The mapping process reveals, reassesses, and questions the dialogue between maps and scores and opens new possibilities of experiences. Such tools as the map-score have to be activated and used in a time devoted to experimentation.

The experiment we led in Washington, DC enriched and built upon our earlier theoretical framework (Christmann and Olmedo 2016; Olmedo and Christmann, Forthcoming): (1) it demonstrated that the score concept could enhance sensibility mapping, by bringing precision to the expression of actions and sensory experiences; (2) it demonstrated an option for hybridizing maps and scores into a map-score that is produced after a performance and meant to be performed again by others; and (3) it shed new light on intentionality in mapping through experimental processes. Importantly, the experiment shows what we can learn from applying exploratory mapping protocols in an artistic-scientific community, with the intent of rehabilitating the role of the feelings of researchers themselves, in order to create reflexive conditions in academic contexts. This method could be also applied not only in an experimental framework, but also in everyday life. A large number of map-scores already exist: a tourist guide could be considered to be a kind of map-score, for example (Del Casino and Hanna 2000). By thinking about and practicing this notion of the map-score, researchers can reconsider the intentions, contexts, and practices of cartographic documents, as well as which kind of relationships they are offering.

We have tried to adapt a protocol originally developed for landscape projects to a research-creation context. While our protocol was originally more focused on introducing the score in geography, the contributions of the participants invited us to think about this process in a new way and insist on the plasticity of the map-scores concept. But, as seen in each participant's writing of their final map-scores, it is not always obvious how a lived experience can be turned into an impulse that leads someone else to perceive the sensory and emotional potentialities of the environment: transformed from a map to a map-score.

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PEER-REVIEWED ARTICLE

How Topographic Maps Affect: Experiencing Washington, DC through the Maps of the "Other"

Alexander J. Kent
Canterbury Christ Church University
alexander.kent@canterbury.ac.uk

Anja Hopfstock
Bundesamt für Kartographie und Geodäsie
anja.hopfstock@web.de

Does the type of map we use affect how we engage with a place in situ*? This paper describes a creative activity that aimed to explore how the use of different topographic maps affects our engagement with an urban environment. Three groups of participants explored the neighbourhood surrounding the Gelman Library at George Washington University, each using an extract from a different map (all with street-level detail of the area) as a guide: (1) a contemporary selection from OpenStreetMap; (2) a United States Geological Survey (USGS) map from 1965; and (3) a Soviet military plan from 1975. The 32 participants recorded their experiences by taking photographs and uploading them to a shared online bulletin board (Padlet). After gaining feedback via group discussion, the resulting 108 images were classified, interpreted and mapped. The findings indicate that the groups' engagement with their environment varied with the specific map used, and was possibly influenced by their interpretation of its function, although differences in individual perceptions and responses were more pronounced than between-map differences. The activity provides a starting point for understanding the role topographic maps play in the relationship between emotions and environment and offers some avenues for further research.*

KEYWORDS: topographic maps; affect; emotion; landscape; playful geographies

INTRODUCTION

The aim of topographic mapping is to provide a detailed, reliable, and authoritative portrait of the landscape that is usually derived from survey, i.e., the direct observation and precise measurement of features. Topographic maps are usually (though not exclusively) produced by a national mapping organization on behalf of the state. The character of the national landscape is expressed through the standardized portrayal of a chosen set of features, which serves the state's interests. Although they are intended to be objective and definitive representations, topographic maps provide a "good view" of the national landscape (Kent 2008) and maintain formal aesthetic traditions of cartography that result in the persistence of national styles (Kent and Vujakovic 2009; Chilton and Kent 2016). Elements of these styles are recognized by some users (Ory et al. 2015) and revered by others. Parker, for example, even describes the therapeutic effect of topographic maps: "When all else around you is going psychotic, you can still depend on a map, and some of us can waste happy hours lost in its calm infallibility. Even the crisp smell of an Ordnance Survey provides its own instant Rescue Remedy" (2010, 2).

For national mapping organizations, topographic maps are almost sacred texts; their cartographic style preserves something of the enduring spirit of the national landscape. Their symbologies resist modernization and the pace of their evolution—at least in terms of cartographic design—is slow. Yet, mapping technologies are advancing rapidly. The emergence of new, globalized, comprehensive mapping initiatives (whether driven by commercial or community interests), and their proliferation through web map services (WMS), has renewed critical engagement with the relevance and currency of state topographic mapping. National mapping organizations are continually responding to these challenges to ensure their products remain relevant, for example by investing in design upgrades that preserve the essence of national styles (e.g., Ory et

al. 2015) or maintain the trust of users (Skarlatidou et al. 2011). This aim becomes especially pertinent in societies where alternative mapping platforms with street-level detail are freely and readily available.

If cartography has the potential to arouse the senses, evoke emotions, and stimulate the imagination (Gardener 2017), producers of topographic maps should expand their awareness of how emotion influences the design and use of their products. Research in the gaming industry, for example, has shown that the intensity, brightness, and saturation of a video game environment produce an emotional effect on players, with particular values correlating with joy, sadness, fear, and serenity (Geslin, Jégou, and Beaudoin 2016). The aesthetics of maps, including topographic maps, can likewise influence feelings and attitudes toward the places they portray (Fabrikant et al. 2012; Muehlenhaus 2012; Kent 2005). However, if the richness of detail that topographic maps provide enables their users to engage more with the places they depict, it is therefore important to consider how users respond emotionally to topographic maps. Whether produced by states or communities, they invite the construction of a personal connection that draws on our imagination and experience of landscape.

Topographic maps do more than merely connect people with places, however; the landscape being remade is personal and we therefore approach each map through the lens of our own experience (Kent 2018). The rich symbology of topographic maps also encourages the free play of imagination and enables the creative manipulation of our experience of places, and therefore our memories of them. Through memory, space becomes place, as topographic maps generate, recall, and renew these emotional associations, enriching our knowledge and understanding of place. This is clearly implied in Harley's autobiographical example of deep mapping, through his personal copy of a six-inch Ordnance Survey sheet of Newton Abbot: "I am able to read it as a text whose image has meaning because it brings to the mind's eye landscapes, events, and people from my own past" (1987, 18). Each place is unique and each culture idiosyncratic (Pánek et al. 2018), yet these individual emotions and memories escape the process of homogenization that is inevitably imposed through a standard cartographic specification. Indeed, Harley's map is "interpreted through the private code of memory" (1987, 20). The emergence of deep mapping (where our understanding of places is deepened by perceptions, memories, and the emotions associated with them) and post-representation (where maps comprise de-ontologised visions that we re-make each time they are used) have accompanied developments in biometric technologies and social media that enable emotional responses to be mapped, shared, and interpreted.

Nevertheless, as Feeney (2017) notes, while the power of maps to enrich our experience and understanding of place by drawing on our emotions is significant, it remains under-researched. One reason for this is that the relationship between maps, emotion, and landscape is inherently complex. The experience of place is unique to each individual (Poplin 2017, 292) and measuring a person's emotional state is one of the most vexing problems in affective science (Mauss and Robinson 2009, 209). Emotions are usually conceptualized and described according to two different perspectives: the dimensional and the discrete. The dimensional perspective, which is more widely adopted, classifies emotions according to underlying states such as valence (positive/negative), arousal (level of intensity of feeling), and motivation (approach/avoidance). Each of these dimensions contrasts different emotional states, for example: pleasure versus displeasure (e.g., happy versus sad); high versus low arousal (e.g., surprise versus sleep); attraction versus repulsion (e.g., excitement versus anxiety). These dimensions form the axes of what has been termed the circumplex model (Russell 1980; Barrett and Russell 1999), which arranges affective concepts in a circle (Figure 1). In contrast, the discrete perspective contends that each emotion (e.g., anger, sadness, contempt) corresponds to a

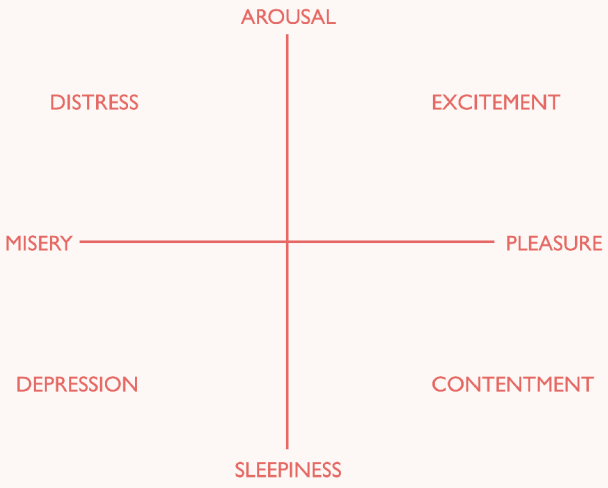

Figure 1. *The circumplex model of affect (redrawn from Russell 1980), which organizes emotional states according to the two axes of valence (horizontal) and arousal (vertical).*

unique profile in experience, physiology, and behaviour (Mauss and Robinson 2009, 211). Although it is possible to see how these approaches might converge (anger may have negative valence, high arousal, and high approach motivation), the dimensional perspective tends to capture the most variance in emotional responses (Mauss and Robinson 2009, 226).

Since affect and emotion provide knowledge that contributes to our understanding of place, it is important to consider the relationship between cognitive and emotional responses to maps. Some, for example, have indicated that the visually simple maps provided by satnavs generate minimal emotional response (Speake and Axon 2012) and others (e.g., Meng 2005) suggest that cognitive abilities are linked to emotional abilities, so that minimizing the cognitive load of a map therefore also limits the "emotional dimensions we associate to places, maps and mapping devices" (Caquard 2015, 228). In contrast, topographic maps are visually complex, with a simultaneous presentation of various themes in detail (such as terrain, vegetation, hydrology, transport, and settlements) that places a greater cognitive load on the map reader. Therefore, they should have greater potential to stimulate the reader's emotional ability and response. By contrast, using more simplified maps may limit the emotional dimensions we associate with places (Meng 2005).

If maps are continually re-made every time someone engages with them (Rossetto 2012, 32), it should be possible to examine how this remaking stimulates creative responses to an environment and to compare those responses. The aim of our research was therefore to explore how the use of different topographic maps *in situ* influenced their users' engagement with an environment and potentially their emotional responses. This paper describes an empirical activity that sought to compare how participants responded to an urban environment depending upon the topographic map they used. We explored whether the type of topographic map, as characterized by its original purpose or its level of detail, can influence these responses, and we critically discuss the extent to which this approach can reveal new insights into the relationship between topographic maps and emotions.

ACTIVITY

The activity was conducted during the first afternoon of a two-day "Maps and Emotions" workshop (jointly organized by three Commissions of the International Cartographic Association: Art and Cartography, Cognitive Issues in Geographic Information Visualization, and Topographic Mapping), held at George Washington University, Washington, DC, on July 1st and 2nd, 2017. The wider aim of the workshop was to explore different methodologies for how affects and emotions can be characterized and mapped.

Existing studies of emotions generated by different cartographic designs (Fabrikant et al. 2012; Griffin and McQuoid 2012; Muehlenhaus 2012) and by different places (Hauthal and Burghardt 2013; Klettner et al. 2013) have provided some directions for exploring the relationship between maps and emotion. Examinations of this intersection tend to fall into two distinct approaches: quantitative methods, which aim to measure participants' emotional responses to stimuli (e.g., Nold 2009; Fabrikant et al. 2012), and qualitative methods, which seek to capture participants' expressive output (e.g., Littman 2012).

Our approach falls into the latter category. We combined a free exploration of the urban landscape with volunteer-employed photography in order to interpret participants' immediate and creative responses to the environment while they used one of three different topographic maps. The basic hypothesis was that participants' level of stimulation and their perceptions of the environment—as reflected in the frequency and nature of their photographs—would differ according to the map they used. Taking photographs can help sharpen observational skills, as participants are more likely to take in and carefully analyse their surroundings through the narrow lens of a camera (Garrod 2008, 385). While the ontology of photography is intrinsically linked to performance (Levin 2009), photography is, like cartography, a socially constructed way of seeing and recording that attempts to construct idealized images that beautify the object being photographed (Urry 1990, 138–139). Indeed, the performance of photography focuses attention on particular subjects, and photographs can be read as the active play of a visual language: to "take" a photograph is active (Clarke 1997, 29). In turn, this offers the possibility of analysing and interpreting the resulting

images, letting us explore their takers' level of engagement with the environment and with which aspects of the environment they engaged.

Thirty-two workshop attendees of various ages and nationalities (including one resident of the area) participated in the activity (19 female and 13 male). They were divided into three groups (comprising 12, 10, and 10 participants), each of which was given a paper extract from a different topographic map: (1) a contemporary selection from OpenStreetMap; (2) a USGS map ("Washington West" quadrangle, 7.5 minute series); and (3) a Soviet city map (see Figures 2–4). Each map provided street-level detail of the neighbourhood surrounding the workshop venue at a similar scale. The use of one type of map per group aimed to ensure that participants received a consistent and immersive map-reading experience during the activity. The legends of the maps were not given, but each map included a scale bar, and we added a symbol (a green star) to indicate the location of the workshop venue to facilitate orientation. The absence of a defined navigational task aimed to provide greater freedom to explore and to respond to the environment; this can be particularly useful in an urban setting where the possibility of routes meets restrictions on mobility.

The choice of these three maps was intended to reflect a spectrum of topographic mapping in terms of producer, time, and interest: a contemporary map generated by a community of users (OSM, 2017), a state organization (USGS, 1965), and a culturally distant and potentially hostile "other" (Soviet General Staff, 1975). Nevertheless, if maps are remade as their users engage with them, this reinforces each map's method of portrayal and its use as an aesthetic lens for engaging with the environment. Each map was supplied as a paper copy, therefore preserving the level of detail and visual complexity that is inherent to topographic mapping. As suggested by Meng's (2005) linking of cognitive and emotional functions, the presentation of more detailed geographical information on paper placed a greater cognitive load on the user (e.g., to interpret the landscape and to orientate themselves within it), potentially stimulating participants in a way that resulted in a richer emotional response.

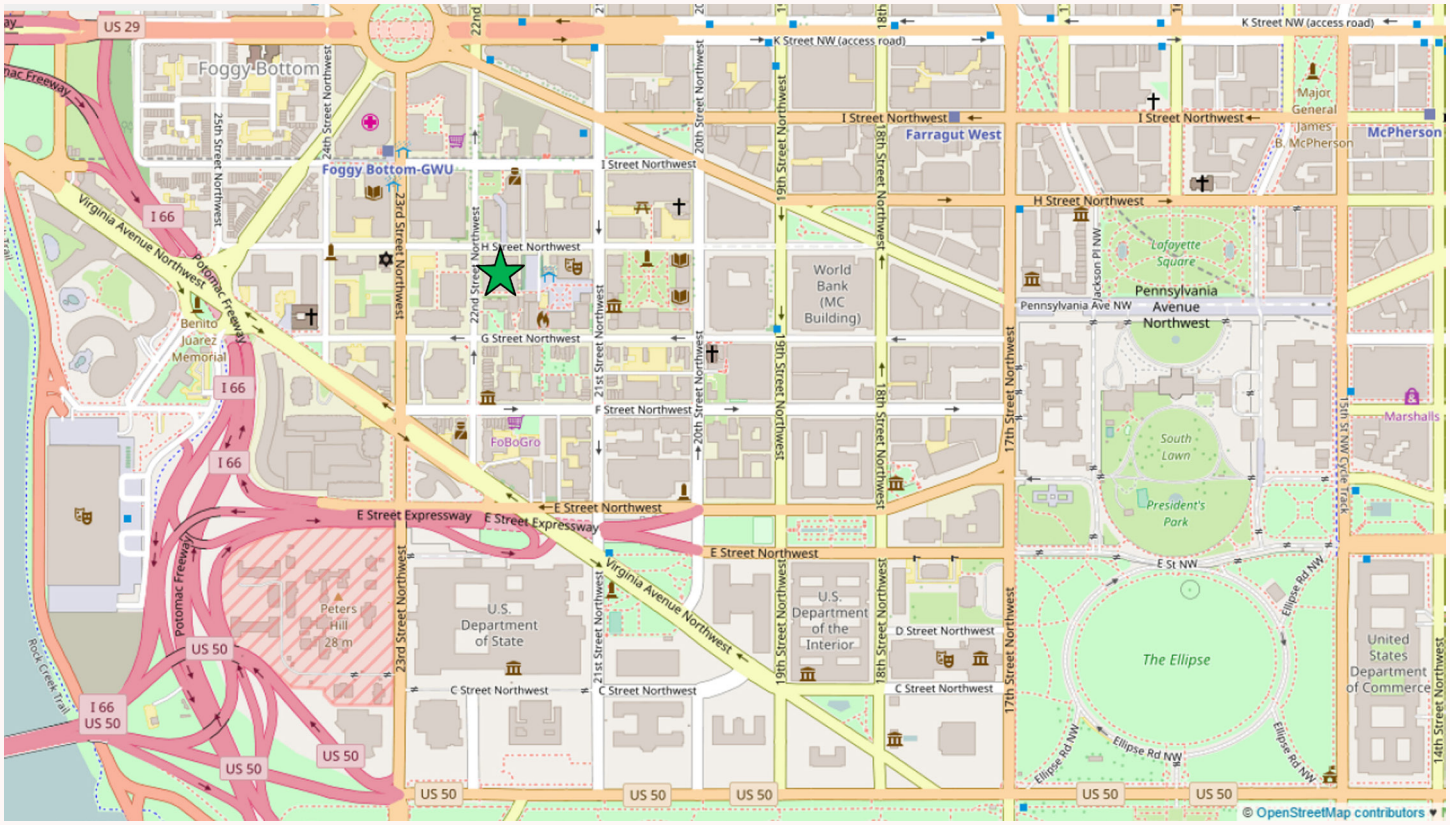

Figure 2. Extract from OpenStreetMap, accessed August 31, 2017 (zoom level 16).

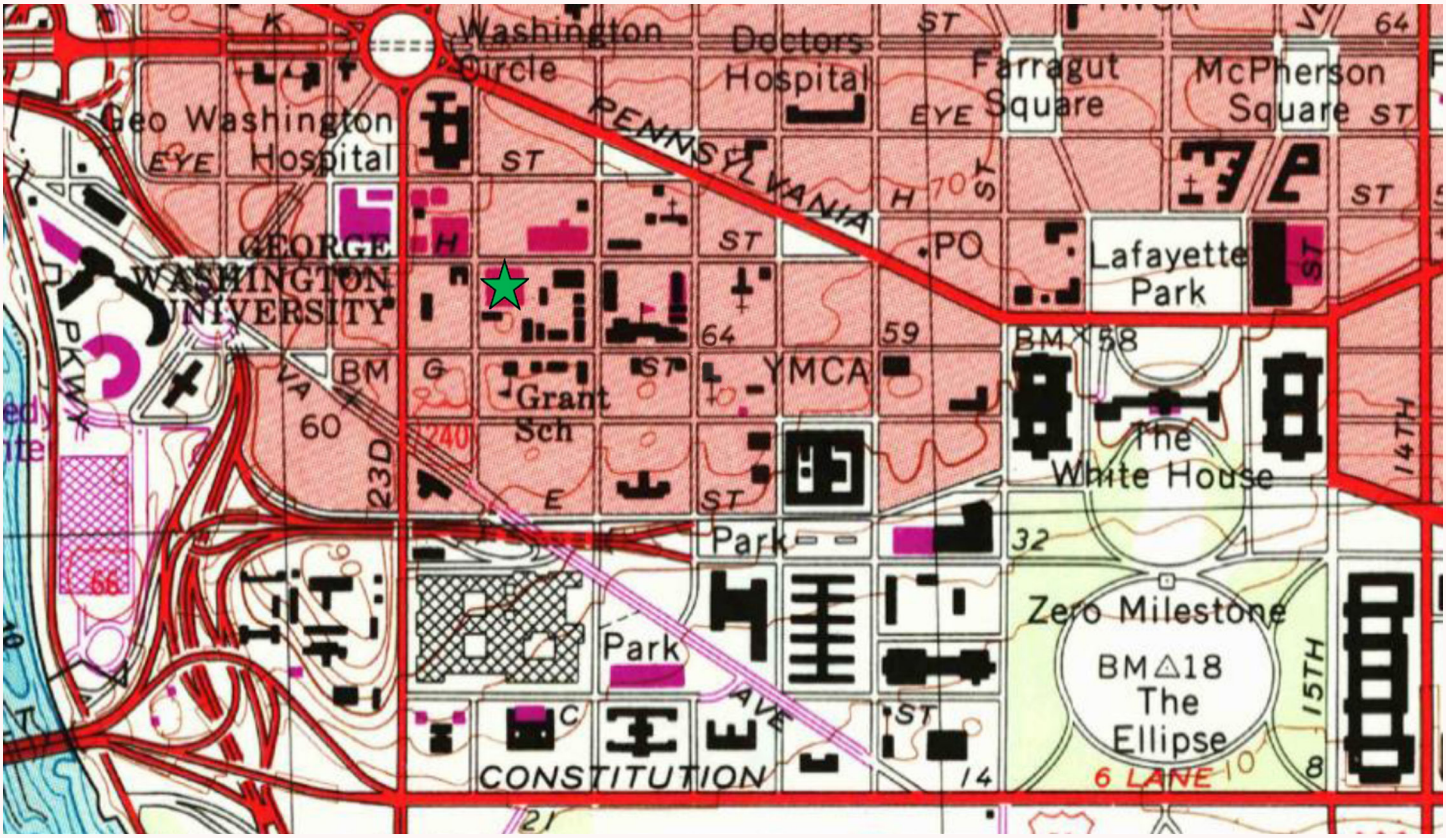

Figure 3. *Extract from a USGS 1:24,000 map (Washington West quadrangle, 7.5 minute series), from 1965.*

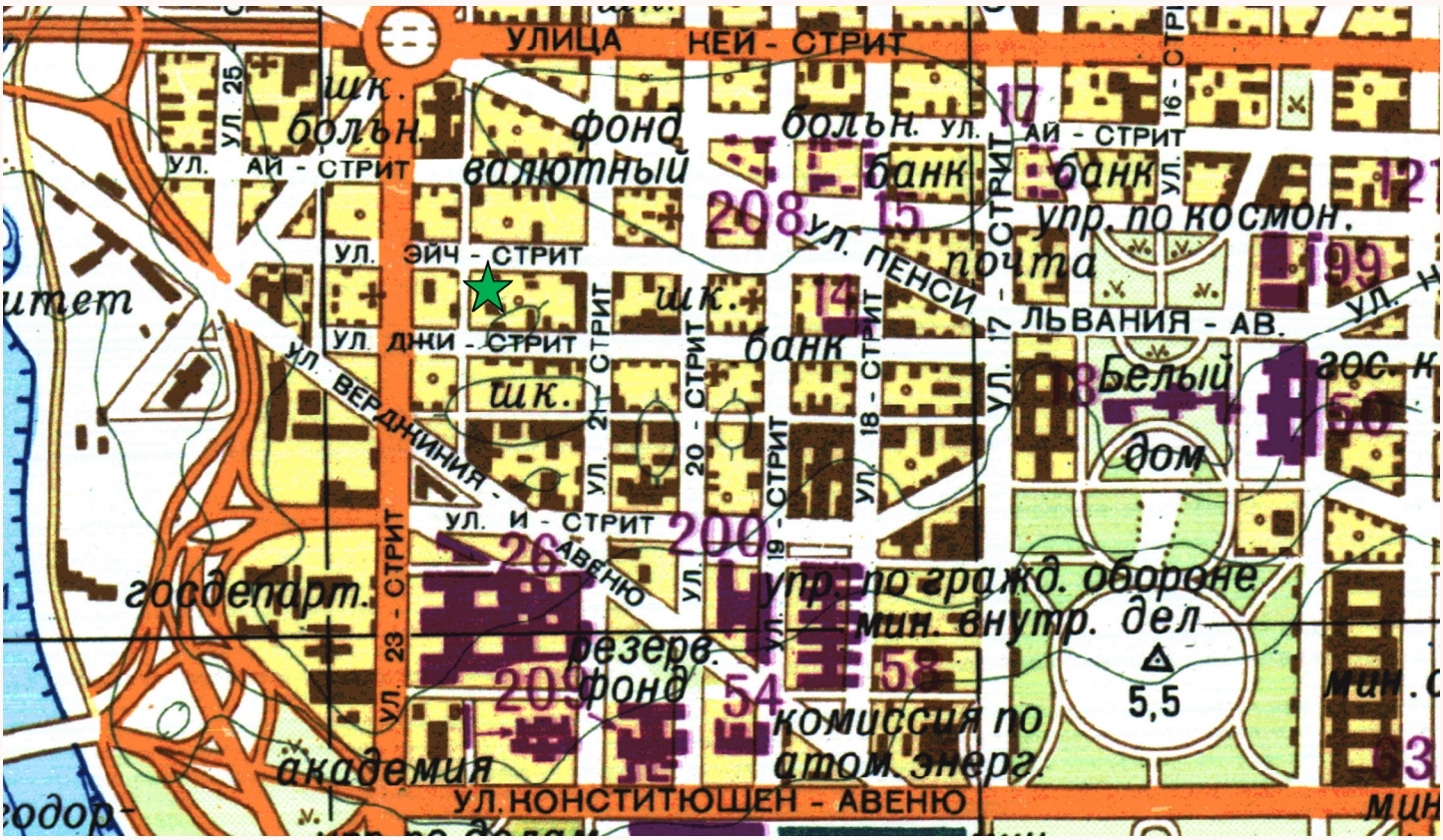

Figure 4. *Extract from a 1975 Soviet General Staff military 1:25,000 map of Washington, DC.*

Using the maps to navigate, each group was given one hour and was asked to take photographs (using their own camera phones) as and when they felt prompted in response to the environment. In addition to taking photographs, each group was encouraged to make observations regarding how each map affected their emotional responses within each neighbourhood. Participants' photographs were uploaded to Padlet, an online virtual bulletin board that allows the posting and sharing of files using a hidden space with a custom URL. Observations and comments could be uploaded as tags associated with the photographs.

Category	Example	Total Images	% of Total
Buildings as Landmarks	Views of whole buildings	18	16.7
Plaques and Signs	Signs on signposts and building entrances	11	10.2
Street Furniture	Benches, signposts, newspaper dispensers	11	10.2
Pavements	Sidewalks and other external floor surfaces	10	9.3
Building Sites	Active construction sites	1	0.9
Plants and Trees	Flowers, leaves, whole trees	6	5.6
Sky/Weather	Clouds	3	2.8
Architectural Details	Particular features of buildings or their surfaces	9	8.3
Views of Street	A broad view along or down the street	13	12.0
Building Interiors	The inside of a café or other building	2	1.9
Monuments	Statues or permanent memorials	4	3.7
Group Members	Posed or casual photographs of other participants	16	14.8
Group Map	The map used in the activity	4	3.7

Table 1. *Categories of the main subjects of each image, and some examples.*

In this way, participants created their own photographic record of their experiences of the city, which could be analysed and interpreted to explore whether we could ascribe general characteristics to each group, such as subject matter or style of photography. The combination of free exploration with elements of ludic (or playful) geographies (in particular, the use of a formerly secret military Soviet map within a very different context to its original design and use), aimed to stimulate emotional responses to the environment (see Pánek et al. 2018). This enabled participants to engage as creatively and openly as possible, and emphasized their freedom to explore. The subsequent interpretation of photographs and field observations revealed the characteristics of each group, while a post-activity discussion established the extent to which the participants were conscious of the maps playing a role in shaping their perception of the environment and their emotional responses.

RESULTS

In total, 108 photographs were uploaded to Padlet by 19 participants (39.6%). In Group 1 (OSM), eight participants uploaded 46 images between them (ranked by the number uploaded per individual: 1, 2, 2, 4, 5, 5, 5, 22). In Group 2 (USGS), four participants uploaded 16 images (1, 2, 5, 8) and in Group 3 (Soviet), seven participants uploaded 46 images (1, 2, 3, 3, 10, 10, 17). Clearly, there are differences between the groups in the number of images uploaded (with Groups 1 and 3 each comprising almost three times the number of images as Group 2) and some participants uploaded more images than others. One person in Group 1, for example, contributed 22 images (47.8% of those in the group and 20.4% in the whole activity). The distribution in the number of images uploaded by individuals in each group also varied, with Group 3 having three individuals who contributed a far higher number of images than others in that group.

The 108 images uploaded to Padlet are compiled by group in Figures 5–7. These include a diverse range of subjects and include close-up photography as well as views along streets. The activity was somewhat overshadowed by a sudden torrential downpour that lasted for almost the whole duration of the outdoor exercise, which presented the groups with unforeseen challenges in the environment, such as finding shelter (and some participants were keen to record this experience). We categorized each image by its subject, generally the most prominent (and usually central) feature; our categories are described in Table 1.

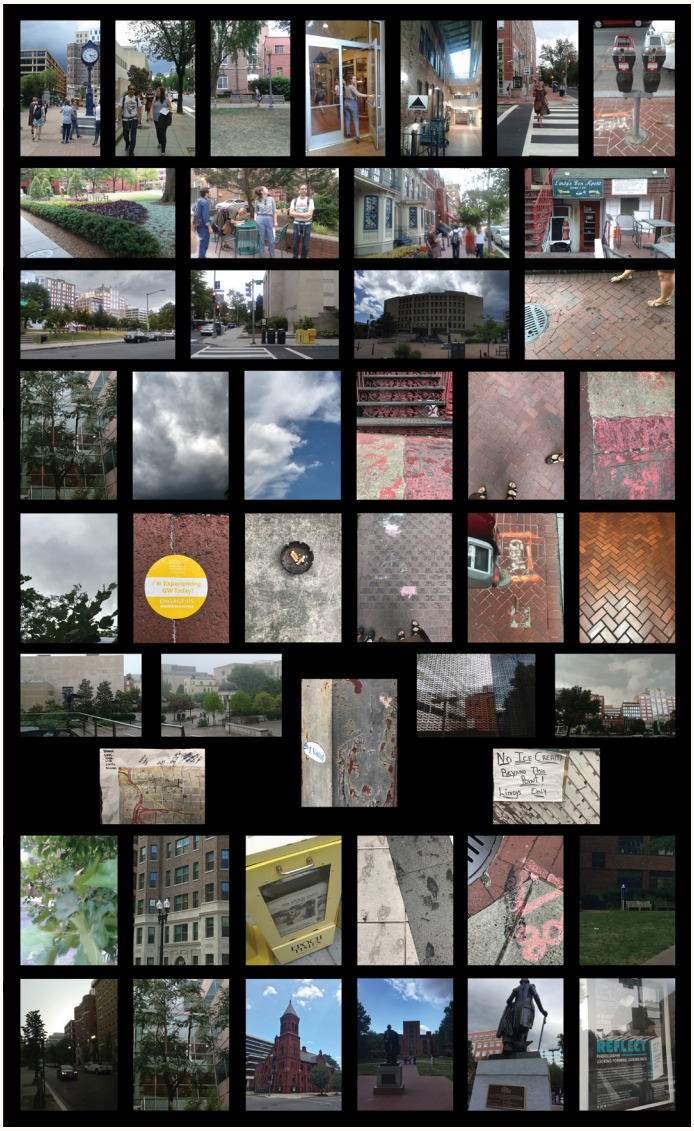

Figure 5. *The 46 images contributed by Group 1 (OSM).*

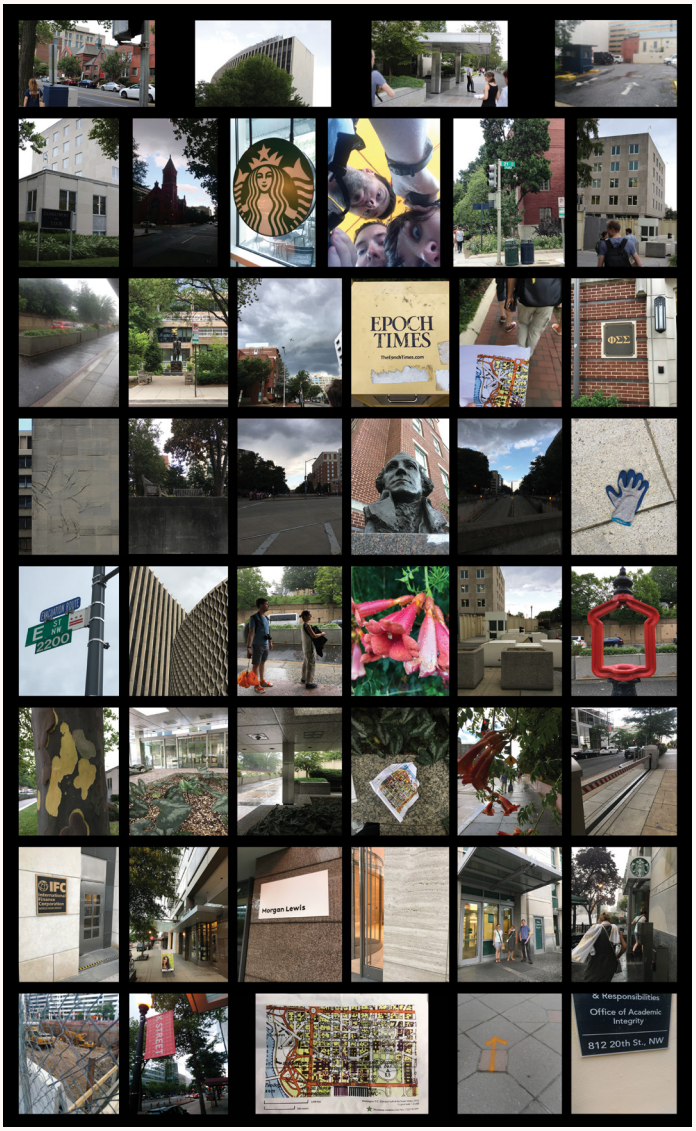

Figure 7. *The 46 images contributed by Group 3 (Soviet).*

Figure 6. *The 16 images contributed by Group 2 (USGS).*

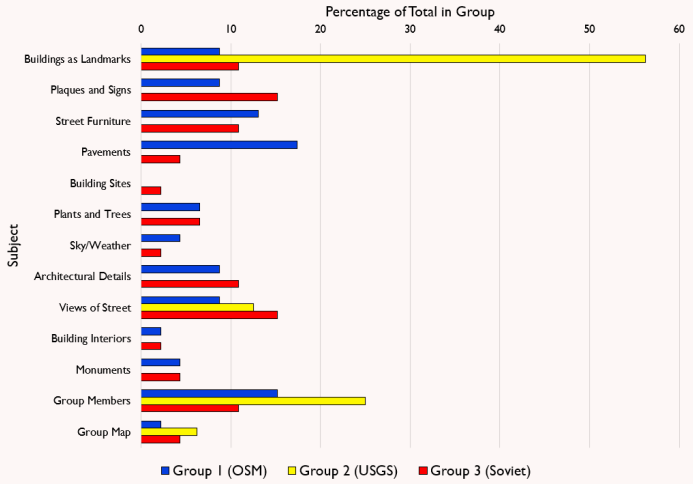

Figure 8. *Graph showing the relative balance of subjects in the uploaded images.*

A graph of the relative balance of these subjects, indicating the percentage of the total images uploaded by each group, is presented in Figure 8. This demonstrates that Groups 1 (OSM) and 3 (Soviet) tended to cover a similar range of subjects and using a similar number of images for each, while the images uploaded by Group 2 (USGS) were focussed on fewer subjects (i.e., Buildings as Landmarks, Views of Street, Group Members, and Group Map). Some examples of these subjects are given in Figures 9–11.

In addition to the subject material, the number and proportion of close-up images were calculated in order to provide more insights into the groups' varying levels of engagement with the environment. We considered the inclusion of a close-up image to imply that the participant responded to a more detailed aspect of the environment and deliberately excluded others, signifying a greater level of observation and possibly engagement (whether positive or negative) by that individual. In Group 1 (OSM), 18 close-up images were uploaded (39.1% of the total), with 14 of these contributed by one participant. In Group 2 (USGS), only one close-up was taken and in Group 3 (Soviet), 20 close-ups were taken (43.5% of the total), with 13 of these originating from one contributor (e.g., Figure 11). The subjects of close-ups included flowers and signs, pavements, architectural details and textures, and the maps given to the groups. It is also clear that some images were taken quickly (since they were blurred and not level), while others were more carefully composed.

Immediately following the activity, all groups returned to the workshop venue to upload images and engage in a group discussion. This also gave participants the

Figure 9. *An image from the "Buildings as Landmarks" category, taken by a participant from Group 1 (OSM).*

Figure 10. *An image from the "Group Members" category, showing participants from Group 2 consulting their USGS map.*

Figure 11. A close-up image from the "Plants and Trees" category, taken by a participant from Group 3 (Soviet).

opportunity to add labels or comments on their images, but few participants used this option, adding text to only 13 out of 108 images (12.0%). The comments were as follows:

GROUP 1 (OSM)

"GWU Library: Starting point of our exercise"

"the passage"

"Starting point under the storm"

GROUP 2 (USGS)

"End of work => socialization process during the raining"

"Route of Group 2"

"building with flag in the map"

"black building in the map"

"red building in the map"

GROUP 3 (SOVIET)

"Group 3 under the umbrella"

"car park where purple building 14 was. . ."

"A street we could recognize on our map :-)"

"Did the Soviets shelter from the rain in Starbucks??"

"20 St Church"

The motivation behind adding comments seems to have been either to record specific features (e.g., buildings identified on the map) or to share the humorous experience of undertaking the activity (especially in the rain). In a plenary session, three questions were asked of all groups to allow the participants to reflect on the activity and to provide more insights into how the maps may have affected their experience:

- Did you use a map on your smartphone or just use the supplied map to navigate?
- Did you find the map prompted you to take photographs of anything in particular, or to take photographs in any particular way?
- How did the map you used affect your experience of Washington, DC?

All groups used the maps provided to navigate and reported that mobile phones were only used to take and upload the photographs. The use of Padlet enabled an interactive and visual comparison that, while accounting for individual preferences, also revealed some common patterns in the way that the environment was seen, felt and recorded. From these comparisons, some characteristics emerged of the role that the individual maps played in the activity.

Group 1 (OSM) remarked that their map was very functional. They explored the details marked on it just out of curiosity: for example, they followed a passage to find a nice courtyard. We asked if the activity had prompted the group members to feel inclined to make changes to OpenStreetMap during the exercise, but the group said that they did not.

Group 2 (USGS Map) reported that their map did not show enough labels for proper navigation and to identify buildings. They mentioned that it took some time to read the map, as a legend was missing. It was thought that some buildings on the map had disappeared or that new

buildings had been built since the map was produced in 1965.

Group 3 (Soviet Map) said that they had identified buildings and places that were important targets for the Soviet Union at the time of Cold War. They started to look at the surroundings from the viewpoint of possible targets. They noted all the gates and blocking features on the street as well as boundary markers. As most of the group could not read the map labels (which used the Cyrillic alphabet), the group used the contour lines and topography on the map for navigation.

After the exercise was completed, we mapped the location of where each image had been taken (Figure 12). Since the images were captured using smartphones, many had geographic coordinates embedded within them. The locations of 47 images were plotted using GeoSetter software, while the locations of the remaining 61 images were identified using Google Street View. The distribution patterns indicate the extent to which the groups explored this area of the city and their relative clustering. Group 3 (Soviet) ventured the furthest from the starting point, with one image being captured over 1 km away from the workshop venue. The patterns are more tightly clustered in Groups 1 and 2, with members of the latter taking more images within a smaller area inside (and surrounding) a nearby shopping mall.

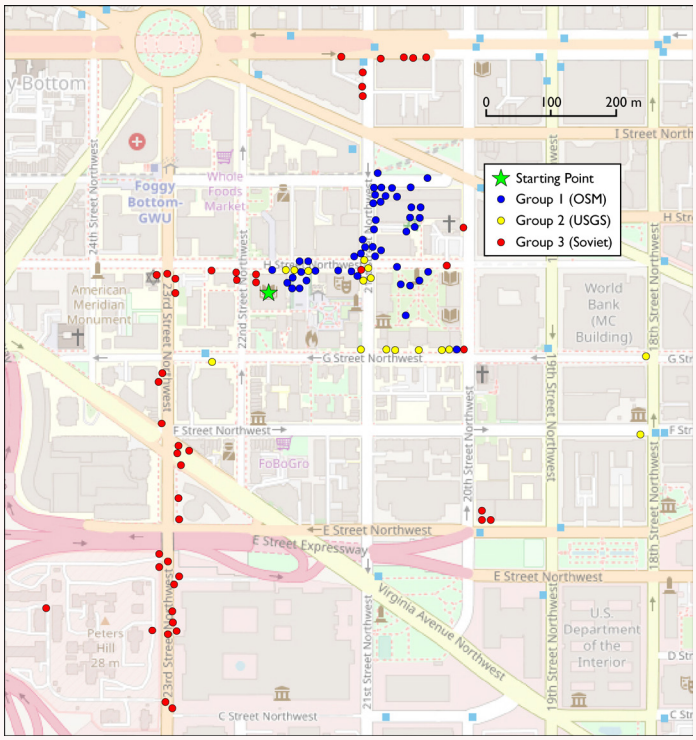

Figure 12. *Map indicating the locations where images were captured. OSM is used as a base, since this is the most current of the three maps used in the study.*

DISCUSSION

Together, the participants' images and comments reflect a range of experiences and responses to the environment that they encountered during the activity. Analysis of the subject matter and spatial distribution patterns indicates how varied these experiences and their associated emotions were between and within the three groups. They also reveal individual preferences of what subjects were photographed and the perspectives (e.g., close-ups) that were preferred.

However, before interpreting the resulting images, the first indicator of the level of engagement with the environment (and the activity in general) is the quantity of images uploaded per group. The most distinctive result is the low number of images contributed by Group 2, combined with their relatively limited exploration of the environment (though they added proportionally more commentary). The USGS map is the least detailed of the three, and it is possible that this influenced the participants' behaviour. Indeed, this would seem to corroborate Meng's (2005) suggested link between detail, cognitive load, and emotional responses. In their feedback, this group mentioned that the map did not include many labels and, together with its age (over 50 years old), this made navigation particularly difficult. Hence, it is possible that this group found the activity less stimulating and sought to record buildings in a more "emotionally detached" manner; most of its photographs were of the Buildings and Landmarks category, and it contributed more images to this category than any other group. These images, and their comments (whether added via Padlet or during the group follow-up discussion) tended to record whether or not certain buildings were present on the map. The paucity of images would suggest a low level on the arousal dimension of the circumplex model described by Russell (1980), emphasized by the fact that the group took no close-ups of the environment, only of the map itself.

By contrast, Groups 1 and 3 were more engaged with the activity, contributing 46 images each. Group 1 (OSM),

for example, mentioned that they investigated features out of curiosity. Having seen the symbols on the map, they then wanted to find them in reality. Through the lens of OSM, with its rich symbology for showing various amenities found in a city environment, the participants perhaps saw the urban landscape as a commodity to explore and enjoy, with many of their images focusing on shops and signs. The detailed symbology of the map invited exploration, which is reiterated by their comment regarding the map-inspired discovery of a nice courtyard. Several close-ups were contributed by one member of the group, who clearly took advantage of the activity's creative freedom by capturing the various textures encountered in the urban environment. The group's members did not venture far from the workshop venue, but some of their images of the group itself convey the fun of sharing the novel experience of exploring an unfamiliar city together. This would correspond to a higher level of arousal and pleasure on Russell's (1980) circumplex model.

Those using the Soviet map (Group 3) ventured furthest from the workshop venue, explored more of the neighbourhood, and appear to have headed for the government buildings that are prominent on their map. They took photographs along the route and their images reflect a similar balance of subjects as per Group 1 (OSM). In the follow-up discussion, however, they implied that the map had directly influenced how they saw with the environment "from the viewpoint of possible targets." The map certainly appears to have stimulated the imagination of participants, with some of the images being taken covertly, as if the participants were Soviet spies gathering intelligence in the US capital. The opportunity to revel in this role play is also reflected in the creativity that the images demonstrate as they focus on recording the functions of buildings and on architectural detail. Perhaps of all three maps, this provided the most immersive and stimulating experience for the participants, and their images appear to reflect their lively approach to the activity. Hence, this group would represent the strongest levels of arousal and pleasure on the circumplex model.

The different sets of images and feedback from the three groups therefore suggest that the maps (and especially how each group interpreted their map's purpose) influenced how participants interacted with and responded to the environment. The detailed urban symbology provided on OSM inspired Group 1 to act as consumers, investigating amenities in the vicinity; the USGS map appears to have been more difficult to follow *in situ* but inspired Group 2 to identify particular buildings (perhaps acting as state officials); while the Soviet map encouraged Group 3 to pretend that they were spies gathering intelligence. Within these contexts, it is possible to observe a relationship between the maps and the behaviour of the participants, since the assumed purpose of the maps directed the groups in their general attitudes towards the environment. More specifically, it is the groups' perceptions of the interests of the map as well as its content that appear to have set the overall context. For example, if Group 3 had not known that their map was a Soviet military plan produced in secrecy during the Cold War, would they have experienced the excitement of pretending to be spies?

Identifying the specific responses aroused by each of the maps in the activity is more difficult, since the subject matter of the images was often the same (particularly between Groups 1 and 3). Although the proportion of close-up photography could be interpreted as a deeper engagement with the environment, the fact that these images were taken by very few individuals suggests this may have been driven by artistic sensitivity to particular aspects of the environment (possibly resulting from their experience as photographers) rather than a link with the map in use. Photography handbooks routinely encourage fostering a sensitivity to detail in order to capture the essence of a place. For example, Luck and Freeman state that "wherever you are, you should be alert to the chance of getting these small but vital shots that will record how it feels to be somewhere; the textures, colours and shapes" (2011, 268). More specifically, the genre of urban photography is characterized by capturing the extremes of visual unity and disunity: the street view and the close-up, the general and the detail (Clarke 1997, 76). The simpler/outdated portrayal of the environment in the USGS map does appear to be responsible for a lower level of engagement in the activity by Group 2 and possibly also reflects a sense of frustration at the lack of ease in using it for navigation. That participants chose to take images of the buildings shown on this map and annotate them (e.g., "black building in the map") suggests that at least some participants were immersed in comparing it with their experience of the environment and perhaps indicates more contentment than excitement according to the circumplex model.

The associations between participants' images and their emotions, and therefore between their images and the topographic maps they used in this activity, is difficult to

establish. Nevertheless, it is possible to attempt some interpretation based on the work of Hallman and Bendow (2007), who analysed the content of 140 family zoo photographs to better understand the everyday and emotional geographies of family life. Their approach examined the purpose and connotation of images (e.g., recording family ties; unity) in order to identify common themes. Regarding the present activity, Table 2 therefore presents an interpretation of the purpose/motivation and the possible meaning/connotation of images by category. Where image tags were added in Padlet, as mentioned above, these were consulted in order to interpret images more accurately.

While it is possible to attempt to plot these images onto Russell's (1980) circumplex model by group, it is difficult to provide any authoritative interpretations of the specific emotions captured by the photographs. Moreover, although it is plausible to suggest that the taking of any of the photographs implies a raised level of arousal, it is difficult to interpret the exact dimension of the emotion felt behind the lens of the camera and therefore to establish a firm link with the map in use. Close-up photography, for example, may be regarded as reflecting a higher state of arousal from the observation required (and possibly surprise), but where this should be placed on the valence dimension is open to question. Images of textures of the pavements with sprayed marks indicating where roadworks will take place could be interpreted either positively or negatively. Indeed, the close-up photographs involved in Garrod's (2007) study of Aberystwyth included images of dog mess and litter. Of course, a major limitation is the interpretation of images of the environment according to how stimulating the image is itself rather than how aroused or positive the emotion was in taking the picture, since there is an assumed link between the subject of the image and the emotion of the photographer. Hallman and Bendow's (2007) images, by contrast, involved family subjects whose facial expressions gave more reliable indicators

Category	Purpose or Motivation	Meaning or Connotation
Buildings as Landmarks	Recording whether buildings are present on the map	Accuracy, completeness
Plaques and Signs	Recording the urban environment/functions	Sense of place/city life
Street Furniture	Recording the urban environment/curiosity	The exotic city
Pavements	Recording textures/obstacles	Art/city life
Building Sites	Recording life in the city	Change in the city
Plants and Trees	Fascination/capturing detail	Naturalizing the city
Sky/Weather	Recording the weather	Heavy rain/novel experience
Architectural Details	Fascination/capturing detail	The intriguing city
Views of Street	Recording the urban environment/perspectives	City life
Building Interiors	Recording the urban environment/shelter	Life in a big city
Monuments	Fascination/recording unique landmarks	The historic city
Group Members	Recording the activity itself/others in group	Novel experience/fun
Group Map	Recording the map used/navigation	Completing the task

Table 2. *Interpretation of images by category.*

of the implied emotions involved. In the results of the present study, there is very little to distinguish between the images of the three groups and therefore differences in the emotions evoked by the maps.

CONCLUSION

The activity described in this study suggests that topographic maps can affect our experience of place. This was demonstrated in the quantity and subjects of images that participants took while exploring an urban environment—a neighbourhood in Washington, DC—and in their own reflections on the activity. All three maps include street-level detail, but the participants' perception of the function of each map appears to have directed how they engaged with their environment and therefore influenced the emotions that they experienced. More specifically, their perception of the function or interest served by the map appears to have had the most influence on how the participants saw and behaved in the environment, either as consumers (OSM), as state officials (USGS map), or as spies (Soviet map). Differences in terms of the level of detail suggest that simplified maps may have inspired less exploration and engagement with the environment, reflecting a low level of arousal and therefore supporting the view that this simplification limits the emotional dimensions we associate with places (Meng 2005).

An association between the use of the topographic maps and particular emotional responses has been more difficult to establish. The number of photographs and the geographical spread of their capture can suggest that different levels of arousal and characterized behaviour may be associated with the use of different topographic maps, but the interpretation of specific emotions (e.g., classified according to the circumplex model of affect) from images is much less precise. By its nature, photography is about capturing the moment, but the intention of the photographer at that moment is not always clear. It is also very easy to interpret an image based on what is meant to be felt by someone viewing the image, rather than what the photographer was feeling at the time of capture.

Inevitably, there are some limitations to this study, and several ways in which its methodology could be developed. Gathering more information about the participants would allow a deeper analysis of potentially different approaches taken according to, for example, gender, age, nationality, and familiarity with the environment and the maps used. As participants were invited to use their own smartphones for capturing images, this led to variation in the photographs taken and the devices used (e.g., through camera quality, ease of use, GPS data and so on) and in users' familiarity with their own smartphones. It is notable that fewer than a quarter of the participants in the activity contributed images, and so it would be worth investigating the role of the group dynamic in this process. Results, for example, might have been different if participants had conducted the activity individually. If all devices were GPS-enabled, it would be possible to analyse the routes chosen and to understand how these routes influenced which subjects were photographed. The dramatic change in the weather also influenced the choice of images taken (e.g., of group members sheltering in the rain) and the activity could be repeated under different—and drier—conditions for comparison. Since the images uploaded are likely to be only a selection of the total number captured, it is likely that there is an aesthetic bias towards those included, which could be removed by requiring participants to upload all photographs taken. In addition, an automated method could be used for analysing the images, perhaps focusing on aspects of colour, that may yield similar findings to that of Geslin, Jégou, and Beaudoin (2016). More generally, it would be interesting to repeat the activity using maps with much less street-level detail to further explore Meng's (2005) hypothesis.

The study raises important questions for undertaking future research into how topographic maps play an active role in generating and re-generating emotions that are associated with place. As the agency of topographic maps, and maps in general, lies beyond their socio-political value and encompasses an ability to affect our emotional experience and therefore our understanding of place, the design of topographic maps could be improved by further research in this area. If emotion is transferred through art (Tolstoy 1995), this research should explore how the artistic elements of topographic mapping can enhance its cartographic language and draw on our emotions more effectively. This will contribute to a deeper understanding of how all maps can play a role in the formation of more authentic attitudes towards environments, before, during, and after they are experienced.

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PEER-REVIEWED ARTICLE

Placemarks on Watermarks: Mapping, Sensing and Sampling the "Rivers of Emotion"

Catherine Schroeder Turk
University of Western Australia
cate.turk@fau.de

Maps are a key discourse for conveying geographical information, yet many cartographic approaches struggle to represent the subjective aspects of a landscape or "sense of place." This paper examines the challenges in mapping emotional engagements with place, considering various cartographic approaches to representing emotions, and how these are complicated by theoretical approaches to conceptualizing place. Where place is theorized as fluid, dynamic, and contingent, we see a mismatch with the logics of cartographic practice and interface design. Participatory digital spatial media offer new possibilities for mapping emotional engagement by overcoming some of these complications. They are thus the focus of the case study of the Rivers of Emotion digital database of emotional engagements with Derbarl Yerrigan and Djarlgarro Beelier (the Swan and Canning Rivers), in Western Australia. The paper reviews emotional responses to the rivers and explores the collation of individual emotional engagements with these places in an online map and database. It concludes with a discussion of possibilities and limitations for mapping emotions and suggests how projects like this can inform collective imagined geographies.

KEYWORDS: mapping; emotion; place; critical cartography; digital spatial media

INTRODUCTION

In this paper I explore how we can study and map emotional engagements between people and place. Places are tricky things to capture or define. They keep changing, our perceptions combining and re-combining with shifting connections. Poststructuralist geographers understand place as ontogenetic, continually mutable in a reflexive process through the thinking and unthinking presence of people within them. Rejecting the concept of an essential definition of place, my focus is instead on examining the practices and processes that contribute to spatial identity, "the constellation of relations," as Doreen Massey (1991, 28) put it, that work together to create place.

The ontogenetic and contingent nature of place presents a particular challenge to cartography. Traditional mapping conventions have been developed to take a static account, representing one author's or institution's perspective, in which data uncertainty is rarely indicated. Dynamic and subjective aspects are harder to visualize with conventional mapping techniques. Writing on the mapping of emotions, Caquard and Cartwright (2014, 103) note that

> the cartography of emotions remains a major challenge due to the dehumanizing character of maps, at least in their conventional form. The map is a rationalized representation of place that is rather limited for conveying emotions.

If we are to use maps as an interface for collating and conveying information about emotional aspects of place, we also need to ask what the format of the map brings with it: the legacy of cartographic authority and limitations in the expression of emotions in cartographic practices.

Digital spatial media or "geospatial technologies" seem to offer new capabilities for collating and curating different forms of emotional expression (Griffin and McQuoid 2012). Digital mapping is flexible, dynamic, interactive,

and has the ability to integrate different media. Oral histories, images, and audio-visual recordings might all be collated within the same spatially referenced database. Coupled with a web interface, databases can be designed for the input of data from public users engaging in participatory and collaborative projects. Georeferenced information can be filtered, and changes demonstrated over time. Does digital cartography, then, provide effective ways of mapping emotional engagements with place?

This paper is structured in two parts. In the first part I consider the complexity of the task of defining and mapping emotional engagements with places. Following a brief review of key elements in the contemporary theorizing of place, I discuss how cartographers have approached mapping emotional and subjective engagement with place. In the second part, I turn to the Rivers of Emotion project as a case study. The Rivers of Emotion project is an empirical study of emotional engagements with a particular riverscape, Derbarl Yerrigan and Djarlgarro Beelier—also named the Swan and Canning Rivers—in Western Australia. The project collated and presented emotional responses to the rivers and invited project participants to reflect on the combination of practices, powers, and actors that make place. By exploring these emotional responses through the lens of "sense of place," I consider how individual stories about being by, in, or on the rivers contribute to the identity of the place. Furthermore I discuss the project's use of digital spatial media. I examine what the digital enables as well as ways in which the revelation of emotional engagements might be constrained in a digital form.

THEORETICAL APPROACHES TO EMOTIONAL ENGAGEMENTS WITH PLACE

In order to produce maps that convey a "sense of place" or subjective engagement with landscape, we need to be able to define and represent what is to be mapped. From this basic position of data collection, it is evident that theoretical approaches to defining a "sense of place" or even simply "place" can create challenges for cartographic practice. The various approaches to place and the theories influencing them have been well chronicled and summarized (Agnew 1987; Seamon 2000; Cresswell 2004; Kuhlenbeck 2010; Relph 2015). Allan Pred defines place as "a center of meanings, intentions, or felt values; a focus of emotional or sentimental attachment; a locality of felt significance" (1983, 46). In 1974, Yi-Fu Tuan developed the idea of "topophilia," a love of place: affective bonds with landscapes shaped by aesthetics and cultural conditioning. In the decade following, cultural geographers worked on revealing the power relations within these cultural conditions, with scholars such as David Harvey drawing on Marxist theory to critique hegemonic constructions of place and motivations for the appropriation of place-based traditions (1989, 303–304). This theoretical work has supported critical examination of the construction of place in a range of applied contexts, including urban geography, tourism studies, and heritage discourse.

Today, geographers draw on humanist, neo-Marxist, feminist, and performative approaches to understand spatial identities. Within a dynamic concept of place, as Doreen Massey (1991) promoted in her "global sense of place," we understand that all places are contingent, constantly made and remade by their fluid interactions. Tim Cresswell summarizes this well:

> Whatever kinds of places are constructed they are never truly finished and always open to question and transformation. . . . places are not fixed, bounded and unchanging things but open and constructed by the people, ideas and things that pass in and out of them. (2008, 137)

As I explore through this article, place is contingent, dynamic, and fluid (both metaphorically and here in the real, wet waters of the rivers case study). Edward Casey's (1996) work describes how a place may gather meanings, and through lived engagement with place these can be re-worked, developed, appropriated, and forgotten. Identifying and following common refrains through descriptions of place (Campbell 2016, 199), we see how stories build upon and relate to each other.

Through empirical study of sense of place it is possible to examine how conceptualizations of a place shift and change. With the movement of the spatial turn through the humanities, a range of methodological approaches have been used to study emotions and place. In their book *Place Attachment*, Lynne Manzo and Patrick Devine-Wright (2014) include discussions on narratives, photo-based analysis, social psychology, located storytelling,

quantitative techniques, qualitative interviews, and participatory research as methods for researching place attachment. Several of these methods are relevant here. In the same volume, Clare Rishbeth (2014, 100) demonstrates how storytelling can reveal attachments to place, with "each story an intersection of site, time and human experience." While in Rishbeth's research, stories are prompted through the research process, Neil Campbell (2016), working on "Affective Critical Regionality," offers a theoretical framework whereby literature, film, and art are primary sources for exploring emotional dimensions of place or region. A place-assemblage combines stories of the past and the present, official published accounts and personal reflections, crafted artistic works, and passing musings. Giuliana Bruno's *Atlas of Emotions* (2002) is a rich example of this, bringing together spatial accounts from film, architecture, and landscape design to explore the dynamics of place. Bristow and Pearce have also recently curated a collection of "essays, creative writing, and sketches of locales and localized affect" though which, they consider space is allowed to "map itself, disclose itself, inhabit its own presencing" (2016, 2). These are all textual means of sharing experience of place, but what about cartography—that key discourse for imparting spatial information? In what ways can emotional engagements be collected and curated? How have emotional engagements with place been represented in maps?

MAPPING EMOTIONAL ENGAGEMENTS WITH PLACE

Several authors have explored the complications of mapping emotions (Kwan 2007; Pearce 2008; Wood 2010; Tuan 2011; Griffin and McQuoid 2012; Caquard and Cartwright 2014). Tuan (2011) nominates emotions, alongside time and morality, as a major discordance between cartography and humanism. He asserts that, in order to create an objective overview of space, cartographers have chosen not to represent subjectivities in the maps they make. Yet, as critical cartographers have worked to reveal, there are many subjective aspects of cartographic practice. Mei-Po Kwan makes the case for an ethical approach that "not only involves reintroducing long-lost subjectivities of the researcher, the researched, and those affected by GT [Geospatial Technologies] back to geospatial practices, but also involves making emotions, feelings, values, and ethics an integral aspect of geospatial practices" (2007, 23). Here I consider three ways in which we might consider emotion as bearing upon contemporary cartography: first, in terms of emotions influencing methodology; second, in the choice of data and data collection methods; and third, in considering the emotional and affective aspects of map design and use.

Addressing the first of these, we can reflect on how emotions stimulate cartographic practice. If a map is a "utopia" as Yi-Fu Tuan (1999) has suggested, it carries an emotional message about how the cartographer wishes things to be. The parallel arguments that a map is a "proposition" (Krygier and Wood 2009; Wood 2010), a "manifesto" (Harley 1991), or even the "conceiving of spatial relationships in the milieu" (Robinson and Petchenik 1976) all suggest subjective and emotional aspects of mapping practices that propel a cartographer to represent place in a particular way. Yet while emotional force may fuel the argument, the discursive grammar of cartography does not readily facilitate a map with visually decipherable emotions. Margaret Pearce (2008, 17) questions whether cartography is "capable of depicting spaces shaped by experience" and discusses how "western cartography is characterized by specific assumptions and structures, and those structures carry limitations." Her paper is nonetheless optimistic about the capacity of cartography to embrace new techniques and promotes the use of narrative as a means of incorporating emotional engagement with place into her maps.

Scholars have experimented with various ways of sourcing data that record emotions, feelings, and subjectivities. Some cartographic techniques seek to tap an affective engagement with place, such as those that draw on psychogeography to record the whims of drifting exploration, or techniques like mental mapping (Gould and White 1993), which use memories of place as a data source. Qualitative GIS practitioners have experimented with the integration of subjective opinions and ratings as datasets within a GIS interface (e.g., Mennis, Mason, and Cao 2013). Quantitative approaches include Christian Nold's Greenwich Emotion Map (**emotionmap.net**; see also other examples at **biomapping.net**), which uses a combination of bio-monitoring and GPS technology to track and measure emotional responses in different locations. His maps draw new contours on the landscape as participants' biophysical

responses measure how they emotionally respond in different places. Looking at the maps, we can identify locations that have inspired a heightened corporeal emotional response.

Analysis of social media feeds, such as a study of photographs uploaded to Flickr (Purves, Edwardes, and Wood 2011) is another potential method for collecting experiences at particular locations. Indeed, given both the subjective and public nature of much social media data, there is scope for revealing much about the way people relate to place. The potentials of datafication have, however, been effectively critiqued by van Dijck, who writes:

> Social media platforms concomitantly *measure*, *manipulate*, and monetize online human behavior. Even though metadata culled from social media platforms are believed to reflect human behavior-as-it-is, the algorithms employed by Google, Twitter and other sites are intrinsically selective and manipulative; both users and owners can game the platform. (van Dijck 2014, 200)

So use of this kind of data requires a critical understanding of both social media participant behaviour and the role of the institutions that collect, interpret, and share data.

Participatory mapping is a further technique used to gather data about emotional engagements with place (Rishbeth 2014), and collectively produced maps are used as means to present subjective geographic information. Coupled with a web interface, mapping databases can be designed for the input of data from members of the public as participatory and collaborative projects. There has been extensive discussion in the cartography literature on the opportunities and drawbacks of using volunteered geographic information in cartography, with questions of data quality, consistency, the number and variety of participants, and capacity to contribute all being factors that shape the data collected (e.g., Sieber and Haklay 2015). Several prominent examples that "crowdsource" qualitative spatial data include: *The mappiness*, an interactive app and map of happiness (**mappiness.org.uk**); *Wikimapia,* a crowd-sourced map of the world that encourages the inclusion of subjective comment (**wikimapia.org**; Bittner 2017); a range of projects that showcase local and oral histories (for example, **edmontonpipelines.org**; **invisiblecities.com.au**); and various maps created with the *Ushahidi crowdmap* software that reveal sites where people have been harassed, feel unsafe, or are in danger (such as *HarrassMap* or other crisis mapping examples; see Kwan 2007 and Pearce 2014, 20, for a more detailed typology of these). In each of these projects, the audience is provided with a conventional map similar to those used for navigation. Often Google Maps or OpenStreetMap are the base maps upon which records of emotional engagement appear as point data (or, within *Wikimapia*, polygons). Clicking on a point reveals information about emotions, yet the points might just as well relate to rainfall records or the location of post boxes. A metadata record of emotional information stored in a database does not affect the look of the map and does not reveal how emotions work to create place. In these maps, conventional cartographic techniques enhance the legibility of the information. Nevertheless (as I will go on to explore in more detail through the case study), the norms of disciplinary cartography jostle with the expression of emotional and subjective spatial information within the discourse of a map.

Cartographers employ a range of approaches when mapping emotional and subjective information. While some, like Nold, seek to quantify and plot emotions, others play with cartographic design to convey emotion. Pearce's (2008) mapping of journal entries draws on narrative descriptions to color the maps produced. Several anthologies of critical cartography (such as Cosgrove 2008; Dodge et al. 2009; Wood 2010) discuss cartographic art as inspirational in this regard, and that "we ought not to separate the analytical from the creative" (Dodge et al. 2009, 332). Artistic approaches often pay less heed to cartographic norms and use visual effects to express emotions. Stuart Aitken (2009) promotes the possibilities for combining cinema and cartography as a way of incorporating emotional aspects. Lisa Parks' discussion of GPS for mapping the subjective—or "plotting the personal" as she puts it (2001, 212)—demonstrates how mobile or ubiquitous mapping can reveal sites of emotional engagement as "waypoints" experienced through a mobile device, when located in the places referenced.

There is a spectrum of approaches, both in terms of data used and cartographic design. Some represent emotions through quantitative data from bio-monitoring, others use qualitative psychogeographies and narrative response. The design of the mapping interface ranges from conventional to map art. Digital technologies seem to offer a chance to play with both, letting designers mash multiple media

into a map interface, or, through geolocation, move out of maps to deliver geodata in different ways. Before examining the Rivers of Emotion database as an example of how digital methods can facilitate representations of emotional engagements with place, I want to digress briefly and consider the possibilities and implications of working with digital spatial media. Researchers have critiqued the way that the digital offers new interpretive frames through which to engage with place.

PLACE IN THE DIGITAL

> The virtual earth that has been constructed is more than just a collection of digital maps, images and articles that have been uploaded into Web 2.0 cyberspaces; it is instead a fluid and malleable alternate dimension that both influences and is influenced by the physical world. (Graham 2010, 422)

Mark Graham has written extensively on the implications of the digital for theorizing place. With Matthew Zook, he developed the term "digi-place" to refer to the "use of information ranked and mapped in cyberspace to navigate and understand physical places" (Zook and Graham 2007, 466). At the intersection of "software (information) and hard-where (place)," it has helped to describe the relationship between the creation of geo-information in a digital format and lived experience in places. Having followed the evolution of digital representation of place from online atlases through to geo-tagging in augmented reality, Mark Graham's more recent work (Zook, Graham, and Boulton, 2014; Graham 2017) claims that the digital changes the very nature of place, such that the "map is the territory" (2017, 44). In a somewhat circular argument, Graham asserts geographic information had an instability when it was passed orally from person to person, but this information became immutable through the ability to record it in a "container" (i.e., on a map). Yet now, with the advent of digital augmentation, it is attached to places as well as containers:

> Instead of just being fixed to containers information can now augment and be tethered to places; it can form parts of the layers or palimpsests of place. A building or a street can now be more than stone, bricks, and glass; it is also constructed of information that hovers over that place: invisible to the naked eye, but accessible with appropriate technological affordances. (Graham 2017, 44)

While I agree that places can be conceptualized as palimpsests with information about them continually recorded, re-recorded, erased, and so forth, it seems that the development of new technological possibilities has tangled up Graham's logic. The technological accessibility of information *in* place does make a practical difference, but the revelation that information now both hovers above and constitutes place is redundant to the people who paint their paths across country, recite prayers along the road to Lhasa, or who cannot help but think of the children's song each time they walk over a bridge in Avignon. The digital nature of spatial information is a different way of encoding this information, but geo-information has long "hovered" over places. Digital encapsulations of place, whether contained in a book, on a screen, or through a placemark, are a partial and temporary fixing of relations; and, as Graham shows in his later discussion of ontogeneity, this information is always in a state of flux regardless of the form of the container. A more pressing question here concerns how the digital recording and presentation of geo-information influences the way people engage with place: how does the digital affect the way people make place and place makes people?

Maja van der Velden (2010, 15) remarks on how information from different cultural contexts such as "indigenous knowledge" is managed in a digital space: "such a database becomes a contact zone for different ways of knowing the world and different ways of making the world." The struggle to classify and contain different forms of information comes to the fore when decisions must be made about cartographic representation or coding within a database. The simple line on a map separating water from land hides all manner of assumptions about geomorphology, cultural constructions of hydro-geography, temporality, and representation. Mark Graham (2017, 53) is not oblivious to these, and suggests they are the subject of critical and radical attention; they constitute "a range of micro-political challenges to the digital status-quo: strategies to inappropriately appropriate platforms, misrepresent,

over-represent, delete, amend, and pervert information." Importantly too, we need to remember the world outside the digital: the contingencies and fluidities of construction, alternative imaginings, as well as the importance of recognizing the partiality and situated nature of any work (on place).

The supposed seamlessness of the flatscreen world can obscure the messiness of crowd-contributed data and the limits of classification and curation. It often promotes the same treatment of data regardless of provenance, quality, or relevance. Information is represented through predetermined interfaces that delimit engagement in certain ways and preclude other types of participation. Scholars working on digital geographies have helped to reveal and critique the power relations inherent within the use of digital spatial technologies (see Zook et al. 2014; Haklay 2013; Elwood and Lesczynski 2013; for the influence of factors such as gender or class, see Stephens 2013; Perkins 2014). Haklay's (2013) call to conduct "deep mapping" suggests an ethic of engagement that enables participants to question and (re)create the terms on which they map, reflecting a broader concern within the digital humanities about access, equity, and control within digital spaces (see Spiro 2012; McPherson 2014). This work has implications for a research method that incorporates digital technologies.

For now, let us turn to the case study of a digital database created to compile emotional engagements with place. Through analysis of how the database works in practice we can examine how some of these complications come to the fore. First, I consider how this project has captured stories and feelings that show attachment to places. As well as overt expressions of emotion in poetry and prose, I examine the way emotional practices are evident in the kinds of interactions people describe having with rivers. I then consider the role of temporality within these records, looking for shifting engagements over time and consider how dynamic engagement is handled by the database. Finally, I reflect more broadly on the capabilities of the digital map and database as a repository, examining the potentials of the digital context as a way of juxtaposing multiple perceptions and representing collective responses. With all the contemporary emphasis on big data and the recording of quantitative statistical information, it is worthwhile to investigate the capacity for emotional and qualitative information to be presented in a cartographic format and the use of digital technologies to explore past and present emotional attachments to place.

SAMPLING FROM THE RIVERS OF EMOTION

The Rivers of Emotion project was developed to record and collate emotions connected with Derbarl Yerrigan (Swan River) and Djarlgarro Beelier (Canning River), which flow through the Western Australian city of Perth (Figure 1). The project was conducted as a collaboration between the University of Western Australia and the National Trust of Western Australia and funded through the Australian Government's Your Community Heritage Program. It was designed to contribute new understandings of the cultural landscape and to provide an opportunity for the community to share their experiences of the rivers. The project delivered a 2012/2013 community snapshot of emotional connections to the riverscape and thus informed a social values audit as part of the Swan River Trust's interpretation plan for riverside heritage trails.

As the joint work of historians and heritage practitioners, the project incorporated several dimensions: archival research; the curation of material in a digital web interface; workshops with school children and participants in the University of the Third Age ("U3A"); and a public symposium. A small booklet compiling historical material was produced to stimulate wider participation and was distributed to public libraries and schools around the region

Figure 1. *Location of Derbarl Yerrigan and Djarlgarro Beelier—the Swan and Canning Rivers (Author, Mapbox).*

(Broomhall and Pickering 2012). The online web interface (shown in Figure 2) offered those who came across the project a means of recording and sharing their emotions. With this online database and map as the catchall and ongoing archive for a range of emotional responses, it is the focus of discussion in this article.

The website invited members of the public to explore the records of emotional engagements with the rivers and to participate by adding contributions of their own. The public could make contributions by registering with the site as a member and filling out a series of web forms to submit information about an incident, memory, or special connection. Most entries were geo-tagged and thus linked to specific locations around the rivers. Contributors could also enter information about the date of the event and kinds of emotions felt, and upload supporting material such as videos, artworks, photographs, or sound recordings. Each entry was approved by site administrators and then became visible to members of the public.

People viewing the website could then click into individual accounts associated with points on the map, or find records through a keyword search function. Each entry had an information page displaying the details provided by the contributor. There are two key ways in which these records were sorted or given associations within the database. Primarily, they appeared in the web interface under four categories depending on the format of the contribution:

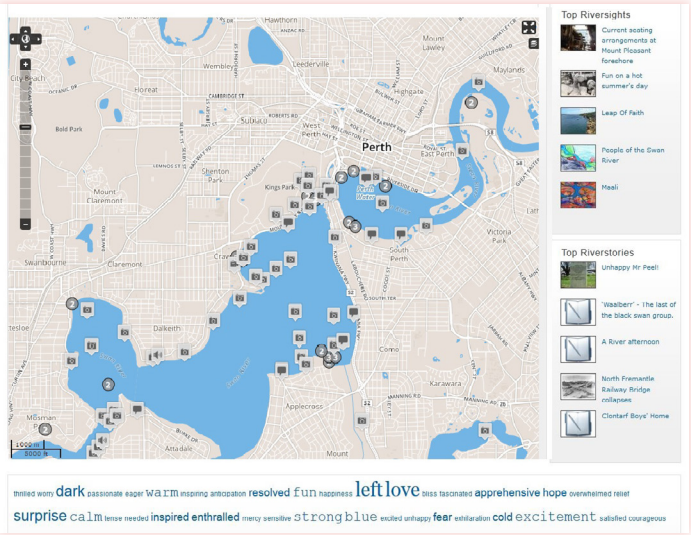

Figure 2. *The online web interface was available at riversofemotion.org.au. It can now be accessed through the Wayback Machine at: web.archive.org/web/*/riversofemotion.org.au.*

"River Scenes" (film), "River Sights" (photographs and visual art), "River Sounds" (audio recordings), and "River Stories" (written texts). Secondly, some of the entries included "tags"—words expressing particular emotions (such as "love" or "fun" or "sad") identified in the source material. These words were included in the website in a word cloud under the map interface (see Figure 2). By clicking on a word in the cloud, all entries tagged with that emotion were displayed on the map; thus, through the map interface, it was possible to identify sites with emotions in common, prompting questions about environments that evoke particular emotions and how stories might build upon each other.

In personal communications with me, the project designers explained that they deliberately chose to use a map as the primary interface so they could identify emotional hotspots where different kinds of intense emotions are linked to certain places around the rivers. Yet they also noted that the requirement to identify a particular point on the map privileges site-based perspectives, rather than reflections on the river as a whole. Another rationale for choosing a map was because the designers considered maps to be a familiar framing of the landscape. They saw a map as something that appeared neutral to different user communities and did not visualize people doing certain activities that would frame expectations of what should be added to the database. The project leaders were nonetheless aware of the problems associated with cartographic discourse and, particularly for this application, that maps often represent a Western viewpoint.

The website used the Drupal Content Management System (CMS): a robust, secure, open-source platform. The map was created with Mapbox (**mapbox.com**) map object layers or "tiles" and configured with customized colors and icons chosen from open-source collections. The website launched on October 24, 2012, and statistics were gathered for the period between October 2012 and June 2013. There were 1,185 unique visitors in 2012 and 19,498 unique visitors in 2013, according to Google Analytics. Visitors returned an average of 2.5 times and viewed an average of 9.21 pages per visit. As is the norm for online participation, the vast majority of visitors were passive viewers rather than active participants contributing their own emotional engagements with the rivers (see Bittner et al. 2016 for a continuum defining participation in crowdsourced mapping). There were only 158 uploads to the site and 202 records in total.

Contributors were not required to provide details other than their name, email address, and a password when registering on the website. This means it is difficult to determine any common characteristics of contributors. Amongst the registered users who contributed were at least ten individuals and organizations represented at the project symposium. The Rivers of Emotion project encompassed several activities and hence many of the 202 records contain data that were collated as part of the archival research and oral history component of the project. The "author" in these records is often listed as an institution, such as "City of Perth Art Collection," "The Perth Gazette," or "Birtwhistle local history library." A further 10 records were included through interviews with project officers, and contributions gathered through workshops with school children were uploaded as video and image files ("River Scenes" and "River Sights"). Forty-five entries were uploaded by individuals, including personal contributions by those who developed the project. This demonstrates an ethics of "mapping with," where the researchers' own emotional engagements with place were included alongside those of other participants whom they inspired to contribute. Within the dataset, no distinction is made between researcher and research-participant.

Taking theoretical inspiration from the cultural studies and critical theory approaches to place discussed earlier, I first consider how the collection and mapping of emotional encounters in this way reveals spatial identities of Derbal Yerrigan and Djarlgarro Beelier. As well as explicit descriptions of landscape, the accounts implicitly relate emotional practices that produce connections to sites and describe how various emotions are performed at the rivers. I then go on to discuss challenges in conveying sense of place through the medium of a website and map. I conclude with a discussion of the limitations and opportunities provided by this kind of project.

EXPRESSING EMOTIONS ABOUT PLACE — "LOVELY BEYOND DESCRIPTION"

Emotions, first and foremost, are revealed in how people recount their experiences of a landscape. For example, upon arriving in 1829, a traveler on HMS *Sulphur* noted: "The Swan River would require the language of a poet to describe it. The scenery on its banks is lovely beyond description; its course is beautifully serpentine" (**bit.ly/2FPmVe8**).[1] The river is "lovely" and "beautiful," so the author is presumably pleased by it. Beneath (or perhaps "beyond") this description is the act of emotional engagement. Written texts like this are a demonstration not of the moment of sensing, but a mediated emotional response. They depend on the capacity of writers to convey how the rivers make them feel. This project is therefore a collation of mediated expressions, a reflection on both the riparian landscapes and those who share their accounts, as well as the research techniques and curatorial decisions made by the project team.

There are broadly two sorts of entries in the Rivers of Emotion database. On the one hand there is user-generated content where contributions were prompted through participation in the project itself. On the other, there is content reproducing historical material collated by the project team and uploaded into the database. These archival entries provide a record of the historical environment, and of historical practices of emotional engagement. They also serve as examples of spontaneous responses to the landscape formulated outside the framing of the Rivers of Emotion project (although included in it through selective curation, of course). One example is W. C. Gilbert's 1827 record in the HMS *Success* expedition notes:

> The scenery was delightful,—the Trees growing to the water's edge,—the transparency of the River,—the Mountains and Plains alternately appearing—and this place only requires a little assistance from Art to render it one of the most delightful spots on earth. (Broomhall and Pickering 2012, 21)

His joy echoes that of James Stirling, Captain of the expedition, who describes the first bend of the Swan River as a "magnificent basin" (Broomhall and Pickering 2012, 21). Stirling's emotive descriptions are articulated with a

1. As the project website is no longer available online, I provide alternative sources at which to view the database contents to which I refer. The database contents can be browsed through the Wayback Machine (**web.archive.org/web/20170912200556/http://riversofemotion.org.au**). Where entries are not available through the Wayback Machine, references have been provided to the project book authored by Susan Broomhall and Gina Pickering (2012).

wider purpose, not the least because they helped justify his desire to found a colonial settlement along the river. An engraving, copied from a sketch drawn on the same expedition, depicts a comfortable scene of lush grass and tranquil waters drawn in a style such that viewers far away find the landscape sympathetic (**bit.ly/2AWAtkG**).

This archival material reveals how, in coming to a new landscape, many judgments were made through comparison with other places. One entry refers to the riverscape as within a "topsy-turvy country," a moniker that emphasizes the strangeness of the environment as a departure from familiar landscapes (Broomhall and Pickering 2012, 24), while another likens the mosquito-infested swamps along the Swan to the jungles of Papua New Guinea (**bit.ly/2HoqPwP**). These descriptions invoke distinct spatial identities or "imagined geographies" to help convey a sense of place.

Returning to the idea of place as palimpsest, naming is another very obvious way in which spatial identities have been both inserted and ignored, erased though colonization, overwritten and re-inscribed. Referring to new places through the re-use of European names (such as Perth or Swanbourne or Dalkeith) has emotional consequences, bringing to these new places a suite of emotions associated with the original locations. Through Nyungar place-naming, too, emotions are inscribed in the landscape. Etymologies such as *Goodinup* (a place of desire of the heart), *Beeabboolup* (a place of abundance), and *Walyaup* (a place of crying) (Bracknell et al. 2015) signify emotions associated with particular sites in the riverscape. The Rivers of Emotion database includes stories and artworks demonstrating indigenous connections to this *budja* (country), and also records the intentional assertion of Nyungar place names, with one entry referring to a speech by politician Alannah MacTiernan in September 2003:

> The naming of the Canning River twin bridges in Langford as "Djarlgarra," the traditional name for the river, was selected after consultation with local Noongar as the "meeting of Aboriginal and European cultures as the general area is where Europeans first chose to settle in 1829." (Broomhall and Pickering 2012, 26)

Names are often very deliberately chosen for the emotional connections they invoke.

Archival records are complemented by accounts generated through the project itself, in workshops, the symposium, and the web-based participation process where contributors were primed to think reflexively about how the rivers make or have made them feel. Researchers took a deliberate decision not to define emotions, but rather to give participants a free-text space to write in their own terms how they think places are emotional (Susan Broomhall, pers. comm.). The intention was for the participants to inform the project team about public perceptions and definitions of emotion. The project philosophy was inspired by the following assertion by Julian Rappaport:

> If narratives are understood as resources, we are able to see that who controls those resources, that is who gives stories social value, is at the heart of a tension between freedom and social control, oppression and liberation, and empowerment versus disenfranchisement. (1995, 805).

Hence the aim of the project was to elicit a wide range of content from diverse groups and not to predetermine what it might look like. The wording on emotions in the book and on the website was deliberately broad, promoting the sharing of stories, memories, experiences, feelings, affections, and emotionscapes.

Researchers did nevertheless observe limits in the ability of respondents to verbalize emotion and therefore included a vocabulary of prompt words to assist this. Contributors could either choose a "tag" from this list or write their own emotion words in if they could not find a term that fit. Although the database was able to encompass expression of emotion in different forms—through sketching, painting, sculpture, photography, video/sound recordings, and text—the capacity for people to convey how they feel is shaped by the form. As I go on to discuss, the ability to re-present these in a digital format is another complicating factor in conveying emotions to users of the database. For example, clay sculptures produced by school children in response to the river could only be included in the digital database as photographs or text descriptions.

EMOTIONS IN RIVER PRACTICES

Another strategy for uncovering emotional engagements with place is through an examination of emotional practices, in the form of the interactions people have had with the rivers (see Scheer 2012 for a detailed discussion of this theoretical approach). Many contributions to the database describe the rivers as a place of recreation. Some record everyday interactions, of coming down to the rivers as calming (see for example these interviews with Orana Catholic Primary School students [bit.ly/2DpJDaM]). Others talk of special times or occasions enjoyed at the rivers. There are childhood memories of family outings (Figure 3).

One childhood memory in the database is a quotation of Nyungar Elder, Irene Stainton, recalling enjoyment and sustenance from the rivers:

> Aunty May used to take us turtle fishing near Guildford Bridge. We used to catch them with a fishing line, using small pieces of meat for bait. Aunty May would wring their necks and we would take them back to her house where she would cook them in the oven, placed on their backs. I remember the meat being quite juicy and we would dip our warm damper in to soak up the juice. (bit.ly/2S10MQi)

Learning to swim, paddling, and fishing: these are bodily, affective experiences, conveying the physical presence of the storytellers in the landscape and familiar practices associated with place. The also tell us about practices that pass on emotional attachment, extending these from individual experiences into a collective way of identifying sense of place.

Indeed, reading multiple entries we can begin to see how stories work together to create larger narratives of the role of the rivers in people's lives. It is possible to identify tropes—such as, for example, the number of contributions demonstrating the fine line between fun and fear, particularly in on-water adventures:

> Often our course took us down towards the mouth of the river towards Point Walter and then turn around a marker called "suicide." Yes, we did get knocked down jibing around the marker. As I was working the main, I finished up being the only one of five left on board. We finally righted ourselves and sailed in a very wet fashion back to the finish line. No trophy that day. (bit.ly/2U4xopH)

The rivers have sad histories of tragic deaths and suicide, with this element of the rivers discussed and painted by Jo Darbyshire through several separate entries (bit.ly/2REGInr; bit.ly/2FGnPKm). Another database record depicts a marble monument remembering children who drowned in a boating accident. The emotive act of establishing a memorial on the rivers continually presents the event over time, and the recording of the memorial in the database recognizes not only the emotions attached to the accident, but the process of reinscribing emotional engagement that occurs as people visiting the rivers today interact with the memorial. Yet, perversely, while tragedies can loom large in the collective imagination associated with places, here they are another entry in a database, accorded the same treatment as a passing whim. This is but one way in which the collection of stories in the database is at odds with how stories come together in our memories to create a sense of place.

Another aspect of place difficult to compress into a soundbite or map

Fun on a hot summer's day

Nothing could be more fun on a hot summer's day, than for the Mums of the street to organize a picnic on the river's edge! We all packed into the couple of old cars & drove to our favourite Peppermint Grove, at the foot of Johnston Street, where the cool trees shaded the grassed verge close to sand & the lapping river. Exploring, we paddled, under watchful parental eyes, finding shells, jellyfish, blowies and driftwood. We sailed our homemade war ships, all grey & black, that had been lovingly fashioned by our handymen Dads.

Author: Margaret McLean
Date: 1940s
Tags: fun lovingly watchful

Figure 3. *"Fun on a hot summer's day," Margaret Maclean. (bit.ly/2DoISPw)*

entry is the very multiplicity of impressions that coincide when experiencing place. Sitting by the rivers, there are very many shifting things that can impress: the sound of water lapping, mingling with traffic in the background, bird calls, light playing, and a cacophony of thoughts and recollections. One of the poetic contributions to the database by Nandi Chinna entitled "Derbarl Yerrigan" reproduces this layering of stories, described here as "misunderstandings":

> There are so many misunderstandings about a river:
>
> [. . .]
>
> Is it a mixing of sweet water with salt,
> turning back upon itself, mingling interior and exterior
> estuary nibbling at river, river haemorrhaging
> into the widening space?
>
> Is it the flick of a serpents tail,
> or the wake left behind as its rippling skin
> cuts swathes in limestone hills?
> Or an ancient trail along which people walked
> following tributaries and at each place
> re-telling the story of every drop of water
> that seeps from the ground, high dives from stony ledges
> and cleaves relentlessly westward?
>
> **(bit.ly/2DqeYuk)**

Chinna's mixing of geomorphological elements with Nyungar connections to *budja* is added to throughout the poem with other impressions from her personal interaction with the river and the citation of both historical and contemporary writers. Chinna's writing is inspired by walking through the landscape and she has published a volume of poetry about places along the Swan River, written on her walks (Chinna 2014). This poem, here a database record, invokes the very sense of mingling stories that flow through the river's identity, and at the same time it is a discourse on the act of reflection as revealing the multiple stories that entwine around a place.

By searching through the database entries by keyword it is possible to construct basic relationships and find common ideas. Several sites tagged as "happy" are where people bathe in or relax by the river. "Dark" is associated with places where the river narrows and refers, the detailed text of the records shows, more to spaces under bridges or where one might be at night rather than the cliffs or dark spaces along the shore. In this way a link can be drawn between individual affective responses and more common imaginings of sites along the river. It requires the aggregation of many stories and would probably be more effective with a larger sample size than the existing entries in the database. A further step that has not been taken here in the design of the database is the possibility of flagging associations between entries as they are read. Within individual records in the database, readers do not see explicit connections with other contributions. Entries are discrete, each an individual response, and it is not possible to easily find out if there are similar stories or whether responses to the same place build upon each other or change over time.

RIVER STORIES THROUGH TIME

By highlighting the motion in e*motion*, Giuliana Bruno suggests that space is mobilized by emotions: "set into motion through the lived connections of being" (Bruno 2002, 410). In the act of sensing, place is activated and "shimmers" through the engagement of actors in place. Reading about or viewing emotional engagements, web visitors might, in a way, be transported to the sites of interaction. However, following journeys or tracing evolution through time is much more complicated in the context of the digital database and cartography project.

The database and map provide a simplistic representation of dynamism. While it is tempting to imagine the project map as an overall scheme of emerging and accumulating stories, each entry on its own has a more complex temporality. Many refer to a series of memories:

> Point Walter is a special spot for my husband and I. It was the location of our first date, our first kiss, where we celebrated our engagement, and then in 2011 where we were married. I

> hope in a few months it will also be the first place I take our son. So much love in one location. (bit.ly/2FDx6Tz)

Like many others, Melissa Kirkham's entry above is about the inscription and re-inscription of the same site through a continuing connection, even imagined into the future. Time crumples together, too, in Albert Corunna's explanation of how "camping sites, places of birth, and burial sites are significant in our [Nyungar] connection to country" (Broomhall and Pickering 2012, 26). Multiple temporalities are thus combined through the compilation of an entry in the online platform, and given a new, single time-stamp. Re-*present*ing the past through the digital, the database contains data recorded over a time frame of several hundred years and extending further in relation to indigenous occupation. The representation of this is therefore necessarily more complex than a timescale slider and markers appearing or disappearing from the map.

Caquard and Cartwright emphasize sequencing as another important aspect of temporality within cartography, writing:

> The simple location of the events alone is not sufficient to grasp the meaning associated with place. The sequencing of those events is a major element to make sense of their full spatial meaning. . . . in order to be mapped stories have to be envisioned as integrations of space and time; as spatio-temporal events. (2014, 102).

Although contributors are asked to provide a date relating to their entry, the Rivers of Emotion map interface did not allow for the sequencing of stories/images/sounds. Website visitors thus missed out on the opportunity to read stories in temporal context. As Margaret Wickens Pearce's case study of canoe voyageur John Macdonnell in Canada demonstrates, innovative cartographic work would have been required to represent narratives of movement through space. Pearce used color hues to denote different moods and emotional responses along Macdonnell's river journey, creating "affective geographies in the map by fostering performativity and intimacy and encoding for the movement of emotions in the landscape" (Pearce 2008, 30 and Figures 4–8).

The use of novel techniques such as the integration of moving icons or color coding could help readers to understand the complex interplay of spatial, temporal, and emotional elements. There are many possibilities here for visual interfaces to include complex and cinematic components. The clay figures of school children could be 3-D scanned and rise out of the mud of the river at relevant places. There is the capacity to meld stories into one another, showing how a place transitions through time. Or, animated lines could follow narrative journeys and trace movement through the landscape, perhaps incorporating mash-ups with video from GoPro cameras that follows a user's visual experience through place (for critical discussion of animated maps, see Mapbox 2013 and Wilson 2017). One might take inspiration from Lisa Parks, who writes:

> By inscribing the materiality of human movement onto the discourse of cartography, the GPS map brings global positioning and social positionality together. And in blending the stories of location with digital cartography, plotting the personal transforms maps into situated "world-views." (Parks 2001, 217)

In this vein, we might even find ways of flicking between different participant perspectives to represent the multiple authorship or the varying positionality of map contributors.

REFLECTIONS

The more complex a representation, the more tempting it is to become drawn into the cartographic logic of encapsulation and order. The overview of the map prompts us to consider the database as analogous to the way information comes together (and moves apart) in the construction of spatial identities, as a digital form of Casey's (1996) gathering. But the map is not the territory, and the database is not the imagined geography. Like Haraway's (1991, 189) "God trick," or Nagel's (1986) "view from nowhere," the database, and indeed the map, seem to bring all these impressions together, suggesting that we understand an objective overview of the situation. The database, recording traces of the way people have experienced particular sites along the rivers, is a bit like a kind of multi-dimensional

digital photographing of ideas coming together and coalescing to form a sense of place. But, like a photograph, the database is not all-encompassing and its technology, authoring, and temporality need to be questioned.

Many aspects of the map are obscured from view, and without an account of the map's curation, we are not able to see the processes of selection underlying this representation of place. The database is a partial view, combining particular kinds of responses. Kitchin, Gleeson, and Dodge (2013) employed narrative reflection to write about "unfolding" and revealing mapping praxis. While a revelation of project genealogy cannot hope to consider all possibilities, it does help readers to understand the contingencies by which decisions have been made, providing critical metadata on the map's content. Analysis should include both what the project entailed as well as considering what might have been. It also requires looking at the agency of those not necessarily credited with a voice, including non-human agents such as the river itself (see Smith 2017 for a detailed discussion of the agency of rivers). While a full-length narrative analysis is outside the scope of this article, research for this paper included retracing the decisions made in designing the project and compiling the database, website, and map. Critical examination included analysis of factors such as those identified by Mark Graham (2017): participation, access, control, and representation, and I address each briefly here.

Reflecting on the process of digital participation in the Rivers of Emotion project, there are several ways in which both the contribution of information and accessibility are limited. The project had a short time span tied to the funding available to keep the website active. It was taken offline in late 2017. The project has also been affected by the limited number of people who knew of it and were inspired to contribute, despite efforts to promote it through outreach in schools, the symposium, and publication of a book. Additionally, individuals wishing to contribute required access to the internet, an email account, and sufficient computer literacy to complete web forms (and in some cases to upload documents). The project team proactively sought to address accessibility issues by working with both children and older people who might not be able to access the interface of their own accord. These people, and those whose words or works are within archival material, could not, however, determine how their engagements with place were represented.

Power over these contributions is exerted through the network of software, institutions, and discourses that hold the map together. Even the contributors who authored and submitted their own emotional experiences are bound by the protocols of the database for submitting information and how it appears in the context of the map. Given the project is a public website, it excludes emotional engagements that people prefer to keep private. While authors could choose a pseudonym, they did have to provide a valid email address. Once a contribution had been made, the author was not able to control any settings that might determine who could read it or how the contribution appears online. Once shared, the report was unable to be edited. The curators could in principle exclude or alter content—although this was not ever considered necessary. As it is, the curators exercise power in re-presenting these stories, sounds, and images in the context of the Rivers of Emotion database. The context in which a story is heard or an image seen affects how it is interpreted. In particular, taking these experiences out of the landscape and into a secondary medium changes their affective power. We are no longer in place, surrounded by the same physical impetus. On the other hand, the entries gain new meaning through their juxtaposition with other contributions, from different people, with different responses at different times. The website user can choose the path they take through this online catalog: sorting, filtering, and determining the method by which they enter into and out of database records. They, too, have the privilege of a cartographic voyeurism, scrolling around the landscape, able to zoom in on other people's memories. Website visitors did not have to identify themselves or go through any form of security before accessing the content. It is interesting to note that despite the rhetoric defining online users as "produsers" (Bruns 2007) or "prosumers" (Toffler 1980), suggesting an elision of audience and contributor, these two modes of interacting with the database are quite distinct.

The ability to hover over and zoom in and out of the riverscape is just one consequence of choosing a map to present this data collection. Returning to the discussion of cartographic representation, the use of a web map provides, as the designers intended, a familiar entry to the landscape. The information could have been presented through alternative means, such as a book, web discussion forum, film, or museum exhibition. The use of an online map provides access to a widely dispersed audience and allows the incorporation of multimedia elements. It also has the benefit of showing us the areas of the riverscape that do not have

data recorded—the blank spaces on the map. These indicate forgotten places or locations that may have meaning to people who were not involved in the project. Use of a mapping interface also promotes the sorting of multiple records and, with more records and a more sophisticated interface, might have led to deeper understanding of how engagement with the rivers has changed over time.

Moreover, as I noted earlier, the cartographic authority of the map influences the representation of information. The map has a discursive power that appears to provide a comprehensive overview, in a clean manner. As such, it hides the messy and contingent nature of the data. This is unfortunate, as one of the key elements that defines sense of place is contingency. In presenting and reading a map of this nature, it is exactly this contingency that needs to be emphasized. Instead of a comprehensive definition of spatial identity, entries in the database should, I suggest, be considered as recordings of the way people have thought about and relate to place. These are samplings, but not "samples" in a scientific sense. Neither should we assume they are representative of other ideas or places. Assembling them here provides impressions or tastings, rather than any sort of comprehensive attribution of spatial identity. Place is fluid, and these samplings, as moments of realized engagement, are partial, positioned observations of flow. Each recording enables a digital placemark on a shifting, sometimes legible watermark.

However fleeting or ephemeral, there is nonetheless a value in sharing these moments. In the revelation of different perspectives, of conflicting accounts, as well as the compassionate recognition of shared experience, there is capacity to open up the concept of sense of place in order to account for more than individual impressions, taking in the seething collective of imaginings. Larsen and Johnson (2012, 640) suggest that sharing moments of contemplation, "wonder," and "compassion" "opens up an affinity politics [that] lies in the attunement to and understanding of the constant mutability of the world . . . and the compassion intrinsic to grounded social and ecological relationships." Kye Askins (2016, 526) too, suggests that through emotional engagements, including conflict, "it is precisely the emotional that opens up the potential for making connections, and through which nuanced relationships develop, dualisms are destabilized, and meaningful encounters emerge in fragile yet hopeful ways." Cartography certainly can play a role in communicating emotional engagements and facilitating such exchanges. Indeed, Francaviglia (2005, 188) finds a similar sort of affinity inherent in the spirit of cartography when he writes:

> Mapmaking and exploration may answer questions about the discovery of places that are very remote, but they always involve human emotions that are surprisingly familiar. In the end, all cartography—like all exploration— attempts to conquer the unfamiliar by making it comprehensible.

Maps that reveal these emotional experiences work to increase understanding of and between people, as well as recording geographical knowledge.

The Rivers of Emotion project encouraged a public awareness of emotional connections, revealing stories for wider circulation. Yi-Fu Tuan wrote of attitudes that reflect a governmental logic where

> the words "attachment" and "love" have no place in social science discourse and sound more like poetry than a basis for a serious argument in political and planning councils where hard budgetary decisions are made. (1974, xii)

Yet through projects such as this just the opposite becomes true. As land managers and planners seek to promote the development of recreational spaces or to document the reasons why a place has "intangible value," it is the recognition of emotional engagements that gives power to otherwise opaque processes like "public consultation." Content from the Rivers of Emotion database has informed the Interpretation Plan for the Riverpark (Swan River Trust and National Trust of Australia [Western Australia] 2014), and hence is used as a basis for governmental decision-making and management practice. Emotions direct people to contribute to such consultations and to act to defend places.

In our everyday lives, emotions underlie the desire to spend time in certain places. Places thus become the settings for our memories and stories. Another extension of this research would be to follow place narratives/river stories as they are retold, considering how they circulate. The database is an assemblage combining different sorts of impressions and, when read and recounted, these in turn will

take on new meanings as database users pass them on to others. Much of the information in the database pre-exists its digital encapsulation and it is capable of breaking free from it.

CONCLUSION

Here I have discussed the practical and technical limits of cartographic discourse: clay figures, however converted and inserted into a map, will be different from their real, tactile form. In examining maps of emotions, it is evident that there is a tradeoff between the map as a straightforward and legible discourse for navigating the landscape, and the visual appearance of the map in revealing the complexity of places, which we recognize as dynamic, contingent, and multiple. More artistic representations might produce interfaces that inspire empathy and reveal subjectivities in the landscape, or even follow these as they shift. In the Rivers of Emotion case study, the map is an ordering device rather than a visual representation of emotional engagements. Clicking through a point on a map, we are led to artworks, films, and stories that help us understand more about these riverscapes. There is scope for future research about the affective power of different map designs and their capacity to impart particular sensations or facilitate shared experience. What sorts of cartographies promote compassionate recognition? Further, can these maintain a fidelity to the form and content provided by multiple voices?

Collaborative cartography projects are contributing to the process of opening up mapping to reveal subjective engagement with place. Starting with the premise that places are fluid assemblages of stories, actors, and engagements, by sampling these stories we gain insight into the respiratory process of sensing and emotionally engaging with place. Of the various approaches discussed, this paper has examined the use of digital databases and cartography as a means of compiling and curating accounts of emotional engagement with places. The Rivers of Emotion case study has revealed the sorts of information a project focusing on emotions can provide and has examined the way stories combine to create broader understandings of spatial identity. I have also considered technical and theoretical limitations to the database and mapping work. While I cannot hope to find a comprehensive cartographic overview of spatial narratives entwining around a place, what a project of this nature does provide is a way of sampling and recognising consonance in river stories, sights, sounds, and scenes. The emotional offers a way of talking across and between oral histories and archival research. It provides way of compiling the living of experiences in different times and by different people, mediated through the recognition that we can identify our emotions in the expressions of others.

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The George F. Jenks Map Collection

Travis M. White
University of Kansas
tmwhite@ku.edu

The Kenneth Spencer Research Library at the University of Kansas (KU) houses two collections related to the renowned cartographer George F. Jenks: the Personal Papers of George F. Jenks (call number PP 474) and the George F. Jenks Map Collection (MS 347). Dr. Jenks taught in the KU Geography Department from 1949–1986 and established the cartography program there. He became internationally recognized as a preeminent cartographer and scholar alongside peers Arthur Robinson, John Sherman, and Erwin Raisz. Both collections consist primarily of maps and documents that Jenks collected or produced in support of his research, teaching, and cartographic activities. Importantly, the map collection preserves the artwork underlying many of Jenks's published maps, including hand-drawn sketches, photo negatives, and compilation artwork. This article highlights items from both collections which, when viewed chronologically, document two parallel stories: one of an evolving research agenda, the other of an evolving discipline.

Jenks's career corresponded with the maturation of academic cartography and the emergence of computerized map production and statistical analysis. He spent many years developing and refining a formal cartographic curriculum, which he documented in the appropriately titled "An Improved Curriculum for Cartographic Training at the College and University Level" (Jenks 1953) and "The History and Development of Academic Cartography at Kansas: 1920–1980" (Jenks 1991). At the same time, Jenks devoted himself to a series of thematic mapping projects and research challenges. The map collection is arranged chronologically, and perusing its contents reveals five broad, overlapping phases of his map research and production: (1) Kansas-centric cartography, (2) data classification and generalization, (3) 3D representation, (4) map symbol perception, and (5) automated line generalization. The following sections highlight examples from each of these phases.

Figure 1. *Dr. Jenks expounding on something map-related.*

Jenks spent much of the 1950s producing statistical maps of Kansas. Representative examples of this work can be found in *A Kansas Atlas* (Jenks 1952) and the *Kansas Industrial Resources* atlas (Jenks 1956). At a time when most state mapping agencies were either nascent or nonexistent, having a cartographer of Jenks's caliber proved to be a boon for both the state and private industry. *A Kansas Atlas* was a rarity upon publication: a multicolor, in-depth statistical atlas devoted to a single state. Jenks mapped an exhaustive array of topics, ranging from population dynamics to agricultural productivity, using a variety of

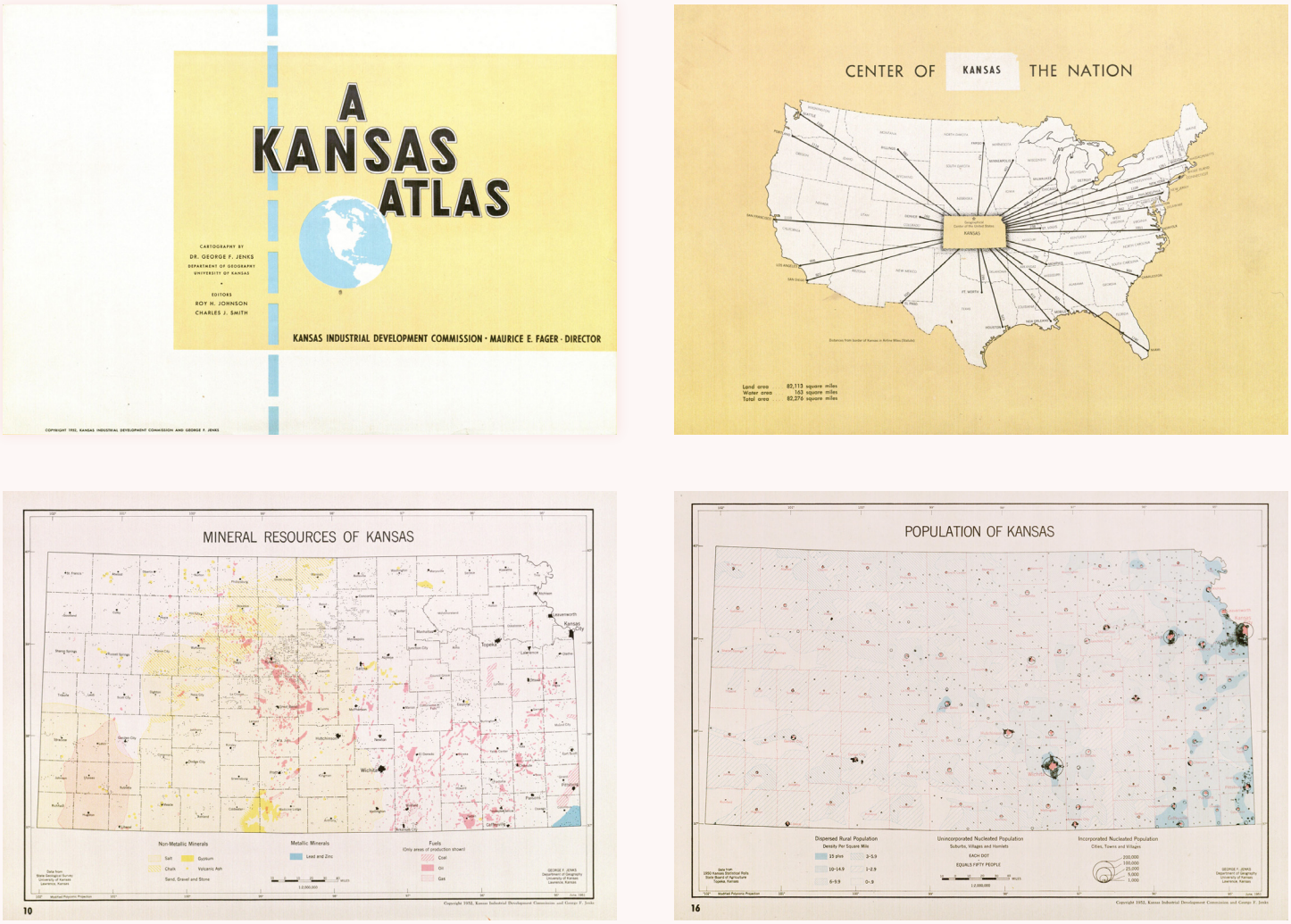
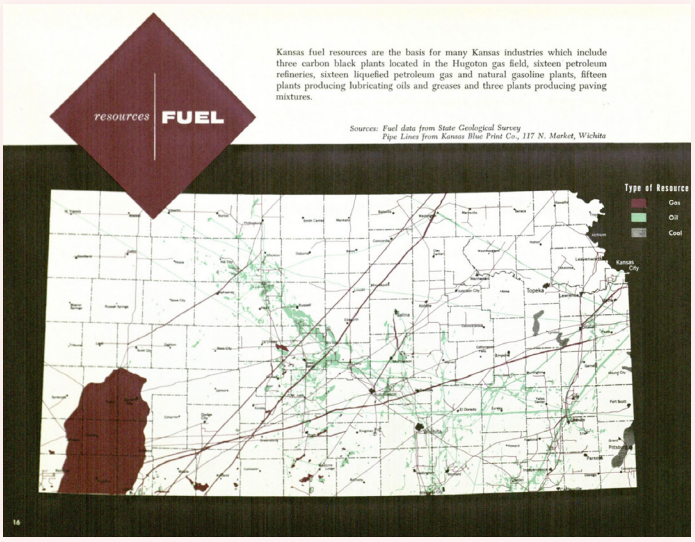


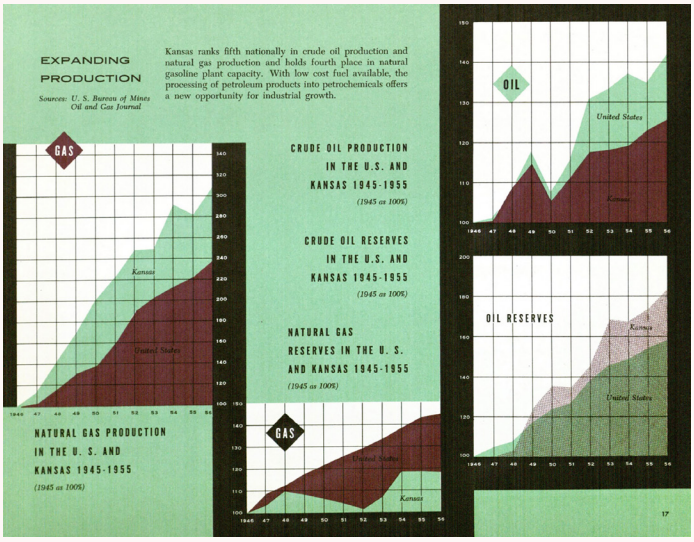
Figure 2. *Selections from* A Kansas Atlas *(1952). The collection contains preliminary artwork, proof prints, and finalized prints of each graphic.*

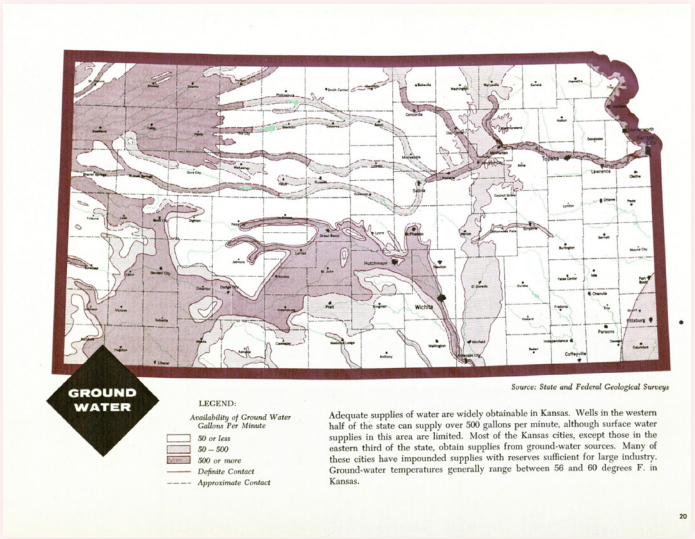
cutting-edge symbolization techniques. Robert McMaster (1997) claimed this was the first-ever state atlas. Jenks's thematic organization and map symbolization methods were pioneering efforts of the time; those methods continue to be used today.

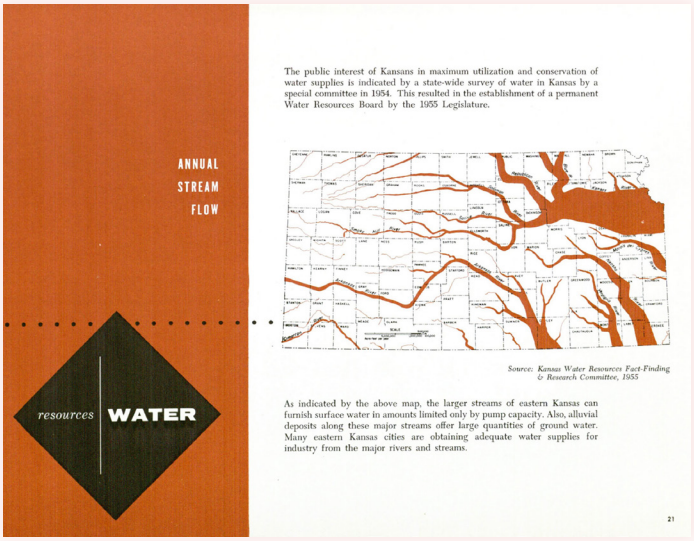
The *Kansas Industrial Resources* atlas (1956) is a masterclass in two- and three-color map design and artful cartographic generalization. To this day mapmakers struggle with the challenge of generalizing data so that important information stands out while preserving the accuracy of that information. Jenks simplified and elevated mundane topics such as railroad freight service and electricity grids into visually arresting, statistically accurate map displays. Figure 3 presents several examples of this aesthetic. For instance, the Annual Stream Flow map uses line width alone to communicate how Kansas streams carry more water as they move south and east.

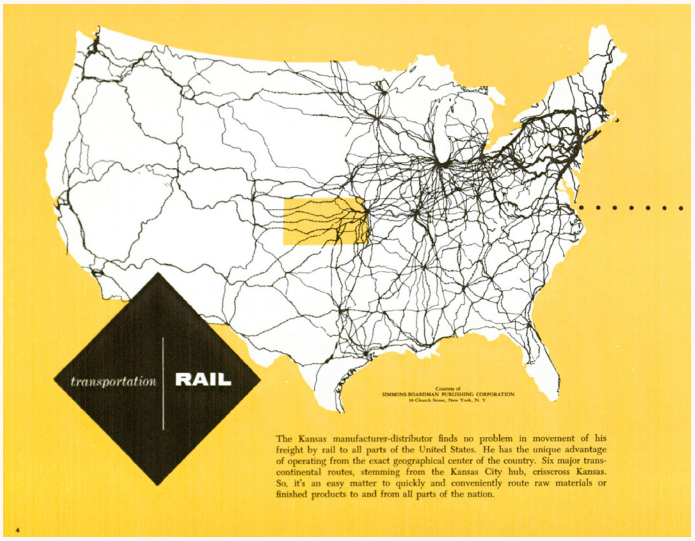
Beginning in the early 1960s, data classification and generalization became a prominent theme of Jenks's research. Two of his publications, "Generalization in Statistical Mapping" (Jenks 1963) and "Class Intervals for Statistical Maps" (Jenks and Coulson 1963), remain seminal pieces in the cartographic literature. Through this research, Jenks helped to systematize the process for classifying spatial data and devised rules to guide the selection of effective classification methods for choropleth maps. The research culminated in his most recognizable contribution to cartography, the eponymous Jenks Optimization and Jenks Natural Breaks methods of data classification (Jenks and Caspall 1977). The map collection contains the maps and











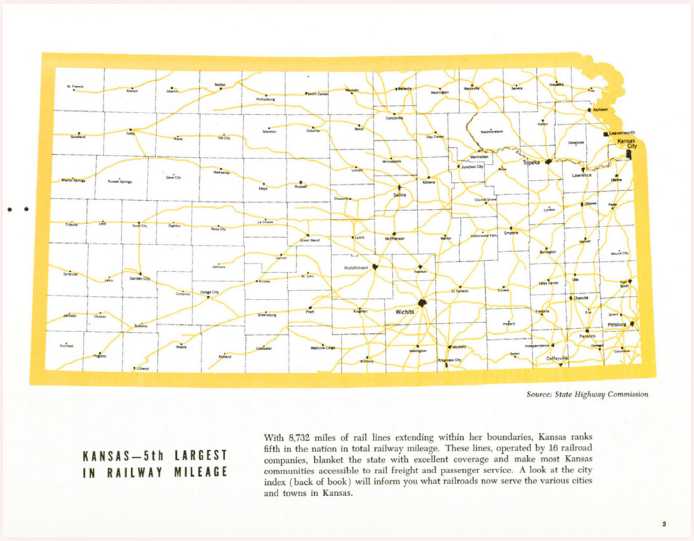


Figure 3. *Selections from the* Kansas Industrial Resources *atlas (1956). The collection contains preliminary artwork, proof prints, and finalized prints of each graphic.*

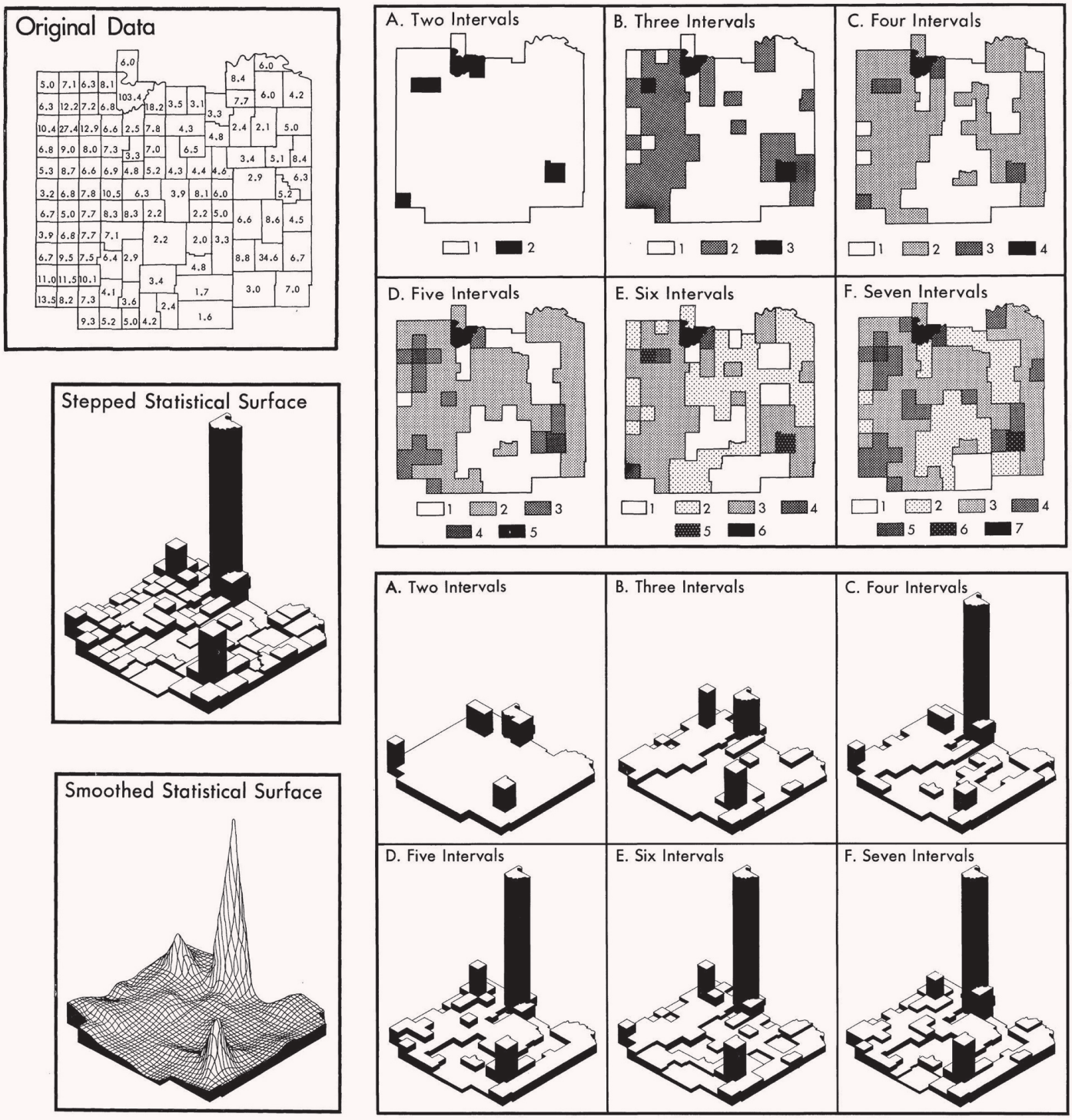


Figure 4. *Graphics from "Class Intervals for Statistical Maps" (Jenks and Coulson 1963), illustrating the process of data generalization. Different class intervals affect the appearance of the data on the map. The collection contains the preliminary artwork, photographic negatives and masks, test prints, and finalized prints of each graphic.*

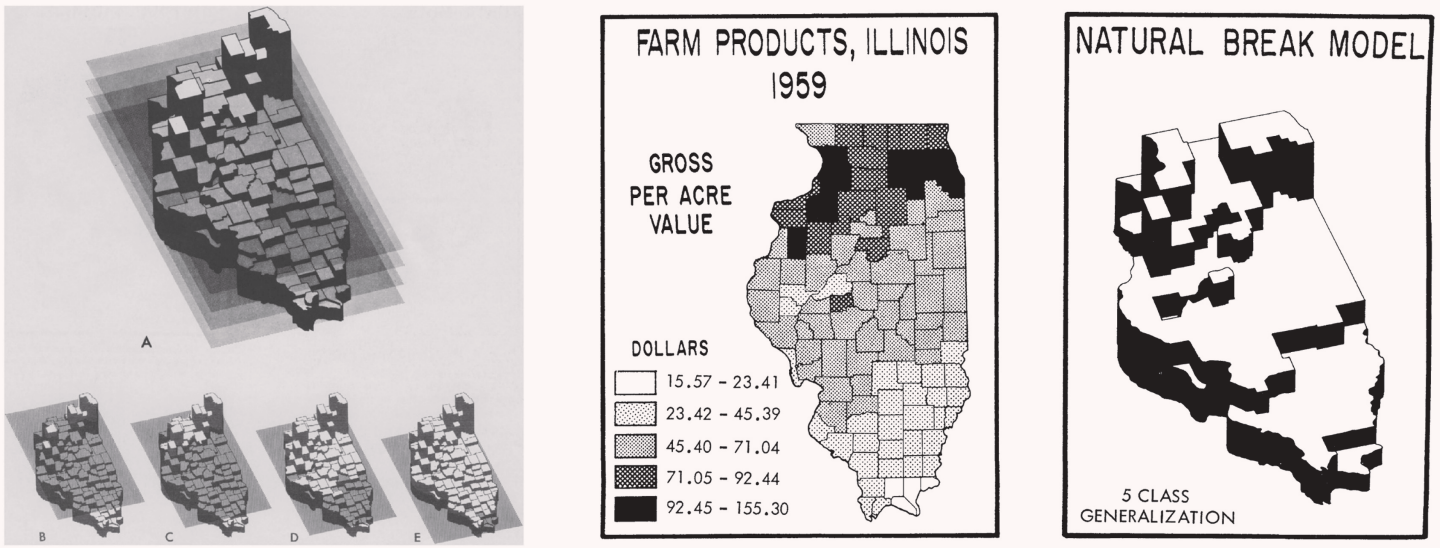


Figure 5. *Graphics from "Error on Choroplethic Maps: Definition, Measurement, Reduction" (Jenks and Caspall 1971), which introduced the Natural Breaks method of data classification. The collection contains the preliminary artwork, photographic negatives and masks, photographic positives, test prints, compilation artwork, and finalized prints of each graphic.*

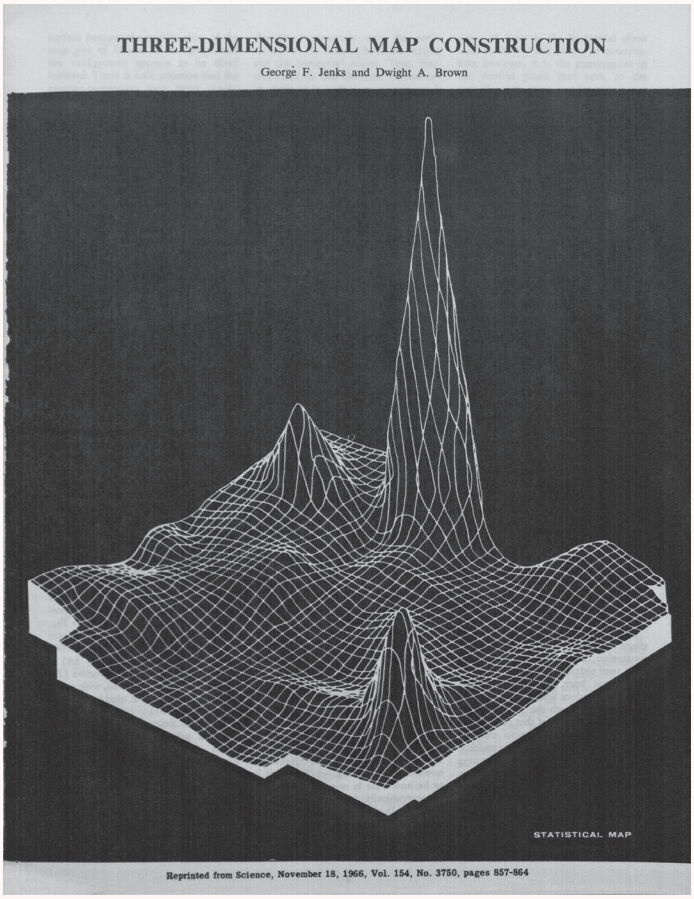


Figure 6. *A three-dimensional "smoothed statistical surface" map representing population density in central Kansas. This graphic graced the cover of the November 18, 1966 issue of Science. Jenks originally created this graphic for his class intervals research. The collection contains the preliminary artwork, photographic negatives and masks, photographic positives, test prints, compilation artwork, and finalized prints of each graphic.*

graphics Jenks created to devise and illustrate these two concepts, some of which are still used in contemporary cartography textbooks.

Another staple of Jenks's research was three-dimensional map construction. From the mid-1960s onward he refined 3D mapping techniques, first by hand and later using computers. Jenks ran many experiments and published several papers exploring map construction and optimal viewing perspectives in three dimensions. One publication, "Three Dimensional Map Construction" (Jenks and Brown 1966), remains highly recognizable within cartographic circles, and also featured one of Jenks's most famous maps: a three-dimensional representation of population density in central Kansas. Interestingly, this graphic was initially produced for his 1963 paper on class intervals (Jenks and Coulson 1963) but he continued to use it as the basis for many successive graphics and ideas. Given the time-intensive nature of pre-computer, photo-mechanical map production, it is not surprising that many of his maps appear again and again throughout the collection.

Jenks believed that understanding map users was crucial for effective map design, and many of his experiments were designed as user studies to explore their perception and understanding of mapped information. His concern for the user's experience led him to psychophysics and the psychology of perception. Beginning in the early 1970s, Jenks incorporated eye movement into his user studies. The examples provided in Figure 7 were used in experiments

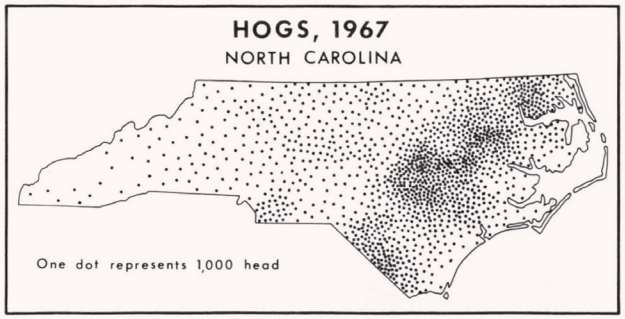


Fig. 1 – This small scale dot map is a commonly used type of thematic map. Some readers of such maps seem to group clusters of dots into regions of homogeneity while others try to extract factual data as they would from a census table.

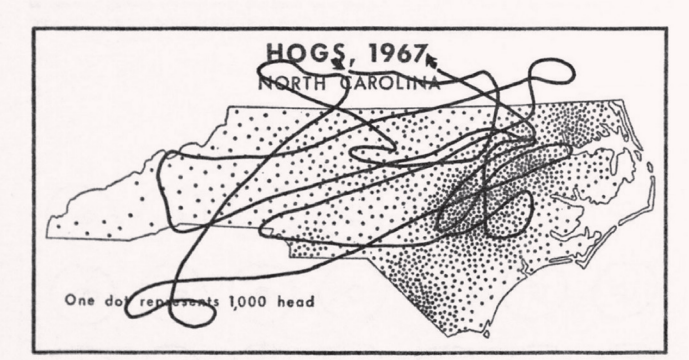


Fig. 6 – The scan path of a graduate student reading the map. If one follows this path it soon becomes evident that redundancy and erratic movements of the eye are part of the map reading process. This is also true of the scan paths of readers looking at pictures and other types of illustrations.

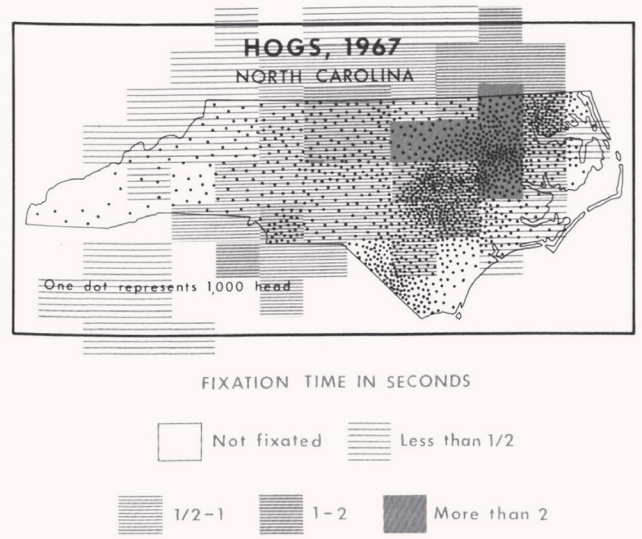


Fig. 9 – The time spent at each decoding position is shown by the areal patterns on this map. It can be assumed that time spent looking at certain map features is related to either the interesting nature of those features, the information available from those features, or both. In this case very little importance seems to have been given to areas of low hog density.

Figure 7. *Jenks frequently featured North Carolina hog maps in his cartographic experiments. These graphics appear in his 1973 paper "Visual Integration in Thematic Mapping: Fact or Fiction?" The collection contains literally hundreds of photographic negatives, photographic positives, test prints, finalized prints, and experiment booklets of these and similar dot density hog maps.*

reported in "Visual Integration in Thematic Mapping: Fact or Fiction?" (Jenks 1973) and "The Average Map Reader Lives!" (Jenks 1974). This early foray into perception served as a template for other cartographers to build upon, to the point where cognitive psychology became and remains an essential component of cartographic research.

From the late 1970s until his retirement, Jenks's gaze shifted to the burgeoning realm of computerized cartography. Having run the KU cartographic production laboratory for decades, Jenks was keenly aware that new technologies would reshape conventional map production workflows. What caught his particular interest was how the shift from manual to digital techniques would affect the representation of linear features such as coastlines and rivers at various scales. Consequently, Jenks spent the last major "phase" of his career refining methods of automated line generalization. Both collections contain an abundance of plotted lines and maps Jenks created using his own generalization algorithms and indicates that he remained a prolific researcher even near the end of his career. These items also highlight how Jenks embraced new technologies to accommodate—and possibly even answer—old cartographic questions, as well as continually improve the overall quality of finished maps. Automated feature generalization remains a persistent challenge as interactive map standards continue to evolve.

This article only skims the surface of Jenks's celebrated career and the contents of Jenks's personal papers and map collection. The reader should note that while many of the maps featured here may not appear noteworthy by today's standards or software capabilities, they were considered revolutionary and cutting edge in their time. Perusing both his personal papers and map collection reveals the breadth and depth of Jenks's cartographic expertise. He was an innovator, recognized as an expert in symbology, cartographic reproduction techniques, and the links between cartography, psychology, and human factors. The Jenks collections document the breadth and depth of all of these scholarly and investigatory activities. A key strength: the exhaustive preservation of material allows one to follow an entire creative process from its earliest stages to the final, published product.

The Kenneth Spencer Research Library is open to the general public, and the contents of both the map collection and Jenks's personal papers are available to view by appointment in the library's reading room. I am indebted to Dr.

Karen Cook, Special Collections Librarian in the Kenneth Spencer Research Library, for her guidance during the archiving and processing of the Jenks Map Collection.

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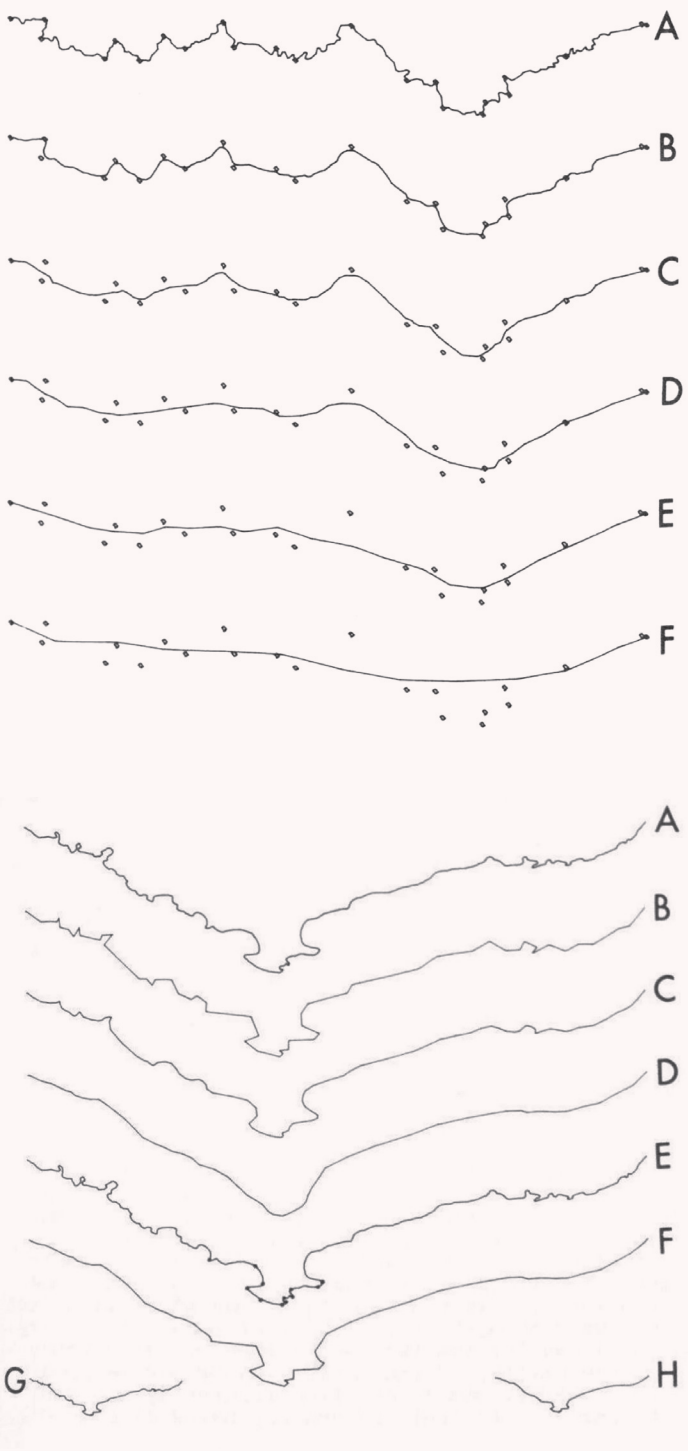

Figure 8. *Jenks spent over a decade developing and refining simplification algorithms for multiscale line generalization. These graphics, from "Thoughts on Line Generalization" (1979), illustrate how Jenks used selective coordinate pairs to digitally smooth and retain the significant details of linear features. The map collection contains hundreds of computer printouts similar to these examples, many annotated with notes, formulas, and handdrawn comparisons.*

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Visualizing Bird Migration with Animated Maps

Brian Jacobs
National Geographic Magazine
briantjacobs@gmail.com

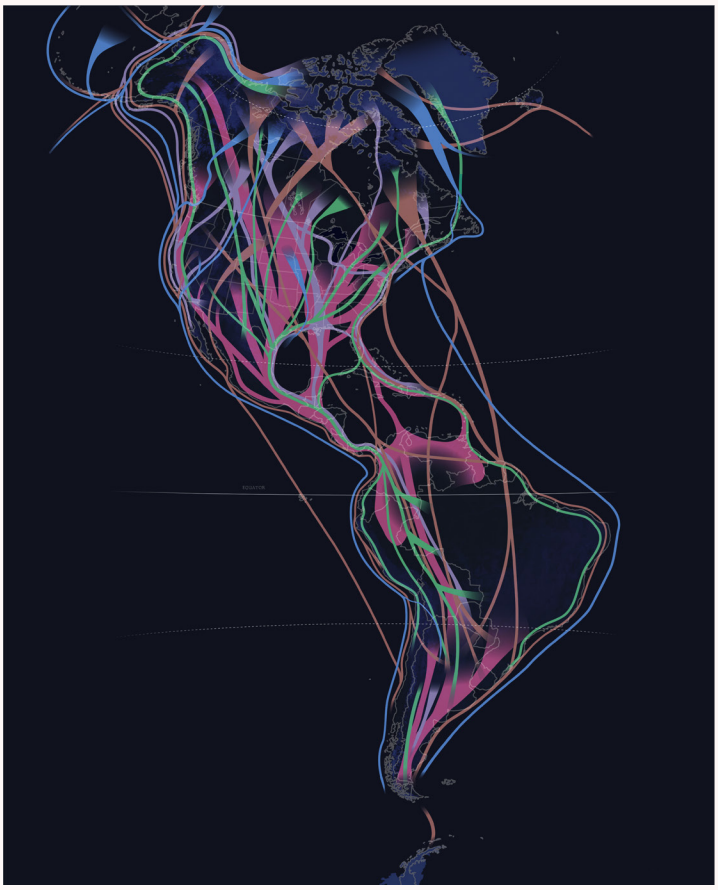
The following is an updated edition of an article that originally appeared in Source: *source.opennews.org/articles/how-we-made-billions-birds-migrate.*

"Billions of Birds Migrate" is a data-driven feature published in February 2018 on nationalgeographic.com, showing the journey of several species of migratory birds across the western hemisphere, through text, audio, photography, and animated maps. The project began as part of *National Geographic* magazine's involvement with the **Year of the Bird** campaign, an effort to bring more attention to the role of birds in their habitats and **why birds matter**. Alongside the web feature, the magazine also covered the same topic in a map poster created by Lauren E. James and Fernando Baptista, circulated as a supplement in the March 2018 issue. The poster includes maps of migration routes in both the eastern and western hemispheres. It's a concept that was previously explored in posters made in 1979 and 2004.

This new map updates bird routes to reflect the knowledge we've gained over the past decades about where birds go, and features original illustrations that highlight important species. This map was breathtaking in scale and detail, but how would it translate for the web? It is possible to take an existing print graphic like this one—the result of many hundreds of hours of research and artistry—and adapt it for screens. Some projects lend themselves well to such a conversion, but some are so complex and heavily annotated that it becomes a burden to funnel it into a vastly different medium. For this poster, there was a danger of doing a disservice to the vision of the graphic by shoehorning the double-sided layout into a pocket-sized screen.

Left: Bird Migration in the Americas, *supplement to the August 1979 issue of* National Geographic. *Right:* How Birds Migrate, *supplement to the March 2018 issue. Not shown: the eastern hemisphere flyways on the reverse side of the 2018 poster.*

That risk, combined with the more practical fact that I would need to work simultaneously on the digital piece while the poster was still being completed, led us, the editors and directors in the maps and graphics department, to agree to not fully adapt the poster for the web. Ultimately, what I used from the poster was a re-colored (and reprojected) single image of the "flyways" of the western hemisphere (the interstate system of seasonal migration), for 5 different groups of birds.

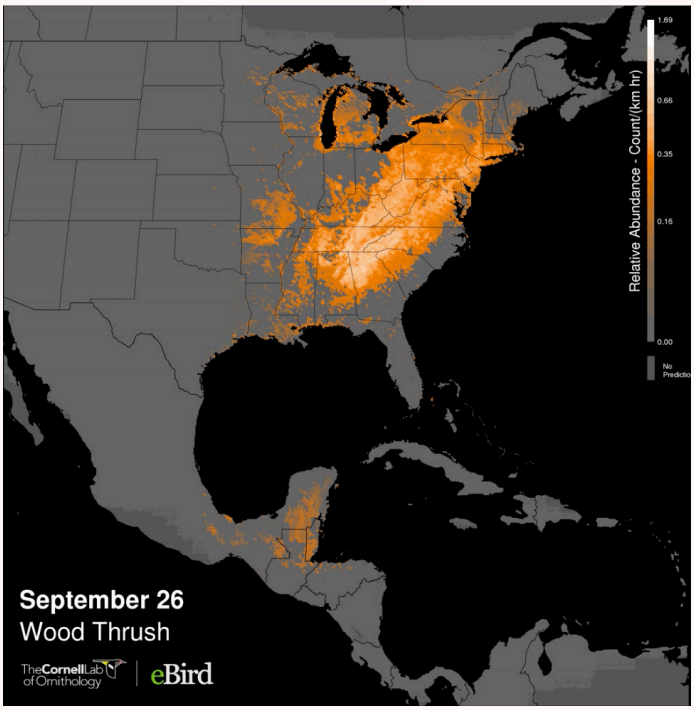


Left: The flyway image used in the digital version differed slightly from the print poster. I reprojected the map because bipolar oblique was incompatible with my automated video creation workflow, which used the GDAL raster processing library. I also recolored the map to work better on the dark background of NASA's night lights (right).

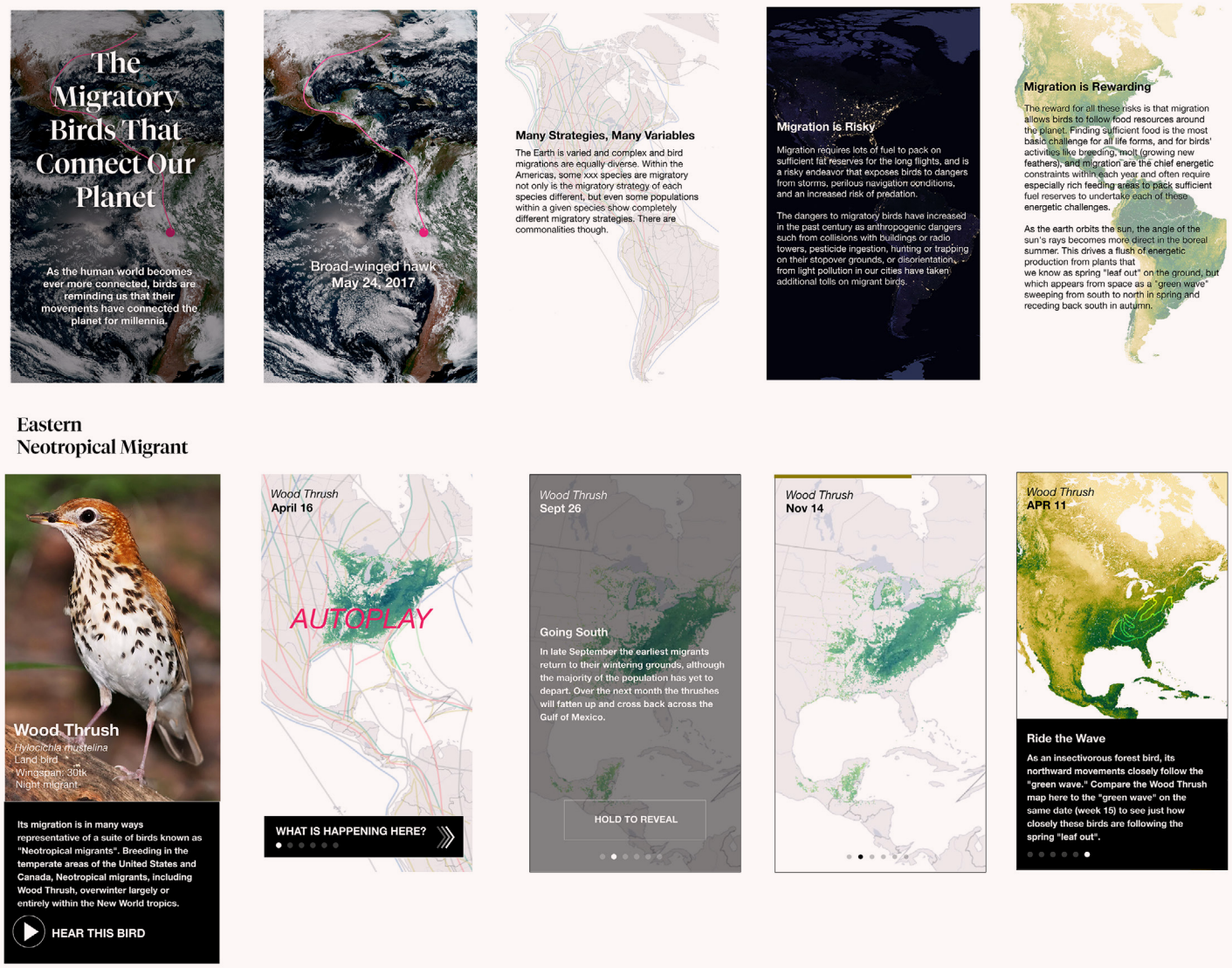
Instead of converting the poster, we chose to use an approach that would take better advantage of an interactive, screen-based medium, highlighting different aspects of bird migration through fewer species. The creation of this web-based spin on the topic of bird migration is what I will describe below.

DATA AND DESIGN

The framing and design of this project started with evaluating available bird migration data to narrow the selection of bird species to highlight. Through a collaboration with the **Cornell Lab of Ornithology**, I consulted with eBird project lead Marshall Iliff. **eBird** is a vast, crowdsourced database of bird sightings around the world. I knew that eBird had created what they call STEM data: **Spatio Temporal Ebird Modelling**. Reports of bird sightings tell us where birds are, but they're also a reflection of where birdwatchers go. The STEM models account for this and attempt to paint a broader picture of bird abundance, combining sightings with bird habitat information and satellite



Screen capture from an animated abundance map of the Wood Thrush, by eBird.



Mockups showing some screens of a mobile layout.

data to model the movement of entire species of birds. eBird had previously published animated maps of these models and this was our starting point.

Iliff advised which species would yield the highest quality data from existing STEM models. We tried to strike a balance between which species would show the robust patterns that make for a good visualization, and which would tell a story about the diversity of migration strategies employed by different bird types and within different geographies. STEM modeling does not exist for the eastern hemisphere, so we focused on the west. These data and research led to initial designs.

In my initial mockups, I not only showed individual species through photography, maps, and birdsong, but also placed these birds into a larger context of continental and intercontinental migration through introductory graphics. The concept was to give readers a general understanding of what drives bird migration. As they scrolled down the page, casual readers would see seven featured species with corresponding map animations (set to play and loop automatically) that gave a sense of the pulse of migration. More dedicated readers could go deeper, stepping incrementally through time and tracing notable features of each species' migration through additional text descriptions. Static mockups were crucial in presenting this concept to department managers before starting production.

CREATING ANIMATED MAPS

While this project uses data from disparate sources, each of its various animated maps have a lot in common. They're the result of data processing scripts that allowed me to regenerate the animations many times, in order to experiment with different visualization styles. Each map animation started with folders of images that were then processed and compiled into video files.

The raw data for the animated bird abundance maps came in the form of GeoTIFFs from the eBird project. GeoTIFF is a common raster format that includes geospatial metadata, such as the geographic location, map projection, and units of the data's coordinate system. Each file represented the relative abundance of a species, through a single, high-precision channel of data indicating the expected number of birds within each 1 km^2 area at 7 am. Migration happens over time, and the data reflect this. One year of a bird's distribution and abundance is represented by a collection of 52 weekly files.

To scrutinize the data before processing, I used the *gdalinfo* command found within the open source **GDAL raster processing library**. The *gdalinfo* command **describes the contents and metadata of a GeoTIFF**. Knowing how my data was structured was crucial for responsibly transforming it. The metadata revealed the high-precision nature of the data. I needed to account for this explicitly in order to properly process it into a less-precise, browser-friendly image.

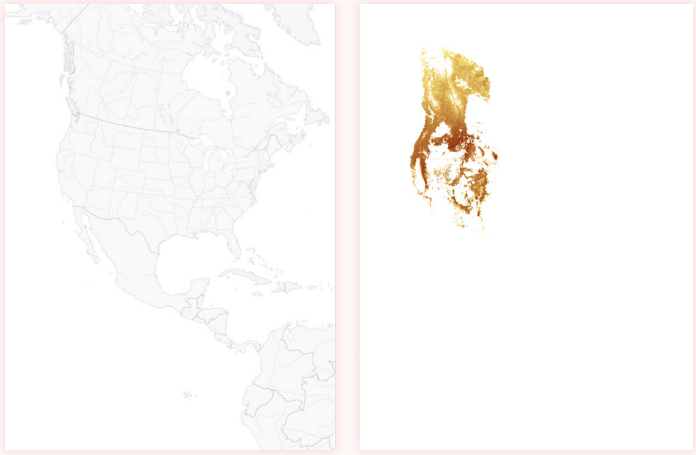
A preview of 52 weeks of raw data showing the Western Tanager, a yellow/black/orange songbird found in the American West.

To get a consistent animation, and make a species' migration pattern more apparent, I followed the same set of steps for each set of data associated with the seven species of interest: reproject the migration data, apply a color ramp, composite it with a base map, create a video from the composite, and add labels.

INITIAL CARTOGRAPHY

After previewing each dataset to understand it (as seen in the grid of images), I then created basemaps in Adobe Illustrator, working through one species at a time. I used the **MAPublisher** plugin, which allowed me to import data directly into Illustrator and reproject it, without having to resort to a GIS program like QGIS or ArcGIS, though either would have worked for this purpose. I used **Natural Earth** for landmasses and other reference data, and chose a Lambert azimuthal equidistant projection, centered on the western hemisphere and cropped to an extent a little larger than the species range.

I exported the map as a GeoTIFF file, which was used for a few purposes. It served first as a basemap that gave the geographic context for the migration pattern. I also used the metadata stored in the map file as a template, establishing the parameters for the bulk processing script that I ran on each of my 52 files. If I later modified the file's crop or projection parameters, the script, which pointed at the file, would adjust its processing accordingly, and all data would continue to align.



Left: The basemap for the Western Tanager. Right: A composite of all Western Tanager files in one image, helpful for previewing the needed extent.

GEOGRAPHIC PROCESSING

For automating the processing of each set of 52 files, I used **Mapbox's Rasterio**. It's a Python library that uses GDAL for geographic transformations and it integrates well with other Python libraries (like **NumPy** for data manipulation and **Spectra** for color ramp generation). I used Rasterio to reproject and crop each of the 52 files, so they aligned to the geographic metadata within the exported basemap.

Before creating images from the data, I first had to rescale the pixel values. Each file represented a distribution of bird abundance. From week to week, the minimum and maximum values of abundance could vary wildly. So I first analyzed all 52 weeks of files to tally the very lowest and highest values. I could use this total range of activity to consistently visualize the data across the whole year. To do so, I needed to first rescale the values to a new, visually oriented range. By converting my original range of abundence numbers to a new range of 0–255, I created a monitor and web friendly 8-bit image. I then created a color ramp of the same length (256 colors), using the Spectra library, and I **mapped the intensity** of each value to each color. I ran these two steps repeatedly as I experimented with colors and boundaries.

COMPOSITION AND EFFECTS

Because web browsers **don't universally support** video with transparency, I needed to composite each colored frame to a common base. I used the basemap I had previously generated in Illustrator, with additional shaded relief to show migration patterns in the context of elevation changes. There are good reasons *not* to embed state and country boundaries into a video: you can avoid excessively thin and thick line weights when a video scales, as well as compression artifacts. But I did it here so that I didn't have to bring additional SVG layers into the browser.

To take the 52 processed abundance images and merge each of them with a common basemap, I used **ImageMagick** and its *convert* command-line tool. ImageMagick is the command-line, open source equivalent of Photoshop. Its **documentation** and **cookbook** are quirky, but, being over 30 years old, it's robust and reliable. I used *convert* for two purposes: to **composite** each image to the basemap, and to add a **feathered vignette** to fade out the edges of the image.

52 reprojected, colored images. Compare the shapes in each frame to the previous grid. Reprojection warps the data such that the west coast of North America begins to assume a familiar shape.

52 weeks of data, composited on to a common base, with a vignette effect on the edges of each.

From a folder of processed images, I then used the command-line ***ffmpeg*** tool to encode an mp4 video at my desired speed, with a few different sizes for desktop and mobile. Care must be taken to **create an mp4 with the right encoding** to properly load on mobile and desktop devices.

This script was time-consuming to develop and debug initially, but it saved an immeasurable amount of time

because I could tweak settings and output new videos with new color ramps, frame rates, basemaps, etc. Alternatively, I could have cobbled together steps within QGIS (using the **TimeManager plugin**), Photoshop, and After Effects, but fully automating this process within a single environment was an investment for future projects that would use video maps.

LABELING

While I made some concessions by putting boundary lines within the videos themselves, I didn't compromise on labelling. Text legibility is crucial, as is adhering to National Geographic cartographic style and policy. So I rendered labels in the browser as HTML text. I used Illustrator to register label placement and style atop the same basemap I had used previously, and also added vector leader lines to highlight important features. I used the **ai2html** script to export the labels from Illustrator to HTML/CSS positions. I also exported the leader lines as SVG so I could control their visibility step-by-step in the browser and render them with the desired stroke width independent of map size. In the browser, each layer was aligned with CSS and together, all layers appeared as a unified map: HTML labels (top), SVG leaders (middle), and the animated map (bottom).

When rendered in the browser, all labels and leader lines are initially hidden and then strategically turned on after each button click via Javascript/CSS. Custom labeling for seven species and 5–7 steps across desktop and mobile was a manual and monumental task. When I had **all the pieces together**, the maps were sent to Scott Zillmer, a National Geographic map editor, for review.

Screengrab of all the labels and leader lines used for all the steps of the Western Tanager map. The map looks messy because it's a composite of every step of my animation.

ANIMATED BIRD, ANIMATED EARTH

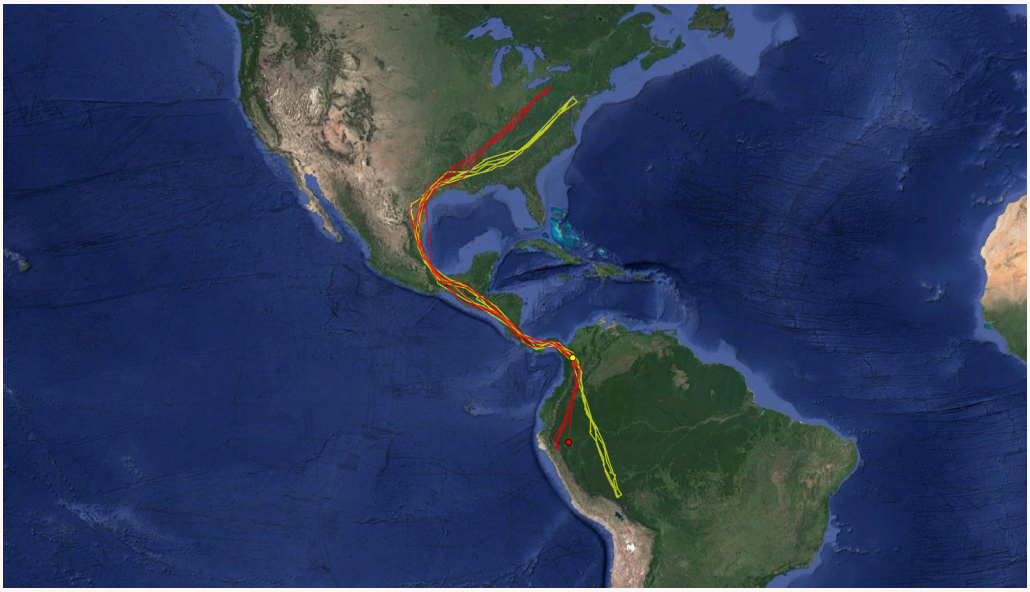
In addition to the bird abundance animations, the piece starts with an animation of the Earth. It shows the time period of October 8–12, 2017, along with an individual Broad-winged Hawk's migration. With this visualization, I could both start with some drama, and show the breadth of a single bird's journey as it travels through a dynamic Earth.

Having previously experimented with data from the **GOES-16 satellite** and seen some **impressive animations**, I knew that depictions of the entire western hemisphere were possible at a continental scale and as fast as an image every 15 minutes. I also suspected that some of our species of interest had been GPS-tagged for study. After some research and experimentation I was able to combine these datasets to show a bird's route synced over time with an animated Earth.

DATA ACQUISITION

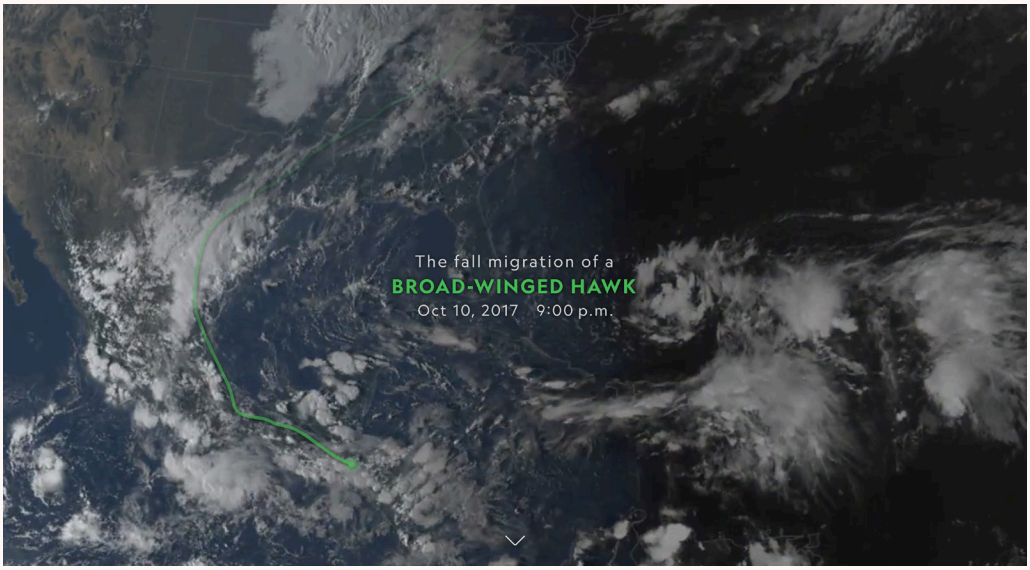
After looking in **Movebank** for GPS tracks of our birds of interest, I contacted the **Hawk Mountain Broad-winged Hawk Project** for a track of a Broad-winged Hawk after about March 2017. GOES-16 data only exist past this point, which was the data source of choice due to its spatiotemporal resolution. GOES captures frequent imagery of the same portions of the Earth, which works well for

animation. The organization agreed to let us use a track of Patty, one of a number of birds that they have tagged with a GPS device. Patty spends much of her time in her summer range in the northeast United States and in her winter range around north Peru. Between those times she's migrating across continents.



Patty, the Broad-winged Hawk, is shown in red. Her entire route from North to South America is shown along with that of another hawk, Rosalie. Source: Hawk Mountain Bird Tracker.

Knowing Patty's migration period narrowed the search for satellite imagery. Within the restricted time range, I downloaded GOES-16 data from the **AWS Public Archive** using the **Boto3 Python library**. I used the 15-minute increment entire-planet ("full disk") dataset in order to capture North and South America in the same view. Each file was about 400MB; I used an external drive to avoid filling up my primary drive and avoid crashes.

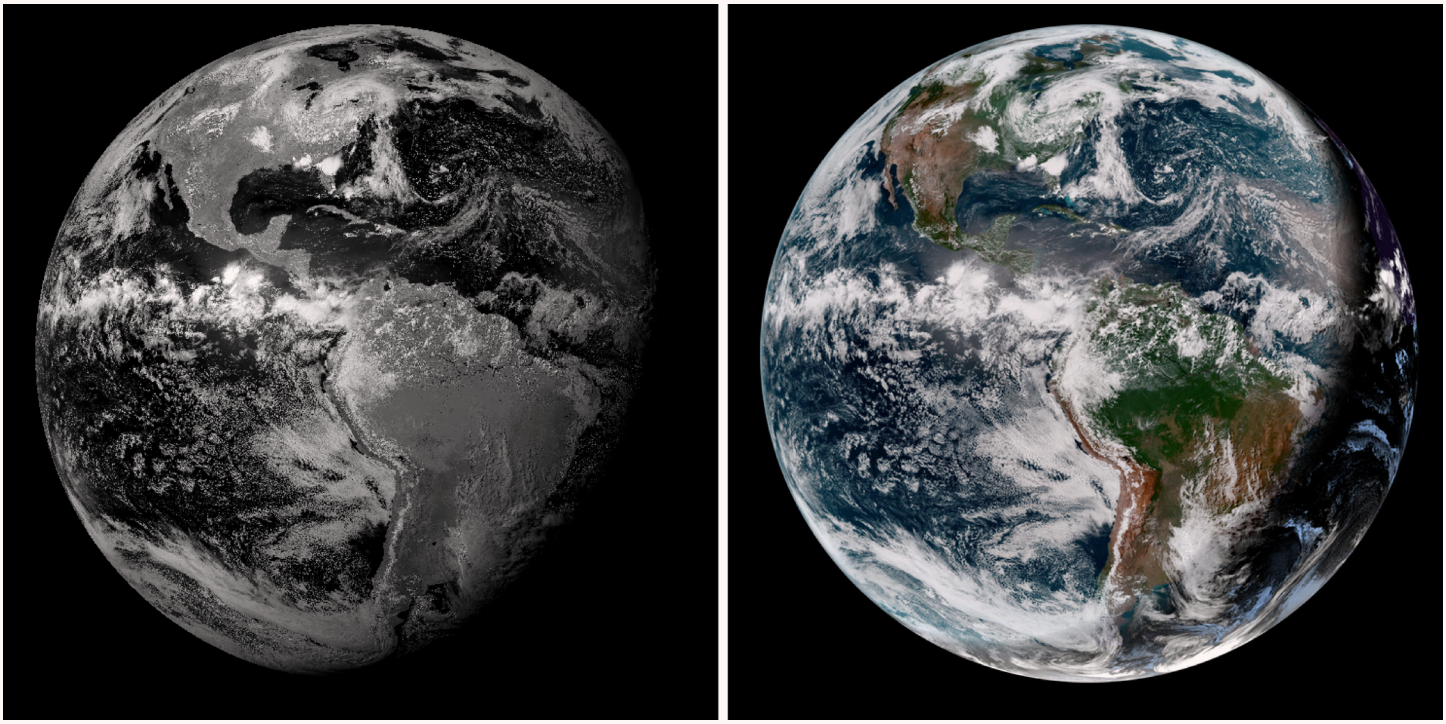


Patty's filtered GPS recordings generalized into a line overlaid on GOES-16 imagery.

Data limitations impacted experimentation. Patty's tracker did not record locations at even increments. Sometimes multiple locations recorded per day, but at other times there were multi-day gaps during which she might migrate a significant distance. I tried different spatial extents, depicting various portions of the route that expressed movement while still conveying a sense of distance.

I expected users to view the animation for about 20–30 seconds, given the multiple overlay steps. While I could have animated the movement of Patty's entire route, animating weeks of earth imagery in 20 seconds was visually problematic because—aside from the hyperkinetic dance of clouds—GOES-16 captures the Earth in day and night, and thus flickers from light to dark at a disorienting rate. I opted for a much shorter clip to reduce this flicker, at the expense of route distance.

Lastly, GPS tracks are typically pretty messy, as animals don't move in straight lines. To tidy the visualization, I generalized the lines to at most one location per day, which worked well at the display scale.



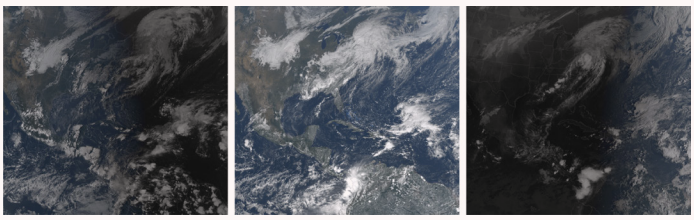
Left: A depiction of a single band of GOES-16 data. Right: Multiple bands of GOES-16 data combined together to represent a more familiar depiction of the Earth. Note that on the right, where the Earth is in nighttime, the clouds are shining bright, as compared to total darkness on the left. This image is using an infrared channel to bring out clouds at night. Source: RAMMB.

PROCESSING GOES-16 DATA

The key with this animation was to ensure that the GPS track of the bird with the basemap was appearing in the right place at the right time. Alignment in space proved to be the bigger challenge. While the bird's GPS data provided latitudes, longitudes, and timestamps, getting control over the GOES-16 image geospatially was a challenge.

The raw GOES-16 data forms a circular image, a "full disk" of planet Earth. The GOES-16 satellite captures the western hemisphere with a particular perspective view of the Earth, a result of its geosynchronous orbit. Its raw data comes as a **NetCDF** file. It took a few extra steps to extract the geographic information from this format, as GDAL's tools don't automatically understand how to parse it. I read each file with a Python script and accessed the metadata that stored the satellite's distance from the Earth and the center coordinates of its focus. From these parameters I was able to calculate the geostationary projection, which I wrote to a new GeoTIFF file using Rasterio. I then tested the file in ArcGIS by overlaying country boundaries to see how well the borders aligned with coastlines. It took a lot of trial and error to get things to reproject correctly with help from **blog posts**, **code samples**, **python notebooks**, and **other sources** of inspiration. NOAA's GOES-16 documentation is lacking.

Working with satellite imagery isn't like working with a normal photo. Data don't typically come neatly as RGB channels for a single image; they come instead as a collection of individual bands corresponding to different wavelengths of light. You then make band combinations according to what you're trying to express. In the case of GOES-16, these bands represent **visible light, near infrared, and infrared**. For what I was trying to show, I wanted a true-color view of the Earth. To attain this, I took the red, green(ish), and blue bands from within the NetCDF file and assigned them to the three RGB channels of an image. To get the clouds to be visible during the nighttime



Three frames of processed GOES-16 imagery.

view of the Earth, I embeded the infrared band across all 3 channels.

I worked in Illustrator to preview a cropped and projected version of the GOES-16 data. I also prepared an additional map layer of state and country boundaries for use as an overlay on the GOES imagery. I used ImageMagick to composite each GOES frame with the boundary layer. All frames were then composited into a video with ffmpeg.

MERGING VIDEO WITH PATTY

I wanted fine-grained control over the appearance of Patty's line atop the satellite imagery across desktop and mobile devices. To do that, I didn't include Patty in the video itself, much like how I didn't include leader lines and text within the migration animations. Instead, I looped the video, and animated a line using SVG in lockstep with the video's progress. This is a similar concept to one used in another bird project, where my colleague Kennedy Elliott layered **animated explanatory SVGs atop slow-motion hummingbird videos**.

I draw Patty's route in the browser directly from GPS data, using a web friendly GeoJSON file that contained latitudes, longitudes, and associated timestamps. Knowing the parameters that determine the **map projection** of my GOES-16 video, **I make an identical map frame with D3**. With that frame, I could reproject the GPS data to match my video. Browsers **scale SVGs** and **videos in different ways**, so a good amount of trial and error went into solving alignment issues.

Animating Patty was aided with the help of **a tutorial** and **example** visualizing a typhoon's path. This also took some trial and error because Broad-winged Hawks don't migrate at night. Since Patty's data was of limited granularity, I wrote custom overrides to ensure that she only moved during the daylight parts of the video, while respecting the timestamps in the data. There are some perceptual problems in combining two datasets with different time-steps, but one thing was certain: I would not remove frames from the GOES-16 video to stutteringly match Patty's timestamps. A smoothly animated **glittering blue** dot from space was too spectacular to pass up.

CONCLUSION

I KNEW FROM THE DESIGNS that this project would have a lot of maps, but it turned into a larger affair than expected due to the combination of techniques and technologies used to bring the animated data together. To coordinate all the different layers, I had to experiment and problem-solve to bring the data and graphics together in a reasonably graceful way. With enough research and a supportive graphics department, I was able to make something that I was proud of, and was able to learn plenty in the process.

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Seeing the Watershed Through the Streams

Lauren Rosenthal McManus
laurenrosenthalmcmanus.com
juicenart@gmail.com

Ecology serves as the conceptual framework of my investigation, and maps provide the visual language for my expression. I make prints, drawings, and sculptures that use watersheds as symbols of interconnectedness.

My work leads me into the landscape in multiple ways: walking into the woods and along stream banks awakens an immediate sensory experience of place; composing images with spatial data provides an expansive geographic perspective; repetitive mark-making opens a meditative path that offers insights gained through time spent with sustained focus. Together, these practices define my creative exploration about how we understand and imagine ourselves in relationship to the natural world.

Over the last several years, I've been combining abstract analytical representations of landscapes with perceptual records of the world to examine the intersection of these macro- and micro-scaled interpretations of place. One body of work that has emerged from this inquiry is an ongoing series of watershed maps, created using pigments made from rocks

Middle Delaware - Musconetcong Drawing, 2017. 12ft × 8ft, ground rock, water, gum arabic. Temporary installation at Art Yard, Frenchtown, NJ.

Middle Delaware - Musconetcong Drawing, *detail.*

Video: *Drawing the Delaware @ ArtYard*

Click to watch a time-lapse of the creation of Middle Delaware - Musconetcong Drawing.

collected along lakes and streams. These maps render physical geographies with raw materials filtered through a tangible human connection with nature. In this way, each map is a visual artifact of my experience exploring a particular stream, river, or lake, and holds evidence of time spent wandering in the woods, transforming rocks into pigment, and examining the specific shapes of each basin.

I made the first of these maps in 2005 with sedimentary rocks gathered along the Haw River in the Piedmont region of North Carolina. I ground the stones by hand with a small mortar and pestle, mixed the resulting powdery pigment with river water, and brushed it directly onto the gallery wall in long, horizontal strokes, coating the entire 10ft tall by 15ft wide surface in a wash of reddish dust.

Haw River Drawing, *2005. 10ft × 15ft, ground rock, river water. Temporary installation at Alcott Gallery, UNC Chapel Hill.*

Haw River Drawing, *detail.*

While projecting an image of the Haw and its tributaries onto this painted surface, I saturated a small brush in river water and used it to trace each stream, erasing one meandering line after another from the field of rock dust. This process of erasure evokes the way that water marks the landscape by eroding rock and soil in its path from ridge to valley. I've since depicted several other watersheds in this fashion, painting directly onto gallery walls with the most basic substances of rock and water, and then washed them away at the conclusion of each exhibition. I've also developed a more permanent series of works on paper using these site-specific pigments.

Georgia O'Keeffe once said, "It is only by selection, by elimination, and by emphasis that we get at the real meaning of things" (Turner 1999, 1). Each of my maps *selectively* depicts only the hydrological and/or topographical features within the boundaries of a specific watershed. I've *eliminated* the markers by which we usually locate and navigate, such as labels, political boundaries, and built structures. These choices *emphasize*

Artist materials. Photo credit: Kevin Rivoli, The Citizen.

Hemlock Lake, *2017. 5in × 11in, ground rock, water, and gum arabic on paper.*

Canadice Lake, *2017. 5in × 11in, ground rock, water, and gum arabic on paper.*

Cayuga Lake, *2017. 29in × 21in, ground rock, water, and gum arabic on paper.*

Tinicum Creek, *2017. 15in × 11in, ground rock, water, and gum arabic on paper.*

the patterns of nature and reframe community boundaries around vital bioregional relationships.

The fractal geometries of river networks resemble the netted venation of leaves and insect wings, the bronchial tree that allows us to breathe, and the circulatory system that channels blood through our veins and arteries. The linear patterns of topographic data, which describe the outermost layer of the Earth, resemble the textures of wood grain, the growth lines of tortoise shells, and the contours of our own outermost layer, the epidermis.

I am often surprised by the visual correlations that emerge in my work. In speaking with various audiences, I've been told that the abstract forms in my maps of streams feeding the Delaware River are reminiscent of fetal life support systems and that the shapes in my Finger Lakes maps resemble female genitalia. Though I had never considered either of these parallels, I find these vital anatomies of human reproduction to be beautifully appropriate metaphors for the creative, life-giving force of our freshwater networks.

By exposing such similarities, my maps remind us that in a world that often seems chaotic, there is a natural order to which we belong and to which we are responsible. These maps offer an opportunity to reorient, to identify with watersheds, and to find meaning in our inherent interdependence.

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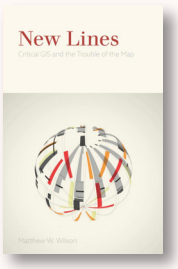
Tohickon Creek, *2017. 21in × 30in, ground rock, water, and gum arabic on paper.*

NEW LINES: CRITICAL GIS AND THE TROUBLE OF THE MAP



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Review by: Stephen R. Appel, American Geographical Society Library

Cartography is going through a sea change; social media and the internet have become to cartography what GIS was to Geography: disruptive and transformative. As a geospatial information specialist at a geography research library, I constantly find myself suspended between admiration for the careful and painstaking precision of pre-digital mapping, and demands from researchers and students for immediately visualized results using the latest mapping technology, which increasingly means using web-based, free, and/or open-source tools. Much GIS literature takes a more-or-less positivist view of geospatial technologies—discussing them theoretically, as tools applied to problems, rather than pragmatically considering their palpable effects on people and societies. This approach makes much of that literature seem increasingly out-of-touch. *New Lines: Critical GIS and the Trouble of the Map* is a refreshing view and interrogation of Critical GIS and Critical Cartography praxes, and one that could well prove as influential as John Pickles' *Ground Truth* (1995) in the way it challenges normative understandings of GIS and mapping technologies. *New Lines* employs a social history encompassing cartography, digital mapping, archival research, and modern philosophy, along with a nuanced consideration of modern digital culture, to propose that Critical GIS scholars reexamine and reconsider what the author, Matthew W. Wilson, calls *the critical turn*.

The author is an associate professor of Geography at the University of Kentucky, where, along with Jeremy Crampton and Matthew Zook, he is co-director of the New Mappings Collaboratory. According to the Collaboratory website, the participants claim to "draw on applied and conceptual traditions in mapping practices and mapping thought" (**newmaps.as.uky.edu**). Wilson's research in the Critical GIS domain canvases Qualitative GIS, neogeography, the geoweb, mixed-method GIS, and the social history of GIS. He has co-authored a number of publications with other familiar GIS and Society scholars including Mark Graham, Trevor Barnes, and Rob Kitchin. Reading this book transported me back to the "GIS and Society" seminar in graduate school that first exposed me to Critical GIS. At that time, I had been learning about the tools, buttons, and menus involved in geographic information systems and learning to *do* GIS to perform analysis, answer questions, and solve problems. The title of Wilson's Introduction, "But Do You Actually *Do* GIS?", captures the same Critical GIS challenge I first encountered in that graduate seminar. *New Lines* is clearly intended for an academic audience, and, like Pickles' *Ground Truth*, this book could be a challenging read for someone who has never been exposed to this approach to the social dimensions of GIS technology. Frankly, I was unfamiliar myself with much of the philosophy employed in the book; but, fortunately, the endnotes are descriptive, abundant, and thorough. *New Lines* employs the concept of the drawn and traced line—evocative of pen-and-paper cartography—as a metaphor for the evolution of GIS and cartography, and uses it to reexamine the critical praxes of GIS and Cartography in scholarship. In raising the question "If the tracing of maps is a key part of learning the craft of hand-drawn cartography, how might we trace the digital map?" (47–48), the book addresses what it identifies as five fractures or interventions in these lines: *criticality, digitality, movement, attention,* and *quantification*.

The first numbered chapter, "Criticality: The Urgency of Drawing and Tracing," traces the social history of Critical GIS. Wilson discusses the impacts of the Friday Harbor meetings, a 1993 gathering at which GIS practitioners and scholars critical of GIS began to hammer out their differences and to catalyze GIS and Society as a field of study. Much relevant scholarship has emerged since then, and Wilson aligns these debates about technology, positivism, and Geography with elements of the wider Critical praxis—including neogeography, pervasive digital culture, location-aware society, big data, social media, and spatial media.

At this point, Wilson asks if the term *critical* has run out of steam—has it been invoked so often that it has lost its impact? Referring to the debates around the political implications of Mercator's projection, arguably a cliché of critical map critique, he asks what, in our location-aware society, will constitute the new Mercator—what might the collective critical attention focus on next? Wilson employs the example of the problematic American Geographical Society (AGS) Bowman Expedition to Mexico, specifically the 2005–2008 México Indígena project (**americangeo.org/initiatives/bowman-expeditions**), to highlight the importance of considering the meaning of participation, empowerment, and local knowledge. The chapter closes with a discussion of *correspondence* that encourages an experimental vision and process, and centers on the impact of the digital on abstraction and generalization—a topic further expanded in the following chapter. "How," Wilson asks, "might cartographic experimentation forgo the rush toward a faddish polishing of infographics and instead amplify the disruptive potential of geographic representation?" (45).

In Chapter Two, "Digitality: Origins, or the Stories We Tell Ourselves," Wilson retells the story of the Laboratory for Computer Graphics and Spatial Analysis (LCGSA) at Harvard to demonstrate how, even from its earliest days, computing systems disrupted cartography and challenged mid-century tradition. The author does this largely by focusing on his own work with the archives of LCGSA founder Howard Fisher. This chapter discusses the transformation of American Geography in the 1960s, and constitutes a veritable Who's Who of mid-20th century Geography, including figures like Betty Benson, Arthur Robinson, Waldo Tobler, William Bunge, and of course, Fisher himself.

Digitality was disrupting geographic representation well before the term GIS was coined. Bunge, and others associated with the University of Washington, were using computer cartography to bring a more logical and scientific approach to Geography by employing techniques that seem mundane today but were revolutionary at the time. This storytelling is not about nostalgia; Wilson uses it to position the computer as an interruption between the map author and the reader, and avers that Critical GIS must adapt to this interruption.

The third Chapter, "Movement: Strange Concepts and the Essentially Subjective," traces the history of Waldo Tobler, Allan Schmidt, and Geoff Dutton, and their work in map animation. Wilson, however, sees the notion of movement as broader than just moving map features. He employs the postmodern philosophy of Gilles Deleuze to argue that, like the movement-image conceptualization of film, animated maps are more than the sum of individual frames in a flipbook. Wilson likens Deleuze's discussion of film's ambiguous position as neither art nor science to both Robinson's ideas on the limits of standardization and to Thrower's seminal works on animated cartography. He closes this chapter with a discussion of the rapid evolution of mapping technologies, and wonders if cartographic theory is keeping up with the changes.

"Attention: Memory Support and the Care of Community" is the fourth Chapter, and it focuses on what Wilson calls the *attention economy*: how do maps compete for attention under what he terms the *mediatization* of everyday life? He investigates this question by employing the Foucauldian idea of Biopolitics—denoting social and political power over life—and cleverly intertwines this with the work of GIScientists on participatory mapping and public participation GIS. Geospatial technologies are often trumpeted as a revolutionary engine for the empowerment of community-based organizations, but this is an assertion about which Critical GIS scholars are justifiably censorious. Wilson discusses the roles of community organizations in *attention economies*—highlighting the importance of "recognizing systems for geographic information as one part of an expanding digital culture" (101)—and of thinking beyond GIS and map output. Critical GIS practitioners, he tells us, must embrace the geoweb, while at the same time recognizing that "the rise of digital culture is unevenly experienced" (106), and that some communities remain on the wrong side of the digital divide. The author draws particular attention to the way community organizations often struggle to make social media and other emerging information technologies work for them despite the divide, alongside their more mundane struggles with high staff turnover and limited financial resources. The chapter closes with three *jumping off points*. First: that university-community partnerships have a rhythm that extends beyond the university calendar, and that partnerships should not start and end with the GIS course. Second: that these partnerships require a collective memory, both technical and social, with facilitators paying careful attention to avoiding apathy and project stagnation. The third point is that, in the context of ever-changing digital

media, attention work is a key aspect of a culture of action for building solidarity.

In the fifth Chapter, "Quantification: Counting on Location-Aware Futures," Wilson takes up a recurring theme in Critical GIS praxis. Quantification dominates debates on positivism's influence in geography, on efforts to advance a Qualitative GIS, and on the data models that prevail in GIS practice. In this regard, Wilson also discusses what he terms the *quantified self-city-nation,* drawing attention to the relationships between the idea of "smart cities and smart societies" and of personal quantification via the tracking of personal metrics with wearable devices. In this, the interdependence of scales is significant; the smart city is about controlling the individual, but control is dependent on voluntary individual quantification. Following from earlier discussions of the attention economy, he examines marketing around smart cities and wearable technology. Wilson discusses the interplay of what he sees as three *dualities*: interoperability–propriety, competition–habit, and fashion–surveillance, in the context of a *quantified self-city-nation* wherein mass collection of metrics on individuals constitutes a "neoliberalizing vehicle for reterritorialization of the body, the city, and the nation" (126). He considers the proliferation of quantification of proximity (citing an example of AT&T collecting location information for market research) and the ambiguous line between fashion and surveillance (the third duality) when it relates to the increase in sensors in our daily lives and on our bodies. At the chapter's close, he re-conceptualizes the map through the dualities, as an object of interoperability and propriety, competition and habit, fashion and surveillance. "The digital map that guides us toward consumptive opportunities in our neighborhoods both creates and safeguards these neighborhoods" (132).

The great strength of this book is the manner in which the author re-situates familiar Critical Geography arguments and histories with mainstream topics—social media, spatially enabled society, and digital surveillance—and with theoretical considerations from well beyond the discipline. Maps and GIS are powerful, and spatial technologies have been a transformative force, but the broadly dominant positivist approach has failed to account for and engage a wide range of their significant effects on people and societies. I found a striking criticism of positivist mapping in the opening paragraphs of the closing chapter: "The force of [Robinsonian] thought simply does not take maps seriously enough" (136).

New Lines: *Critical GIS and the Trouble of the Map* reinvigorates some of the discussions that GIScience scholars have debated for decades by presenting material that is substantial without being impenetrable. I would recommend this book to anyone studying GIScience, and especially to those interested in GIS and Society, though Wilson's discussions are also relevant to the GIS community at large. It may also appeal to those interested in the digital humanities, particularly humanities GIS. This book challenges everyone who usually deals primarily with the technical issues of GIS to more carefully consider the impacts of these technologies on society; I know it challenged me.

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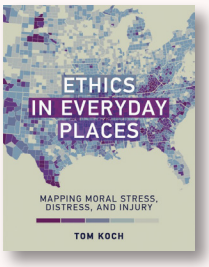
ETHICS IN EVERYDAY PLACES: MAPPING MORAL STRESS, DISTRESS, AND INJURY



By Tom Koch

MIT Press and Esri Press, 2017

288 pages, 34 maps, 10 tables, 7 graphs, 14 diagrams, $35.00, hardcover.

ISBN: 978-0-262-03721-1

Review by: Daniel G. Cole, Smithsonian Institution

I read *Ethics in Everyday Places* after finishing the third edition of Mark Monmonier's *How to Lie With Maps*. While Monmonier's book is geared toward a general audience, Koch's work focuses more specifically (although not exclusively) on cartographers, and on mapping as "the medium for ethical exploration" (xii). He cautions: "Readers who are looking for an easy fix, a straightforward, uncomplicated ethical rule, or an inflexible moral standard will be disappointed" (xv). Koch also points out that "This is a

book about ethics and morals as understood through maps and what they say" (xvi). This review shall look at how the author uncovers these often-ignored dilemmas, and exposes them to examination.

In the first nine pages of Chapter 1: "An Ethnography of Ethics," Koch undertakes a philosophical discussion on ethics, moral stress, distress, and the moral injury that can result from actions taken. He addresses the quandary faced by many people in different professions who find that doing their jobs or "just following orders" results in moral injury, or even in loss of life. This problem, he points out, is not limited to any one field, and he questions the grounds upon which we may empower our consciences to guide us in our work as well as in our lives.

Koch begins his cartographic examination with a section entitled "Map Talk," where he writes that maps are just "a kind of talk" (10) and, as such, they use their particular language to say some things and to leave others unsaid, by means of what is shown versus not shown. Understanding maps as a kind of talk explains how maps are supposed to be simultaneously objective and persuasive, a dichotomy that can lead to the sort of quandaries that arise "when you've done everything right but know you have done something wrong" (1). The goals and scope of the text are established early on: "This is neither a book about cartographic ethics nor a learned treatise on the limits of knowable truths. It is instead an attempt to investigate problems arising at the intersection between sets of conflicting expectations and standards governing personal practice, professional ideals and social policy" (11). Maps are the principle medium in the author's investigation because, he writes, they are "a way to see all this philosophy in action" (10).

In Chapter 2 ("Ethics, Geography, and Mapping: The Failure of the Simple"), the author begins by examining quandaries inspired by his experiences at the 2005 North American Cartographic Information Society (NACIS) conference. He is particularly interested in the concerns that attendees voiced surrounding the subcontracting of cartographic and printing work overseas, and he sees a conflict between "an economic ethic whose bedrock presupposition made gain their sole objective," and a professed "morality of community and social good that extended beyond personal benefit" (23). Koch then turns to the popular NACIS Map-Off competition, where contestants presented maps created within five days in response to an assigned theme (in 2005, it was Hurricane Katrina). The worst submission, in Koch's opinion, was not only poorly designed, but, it transpired, was not even produced for the Map-Off: it had been a newspaper job assignment some weeks earlier. Of this situation, Koch asks: what are the ethics of fair engagement (that is, of competition rules)? The author also notes that all of the maps failed to take account of the mapped situation's complexities. What, he asks, are the ethics of mapping this hurricane while "ignoring the history of recurrent gulf hurricanes [and] repeated reports" of inadequate levees (24)? Shouldn't these maps have taken into account the abundance of information available on the inevitability of the disaster due to foreseeable interactions between known hurricane paths, inadequate levees, and an over-reliance on cars for evacuation?

Later in the chapter, under the heading "Moral Philosophy," Koch names and discusses four major ethical approaches: consequentialism (utilitarianism), rule-based ethics (deontology), virtue ethics (Aristotelian), and moral realism (Jamesian pragmatism). He then posits that, "for the average mapmaker, ethics is primarily deontological" (32), in that not only do "they have an obligation not to steal another's work," but they are also "expected to tell the truth as best they can" and not "manipulate data in a manner that is self-consciously untruthful" (31). However, he notes, all maps lie due to abstraction and generalization, despite the upright cartographer's intentions to be as objective as possible. Near the end of this chapter, Koch states that, "One must look at actions *and* consequences, rules *and* results, in evaluating a map (or story or statistic) and our responsibility for and to it" (34). Further, he writes, we must serve the public, rather than just our employers or ourselves.

Chapters 3 and 4—"The Tobacco Problem," and "The Morals of the Map: Stress and Distress"—are derived from Koch's paper in *Cartographic Perspectives*, "'False Truths': Ethics and Mapping as a Profession" (2006). The third chapter starts with the potential problems arising from mapping long-lived tobacco smokers. Consider the cartographer who creates a "false truth" by using only a portion of a data set to produce a map that suggests longevity results from tobacco use: is that cartographer simply a mindless drudge, or are they complicit in the falsehood? By way of illustration, Koch considers the career of Arthur Robinson and the ethics of Robinson's cartography. Robinson was, clearly, a great cartographer and teacher,

but one who was grounded in military cartography, and whose cartographic "ethics . . . began and ended with the resulting maps' military utility" (43). He did not ask his subordinates, or his students, to think about the ends to which their maps would be used, or to question the data they were asked to map—because for him, it was of no concern. Joe Bryan and Denis Woods' book, *Weaponizing Maps* (2015) deals with just this issue, and covers pertinent, additional ground.

At the start of Chapter 4, Koch describes the scenarios he has employed to engage students in the ethical challenges of persuasive mapping. One of the problems these scenarios addressed was the choice between earning a living or forgoing wages for some "higher" principle. Many of the students would become distinctly uneasy after being asked to consider that statistics are frequently partial, or at least incomplete, and that facts may be biased. Nonetheless, Koch would pointedly ask that, if maps can kill, or can at least contribute to killing—as noted in the promotion of "a smoking campaign targeting seniors" (58) or as part of a military mapping operation—what does it mean for the job at hand?

Koch also describes how he, on one occasion, organized a debate on the Tobacco Problem (from Chapter 3) at a mapping medicine seminar at the University of Regina, one that resulted in a wide variety of responses and a great deal of sometimes-heated discussion. In discussing the question of whether data were always neutral, he also described to the seminar the use of "redlining" maps in the 1930s to delineate and classify neighborhoods based on economic indices. Subsequently, these ostensibly objective maps—created to further public good—were used to entrench racial discrimination and economic division through denial of loans for homes and businesses in the redlined areas.

> Here we have at least three ethical imperatives in conflict. The first assumes racial equality is the issue and that redlining violated its promise. The second is purely economic or at least business based. Banks are obliged to do whatever is needed to maximize their returns for shareholders. If African Americans or any other groups are a poor financial risk, well, numbers don't lie: too bad for them. Finally, there is the question of the role of the government and the manner in which it enacts its moral suppositions. (62)

This neighborhood classification, which some commentators have pointed out served largely to *create* the conditions it supposedly reported, resulted in what could be characterized as "ethically bad maps, albeit well drawn" (62). Koch finishes the chapter with a quick note on the number of books available on lying with both statistics and with maps, with the point that there is no great trick to choosing a scale, projection, dataset, and classification scheme to make a persuasive map proving any point one wants.

Chapter 5 starts with an examination of the ethics and morals of mapping poverty and disability. There are a great many ways of measuring these subjects, and there are a great many ways to map each of those different measures. Each can be justified on grounds of "objectivity," but their validity as a characterization of the situation is undermined by the fact that they are often presented in isolation from the contextual complexities that give them meaning. Koch examines a number of maps and data sets of United States and world poverty and inequality, and finds that they all fail to do more than trigger "a kind of moral unease without an imperative to act" (93). There is no imperative, because the maps do not illuminate the "context in which collective responsibility is demonstrable" (93).

"An Education Example" is the sixth chapter, and it starts with an examination of school funding maps for the New York City area. A legal challenge that sought redress for, and prohibition of, discriminatory funding practices provides the stage for reviewing a number of maps prepared from the wealth of available economic, geographic, and social data. Despite the shortcomings of the various maps, including missing data and irregularities in data compilation, they do illustrate unequal educational opportunities, and Koch's follow-up graph and table for 2016 indicate that moderate funding improvements were made. The New York City lessons are then applied to a similar, long-standing situation in Buffalo, New York. Koch concludes the chapter with a section on Supply-Chain Ethics, where poverty leads to ill health and underfunded schools, with predictable failures of education and other opportunities. The author writes that, "as cartographers . . . we usually ignore the ethical supply-chain that carries the links of cause and effect to individual outcomes or specific circumstances" (114). He goes on to say that this results in

tunnel vision, and an inability to link one dataset to another—a situation that begs for a holistic mapping that would allow a more complete picture to be seen.

Chapter 7, "Mapping Injustice as Transportation," opens with the refusal of Rosa Parks to accept segregation on the buses in Montgomery, Alabama, and goes on to discuss transportation accessibility. Koch offers an image of the 1933 London Underground map, which, alongside its successors around the world, hints that accessibility is limited to those who can handle stairs and walkways, especially when the elevators go out of order. He proceeds to proactively redesign the London transit map to show only the wheelchair-accessible stations, reducing the number of nodes in the system by two-thirds. Both of the London Underground maps—the official one and Koch's limited access version—are "objective," but each operates under different assumptions. The question then becomes: is the level of service available to wheelchair users commensurate to that afforded the non-disabled? Koch's map suggests that it is not.

Chapter 8, "Ethics and Transplantation," deals with organ transplants and addresses the unethical practices of "organ tourism" and "premature harvesting." On page 140, Koch presents a map, produced by the United Network of Organ Sharing (UNOS), dividing the United States into the eleven districts it uses to administer organ registration and distribution. But he then points out that it ignores many substantial, related issues, such as the lack of rural access to transplant hospitals, and the often-prohibitive cost of transplantation that is borne by the patient. In response, he offers his own map—with an odd thematic color order and a strangely disjointed slice of southeastern Alaska placed to the west of the rest of the state (which is itself in a different projection)—showing heart transplant waiting times, with point locations of transplant hospitals categorized by the number of transplants performed. This map, unlike the UNOS map, brings to prominence the 11 states that in 1999 had no transplant hospitals at all. He points out, too, that socio-economic inequities "were and are inherent in the US graft organ system of collection and distribution," (148) and that these are tied to ethnicity and race, but admits that no national-level data are collected on this. Koch finishes this chapter with three tables of organ donations and recipients in Buffalo, New York City, and Los Angeles, broken down by race and ethnicity. In summary, he states, "the ethics of graft organ transplantation are enfolded in the greater issues of inequalities of income, education, and healthcare" (157).

Koch uses an "ethical-moral equivalent" of Tobler's First Law of Geography—"The closer we are geographically to those in need, . . . the more we are called on to help" (162)—to open Chapter 9, "The Ethics of Scale." Writing about the maps in Michael Kidron and Ronald Segal's *The State of the World Atlas*, Koch notes that it has gone through nine editions since 1981, but that in that time it "has not provoked an international movement to disarmament, income equality among nations, or an international fight against poverty" (166). This is largely due, he writes, to the way matters of scale interact with our sense of involvement and responsibility. He notes the problem North Americans have empathizing with the poor of smaller countries (such as Bangladesh and Haiti), especially when mapped at a world scale, and even with poor communities in Mississippi or the indigenous First Nation Cree. To illustrate this scale issue, he compares a set of choropleth maps of childhood poverty rates by state (169), with county-level poverty maps from earlier in the book (78). The state-based maps smooth out intra-state variations, and even suggest that there are states where childhood poverty is not a problem—a conclusion hard to reach when viewing the county-based map. Koch notes that none of his ethical questions are about the maps, the methodology, or the algorithms employed, since mapped numbers are just facts out of context. The issue is what is done with the numbers. "As professionals, we are trained to ignore our individual ethical sensibilities. We are trained as well to ignore the broader context" (172). Koch emphasizes the importance of using maps to make people think and act both locally and globally, and asks each of us, as mapmakers, how we will do that.

In his tenth and final chapter ("It's . . . Complex"), Koch makes a number of commendable remarks: "Maps and statistics are techniques that, like the rhetorician's persuasive speech, can be used to advance almost any argument, any proposition" (178). "In charting, graphing, mapping, and writing, we define and refine a dataset's selective message" (179). "Across a two-dimensional plane, maps reveal the results of our ethical choices in a landscape we understand as our own. Seen this way, the map is the practical endpoint of an ethical supply chain that begins with a set of shared moral definitions and resulting injunctions that underlie propositions enacted in the construction of

the mapped landscape" (180). "Professionals like NACIS members have little knowledge of the means by which their ethical aspirations and moral sensibilities can be understood, let alone deployed in the experiential world" (182). "It is . . . easier for the artist, cartographer, journalist, or statistician to ignore the ethical propositions of an assignment than to question them" (186).

Tom Koch's book serves as "a call to awareness . . . that . . . our choices matter" (187). The issues raised in *Ethics in Everyday Places*: *Mapping Moral Stress, Distress, and Injury* are important matters, and, as its author points out several times, it is often much easier to live with the ethical distress of ignoring the issue than to handle the practical consequences of acting on moral imperatives.

The value of its ethical message aside, I do have some practical criticisms. This book contains a large number of poorly constructed maps. In many cases, their poor symbolization and other problems are part and parcel of, or bound up with, the ethical problem under discussion. However, in some instances, such as Koch's redrawn newspaper map of the Iraq War (46), it is hard to sort out the author's mistakes from what might have been problems in the original map. Occasionally, his text simply does not reflect what is on the map—for example, where he writes of triangles and circles on a vector version (12) of John Snow's famous map of cholera (13), which clearly shows diamonds and hexagons. It is hoped that some of the typos and errors in mapping practice can be corrected in a subsequent edition—it would make matters clearer. Overall, despite my quibbles, I really liked this book, and wish that all cartographers would take the time to read it and to ponder the author's suggestions. I think, too, that this book should serve as an excellent teaching tool for upper-level undergraduate and graduate-level cartography and GIS students.

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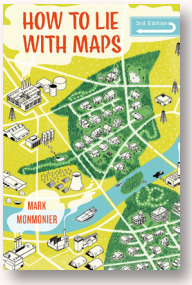
HOW TO LIE WITH MAPS, THIRD EDITION



By Mark Monmonier

The University of Chicago Press, 2018

241 pages, 97 b/w figures, 17 color plates, $22.50, softcover.

ISBN: 978-0-226-43592-3

Review by: Evan I. Levine, Brown University

The production and consumption of spatial data is at an all-time high, as satellite imagery and crowd-sourced information proliferate past the point of ubiquity. Given these circumstances, this third, revised, edition of Mark Monmonier's *How to Lie with Maps* has arrived at a fortuitous time indeed. The University of Chicago Press has produced a handsome, updated volume, with some welcome additions, revisions, and reorganizations. In this edition, Monmonier's focus remains on the same themes previously explored in *How to Lie with Maps*, centering his attention squarely on the cartographic paradox: how is it that maps can be objective and yet must—because they all require a certain degree of selection, reduction, and simplification—at the same time, lie? The author aims to help his readers develop a critical and informed eye for maps, a perspective that allows them to differentiate the good from the bad (whether intentionally or inadvertently misleading), and, in this way, to create a culture of healthy skepticism towards all forms of media.

Reviews of the first two editions of *How to Lie with Maps* have highlighted the book's popularity and success, as it broke free from its academic origins to reach a wide audience of both academics and laypersons. In the twenty-two years since the publication of the second edition, however, much has changed in cartography and in the global political and social climate. With that in mind, it is important to explore whether Monmonier's take on maps remains relevant, and if his approach to cartographic (in)fidelity remains appropriate. I find that the answer, on both counts,

is largely positive. I hope to show this by exploring the text—with particular attention to changes in the new edition—and examining it in the light of some of the concerns raised in reviews of the earlier versions.

The overall construction and organization of the third edition will be familiar to readers of the earlier editions. Monmonier has added a new, very brief preface, in which he notes some of the major changes in cartography over the last two decades—mainly in the realm of things digital—and outlines the necessity for an updated edition and some of the major changes therein. The body of the text—bookended with a brief introduction and even briefer epilogue—is composed of four chapters on basic elements of cartography, and nine chapters exploring particular scenarios in which maps can mislead their readers. As in earlier editions, the first block of chapters serves to catch readers up on the major characteristics and central methods of maps and cartography, laying the groundwork for subsequent chapters. The author's approachable, vernacular writing style—overflowing with contractions and in a dialect dripping with Americana—may come as a surprise to readers expecting a prose that matches the academic rigor of the information it contains. Little has changed in the new edition's chapters on basic map elements (Chapter 2), the "white lies" of generalization that are necessary for the function of maps (Chapter 3), and the most common mistakes that one may encounter in maps produced by professional and amateur cartographers alike (Chapter 4). The most substantial novelty in this section of the text is the movement of the discussion of the use (and misuse) of color in cartography to Chapter 5 from its earlier position near the end of the book. The chapter begins with an overly long digression on the human perception of color that, while interesting and informative, has little immediate relevance to cartographic design or to the dissemination of information in mapping. Monmonier's major points about color could stand on their own without this information. Nonetheless, apart from this and a few other tangential detours, Monmonier's new edition continues to provide a thoughtful, detailed, and, most importantly, accessible introduction to cartographic theory in the brief span of 66 pages. This text continues to shine, as it always has, in the group of thematic chapters that follow the cartographic introduction. Returning readers will recognize case studies concerning the creation of maps for advertising (Chapter 6), urban development (Chapter 7), political propaganda (Chapter 8), national defense (Chapter 9), national identity (Chapter 10), and spatial statistics (Chapter 11). The second edition's underwhelming six-page chapter entitled "Multimedia, Experiential Maps, and Graphic Scripts" has been replaced by a much more substantial group of three chapters on aerial photography and remote sensing (Chapter 12, "Image Maps: Picture That"), cartography and borders (Chapter 13, "Prohibitive Cartography: Maps That Say 'No!'"), and so-called "fast maps" (Chapter 14, "Fast Maps: Animated, Interactive, or Mobile"). In each of these, Monmonier employs both real and imagined scenarios to explore the particular theme at hand, although some of his storylines appear dated. These chapters could have been more effective with updated or more relevant case studies, datasets, or figures. For example, Chapter 6 ("Maps That Advertise") is overly focused on imagined scenarios in which the author's abstraction and humor clash with the historical examples put forth in other sections of the book, and which are so drenched in narrative storytelling that they reduce the overall effectiveness of the discussion. This holdover chapter would have benefited from some contemporary, unimagined examples of map-based advertising to provide readers with the chance to inject their own experience onto the topic.

Chapter 8 ("Maps for Political Propaganda") deserves particular attention as a very effective self-contained unit. Not only is it, in my experience, the single chapter of the book most widely assigned for classroom reading, but it is also a discussion of outstanding relevance in today's political climate. In "Maps for Political Propaganda," Monmonier explores the reemergence of the Mercator projection for the representation of an oversized, threatening Soviet Union and Communist China (108–9), but he falls short in modernizing his example through the exploration of contemporary examples of this practice—for example, the slew of maps portraying Russia as an enormous, threatening landmass looming over Crimea that appeared during and after its 2014 annexation. Likewise, Monmonier's discussion of the Gall-Peters projection (110–112) does not mention recent examples of its recurring presence in the news, including its 2017 adoption by Boston Public Schools. Finally, while the campaign of propaganda produced by the Nazi party (112–118) remains a particularly useful and effective case study, the author misses the opportunity to offer examples of the same techniques being employed by the rising tide of nationalists in Europe and the United States. Contemporary examples would have reinforced the continuing relevance of this chapter, rather than leaving it up to the reader to make the link between specimens from the now-distant Cold War and the current political scene.

Similar criticisms toward out-of-date examples could be levied against other thematic chapters. For example, Chapter 10, entitled "Large-Scale Mapping, Culture, and National Interest," retains an absolutely critical discussion on racialized toponyms that reinforce denigrating stereotypes of minorities and indigenous groups—an examination that forces readers to confront these themes in the light of their own experiences. The rising normalization of hate speech, and of acts of hate, in contemporary American politics and culture give this chapter immediate relevance for readers. However, Monmonier limits his exploration to toponyms coined in America's infancy—effectively ignoring any number of contemporary examples, many linked to acts of institutionalized racism and intolerance.

The same can be said for issues of public health in Chapter 11 ("Data Maps: A Thicket of Thorny Choices") where, in reference to John Snow's endlessly familiar Broad Street map of the 1854 cholera outbreak in London, the author writes that "pandemics are rare, and seldom is the association between disease and an environmental cause so overwhelming that the link is easily identified and unchallenged" (172). By situating this theme in a decidedly historical frame, Monmonier passes up the chance to place this historical spatial analysis in dialog with recent events—such as the lead poisoning and Legionella outbreak associated with the Flint, Michigan water crisis (Hanna-Attisha et al. 2016)—and thus avoids highlighting the continued relevance of John Snow's seminal contribution to cartographic and epidemiological history.

It is in these missed opportunities for renovation and modernization that the third edition of *How to Lie with Maps* stumbles. Relatively little has changed in either the instructional or thematic chapters brought along from the second edition and the most substantial alterations often consist of the addition of a single paragraph or two that highlight how the advent of digital mapping of one sort or another has created changes (or continuity) in the particular topic being discussed. Moreover, these paragraphs can at times feel artificially inserted, particularly when they clash with the polished and inviting prose found elsewhere in the chapter. However, even when they are not integrated in the smoothest possible manner, or as extensively as one might like, they remain necessary additions that serve to bring the text into the present.

In contrast to my opinion that parts of the original chapters still need a new coat of paint, Monmonier does provide, as mentioned above, a much-needed update in the form of the three new chapters on image maps, mapping of that which is off-limits, and "fast maps" (Chapters 12 through 14). Unfortunately, Chapter 13 is less of a thematic exploration of prohibitive cartography than a list of types of maps that in some way exhibit control and enforce relationships of power. Nevertheless, Chapters 12 and 14 allow *How to Lie with Maps* to remain both a classroom staple and major popular introduction to the way every map inevitably presents only one of many possible propositions about the places it depicts. "Image Maps" (Chapter 12) integrates a welcome exploration of raster data and satellite remote sensing, now-common sources of cartographic data that were not discussed in the earlier editions. In contrast with the abstract, and arguably superfluous, exposition of the science behind color that is found in Chapter 5, Monmonier's elucidation of non-visible light is grounded in the context of its utility and reads as a more appropriate exploration of this subject (181). In addition, the major example of the misuse of this sort of data—the perhaps-expected case of the misinterpretation of "WMD sites" in the lead-up to the Iraq war—feels like an appropriate choice for the topic, and certainly fits with the case studies found elsewhere in the text.

In the same vein, Monmonier's Chapter 14, on "Fast Maps: Animated, Interactive, or Mobile," is an absolutely critical addition to the volume. In it, the curtain is slightly pulled back on topics of online mapping, crowd-sourced data, and the contemporary digital environment within which cartography now finds itself. A critical analysis of the Web Mercator projection is advanced—one consistent with the other, broader, discussions of the Mercator projection in Chapters 2 and 8, and highlighting the continued relevance of the themes of projection and distortion in contemporary cartography.

Many of the lingering concerns with the third edition of *How to Lie with Maps* had already been raised in reviews of the first and second editions. Earlier reviewers have opined that some of Monmonier's examples are clumsily executed (Carlucci 1997) or that, even by the second edition, some figures were in need of updating (Trifonoff 1996). The first point has been explored sufficiently in this review, but the latter requires some unpacking. Throughout *How to Lie with Maps*, figures that were highlighted as illegible in earlier reviews—for example, the monochrome Figure 10.7—remain so. In addition, Monmonier has done himself little service in duplicating some figures throughout the text in both color and grayscale, and his points could have stood without figural repetition (Figure 7.1/Plate 5 and Figure

8.16/Plate 8). The appendix on latitude and longitude is less than two pages long, and should have been integrated within the main body of the text—a suggestion that was first proposed by Trifonoff (1996). Finally, statistics that were already out of date by the publication of the first edition of *How to Lie with Maps* remain unchanged in the third edition, and feel even more "incongruous with the contemporary tone of the rest of the book" (Gilmartin 1992) than they did some twenty-six years ago.

Nevertheless, much of the praise that Monmonier received for earlier editions of this book remains applicable, especially so in the contemporary geopolitical climate. *How to Lie with Maps* continues to be inviting and readable, concealing detailed introductions to critical cartographic concepts beneath a veneer of humorous and casual prose (de Blij 1992; Hughes 1996; Walker 2011). Smith's (1991) concern that Monmonier does himself a disservice by not diving into the waters of defining some sort of epistemological truth is, to my mind, overzealous, and the wide applicability of the arguments framed in *How to Lie with Maps* would have suffered from building on a foundation of that sort.

Is this book still relevant, and is Monmonier's take on the topic still appropriate? To the first, I would argue that, while the aim of this volume remains the same as it was at its initial publication, its relevance has only grown over time and the themes explored therein are now more pertinent than ever. Monmonier has succeeded once again in advancing a narrative that will find a wide and varied audience and will instill, one hopes, some level of critical map literacy in contemporary life. To the second question, while *How to Lie with Maps* does at some points feel dated, the cartographic approach he advances remains appropriate for today. Rather than hoping that a new edition of this text will modernize its arguments completely, perhaps we should instead look to the next generation of cartographers and geographers to write a new volume that will truly resonate with the modern condition of cartography.

Taken as a whole, the lingering issues in *How to Lie with Maps* have less to do with the content of the text and more with the high degree of polish one expects to see by a volume's third edition, especially from one that has received such acclaim and wide readership. Nevertheless, Monmonier continues to have a great deal to offer to first-time readers and return visitors alike. This new edition of *How to Lie with Maps* again succeeds in explaining not only the various ways in which maps can be manipulated, but also the necessity for this manipulation. Most importantly, he continues to create a population of informed map readers, who have learned that they must remain skeptical of the biases and motivations of mapmakers. While striving at all times to appear transparent and objective, maps necessarily reflect ulterior motives, which can themselves be opaque. All maps lie, and Mark Monmonier continues to serve as an able guide for readers at any level to begin the process of informed cartographic interpretation and engagement.

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CARTOGRAPHY. MOOC

By Ken Field, Edie Punt, John Nelson, Wesley Jones, and Nathan Shephard

Esri MOOC Program (online), April—June 2018

Review by: Tara LaLonde, Pennsylvania State University

Massive Open Online Courses (MOOCs) can help aid participants in their professional development, discovery of a new topic, or application of new skills. This is a review of the Esri Cartography. (pronounced "Cartography, Period" or "Cartography, Full-Stop") MOOC held from April 18, 2018 through May 29, 2018. Courses in Esri's MOOC Program (**esri.com/mooc**) run in a cycle over four quarterly terms, or sessions, with each individual MOOC lasting six weeks. This particular course aimed to help participants explore cartographic design choices beyond software defaults, and was intended for educators, students, GIS users, and map designers. Hands-on exercises use Esri's ArcGIS Pro to create outputs that are then shared through ArcGIS Online or exported to various formats, including images and videos. During the course registration process, a helpful outline aided in determining whether this MOOC would fit participants' needs.

The course was presented as six weekly lessons, and participants could access a personal online dashboard to track their progress as well as find announcements and answers to common questions. Each of the six lessons began with a brief video, which opened with a lively introduction to the lesson topic from a three-presenter panel, and included segments on a "Map of the Week," a spotlight on a pivotal cartographer, a look at some obsolete analog mapmaking tools, and a discussion of some cartographic design elements to avoid (and why).

Lessons also included two instructional documents in PDF format, ArcGIS Pro project files, a short quiz, and a comment area. A certificate of course completion was provided at the end of the MOOC. The following review includes a brief analysis of each lesson, touching on its strengths and areas for potential enhancement.

Lesson One introduced the term "graphicacy" as the key to understanding how graphics, including maps, are used to communicate messages and information to audiences (Balchin and Coleman 1966). Mapmaking connects artistic and cartographic decisions, while also taking into consideration project constraints such as available time. The Lesson One exercise, which focused on symbology, exposed new users to ArcGIS Pro—its interface, panes, and project set-up—in creating a small-format reference map of Massachusetts. A particularly informative part of the first week's exercise involved the ways that symbol drawing order within a layer could be modified. Options beyond the default selections, such as the creation of a custom color and the modification of a built-in gallery symbol for highways, were also illustrated.

Lesson Two focused on the selection of appropriate projections and on data classification options. The first exercise illustrated the effect of various projections on maps of hurricane data, while the second exposed the learner to multiple data classification methods for thematic mapping purposes. These included natural breaks, quantiles, equal intervals, geometric interval, standard deviation, and manual interval classifications, many of which may be helpful to explore in future mapping projects. Here, and throughout the course, the student was encouraged to explore beyond the software's default settings. One strength of the Lesson Two video and exercises was the explanation of the importance of data normalization when creating choropleth maps—a map type that relies on area comparisons.

Lesson Three introduced the learner to scale and generalization. The "Map of the Week" segment included the well-known John Snow cholera map, which deals with spatial aspects of health phenomena. Some of the "Map Tools" in this lesson may be unfamiliar to GIS and computer mapping technology users; for example, the presenters examined some specialized, adjustable pens used for drawing lines of different thickness. The lesson's first exercise focused on creating a multiscale New Zealand basemap using generalization techniques and scale ranges. An important feature of this exercise, which led the learner beyond the default settings, was a description of how to query a layer based on field values. The exercise also included using the basemap to create a vector tile layer, a data format suitable for use in ArcGIS Online. The second exercise of this lesson focused on thematic mapping, and included choropleth, graduated symbol, proportional symbol, and dot-density maps.

Lesson Four illustrated how the label options in ArcGIS Pro could take time to explore, and why it was worthwhile to take that time. A key message of the lesson was how different a map could look based on the placement and properties of its labels. The first exercise showed how labels could be filtered to include only those in which the user was most interested, through the creation of label classes. The option examples for street labeling—including label priorities, label weights, and font characteristics—illustrated how these changes could impact a map's visual appeal. Another helpful labeling option presented was the use of halos to help visibly separate the label from the map features. While the examples of labeling feature types such as lines, points, and polygons were relatable to many GIS users, Lesson Four also included an exercise on labels as symbols that was informative, but may be used less frequently.

Lesson Five focused on 3D cartography, particularly on 3D symbology and scenes, and included the use of digital elevation models (DEMs) and light detection and ranging (lidar) datasets. Lesson Five's first exercise included a 3D mudslide visualization that incorporated imagery and DEMs to depict the slide's impact, and the second employed a creative and realistic scenario using city buildings, trees, streets, and features to create a 3D map. In the latter exercise, participants learned how to add preset symbology features such as trees, buildings, and icons to the map.

If the user had not previously worked with lidar, elevation, or imagery data, these exercises would provide them with a brief exposure that might, perhaps, interest them in further investigation of this type of data. The urban exercise should appeal to those in city planning and landscape architecture, and prompt them to learn more about the many options for creating realistic, and aesthetically pleasing, 3D maps.

Lesson Six examined mapping across time using small multiples and animated maps. Small multiples depict temporal changes using a series of maps showing the same area and theme at different times. The first exercise of Lesson Six involved mapping earthquakes over time and utilized some of the ArcGIS Pro layout options, such as map frames, and exporting options. In general, layouts were given little attention in this MOOC, which tended to focus primarily on symbology. The second exercise in this lesson highlighted the use of time-enabled layers in the creation of animations. The range of potential animation sharing options, such as those through social media, was illustrated through the export of the animations to different file formats such as MP4 and animated GIF.

Strengths of this MOOC included the well-made and well-structured videos with optional captions and transcripts, and the well-structured exercises. The panelists in each video helped to frame the weekly topic and offered multiple perspectives to help enhance a participant's understanding of it. In addition, the exercises included a variety of supplemental materials, which could appeal to both newer and more advanced participants. The course exercises explored topics relevant to a GIS user's workflow: from working with geospatial data symbology to the sharing a final product with a wider audience via a web map. In addition, the exercises on cartographic concepts could benefit those new to cartography, as they provided a foundation for more advanced study. From my perspective as an educator, the content on thematic mapping, 3D cartography, and animation could integrate well into a curriculum and into instructional exercises. I find—as, no doubt, do many GIS users—that there are some techniques I use more regularly than others, and this MOOC reminded me of a few useful ones not heavily used on a daily basis.

In addition, this course could serve as a helpful way for ArcMap users to become more comfortable with ArcGIS Pro and to transition tasks commonly completed in ArcMap to Pro. This MOOC could also serve as an introduction to working with ArcGIS Online, which users may want to explore through additional training and MOOCs.

Future iterations of the course could be enhanced by including more connections with the GIS education, government, and business communities through adding links to these Esri communities, which could benefit MOOC attendees. They could also include other relevant sources of geospatial data from ArcGIS Online to use in ArcGIS Pro, such as layers from the Esri Living Atlas. This MOOC was focused on the cartographic aspects of ArcGIS Pro, but the addition of more cartographic reference material from outside the context of that particular piece of software would have been helpful. The inclusion of short quizzes to assess the student's knowledge of a topic was also helpful, and the quizzes could be taken multiple times, but the quiz questions were not always closely aligned with the exercises. While engagement with content occurred primarily through the exercises, the discussion forums were the way to engage with classmates. Some

of the lesson discussion forums, though, appeared to have less dialog than others, depending on the extent participants wanted to respond to each other's posts. These few shortcomings of the MOOC were minor in relation to the cartographic and ArcGIS Pro experience that it offered.

Overall, I found that the experience of participating in this MOOC was positive and informative, as it enabled me to explore ArcGIS Pro's cartographic functionality in a sequenced environment alongside others, during a specified time. The time allowed to complete the exercises and weekly sections was manageable. I would recommend taking this MOOC to anyone who wanted an introduction to cartography, and those who are interested in ArcGIS Pro. Many of the items presented in the Cartography. MOOC could be applied to cartographic design projects, and would help the mapmaker create more unique works. This MOOC could also serve as an introduction to other Esri training courses and MOOC offerings, as these focus on related topics, such as ArcGIS Online, imagery, and other Esri products. Participation in a MOOC or other self-paced online tutorial is an option for professional development and lifelong learning that GIS users may want to consider in the never-ending task of keeping up-to-date with changes in software technology. A wide range of learning opportunities, including tutorials, webinars, and more MOOC offerings, are available from the Esri training site (**esri.com/training**), which can help to further one's experience with cartography and ArcGIS Pro.

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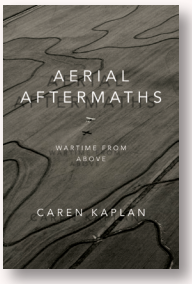
AERIAL AFTERMATHS: WARTIME FROM ABOVE



By Caren Kaplan

Duke University Press, 2018

312 pages, 58 illustrations, $27.95, paperback.

ISBN: 978-0-8223-7017-8

Review by: Jonathan Lewis, Benedictine University

Aerial Aftermaths: *Wartime From Above* examines not only the initial appearance and subsequent evolution of aerial observation, but also the assumptions underlying the creation and interpretation of those views. The author, Caren Kaplan, connects the emergence and development of the aerial view with warfare, and with facilitating the efforts of major colonial powers to control and extract resources from spaces while ignoring their prior uses and depictions. The book begins with a protracted analysis of images from the 9/11 attack on the World Trade Center, taken by individuals and groups of varying official designations. These include photos obtained at ground level by first responders, others taken by New York City's Police Aviation Unit from a short distance above the burning buildings, and still others acquired by satellites and from the International Space Station. This association of aerial views with the state sets up Kaplan's subsequent chapters on the appearance and development of the detached, bird's-eye perspective and its connections with state power.

Throughout the book, Kaplan employs the term "aftermath" to describe the consequences of wartime aerial perspectives. Though originally meaning the second mowing or harvest after an initial cutting, Kaplan laments that it has acquired "a figurative [meaning] as 'something' that 'results or follows' from an event that is 'disastrous' or 'unfortunate,' especially in relation to war" (18). While this suggests that her book will pit power against resistance, Kaplan takes pains to ensure the reader that she is after something quite different:

> This book argues that the history of aerial views—whether observed from towers or mountains or hot air balloons or planes, whether incorporated into cartographic surveys or panoramic paintings—troubles this conventional divide between power and resistance in the storyline of visual culture in modernity. I would suggest that we move beyond de Certeau's evocative opposition between "seen and seeing objects" to consider the possible presence of the unseen and unsensed (2–3).

Over the next few chapters, Kaplan describes some of the key elements contributing to, and illustrating, her argument. In the first of these chapters, she explores the motives and means behind the First Military Survey of Scotland (established in 1747) as a way to illustrate "the formation of geographical knowledge as a quantifiable science" (34).

Military leaders were at the forefront of those arguing for a clear overhead perspective to help suppress recurring rebellions and deter possible invasions from the north. It was their conviction that unknown and unmapped territory was conducive to, and indeed created, insurrection: that is, disorder. Visual representation, therefore, introduced order and stability to areas where the local population had seen its villages burned, prisons built, and opposition leaders executed. The mapping of the Highlands in particular was seen as essential because it was "the incubator of rebellion and disorder through nature, as a terrain given innately to treason and therefore requiring domestication and control" (40).

The Military Survey "became Britain's prime 'laboratory' for the kinds of innovations in surveying and mapping that would become standard operating procedure in the colonization of North America, South Asia, and elsewhere in the years to come" (48). A key player helping accomplish this was Paul Sandby, a young draftsman and landscape painter turned cartographer. Through his efforts, and those of others involved in the Military Survey, Scotland's mountains became tamed, and were transitioned from "'wastelands' as subjects of science and management [into] resources to be tapped and mined as well as reshaped" (62).

Often, the maps initially produced by Sandby and others were considered too "artistic" and so were "made less 'painterly,'" and "'more reliable' if less 'attractive'" (65) by the Board of Ordnance. This meant that the ultimate visual representation passed through many hands, often those of individuals located a great distance from the region and who had never visited the area. This was an important early step in the transition of imagined aerial views produced during the early Renaissance to perspectives that, while equally imagined, were informed by the careful and methodical measurements of surveying.

Kaplan's second chapter, "Balloon Geography: The Emotion of Motion in Aerostatic Wartime," describes the earliest aerial views described and made by individuals carried by balloon, often to literally dizzying heights. She points out that while aerial views existed prior to actual flight, they represented the *expected* view from above.

Those expectations, however, were grounded in conventional depictions of atmospheric perspective as observed from the relatively low elevations of hills or towers. Where painterly depictions showed distant objects as softened and less distinct than those in the foreground, actual aeronauts saw things clearly and sharply, and in vivid color, regardless of distance.

Kaplan points out that efforts were made to bring together and resolve the varied accounts given by aeronauts in order to produce consensus on one unaltered perspective capable of withstanding challenge from the introduction of new information.

> In this moment of contradictory and multiple practices, Enlightenment social and natural sciences strove to bring together the widest possible examples of observable phenomena, and to organize these vast collections in increasingly rational formats. . . . But these most modern of scientists for their age . . . could not fully accommodate their experiences within available science . . . their senses were challenged by new information and evidence (95).

With such confusion over what was seen, military leaders could not hope to acquire, in a single glance, the clear and complete view from above that Kaplan calls *coup d'oeil*. Thus, despite some early, and notably successful, efforts to utilize balloon reconnaissance, the new technology soon lost support.

"La Nature à Coup d'Oeil: 'Seeing All' in Early Panoramas" is Kaplan's third chapter, and it covers the creation of panoramic displays, especially those done in the late eighteenth century by Robert Barker. Kaplan explains the allure that panoramas offered, before moving to the central concern of her book: military themes in aerial images, and how they obscure at least as much as they reveal in the process of drawing attention to matters of importance in battles and in the aftermath of combat.

> In the period during which Robert and Henry Aston Barker produced panoramas, Britain embarked on twenty-five years of almost

> continuous war with France. During the same period, the French Revolution proceeded violently, alarming British conservatives, and generating repressive tactics to ensure public order (132).

The popularity of contemporary military scenes, then, comes as no surprise. Panoramic images such as *View of the Fleet at Spithead* (1793), *Lord Nelson's Defeat of the French at the Nile* (1799), and *The Battle of Waterloo* (1815), among others, immersed viewers in wartime settings. Accompanying pamphlets pointed out important elements and their proper interpretation. They offered a narrative that steered and shaped what viewers saw, and allowed them "to feel connected first-hand to the news and events of the day" (135), including the ability to safely witness battles in visually striking recreations. In her chapter summary, Kaplan points out that panoramas "offered British metropolitans the opportunity to sense more openly the battles that they paid for quite dearly in both blood and money . . . [and] produced a particular kind of wartime visual culture in the context of art and entertainment" (136).

Aerial photography is the theme of Kaplan's fourth chapter, in which she emphasizes the role played in its development by Western political and military interventions in the Middle East. Although it was important in Europe during the First World War, "aerial photography in warfare was first introduced in Libya, three years before the official start of World War I, as Italian forces attacked Ottoman Turkish installations" (140). This region was especially conducive to airborne observation, due to its fine weather, flat terrain, and lack of obstructions that obscured views of the surface.

In this period, concern with the emotional responses or aesthetic observations of early aeronauts faded away as aerial photography became increasingly associated with technical or military objectives, an association that led Charles Waldheim (1999, 147) to "recognize the complicity of the aerial photograph with the map as instruments of surveillance and control."

Kaplan supplements her arguments with examples of both early aerial photography and the rubrics used by the photo interpreters to facilitate generation of military maps. By the end of the chapter, Kaplan has exposed the transitioning rationale for aerial photography from its starting point as a simple tool for reconnaissance all the way into an active, weaponized instrument for killing scores of civilians.

> Advocates of airpower in Europe and the United States argued that it was more moral to plan for massive bombing raids on cities because the scale of violence would force an early surrender . . . since this kind of firepower had not yet been unleashed on European or American metropoles . . . there was no "moral or legal taboo" to prevent the bombing of largely civilian populations in colonized or Mandate zones (175).

The heavy casualties inflicted by aerial attacks, however, increased rather than eliminated local resistance, and necessitated—from the perspective of the British Royal Air Force—additional reconnaissance and bombing. This, in turn, produced "a population bombed into subdued if restive compliance" (178).

In the next chapter, "The Politics of the Sensible: Aerial Photography's Wartime Aftermaths," Kaplan describes the work of three late-twentieth-century artists who utilized aerial photography in order to draw attention to the effects of overwhelming assaults in a period when aerial imagery provided "news" that sanitized the realities of the wholesale destruction of civilian populations.

Photographs in Sophie Ristelhueber's exhibition *Fait* (Grenoble, 1992) showed the scarred land and abandoned equipment left behind after the 1990–1991 Gulf War. Reviews of Ristelhueber's exhibit invoked comparisons with the painted panoramas Kaplan had described earlier: "To see the images in person is to view them in an intentionally created aura, an almost panoramic immersion. . . . Mayer [(2008)] links the exhibition experience of *Fait* to a panorama that overwhelms the senses of the viewer" (193).

The artist Jananne Al-Ani took aerial images of farming areas in Jordan, in which one can discern "traces of past events and inhabitants, liminal presences that can be sensed from various angles and in different lights" (195). Her aerial archaeology "provides evidence that the past is recoverable . . . if the right conditions, subjects and technologies are brought together" (198).

That potential for recovery is the motivation behind the third artistic challenge to military-industrial aerial photography that Kaplan discusses: that of the team of Fazal Sheikh and Eyal Weizman. Their work extends the perspective employed by Al-Ani into "a five-year photographic project in Israel and the West Bank," with particular emphasis on "the northern Negev Desert, which has been emptied of Bedouin inhabitants by the Israeli government and which is now slated for significant development" (200). Sheikh and Weizman intended their work to help supply the "documentation to support indigenous land claims [that] is either lacking or exists in formats that are not recognized by the Israeli legal system" (200).

In a situation similar to that experienced by indigenous Americans, "the politics at work in this 'systematic state campaign' . . . seeks to remove [an] entire inconvenient population from the 'fertile northern threshold of the desert' and relocate them to areas far more arid" (201). In the work of these artists, aerial imagery is used, not to advance the removal or control of "inconvenient populations," but to thwart, and perhaps reverse, the self-serving plans of powerful outside interests.

In her "Afterword," Kaplan explains how aerial photography and reconnaissance has undergone yet another expansion and revision with the introduction of drones. In some areas, monitoring by drones is now continuous so that "on any given day as we go about our daily lives in the United States, many drones are in operation over foreign terrain, conducting surveillance and launching attacks" (209).

Information obtained from drones, satellites, and other sources provides data for the latest set of computer algorithms to analyze. These systems are turning "away from the two-dimensional cartographies that control contiguous blocks of horizontal space and toward the conceptualization of vertical volumes of area that require entirely different modes of remote sensing" (212). This, in turn, means that "strategic doctrines and tactics of airpower would have to adjust to this three-dimensional battle space that would now include tunnels, bunkers, sewer systems, and buried infrastructures as well as street and house to house combat" (213).

Kaplan closes her book by clearly stating her concerns about these developments.

> The United States wages war in such a way that most people at home do not have to think about geopolitics or casualty figures at all while those professionals who do the killing remain safe and sound (211).
>
> Living in the United States during a long war that seems to figure in the public life of the nation only as patriotic sloganeering or security state fear-mongering, . . . [my] country kills people directly, and indirectly, from close proximity as well as from afar . . . [my] job is not to impersonate the universal view from "no where" or to succumb to numb defeatism [but to] become sensible to other possibilities (216).

Aerial Aftermaths is a work that brings together serious and complex ideas from different disciplines. Readers most familiar with one area of study may find the approaches and conclusions from others a little confusing. Those most acquainted with what might be termed a traditional "history of cartography" approach, for example, will be glad to see Denis Cosgrove's name appear. Others, who pick up the book because of its coverage of Middle East history and conflict, will similarly be pleased to see Robert Fisk's name included in the bibliography. But most of the viewpoints summarized in Kaplan's argument come from the study of visual culture. Her success in excerpting pertinent observations from writers in a wide variety of intellectual disciplines, including alternative and emerging ones, is one of her book's major accomplishments. Another strength is her utilization of recent interest in late eighteenth and early nineteenth-century panoramas to place those works in the context of the emerging contemporary conceptualization of the Earth's surface from the air. By distinguishing between affective and objective responses to what was seen from the sky, she effectively demonstrates how existing understandings and expectations were profoundly challenged by the actual experience of seeing the ground from aloft.

One area where *Aerial Aftermaths*: *Wartime From Above* could be stronger involves its treatment of negative evidence. Although Kaplan often acknowledges events or evidence that are significant for their absence, she occasionally inserts speculative explanations for these absences, an approach that discards falsifiability. For example, Kaplan describes a particular Paul Sandby painting of a Scottish

landscape, in which she says that the artist/cartographer had ignored a prominent mountain that he could hardly have overlooked. Committed, as she is, to characterizing the Military Survey as part of an imperial effort at pacifying the local population, Kaplan characterizes the scene as lauding the disciplined work of the surveyors depicted in the painting. Her explanation of why Sandby chose to ignore the much larger mountain directly behind him is that its size would symbolize the folly of any effort to impose order on such an enormous feature. Yet, had Sandby chosen to paint the mountain in question, then one supposes that Kaplan's explanation would have shifted to instead assert that the painter's objective was to show the power science could use to bring such enormity under its dominion. This is a logic that defies challenge, because there are no conditions under which an image (or its absence) cannot be interpreted to support the preferred narrative.

In conclusion, Caren Kaplan's *Aerial Aftermaths* utilizes insights from different disciplines to inform an account of the appearance and transformation of images drawn from aerial observations over a span of several hundred years. While early chapters make it clear that military interest in aerial views was tenuous during the early days of aerial observation, that interest increased dramatically alongside advances in flight. The book's conclusions demonstrate the necessity of understanding both the raw destructive capabilities of current technologies, and how visual representations of that destruction inform and infiltrate the work of contemporary artists. Throughout, Kaplan exhibits a solid grasp of a broad literature from different disciplines and an abiding concern for the urgency of her subject.

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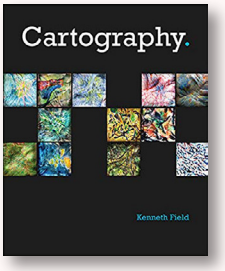

By Kenneth Field

Esri Press, 2018

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Review by: Mark Denil, sui generis

Cartography. (pronounced "Cartography, Period" or "Cartography, Full-Stop"), is the long-awaited and much-anticipated "compendium of design thinking for mapmakers" (*title epigraph*) from Kenneth Field, the indefatigable Senior Cartographic Product Engineer at Esri.

Cartography. has no subtitle—nor should it need one, really—the single word covers it all. That title, however, includes a punctuation mark; and this little dot—in blue on the book's cover—is every inch a gauntlet thrown on the ground. Including, and emphasizing, this bold little dot in the book's title is a brash and confident gesture that constitutes a challenge to all comers. This book, before it is even opened, has declared itself to be complete: it announces that Cartography is here, between these covers, and that what is beyond these covers is Not Cartography. Does that interpretation sound overblown? This aspect of challenge is clearly understood by the publisher: in the July 2018 edition of *ArcWatch*, Carla Wheeler wrote that "everything you need to know about how to create well-designed maps can be found in the beautifully illustrated pages of *Cartography*." (Wheeler 2018). She also quotes the author:

> "This book is boldly intended as a one-stop shop for cartography. It's the book for aspiring mapmakers that can act as a guide and a grounding in the ideas that support better mapping," Field said. "It's also the handy reference for those [mapmakers who are] more experienced."
>
> (Wheeler 2018; *interpolated text in the original*)

One gapes at the confidence and audacity with which the claim is made. Still, given the well-deserved reputation of the author, any reader (and especially any reviewer) must take these statements seriously, and at their face value. Englishman Ken's book thus arrives on the field standing tall on its hind legs—it remains to be seen, however, if that field shall prove to be like unto Agincourt, or unto Hastings.[1]

The softcover version of this publication is perfect bound (that is, it has a glued binding), but its pages are sewn in signatures like a hardbound book. This both promises longevity for the binding and helps the book lay flatter than it would with just glue on a stack of pages almost an inch and a quarter thick. It does, however, make the book's bound edge noticeably thicker than the fly edge. The hardcover version is more conventional in this regard.

The book is printed on very slick, not particularly opaque, glossy paper that provides for sharp text and images. That the paper is a bit slippery for penciled notes is not, perhaps, so important, but one should be warned that while a standard white Pentel Hi-Polymer drafting eraser will efface your pencil marks, it will also lift the ink right off the page.

The odd little graphics on the cover—twelve squares on the front, eleven on the back, and a tall rectangle on the binding—are, we discover (xx–xxi), maps of unseen and nonexistent places painted by Angela Andorrer on the hands of various cartographers of note. Each map is based on "a short [written] extract that described the imaginary country" (xx *unexpressed*). Ken's, which appears on both the front cover and on the binding, is fetchingly Kandinsky-esque.

Kenneth Field is the only author reported on the cover and title page, but two others are included on the "Authors/cartographers" page. Field is credited there with "words, maps, illustrations, and design," but Wesley Jones and John Nelson are noted only for "maps and illustrations." There is also a page of "Contributors" that identifies two dozen generally well known and respected cartographers from around the world. It is my understanding that their contribution was restricted to the map descriptions in the "Exemplar maps" thematic group (more on which, anon).

The end matter of *Cartography*. includes three pages of "Sources and resources," comprised of a reading list of books, journals, web resources, blogs, and tutorials, plus a list of societies and organizations, and another of "Selected cartographers and 'geoviz' experts on social media." I have been informed by my editor that "geoviz" is a cant term of some recent coinage; still, it seems unfortunate. The book closes with seven pages of "Image and data credits" that seem to be arranged in order of appearance, but without the conventional burden of page numbers.

Unlike many books on cartography, *Cartography*. is not divided into sections, chapters, and sub-chapters. Instead, Topics are arranged alphabetically as in a dictionary or encyclopedia, with illustrations and short descriptions of selected Exemplar maps interleaved between the index letters. Each topical entry is afforded a two-page spread, usually made up of a page of text on the left-hand page and an illustration on the right. In some ways, the arrangement reminds me of Bertrand Russell's *Wisdom of the West* (1959), which surveyed Western philosophy from the pre-Socratics up to Russell himself using just this sort of page-spread-per-philosophic-system tactic (only Plato and Hegel had extra spreads, as I recall, but those two were responsible for a boatload of material).

The decision to alphabetize the contents in *Cartography*. is somewhat curious, as is the decision to forgo inclusion of an index. Alphabetical lists are, in themselves, somewhat problematic. As the great British filmmaker—and auteur behind the very best film ever made about maps, *A Walk Through H* (1978)—Peter Greenaway noted:

> If you think about it, the index, the alphabet, is an extremely primitive way of organizing information, and in some ways it is totally absurdist. Where-ever-else, in any epistemological collection, can you put together Happiness, Hysterectomy, His Holiness, Heaven, and Hell—all completely disparate ideas—but all simply united by their initial?
>
> (Greenaway 2002)

1. The Battle of Agincourt in northern France (October 25, 1415—Saint Crispin's Day) was a major English victory in the Hundred Years' War. In it the British destroyed the flower of French knighthood for a generation. The battle is the centerpiece of Shakespeare's play *Henry V*. The Battle of Hastings (October 14, 1066) in East Sussex, marked the beginning the Norman invasion and conquest of England. The Anglo-Saxon King Harold Godwinson (who had already defeated two rivals in the north of England) was defeated and killed by William the Bastard, Duke of Normandy (afterwards known as The Conqueror). Events leading up to and during the battle are depicted in the Bayeux Tapestry.

In this case, anyone beginning a search for information in the 573 pages of *Cartography*. is more or less trapped by the author's sometimes idiosyncratic Topic titles. It is hard to imagine a situation where someone—even an oculist— would approach this tome planning to look up, say, "Eyeball data classification." Similarly, Topics like "How maps are made" or "Maps for children"—which appear under "H" and "M," respectively—bury their significant keywords far away from their indexed initial. A table of Topics (alphabetical) can be found on pages xiv–xv.

While the arrangement of Topics in *Cartography*. is alphabetical, the Topics themselves are further grouped thematically, and each Theme is associated with a colour. This creates a cross-referencing scheme to allow non-sequential associations between scattered entries. Topic titles, at the top of each left-hand page, are in the colour of their thematic group, and there is a one-sixteenth inch wide, fifteen-sixteenth of an inch long, horizontal line of the same colour that bleeds off the page fly. A key to the thematic groups and their colours is provided on page xiii, and a second, thematically arranged table of Topics—"Topics (thematic)," on pages xvi–xvii—lists the heading titles ordered and coloured by theme.

Somewhat oddly, this potentially useful scheme seems to have been set up to fail. To start, there are twelve separate thematic groups, each with its own colour. The colours, however, are barely distinguishable in the one place, on page xiii, where they appear together as large, eleven-sixteenth inch circles only one thirty-second of an inch apart. Everywhere else, the colours are found only in patches or text characters that are either very small, widely separated, or on different pages altogether. The author *must* have known that this would be a problem: in the Topic "All the colours," he flat out states that "humans are able to distinguish and remember only five to seven colours" (12). Why, then, has this basically good idea been elaborated beyond usability?

As has been mentioned, this book has no index. Obviously, an index would have added to the page count, but it is quite arguable that the space required would be well used. Without it, a search for particular information is trapped between the not-always-helpful Topic titles and the functionally invalided Themes. It is anyone's guess what might be actually mentioned under any of the headings. Perhaps Esri Press can be persuaded to make a searchable index available online.

The Topic pages themselves are clearly organized using a well constructed text hierarchy. Page organization is all too often a major failing in Esri Press books, but these pages show the right way to architect a page. Just let the book fall open randomly, and the page texture tells you where you should look first, what is subordinate, and how to drill down into the information. Yes, there is an explanation of the page hierarchy in "How to use this book" (xii), but that is just to cover the bases: these pages really do leverage the canon of page construction to work for you. *Bravo*.

The (thematically coloured) Topic title heads the page, supported by a descriptive sub-title. The main body text is (like all the text) set flush-left / ragged-right, with each paragraph's opening sentence in boldface. The line lengths are a tad long—up to sixty or more characters—but this is preferable to the common Esri Press practice of seventy to eighty characters on a single line. This main text body is supported by a narrower column, in a smaller type size, to the right, without any bold face. Text in this column supports, expands upon, or details factors introduced in the main body. At the page foot, below the main column, in small type (like that of the right-hand column), is an alphabetic "See also" list of related Topics. Because the small characters of the Topic names in these lists are printed in their thematic colours—which often have very low contrast with the page—they are sometimes hard to read. Similarly, because the list is strictly alphabetical, one has to assume that all the suggestions are to be considered equally pertinent—something that would be extraordinary, if true.

Every Topic is accompanied by a full-page illustration—usually of something pertinent to the Topic. These illustrations range from the lush to the exuberant, and most of the time they are well chosen and skillfully executed. Many are gems of elegance. In particular, the one facing the "Aspect of a map projection" page (23) is an example anyone should be proud to emulate. By contrast, the decoration paired with "Anatomy of a map" (15) is just a colourful space-filler. Fortunately, the proportion of this latter type is pretty low.

Finally, throughout the main body of the book, in the lower left corner of each left-hand page, there is an illustration of half of a globe. Its presence is discussed as part of the "Animation" topic on page 16, but most people will instantly recognize it as an element in a flip-book

animation. Unfortunately, it does not quite come off. This reviewer suspects it is not helped by being only half a globe and bleeding off of the page edge: a full globe placed a bit away from the page edge might have given each frame a more coherent image and helped to enhance the illusion.

There are twenty-five Exemplar maps included in *Cartography*., and the commentaries that appear with each one represent the contributions of the Contributors, plus John Nelson. These maps, too, are presented in alphabetical order by title through the book, and are listed on the "Contents" page (vii *unexpressed*). It is a fine collection of maps, as one would expect from such a fine collection of mapmakers, and represents a step towards building a documented canon of cartography as it stands today. All maps are created against a horizon of other maps, which is to say that any map owes more to other maps than it does to its data, its theme, or to anything else. Cartography, in this period of change, needs a stable and persuasively documented canon of paradigmatic exemplars selected and explained by admirable practitioners. Canons like this were first established for painting by Giorgio Vasari (1991) in 1551 and for sailing ships by Howard Chapelle (1967). This book's descriptive blurbs—and they are too short to be called anything else—penned by the contributor who selected that map, begin to provide the expert commentary that is so sadly lacking in most recently published collections of notable contemporary maps. Conceptually, this element is a tremendous addition to the book: *bravo*, once again.

While the selections themselves are sound, the blurbs are sometimes less illuminating than one might wish. Quite a few are excellent and succinct, one or two are a bit turgid and turbid, and the majority range between these poles. At the very least, many of the entries would have benefited from the assistance of an editor.

The contribution of Henrik Hargitai, a Hungarian planetary geomorphologist and media historian, was a commentary on *The Geologic Map of the Central Far Side of the Moon* (1978), by Desiree E. Stuart-Alexander of the United States Geological Survey. By the evidence of the detail shown on pages 252–253, it is certainly an admirable production that carries a wealth of detail with superb clarity and readability, and a subtle use of well-modulated colour. The predominant focus of Hargitai's blurb, however, is on what he calls "its Psychedelia colour scheme." In fact, he opens his commentary by mentioning the "San Francisco-born Psychedelic Movement," and, in each of his three paragraphs, keeps turning back to what he calls the "dazzlingly bright [colours] showing a surface more alien than the extraterrestrial body they represent." Reading this extraordinary appreciation, one has to wonder if Hargitai had ever seen a colour geology map before. The same basic palette Stuart-Alexander employs has, in fact, been used for geology maps since at least the advent of lithography in the mid-nineteenth century. This can be seen in the *Geological Maps* from Clarence King's 1876 *Fortieth Parallel Survey* reproduced in *Cartographica Extrordinaire* (Rumsey and Punt 2004, 30–31), or even in the extract from *The Alluvial Valley of the Lower Mississippi River* (Fisk 1944) on page 223 of *Cartography*. One has to wonder, too, about Hargitai's rather bizarre conception of Psychedelia.

This example is neither the worst nor the best of the lot, but it does demonstrate the unevenness to be encountered in the Exemplar blurbs. Many of them are excellent, but how is a reader supposed to know which parts are sound and which are not? The unpredictable reliability of this part of the book is quite disappointing.

We turn next to the two hundred and forty-three Topics, which are each packed as full as a nut. There is a tremendous wealth of information here, much of it of high quality, although there is a good deal that is less so. The video panel discussions in this book's companion MOOC, or Massive Open Online Course—called, coincidently, *Cartography*., and reviewed elsewhere in this issue of *Cartographic Perspectives*—also contained a lot of good information mixed with a few howling absurdities, but perhaps the most significant factor for both the printed and digital fora is the simple fact that the Topics and Themes are presented and discussed in such an open, serious, and straightforward manner. For many readers of this book—as for many participants in the MOOC—this will be their first experience reading or hearing these matters discussed as serious, significant, real, prominent, and valuable concerns. *Cartography*. will be bought, and read, and passed from hand to hand, and it will have a significant impact on how a great many makers of maps think about that activity. This book sets out to be a versatile and compact toolkit: one not far short of all things to all cartographers. However, like one of those overelaborate Swiss Army knives, not all of its tools work well, and its supposed versatility may in itself hamper its value.

This is not to say that *Cartography*. contains too many tools, but it does contain far too many that are too-briefly summarized. This book is an ambitious undertaking, and it would be absurd for a review to attempt to do more than to try to characterize the whole through a sampling of its parts. Perhaps a good approach would be to select some cartographic topic or other, and try looking it up in what we are told is "a sage, a companion, a guide, a friend, and a compendium of essential information" (xi).

Visual Hierarchy is a critically important element of map composition, and, turning to *Cartography*., we find an entry for "Hierarchies" on page 216. It contains a reasonable discussion of visual hierarchy (and uses that term), but one that is almost entirely restricted in application to a map layout as a whole. Why, one wonders, is the "Hierarchies" entry so confined? There are any number of other hierarchies that might well be involved in a map, such as symbol hierarchies for things like roads, among others—although text hierarchies *are* mentioned in passing. Shouldn't *this* entry be under "Visual Hierarchy" or "Layout Hierarchies"? Be that as it may, the advice given in the article is sound, with its tactics of squinting, desaturating, and size reduction, each of which can help a reader to bypass the automatic reading of a graphic as text, and allow it to be seen as a composition of graphic elements in two-dimensional space. Turning the page upside down can work, too, but it is not mentioned.

Tucked into the small print, though, is an odd remark made in reference to what happens when you squint: "Your brain is also having to work harder to interpret what is being seen, which is the same problem you have when trying to see objects at night without ambient lighting" (216). To the best of my recollection, "ambient light" means the light that is already present in a scene, before any additional lighting is added; thus, in absence of the mention of any other light source, "at night without ambient lighting" means total darkness. Surely, that describes closing the eyes completely, not squinting.

There are five "See also" Topics listed on the "Hierarchies" page: "Contrast," "Dispersal vs. layering," "Focusing attention," "Seeing," and "Vignettes." Of the five, only two actually mention visual hierarchy, and of the two, "Focusing attention" mentions it only in passing. The "Contrast" article tells us that "contrast and hierarchy often work hand in hand" (78), but, as that article conceives contrast as existing on a single continuum ranging from *lack* to *good*, it is really not at all clear how this hand-holding is supposed to take place. Nowhere is the idea of *control* of contrast as a component for establishing and maintaining a visual hierarchy mentioned, or even hinted. This topical atomization is problematic throughout the book: while there is lip service paid to the *interrelation* of the Topics, there is very little scope for discussion of their *interdependency*.

In this example we see two of the primary general problems with the Topics: the downplaying of interdependency and the inclusion of almost random, patent, absurdities. The various discussions of colour contain many examples. *Why*, one asks, are the additive and subtractive primary colours shown in the illustration on page 5 keyed explicitly to Pantone® colour definitions? Pantone® colours are *spot* colours, *not* process colours (although they can be emulated in process), and, as inks, they are *certainly* not additive. Similarly, in the fine print on page 4, cyan is said to be formed by the combination of blue and green: unfortunately, this is flat out impossible—one cannot describe a *subtractive* phenomena in *additive* terms. Cyan is, in fact, *transparent* to blue and green, and *absorbs red*—it *subtracts* red from white light. Several Topics refer to CMY colours, but only once to CMYK (I *think* it is once, but cannot be sure because *there is no index*). In practice, however, CMY is used almost exclusively in *photographic* processes: CMYK is what is comes off a printing press (except when using spot colours, for which there is no Topic). The K, or black, component is correctly identified as being called that in reference to "Key" but we are then told that it is called *key* because "black is usually printed first and other colours are keyed to it" (4). Little could be further from the truth. Black is normally printed *last*, and is very often overprinted on the other colours to avoid knockout shadows and to allow trapping of other, small, mis-registration errors. If this is "sage" (xi) advice, it is more of the parsley, rosemary, and thyme variety than that of a "guide" (xi).

Later, we read in "Purpose of maps" that "all maps, by definition, are reductions of reality because they represent reality at a smaller size than it actually exists" (378). This is clearly and demonstrably untrue: the map printed inside the lid of a box of chocolates is often exactly the same size as the tray of Creme tangerine, Montelimar, Ginger sling with a pineapple heart, Coffee dessert, and Savoy truffle, and that map is as much a map as any other. In the same way, a map can be at a *larger* scale than the thing mapped, in order to show details that might otherwise be hard to

see or label. Perhaps it is best to pass over the mentions of "reality" and "actually exists" in silence.

Finally, why does the author persist in using the term "map marginalia" to describe map furniture? Marginalia are marks made in the margins of a document. They may be scribbles, comments, glosses, annotations, critiques, or doodles, but they are not integral parts of the document itself. Map furniture, by contrast, is the cartographic counterpart of horse furniture. In the same way that items like saddles, stirrups, bridles, halters, reins, bits, harnesses, and martingales are what facilitates equestrianism, so too do legends, scale bars, inset maps, neat lines, graticules, projection notes, etcetera act as affordances that facilitate map usability. It is the furniture makes the employment of the map possible. The author does, in "Anatomy of a map," warn that "the term *map marginalia* can be misleading since the various pieces are often placed within the map itself" (14, *italics in original*). This, however, merely constitutes a warning that there may be some scribbles in the map space, not that the denigrating term *map marginalia* may be inappropriate when applied to such essential features.

This recital could go on—I have pages of notes—but these are examples enough. There is a wealth of sound, valuable, and insightful information in *Cartography.*, but it is seriously marred by errors of fact (for example, about colour), of theory ("... maps, by definition ..."), and of, shall we say, nomenclature (map marginalia). This is very disappointing, and, in view of the undoubted popularity this book will enjoy, likely counterproductive.

In conclusion, *Cartography.* is an impressive accomplishment. It is especially impressive as the work of one highly competent, qualified, and capable individual, but it would be no less an accomplishment were it the product of a large team. Ultimately, it is open to criticisms of detail, approach, conception, and vocabulary, but its evaluation must not be allowed to break down into simple recitations of objections and grievances—there is too much in it that is good to allow that. This book has arrived on the scene with a high profile and a good deal of fanfare, and, as has been mentioned, it will be bought, and read, and discussed, and passed around, and consulted, and quoted for a good long time by people from around the globe. This will be due, in the end, not to the fanfare attending its advent, but to the strengths it possesses.

Its strengths are considerable, and its shortcomings are both many and manifest. Whether the balance is seen to fall one way or the other will be up to individual readers, but I cannot disguise my disappointment that this book just doesn't quite deliver on its promising potential.

Earlier, I posed the question as to whether the field upon which this Englishman's book stands would prove to be like that of the famous English victory at Agincourt, or would it be more like that of the English disaster at Hastings. That question had been penned at the beginning of the review process, and was, at the time, still open. At the end of the review, however, it seems that the field it most resembles is that of the Battle of Schellenberg (July 2, 1704), in the War of the Spanish Succession (which is called Queen Anne's War in the United States). At Schellenberg, in Austria, the Duke of Marlborough staged a frontal attack on a partly fortified hill and, although he took the hill, it cost him six thousand of his twenty-two thousand man English-Dutch army. It is debatable as whether or not this constituted a Pyrrhic victory.

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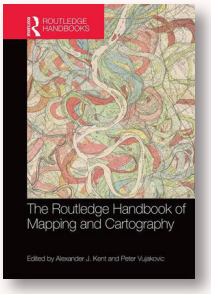
THE ROUTLEDGE HANDBOOK OF MAPPING AND CARTOGRAPHY



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Review by: Timofey Samsonov, Lomonosov Moscow State University

The Routledge Handbook of Mapping and Cartography has appeared at an interesting time. Cartography is going through a very intensive stage of evolution. More maps are now made by people without any cartographic training than are made by trained cartographers (Griffin, Robinson, and Roth 2017), and although the data have never been precisely tracked, there is evidence that the trend is growing. The current situation is a challenge for cartography because, as Mark Monmonier states in Chapter 40, "once mapping morphed into geospatial technology, the traditional visible map became just another form of geographic information" (540).

The wide availability of easy to use cartographic tools to non-professional mapmakers has, arguably, led cartography to a critical moment in which it must rethink its place in science, industry, and society. Although bookstore shelves are well stocked with beautiful and carefully composed literature on practical cartography (Brewer 2015; Peterson 2015; Field 2018), the most recent comprehensive textbooks on the subject are now almost ten years old (Slocum et al. 2008; Kraak and Ormeling 2010). It seems that the rapid evolution of mapmaking has made the challenge of writing such a volume—one that won't be outdated the day after publication—almost too formidable a task to take on. Almost, it seems, but not quite. *The Routledge Handbook of Mapping and Cartography* is one of the few summarizing, international volumes on cartography to be released in recent years. Densely typeset on six hundred pages, it encompasses a huge amount of information covering a wide range of theoretical and practical aspects of modern cartography.

The book is composed of six parts, containing a total of forty-three chapters. Part I contains a critical review of some key concepts and paradigms in cartography. Part II expounds major themes in the history of cartography, visualization, and representation in cultural and historic contexts. Parts III and IV are dedicated to an overview of the scientific grounds of modern cartography, revealing its methodological, technological, and practical sides. The chapters in Part V are focused on various social aspects of mapping, and demonstrate how, where, and by whom maps were used in the past and are used today. The final Part, VI, is an attempt to portray some future perspectives for mapping and cartography.

The first eight chapters outline the emergence of cartography as a science and as a social phenomenon. The opening chapter, written by Gyula Pápay, provides a detailed analysis of the impact that German cartographer Max Eckert had on the formation of academic cartography. Eckert is considered to be the founder of cartography as a science, and this chapter contains a critical analysis of his magnum opus *Die Kartenwissenschaft* ("Map Science"), published in two volumes in 1921 and 1925. Since Eckert's book was written in German and never translated into other languages, this chapter contains valuable and unique information about that seminal publication that is not otherwise found in English. Chapter 2, by Christopher Board, discusses the history of communication models in cartography and how they stimulated discourse about differences between mapmaking and cartography, and how they also provoked criticisms that led to the emergence of new paradigms such as geovisualization.

The third (by Amy L. Griffin) and fourth (by Corné P. J. M. van Elzakker and Kristien Ooms) chapters are centered on the map user—the ways in which they perceive, interpret, and apply maps for their purposes. The history of research on visual perception and cognition outlined in

the third chapter shows not only how the investigation of these difficult topics evolved from trial-and-error-based approaches to more systematic ones, but how even systematic approaches are constrained by difficulties of analysis—for example, eye tracking—and of predicting a user's interpretation. This topic naturally spills over into the fourth chapter, which shows that rigorous, multi-stage research on map use contains many components that must each be given careful attention.

The fifth chapter was written by Matthew H. Edney, and is dedicated to map history. It is, however, not a recounting of the history of cartography, but rather a lesson about how to study this history in a productive way. It describes a variety of modes in which mapping activities happen, and shows how these modes are formed by unique combinations of spatial knowledge, technologies, and social institutions. Chapter 6 (Chris Perkins on critical cartography) stresses the thought that maps are neither value-free nor neutral, but instead reflect the interests of dominant groups. This broad understanding of mapping is facilitated by viewing it through the prism of social contexts, an approach pioneered in the seminal works of Brian Harley.

The first part of the *Handbook* concludes with Chapters 7 ("Mapping as Performance") and 8 ("The Map as Spectacle"), that respectively explore the qualities of mapping as an intellectual and artistic process, and the ability of a cartographic image to both affect the reader and to serve someone else's interests. In the former, Joe Gerlach stresses the generative, emergent, and political qualities of mapping, while in the latter, Peter Vujakovic traces the spectacular properties of Baroque cartography. During that period, powerful elites maintained their traditional positions by mobilizing the technologies of modernity and using maps as a form of a social control. Their will was projected on map readers through a spectacle of fear that implied potential threats, reported incidents, and displayed the ability of the state to project force—all ways of control that can be seen through twenty-first-century cartography, too.

The second part of the book provides an overview of the development of cartography from Medieval Europe to the end of the twentieth century. Peter Barber and Catherine Delano-Smith explore the age of medieval mapping—including mappae mundi and early maps in books, on walls, and on separate sheets, as well as the development of world and regional maps—in Chapter 9. In the next chapter, Radu Leca explores cartography in the Age of Discovery by exposing the inconsistencies of approaching the early world based on Eurocentric geopolitical narrative constructs, and shows us the necessity of decentring those narratives. Leca also discusses how maps function as centering devices integral to the sharing of geographic knowledge in a given cultural context.

Chapters 11 and 12, by Matthew H. Edney, are interconnected, and together present the history of understanding, conceptualizing, and measuring the geographic (as opposed to the geophysical or political) world at various scales. The earlier chapter explores what he sees as the three modes or stages of mapping—space, place, and territorial—progressing chronologically as knowledge about the world grows through more productive refinements in surveying. The latter chapter is focused on surveying itself—revealing the origins and development of systematic surveys, beginning with the French and British triangulations. Part II ends with Chapter 13 on "Cartographies of War and Peace" by Timothy Barney, which investigates the role of mapping in the politics of second half of the twentieth century, mainly in the context of World War II and the Cold War. It highlights the fact that during this period propagandized news maps became one of the major means of manipulating masses of people.

Part III of the *Routledge Handbook* is dedicated to the methodological and technological basis of modern cartography. It contains seven chapters (from 14 through 20) that discuss: geodetic reference and coordinate systems (by Miljenko Lapaine), map projections (E. Lynn Usery), photogrammetry and remote sensing (Stuart Granshaw), geographic information systems (Paul A. Longley and James A. Cheshire), global positioning systems (Martin Davis), mobile mapping (Martin Davis, again), and finally, neocartography and OpenStreetMap (Steve Chilton). Unlike Parts I and II of the book, this part covers a range of topics that commonly pertain to practical cartographic work and map production. Its discussions are also more observational than analytical, and represent the current state of development of each technology, although the chapters on geographic information systems and neocartography are more focused on revealing their impact and influence on cartography than on a thorough observation of underlying technologies.

Part IV is dedicated to cartographic design and consists of eight chapters. The topics include an introduction to

map design (by Giles Darkes), cartographic aesthetics (Alexander J. Kent), layout, balance, and visual hierarchy (Christopher Wesson), colour in cartography (Mary Spence), lettering and labelling (Christopher Wesson), designing maps for print (Judith Tyner), internet mapping (Ian Muehlenhaus), and maps and atlases for schools (Stephen Scoffham). The chapters in this part of the book, like those in Part III, generally summarize the accumulated knowledge and current research agenda of their various topics, but they change focus from the underlying technological foundations of cartography to its forward-facing, human-oriented aspects—those tied to aesthetics, cognition, and to general graphic design principles. Most of these chapters are observational, except for the chapter on cartographic aesthetics, which is written in a discursive style.

Part V unveils the wide range of map use scenarios to be found in modern society. It is the largest part of the book, and includes eleven topics with content balanced between critical analysis and overview. It begins with Chapter 29, a discussion by Denis Wood of individual visions of place and their reproduction in a form of map, and the next three chapters show how this mapped vision can be used as a powerful tool of manipulation. Chapter 30 focuses on the notion of identity, with Alexander J. Kent and Peter Vujakovic showing how maps play a role in forming or reaffirming national, regional, and local identities and explaining how this is achieved. In Chapter 31, by Guntram H. Herb, the narrative leaves the topic of identity and flows into a discussion of the political power of maps. Geopolitical maps, the author states, use misleading design tricks to falsify the truth and are characterized by deception and limited information. Judith Tyner closes this group of chapters with a discussion of persuasive map design: that is, the design of maps that are able to change or in some way influence the reader's opinion. She shows that persuasiveness incarnates in four major forms: authoritative, understated, propagandist, and sensationalist.

Attention shifts next to three diverse usages of maps. In Chapter 33 Peter Thomas roots the history of schematic mapping in the quantitative revolution of the 1960s. He highlights the learning function of schematic maps and describes how the underlying concepts of choremes and chorotypes can be used to link general spatial theories with particular spatial contexts. The following chapter, on cartography and the news, was written by Peter Vujakovic, and explores journalistic mapping and its significance in this current period of geopolitical and environmental uncertainty. Vujakovic reminds us that we live in a map-immersed world, and that personal geographies are largely shaped by what we see in news. Chapter 35, by Vyron Antoniou, Cristina Capineri, and Muki Haklay, overviews various aspects of volunteered geographic information—its representation in the form of data and maps and its influential role on the work of national mapping agencies, on citizen life and science, and on emerging new cartographic activities. "Maps and Imagination" by Peter Vujakovic and "Gaming Maps and Virtual Worlds" by Alison Gazzard (Chapters 36 and 39) explore how maps are used to create landscapes in literature and in computer games. In both, maps serve similar functions—helping to increase the immersiveness of the spatial experience during reading/playing, acting as an integral component of the story or as a supplementary source of information about it, or even as the canvas upon which the story unfolds. Chapter 37, by Kate McLean, touches the untouchable: it is devoted to mapping the invisible and the ephemeral, and presents the particular experiences encountered in mapping smells in urban environments. In Chapter 38, Inge Panneels discusses mapping in art: how and why artists use maps and mapping and where this trend of map use is heading. The artistic side of map use manifests itself in various incarnations such as earthworks, the undisciplining of cartography, and the emergence of art-geography, as well as in the visualization of complex global data and in critical and/or experimenental cartography.

The final part of the book (Part VI) consists of four chapters that suggest some possible future developments in cartography. In Chapter 40, Mark Monmonier presents his hunches and hopes on the impact and evolution of digital trends in cartography—focusing mainly on various uses of geographic information in current and future society. Chapter 41 by Danny Dorling ("Can a Map Change the World?") is dedicated to the image of a world that is produced by maps. The question of who will produce maps in the future, and how these people should be educated, is discussed in "Educating Tomorrow's Cartographers" (Chapter 42) by Beata Medynska-Gulij. This final part of the book ends with a short and intimately personal note from William Cartwright, who presents his own story on how manual map drawing was irreversibly replaced with automated technologies.

The editors of *The Routledge Handbook of Mapping and Cartography* claim that the goal of this book is to provide a

starting point for further research, innovation, and discovery, rather then to cover all facets of mapping and cartography or to deal with any of these themes comprehensively (2). Thus, this book is primarily motivated by the range and diversity of approaches to mapping and cartography that have resulted from transformations to its theory and practice arising from the rich conceptual and technological developments that have occurred in recent decades. It does this by situating these innovations in cartography's historical context, and by demonstrating how that context is reimagined through the innovations. In my opinion, one of this book's major contributions is that it brings a wide variety of rarely discussed and unusual topics to the public—providing a deep vision of cartography not only as a science and practice, but also as a social phenomenon. I have, myself, taken twenty-eight pages of notes in the course of reading this book—notes taken not only for the purpose of writing this review, but also as memoranda of the information I feel is new, and important to improving my competence in cartography.

The parts and chapters of the book are logically arranged in the order of chronological and methodological precedence—Part V, for example, "takes the finished map as the point of departure" (4) for its constituent chapters. The wide context that the book embraces requires some chapters to be more theoretical in nature, while other chapters reflect the practical side of cartography. Unlike traditional textbooks, which represent the state of contemporary science in a declarative manner, the current volume contains a very significant fraction of chapters expounding the various authors' critical opinions on the topics they discuss. This approach fits in very well with this volume's target audience of advanced-level undergraduate and graduate students.

However, since not all of the chapters are focused on critical analysis, the book looks somewhat variegated. Stylistic diversity produces a large fracture in the book's canvas right in the middle of the narrative. In particular, Parts III and IV break the critical mood established at the beginning of the book by providing only commonly known information about the foundations of cartography and map design, and they are immediately followed by chapters that return to critical analysis. My first impulse was to tear these parts out and place them into a separate book. I feel strongly that critical discussion on each topic, rather than simple observation, would provide more a valuable, provoking, and homogeneous output, while serving the future-oriented goals of the current volume much better.

I was also somewhat disappointed by the appearance of the book, which does not have a feel of a modern effort on cartography—it contains a lot of old, manually drawn maps, and it is typeset in old-style Bembo font (which is, by the way, much too small and is very hard to read). Even the image on the front cover is an old geological map, as if *The Routledge Handbook of Mapping and Cartography* is a book about the old era of manual cartography. The *Handbook*'s unfortunate layout looks boring and outdated, masking its aim to motivate modern researchers to push the boundary of a mapping science. Why, too, one wonders, has the topic of automation, clearly essential for future developments in cartography, not merited attention in the book? Surely, it deserves at least a separate chapter.

Not all of the component parts of the book are easy to understand—especially difficult are those focused on social aspects and on unusual interpretations of cartography. For example, the three concluding chapters of the first part (covering, respectively, critical cartography, mapping as performance, and mapping as spectacle) were hard to follow, and I was not able to understand quite everything in the chapter on mapping as performance. I surmise, however, that there are some subjective overtones in this, since I was never strong in literary criticism, or on humanist thinking and writing. If, like me, you are accustomed to looking at cartography from geographic and technical points of view, you, too, will probably experience problems in reading chapters like these. Be prepared to wade through the thorns!

The Routledge Handbook of Mapping and Cartography is a solid, scholarly contribution that presents cartography as a faceted discipline with a rich history, diverse present, and multipath future. The book does not get far beyond Anglo-American cartography—twenty-two of the forty-two authors are from the United Kingdom, and eight are from United States—which makes it somewhat one-sided, but does not diminish its scientific value. While the editors and authors were not concerned with covering all aspects of cartography, they came pretty close to that in the theoretical chapters. The total coverage of material is impressive, but many presentational factors, including the cramped typesetting and stylistic diversity, can make this hard to see. It pays to be patient and unhurried in your reading.

In my opinion this book will be most interesting to those readers that already have some practical experience in cartography and want to expand their understanding of the origins of that practice and the power of the map as an instrument that sculpts our mental image of the space, place, territory, and, ultimately, the entire world.

I would like to sincerely thank the editors of *Cartographic Perspectives* for their valuable comments on this review, which helped to greatly improve its logic and wording.

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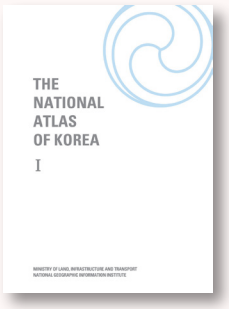
THE NATIONAL ATLAS OF KOREA, VOLUME I: NATIONAL TERRITORY



Edited by Jeong-Rock Lee, Jungjae Park, Taesoo Lee, and Jongnam Choi

Ministry of Land, Infrastructure, and Transport; and National Geographic Information Institute, Republic of Korea, 2014

170 pages, color maps, color photos, charts, and other illustrations. Free online; see "Obtaining this Atlas," below.

ISBN: 978-8-9856-8230-5

Review by: Aimée C. Quinn, Central Washington University

I was very excited to read about the production of a new five-part national atlas, and I have not been disappointed by this first volume of *The National Atlas of Korea*, devoted to the Republic of Korea's history, government, culture, and socioeconomics. Beautifully bound in boards covered with dark blue cloth, with the Korean title imprinted on the endpapers, fewer than ten numbered pages in this 170-page atlas do not include some kind of color map, photo, or other image. This work, made in the grand tradition of national atlases, harnesses new technologies like GIS and data mining to illustrate the dynamic growth of Korea and to display its dramatic societal and territorial changes. The volume begins with a Foreword by the Republic of Korea's Minister of Land, Infrastructure, and Transport (MLIT), and a Preface written by the Director General of the National Geographic Information Institute (NGII). These two agencies are responsible for the production of the *National Atlas*. Four pages are given over to a detailed Table of Contents, which is followed by a two-page satellite image of Korea. The volume's last pages reference the photographic sources and copyrights. In between this fore and aft matter is the meat of the atlas, divided into four overall sections: "Territory," "Government and Local Autonomy," "Transformation and Development of the Land," and "Korea in the World." As a government publications librarian, I regularly see and read works presenting the viewpoints of United States federal and state government bodies, and one reason I wanted to read this atlas was to learn more about this country through the eyes of its people and their government. One note about the text: the editors frequently refer their country as "Korea." Several of the maps show the entire peninsula with the Republic of Korea highlighted while the Democratic People's Republic of Korea is contrasted in a solid, lighter color and without any geographic or geocoded features.

This edition thoroughly revises and updates the 2007 version of the national atlas, which was itself a revision of the original 1989 edition. Each of these earlier editions are of interest in their own right, as was the 2009 concise edition, but none were as comprehensive a project as this

one. *Volume I*: *National Territory*, the subject of this review, introduces the overall project—a three-year plan to issue five volumes that capture, showcase, and revitalize a Korea that is strong—economically, socially, and politically. After 60 years of strife and hardship, the reinvigorated Republic of Korea is using this national atlas as a platform to highlight the major changes and accomplishments made since its independence in August 1948, while acknowledging and documenting the residence of the Korean people on their land since early times. According to the introduction to *South Korea, a Country Study* (Savada and Shaw 1992, xxiii), "Korean historians trace the ethnic roots of the Korean people at least as far back as the pottery-using cultures of the fourth and third centuries B.C."

The atlas' first section is entitled "Territory"—a term that was chosen deliberately, in order to provoke the reader's consideration of all the nuances of that important term. Korea is a place where the people have long held very strong ties to the land, despite having often been dominated for long periods by other countries. At different times in the relatively recent past, Korea had been invaded and controlled by both China (Manchu) and Japan, before finding independence in 1948 as a result of the 1945 Allied victory over the Axis powers. The term *territory* is thus used to inform readers of the atlas about Korea's national record and proud history. The desire for independence is well illustrated by one of Korea's best known and loved poets, Yi Yuk-sa and by his best-known poem, a beautiful work with an anti-colonialist spirit.

> July's the month when green grapes ripen
> Back in my village at home.
> The village legend ripens in clusters
> The dreaming sky settles on each grape.
> A white-sailed boat will come drifting by
> As the sea bares its bosom to the sky
> And the longed-for guest will at last arrive
> His weary limbs wrapped all in green.
> With a feast of grapes I'll welcome him
> Happy with dripping hands.
> Quickly, prepare the dishes, lad,
> White napkin on a silver tray.
>
> (Yi Yuk-sa, *Green Grapes*,
> translated by Kim Jong-gil:
> **hompi.sogang.ac.kr/anthony/YiYukSa.html**)

The defense of Korean territory from invasion is a central theme of this atlas. The maps, photos, and charts in the "Territory" section all support the ideal of resistance and resilience through the revitalization of trade and transportation systems, as well as through the land structure (the term used for human-made landmarks like railroads, airports, etc.), geography, topographies, dialects, histories, economics, and demographics of Korea since ancient times.

In addition, utilizing GIS and other visualization tools, MLIT and NGII worked together to create new data products that examine the development of cities and the effects of urbanization on the infrastructure across each administrative region. Detailed maps show the transformations that have occurred in the national administrative regions as rural communities grew into large city centers. Starting on page thirty-four there is an examination of the Korean Ocean Observation Network (KOON), through which data related to various oceanic and environmental conditions are collected from the Pacific Ocean. The final six pages in this section are devoted to the Demoratic People's Republic of Korea, and include some demographic, economic, and trade data. It is interesting to note that the "Territory" section is the largest in the atlas, a fact that suggests the importance of the idea to the Korean people.

The second section, "Government and Local Autonomy" is only twelve pages in length, yet is packed with information about civic life. There are, we learn, five main parts of the Korean government: the Executive (Administrative), National Assembly (Legislative), and Judiciary, plus the Constitutional Court of Korea and the National Election Commission. The Administrative branch comprises 17 executive ministries, 3 ministries, and 17 offices. On the map of administrative regions each is differently colored, and each has a chart highlighting such government data as the number of firefighters or police officers in that region, as well as the number of legal cases heard there by the courts. There are a lot of data compacted into these pages.

The third section, "The Transformation and the Development of the Land" is a hodge-podge of eclectic thematic maps. They range from the effects of the Republic of Korea's military involvement in such recent wars as Iraq and Afghanistan, to the changes brought on by the growth and globalization of Seoul. Through both words and illustrations, the reader learns of transformative changes to the land and to transportation networks, and

those brought by Internet use and smart phones, before moving on to spatial and territorial planning. That word *territory* crops up again, and it is almost as if we were back in the first section as we look at very similar maps. The difference is that these maps belong to a series of comprehensive territorial plans from 1972–2001. This spatial development is all part of a larger, national plan, which is then taken down to the regional administrative level. At the regional level, the atlas turns to research and development, local economies, industry, demographics, and quality of life. The quality of life illustrations are some of my favorites, along with the maps of population and human settlement. I really appreciated the combination of maps, charts, and photographs in this section of the *Atlas*, and it was interesting to see the juxtaposition of maps developed from newer GIS technologies with the ancient maps found on pages 24 through 33. I am left with the impression, however, that these newer technologies could have been utilized more fully, such as to intersect layers of data. For example, school data and happiness data could have been combined to show if children attending school in the Republic of Korea are happier than school children elsewhere in the world. Instead the reader has to find and compare data from different places in the *Atlas* to discover this.

The fourth section is "Korea in the World," and it begins with a world map on Robinson's projection, with countries color-coded by the date of establishment of diplomatic relations, and superimposed with colored dots representing the types of major treaties in effect. This base map is used, with a of couple variants and exceptions, throughout this section to illustrate Korea's place on the world political stage, and in such global economic fields as international investment and trade, global research, and lending/aid to other countries. The last part of this section looks at the cultural richness of Korean heritage through photographs of sites and celebrations, with the location of each mapped. There are photos of temples and historic villages, as well as of dances, martial arts, festivals, and collections of cultural artifacts with historic significance. These include the *Baegun Hwasang Chorok Buljo Jikji Simchi Yojeol*—roughly translated as the *Anthology of the Great Buddhist Priests' Zen Teachings*—which was produced in 1377, and is the oldest known book printed with movable metal type anywhere in the world.

The final pages of this atlas contain three beautiful, 1:1,2000,000-scale maps of the Northern, Central, and Southern regions of Korea, and come complete with an Index. All in all, this book can perhaps be best described as it was in the Preface: "the *National Atlas of Korea*, with name of localities in indigenous language, will circulate a truthful understanding of Korea's physical and human environments internationally" (ii).

OBTAINING THIS ATLAS

All volumes of *The National Atlas of Korea* are available online for viewing or download at no cost by visiting **nationalatlas.ngii.go.kr**.

Distribution of the five hardcover volumes of the atlas has been delegated to the Korean Geographical Society (KGS). We are told that KGS is distributing a very limited number of the books for $150 per volume (excluding shipping). It is suggested that interested parties contact KGS directly at this address: Korean Geographical Society. 1413-ho, 213-12. Saechang-ro. Yongsan-gu. Seoul. 140-871. Korea.

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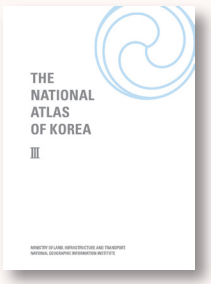
THE NATIONAL ATLAS OF KOREA, VOLUME III: HUMAN GEOGRAPHY



Edited by Bae-Gyoon Park, Wonho Lee, Chul Sue Hwang, Jinmu Choi, Jongnam Choi, and Gregory Chu

Ministry of Land, Infrastructure, and Transport; and National Geographic Information Institute (NGII), Republic of Korea,2016

252 pages. Free online; see "Obtaining this Atlas," below.

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Review by: Yeong-Hyun Kim, Ohio University

In 2016, the National Geographic Information Institute (NGII) of the Republic of Korea (South Korea) published the *National Atlas of Korea (English Edition)*, a much-revised third edition of a work first published in 1989. Due to the South Korean Ministry of Land, Infrastructure, and Transport's continued support, the new edition was published in five volumes in print, and is also freely available online. All of the maps, text, tables, and illustrations of the *Atlas* are available at **nationalatlas.ngii.go.kr** in both Korean and English, and are downloadable as PDFs. The focus of this review is on Volume III of the *National Atlas of Korea*, which is dedicated to human geography.

This volume of the *Atlas* aims to present both the dynamic transformation and the sustainable development of South Korea's "national territory and human life" (page iv). It consists of four sections: the first, "National Territory and Places of Life," provides a geographical overview of South Korea's human-environment interactions, with a particular focus on urban and regional development. The second section, "Population and Living," addresses population growth, distribution, and migration along with their impacts. This section also highlights several important recent changes in South Korea's demographic trends that include an aging population, a small but growing foreign-born population, and a significant increase in single-person households. The third section of the volume, "Industrial Activities," is devoted to the structural and spatial transformation of the South Korean economy, looking at the changing location of economic activities both within South Korea and across international borders, as well as the rise of new industries and growth sites. The fourth and final section, "Society and Culture," describes the sociocultural, political, health, and educational geography of South Korean society. Volume III of the *National Atlas of Korea* brings together 16 sub-sections on the economic, urban, social, cultural, political, population, and environmental geography of South Korea, with articles contributed by many of that country's best-known and respected human geographers.

The English edition of the *Atlas* is undoubtedly one of the most comprehensive and valuable sources of information for the general public about contemporary South Korea. For both students and schoolteachers, it should serve as a very useful reference to help them visualize what is happening in that country. Many academics, researchers, and other professionals who are interested in understanding key issues in the changing human geography of South Korea will also find the *Atlas* useful in identifying practical data sources and, more generally, providing a starting point for further exploration.

According to its "Preface," Volume III of *The National Atlas of Korea* should serve to promote "an accurate understanding" of South Korea to future generations of Koreans and achieve "a truthful understanding of Korea's human environments" (page iv) around the world. One may ask whether it is possible, or even desirable, for a national atlas to provide an accurate and truthful account of a country's human geography, something that is subject to diverse and often mutually contradictory interpretations. South Korea's human geography is changing rapidly and somewhat unpredictably with the ongoing economic and geopolitical changes in the East Asian region, and whether this picture of the land and its people will retain its relevance in the future is not at all assured.

The human geography of South Korea has been significantly transformed in recent years, but at the same time it has continued to maintain many of its basic elements. Volume III of *The National Atlas of Korea* is comprehensive, but it lacks a concluding section which could have offered a much more integrative summation of the various issues and their implications for the land and the people of the Korean Peninsula. It would also have been much more helpful if each section and subsection of the volume had a short introductory overview describing the core themes and issues it covers, and how they are related to those in other sections. It is never easy for an extensively comprehensive atlas, such as *The National Atlas of Korea*, to present a series of interrelated and connected themes, but clearly written and informative introductions would have helped.

These interconnections are further confused by the organization of some of the subsections within sections. For example, the "Sustainable Land Development" subsection of "National Territory and Places of Life" covers a range of diverse topics, including regional development plans, natural disasters, accidents, and crimes, which might not be particularly relevant to a discussion of sustainable land development. If the goal was to use a human security approach in analyzing the sustainable development of South Korea, this material might better have been combined with the "Use of National Territory" subsection covering challenges in food, water, and energy security, among other topics. Another example of the awkward organization of subsections and topics can be found in the

"Industrial Activities" section. While international trade has played and continues to play a highly significant role in the growth and expansion of South Korea's industrial activities, this topic is discussed only briefly (150–151) and is not emphasized in the subsections detailing individual manufacturing and service industries.

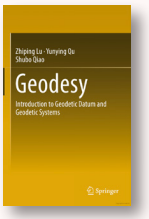
Despite its shortcomings, Volume III of *The National Atlas of Korea*: *Human Geography* is an important contribution to furthering our geographical knowledge and awareness of current issues in South Korea. It is an authoritative source of facts, statistics, and of course maps about South Korea's people, economy, culture, cities, industries, politics, and other human geographical features.

OBTAINING THIS ATLAS

All volumes of *The National Atlas of Korea* are available online for viewing or download at no cost by visiting **nationalatlas.ngii.go.kr**.

Distribution of the five hardcover volumes of the atlas has been delegated to the Korean Geographical Society (KGS). We are told that KGS is distributing a very limited number of the books for $150 per volume (excluding shipping). It is suggested that interested parties contact KGS directly at this address: Korean Geographical Society. 1413-ho, 213-12. Saechang-ro. Yongsan-gu. Seoul. 140-871. Korea.

GEODESY: INTRODUCTION TO GEODETIC DATUM AND GEODETIC SYSTEMS



Zhiping Lu, Yunying Qu, and Shubo Qiao

Springer, 2014

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Review by: Fritz Kessler, The Pennsylvania State University

Where is 13° 42' 56" and 127° 47' 33" located? This seemingly simple question is fraught with complexities. Let's begin by assuming that the latitude value is first and longitude is listed second. Next, one would need to know the cardinal direction (north or south latitude and east or west longitude) associated with each value. If we say that 13° 42' 56" is south and 127° 47' 33" is east, then this point is located in or near East Grace Park, Caloocan, in The Philippines. However, to precisely and accurately tie these coordinates to a location on the Earth's surface requires a *datum*. A datum provides the horizontal and vertical control that allows determination of accurate coordinate locations and elevations. Datums are important concepts in the field of geodesy, and are just one of the range of classical and modern themes in that field that are the subject of *Geodesy*: *Introduction to Geodetic Datum and Geodetic Systems*. This textbook—the authors of which are on the faculty of People's Liberation Army Information Engineering University in Zhengzhou, Henan Province, People's Republic of China—is an English edition of a text that was originally published in Chinese in 2006.

Geodesy begins with a preface that explains the motivation for pursuing this topic. It is followed by an abbreviations reference section that defines the dozens of acronyms—acronyms that can be challenging even to an experienced reader—that appear throughout the book. The table of contents provides a very detailed description of each chapter's contents, and there is also a one-page biographical overview of the authors and their affiliations.

Chapter 1 begins with an introduction to geodesy and its objectives, and then surveys the fields that fall under that rubric. Applications of geodesy in fields such as engineering construction, geosciences, and disaster prevention are discussed in turn, followed by the historical development of different forms of geodesy—physical, satellite, and dynamic. Other topics briefly discussed in the latter sections of the chapter include space geodesy, satellite navigation, and the Earth's gravity field. A short Review and Study Questions section closes this chapter, and is a feature found in all chapters in this book.

Chapter 2, "Geodetic Data Collection Techniques," details the specific measurements, techniques, and instrumentation that can be used to derive data for geodetic purposes. It is divided into two parts, the first of which provides an overview of various measurements that are characteristically collected for geodetic purposes, including horizontal and vertical angles, distances, and astronomic observations such as astronomic latitude, longitude, and azimuth. This part also discusses the equipment used for that collection, and the collection methods employed. Tools of the trade,

such as the theodolite and electromagnetic distance measuring devices, are described, and methods such as leveling are explained. The second part of the chapter details the Global Positioning System (GPS), beginning with an overview of GPS and its various components. Other GPS-related topics discussed include measurement and positioning (pseudo-range, absolute, and real-time), satellite laser ranging (SLR), the very long baseline interferometry (VLBI) system, satellite altimetry (used, for example, to measure the velocity of ocean currents), and gravimetry (useful in determining gravitational acceleration).

Chapter 3, "Geodetic Datum and Geodetic Control Networks," covers horizontal and vertical datums. Several topics related to the creation of a horizontal datum are described, including the methods of establishing a control network (traversing and triangulation), accuracy hierarchies (first-, second-, third-, and fourth-order), density of control points, and reconnaissance for monument site selection. There is an interesting section on how to erect a monument or survey control point for horizontal control. A discussion of vertical datums is next, and begins with the importance of leveling and continues with a treatment of the process of establishing a vertical datum in China. The process of integrating horizontal and vertical datums into a three-dimensional coordinate datum is tackled in the last section of this chapter. Latitude, longitude, ellipsoid height, and velocities measured by orbiting Earth's satellite can be integrated within a four-dimensional geometric datum, something not possible using classical horizontal and vertical datums because they are normally treated as separate one-dimensional frameworks. GPS, VLBI, and SLR systems such as EUROLAS or Global IVS Network provide the infrastructure needed to define three-dimensional coordinate datums. China's efforts to establish its own three-dimensional coordinate datum—the China Gravity Basic Network 1957, 1985, and 2000—are discussed in the concluding part of the chapter.

Chapter 4, "The Geoid and Different Height Systems," presents an overview of height and how it is determined. The chapter starts by reviewing gravity and explaining its role in describing the Earth's shape. Included in this discussion is an overview of the Earth's treatment as an ellipsoid. The crux of the height discussion comes next, with a review of the different characterizations of height: orthometric, normal, dynamic, and geodetic height. Following this discussion is a description of transformation methods between different height systems.

Chapter 5, "Reference Ellipsoid and the Geodetic Coordinate System," focuses on the relationship between geodetic measurements of the Earth's surface and how those measurements can be associated with—or reduced to—a chosen ellipsoid. Discussion begins with a review of spherical trigonometry that includes topics such as spherical triangles and trigonometric identities. The reference ellipsoid is again revisited, but this time the focus is on a detailed presentation of the various defining parameters and their interrelationships. This information is necessary equipment for the reader's understanding of the rest of the chapter—an examination of the formulaic relationships between different coordinate systems (for example, between a geodetic coordinate system and the geodetic spatial rectangular coordinate system). Some of the topics in this discussion include the understanding and derivation of the radius of curvature in the prime vertical, the radius of curvature in the prime meridian, and the mean radius of curvature, all of which are useful when defining coordinate systems. The next section presents a thorough overview of the geodesic and its properties on the reference ellipsoid, followed by a discussion of reducing geodetic observations made on the Earth's physical surface to a chosen reference ellipsoid—an important step in the creation of accurate coordinates.

Chapter 6, "Gauss and UTM Conformal Projections and the Plane Rectangular Coordinate System," focuses on representing reduced geodetic measurements, defined on a reference ellipsoid, using conformal map projections and plane rectangular coordinate systems. The chapter begins with a concise overview of the role that map projections play in general, and the uniqueness of conformality in particular. The Gauss-Krüger conformal projection and its historical development is the focal point of the discussion, particularly in the context of its role in the Universal Transverse Mercator (UTM) system. This discussion pays particular attention to the numerous Gauss-Krüger formulae that mathematically describe, for example, the projection's distortion, scale factor determination, and the forward and inverse ellipsoidal forms of the projection plotting coordinates. The chapter concludes with a discussion of the characteristics a Gauss plane imposes on such concepts as true and grid north, grid convergence computations, arc-to-chord and distance correction, and scale factor calculations.

Chapter 7, "Establishment of Geodetic Coordinate Systems," reviews the concept of a terrestrial reference

system and the practices of establishing of such a system. The chapter starts by introducing transformation methods between, for example, different geodetic coordinate systems and different geodetic Cartesian coordinate systems. Attention focuses next on the geocentric coordinate system itself, and its many application. Some of these applications include construction layout, navigation, and space technology. The conventional terrestrial reference system (CTRS) and coordinate terrestrial reference frame (CTRF) are both explained in detail. This preliminary discussion paves the way for a comprehensive look at the different geodetic coordinate systems in use by China. The bulk of the attention is focused on the China Geodetic Coordinate System 2000.

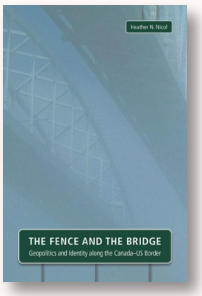
An extensive bibliography of approximately 250 sources and an index concludes the book.

Like many fields, geodesy has witnessed important technological changes in recent decades. *Geodesy*: *Introduction to Geodetic Datum and Geodetic Systems* presents a comprehensive overview of the field that includes both classical approaches to geodetic measurement techniques and modern practices with satellite geodesy. There isn't anything shockingly new regarding the treatment of classical geodetic methods here—in fact, other texts provide a more comprehensive review of classical geodesy. However, that is not is not this book's strength, which lies in explaining the connection between classic and modern geodesy. This bridge is clearly present in the authors' Chapter 7 discussion of China's evolution of a geodetic coordinate system, which takes the reader through an interesting journey detailing decades of coordinate system development.

An allied strength of *Geodesy* comes in the considerable breadth of material presented. While some geodesy texts may delve into great detail on a selected number of topics, *Geodesy* discusses an extensive list of topics that widely samples from the field. While the discussions are at times thinly presented, the reader is introduced to many topics that might otherwise not be covered. Most topics are described in sections comprised of short paragraphs, making it easy for the reader to quickly grasp the material. Copious equations are found throughout the chapters, many of which include worked examples. To help elucidate the topics, the authors have provided many real-world examples. There are numerous illustrations included—mostly black and white line drawings—that help to illustrate specific concepts. A separate listing of the figures and equations would have made it easier for the reader to find a specific one, but this helpful addition is not included.

Overall, this is not a book for the faint of heart. It is packed full of dense information on a topic that is fundamentally complex. One should think of this book as more encyclopedic in its presentation instead of something that is to be read cover to cover—although certain readers will undoubtedly want to take that approach. If your work involves geodesy, or is tangentially related to the field, this book is an important reference.

THE FENCE AND THE BRIDGE: GEOPOLITICS AND IDENTITY ALONG THE CANADA-US BORDER



By Heather N. Nicol

Wilfrid Laurier University Press, 2015

296 pages, $34.39 softcover, $39.58 Kindle e-book.

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Review by: James C. Saku, Frostburg State University

Humans tend to claim ownership of specific territories, and boundary issues between individuals, groups, and countries are nothing new. They have been common both among nomadic groups and among those living more sedentary lives. It is unsurprising, then, that Canada and the United States have had a long history of border disputes arising from various economic and political issues.

The Fence and the Bridge: *Geopolitics and Identity along the Canada–US Border* is an engaging book that presents a very comprehensive analysis of the historical and contemporary issues that have shaped the border between these two nations. The first of its eight chapters examines the Canada–United States border relationship in the late eighteenth and early nineteenth centuries. At that time, the border between both countries was considered an unstable frontier that effectively drifted north and south. The author, Heather Nicol, notes that while Canadians portrayed

the Canada-US border as a wall or fence protecting them from the United States, Americans perceived the border as merely a thin line between the two countries.

Chapter 2 analyzes the role of the Canada-US border within the context of national identity, citizenship, and controls on immigration in both countries. Nicol indicates that the emergence of naturalized geopolitics, which involved nation-building on both sides, created a distinct difference in the way the border was perceived by people on either side. Canadians strongly resisted the potential threat of annexation by the United States, by forming a confederation of British North American colonies and promoting a national, Canadian identity, one in which multiculturalism played a key role. From its earliest days to the present, Canadian society and politics have valued racial tolerance and multiculturalism. This formed a sharp contrast with the self-image of the United States, which viewed itself as a cultural melting pot. Similarly, the relationship between the Government of Canada and the First Nations is fundamentally different from that between the Government of the United States and Native Americans. While Canadians maintain a partnership relationship with their indigenous population, the US policy is one of custodianship.

The third chapter focuses on the role of the evolving economic relationship between the two countries, which played a role in defining and explaining their border. During the late nineteenth century, there was a tremendous flow of capital from the United States to Canada, and Canadians came to be dependent on US investment, particularly in regard to the exploitation of natural resources. This capital flow led to the establishment of American companies in Canada. During the same period, however, Canadians were involved in the exploitation of natural resources for the US market. This relationship was considered cordial and beneficial to both countries. However, as Nicol points out, cross-border trade of both industrial and agricultural goods was subject to taxation by both countries, a practice each saw as an integral part of a national trade strategy. To regulate duties on goods crossing the national boundary, a customs house was constructed in Saint-Jean-sur-Richelieu, Québec, on the old route between New York and Montréal.

The emergence of the more recent and harmonious border relationship that exists between Canada and the United States is examined in Chapter 4. While the boundary had been for the most part defined by an 1818 treaty, it was not completely surveyed until about 1874. In 1908, the two countries signed a treaty that established an International Boundary Commission (IBC). Made up of two commissioners, one from each country, the IBC was assigned the responsibility of remarking and refining the boundary between the two countries from the Atlantic to the Pacific coasts. In addition to the IBC, a joint commission was created to deal with disputes pertaining to the waterways used by both countries. Later, in the early twenty-first century, Canada and the US initiated a partnership on border issues that set common goals, procedures, and governing institutions, and led to the development of common policies on trade and defense.

Chapter 5 deals with issues on the emergence of new approaches to border management and security. According to Nicol, institutionalization of the border became the norm in the late twentieth century under the North American Free Trade Agreement, and involved the development and implementation of new technologies for monitoring the biometric data of persons crossing the international boundary. This was done not because the old ways of managing the border were ineffective, but because expensive new techniques like retina scans and voice detection were *perceived* as providing a more reliable means of risk management. One important repercussion of this institutionalized approach is that it normalized extraterritorial border management. For example, the US Transportation Security Administration (TSA), which collects information on domestic and international flights landing in the United States, now operates extraterritorially, requiring that information about passengers flying between Canadian airports also be handed over.

In the sixth chapter, Nicol examines the sudden changes that 9/11 brought to the previously harmonious Canada-US trans-border relationship. After 9/11, many in the United States saw the Canadian border as a security threat, largely due to what Nicol believes to have been a misrepresentation of Canada's immigration policies. She supports this position by identifying several historical situations when the border was similarly perceived, falsely, as dangerous. These included the period after the American Revolution, the War of 1812, the Indian Wars, the American Civil War, and the Cold War. More recently—both in December 1999 when Ahmed Ressam (the so-called "Millennium Bomber") was arrested attempting to enter the US, and three years later in December 2002,

when false reports of Pakistani terrorists entering New York State through Canada gained wide circulation—public anxiety among Americans brought largely imaginary concerns about border security to a high pitch.

Chapter 7: "Canada, the Border and American Hegemony: Cosmopolitanism? Or Not?" examines the Canada-US border in light of how the concept of cosmopolitanism is understood on either side of the line. In the United States, the concept is tied to global influence, leadership, and exceptionalism, while Canadians see it in a more European way, as existing within the context of globalization. Where the view of the border from Canada is of a change of jurisdiction, the view from the south is of a metaphorical or physical wall. This US policy of isolationism contrasts with its concurrent policies claiming world leadership. Certainly, US National Strategy Documents authored between 1998 and 2010 reflect an assumption of US world leadership in all matters, but attempts to impose "leadership" through recent military and political adventures in Afghanistan, Iraq, and Ukraine have not really worked out well.

Nicol wraps up her findings in Chapter 8. She notes that while tariffs tended to inhibit trade between the two nations well into the twentieth century, these restrictions were gradually relaxed, leading to more open and interconnected trans-border relations. She concludes that, by the end of the century, Canadians had a twofold perception of the border: as a wall defending them from Americans, and at the same time as a gateway opening upon a mutually beneficial trade relationship. After 9/11, however, the implementation of new security policies, many involving new technologies, led to aggressive US border management practices, including demands for information on people living outside the United States. These extraterritorial demands challenge the continued existence of open border policies.

The Fence and the Bridge provides an extraordinary wealth of information about the evolution of the Canada-US border, and it reflects the author's extensive research into a broad range of historical and contemporary source materials. Especially interesting is Nicol's use of cartoons and sarcastic depictions of events between Canada and the US to illustrate or support arguments about border issues between the two countries.

However, while the figures are an important part of the book, they are not always easy for the reader to grasp, and it is at times difficult to relate them to the issues discussed in the text. It is not helpful when illustrations are placed quite far from the text that refers to them. For example, Figure 1.10 is cited for the first time on page 33, but the figure itself is placed on page 51.

This book can be very difficult to read and understand, due largely to the author's extensive use of specialized terminology and jargon. The text's difficulty will likely pose a challenge to most undergraduate students, but graduate students (at least of political geography) should be okay—although I, too, will admit to having to re-read several chapters, myself.

Public opinion is conspicuously absent from the book's discussions. The author should, perhaps, have talked to politicians and citizens in both countries about their perceptions of the border. This would have been particularly illuminating to the analysis in Chapters 4 through 8, which expressly deals with contemporary border issues. The border between Canada and Alaska was not extensively covered, although there was some discussion of the wider polar regions.

The author is a political geographer, and writes for a parochial audience, but students of history, anthropology, culture, political science, and international studies will all find *The Fence and the Bridge* very useful, reasonably priced, and affordable. Those interested in border questions, generally, or in the Canada-US border in particular, will find this book a worthwhile acquisition.

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Robinson, Arthur H., Joel L. Morrison, Phillip C. Muehrcke, A. Jon Kimerling, and Stephen C. Guptill. 1995. *Elements of Cartography, 6th Edition.* New York: John Wiley & Sons.

Articles in Periodicals: Author's or authors' names as in *Books,* above. Year. "Title of Article." *Title of Periodical,* volume number, page numbers, DOI if available. Follow punctuation and spacing shown in the following example.

Peterson, Michael. 2008. "Choropleth Google Maps." *Cartographic Perspectives* 60: 80–83. doi: 10.14714/CP60.237.

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Danzer, Gerald. 1990. "Bird's-Eye Views of Towns and Cities." In *From Sea Charts to Satellite Images: Interpreting North American History through Maps*, edited by David Buisseret, 143–163. Chicago: University of Chicago Press.

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