



Experiencing hybrid spaces a scoping literature review of empirical studies on human experiences in cyber-physical environments

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ABSTRACT

Whether we are taking a leisurely stroll through the city or rushing about our daily business, our everyday lives are today informed, mediated, and entertained by digital technology. As a consequence, new spatial arrangements are constituted that have been conceptualised as hybrid spaces. They evolve in connection with mobile devices and ubiquitous Internet access and are characterized by an imbrication of the physical environment and digital technology. Although hybrid spaces permeate our everyday life, there is little empirical research on experiences in hybrid spaces. This paper presents a scoping literature review on experiences in hybrid spaces. Based on a synthesising reading of research evidence from 28 empirical studies, three overarching thematic strands were identified: place, mobility, and social interaction. However, the empirical research field appears nascent still and lacks convergent and consolidating approaches, particularly across disciplines. Nevertheless, while digital technologies have so far been associated with processes of domestication and a diminishing importance of places, mobile devices and especially AR applications can draw people outside and foster spatial meaning-making. Hybrid practices change spatial uses and produce new patterns of urban functions at multiple levels. Moreover, hybridisation challenges fundamental notions of 'place', as digital augmentation allows for the coexistence of an infinite number of modifications of a place and can encompass past, present and future representations. While what we gain and lose through this development remains an open question, we provide concrete guidance for future research on what and whom to investigate, as well as how to do so.

1. Introduction

Whether we are taking a leisurely stroll through the city or rushing about our daily business, our everyday lives are today informed, mediated, guided, and entertained by digital technology. Whatever the mode of transport, we rely on GPS-enabled technology for navigation. On the move, we might entertain ourselves by catching a few Pokémon or listen to music to block out the noise of a busy train at rush hour. Choosing a restaurant for dinner is not just a matter of personal preference - online reviews are heavily relied on. If our company for dinner is late, they will be in touch via social media and may even share their location live. The waiting time, even if it's only a few minutes, will be filled by checking the news on the smartphone.

In short, the impact of portable technologies and ubiquitous Internet access on how we interact with each other can be felt throughout all

aspects of human life (e.g., Oleksy & Wnuk, 2016; Valori et al., 2024). Professional and personal activities of most individuals are mediated through technology in some way nowadays, as are politics, the economy, and public discourse. As a consequence, the pervasive presence of technology, be it mobile devices or permanently installed technologies, affects how we experience, navigate, make sense of, and constitute spaces.

Such situations, characterized by an imbrication of the physical environment and digital technology - e.g. a restaurant as a physical place and its connected online representation or the tube as a means of transport which can be a place of diverse practices mediated by the smartphone such as chatting with friends or watching TikToks - bring about new spatial arrangements that have been (inter alia) conceptualised as *hybrid spaces* (de Souza e Silva, 2006) or *cyber-physical spaces* (Lettkemann & Schulz-Schaeffer, 2021). Following de Souza e

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Silva (2006), we will refer to these spaces as *hybrid spaces* for the remainder of the paper because the term *hybrid* emphasises newly emerging qualities which cannot be captured by a simple idea of merging ‘cyber’ and ‘physical’. In her seminal paper on hybrid spaces, de Souza e Silva suggests:

A hybrid space is [...] a networked space, constituted by a mobile network of people and nomadic technologies that operate in noncontiguous physical spaces. Therefore, to integrate this space, a node (e.g., a person) does not need to share the same geographical space with another node of the mobile network. The hybrid space is created exactly by the merging of different and discontinuous places within one another.” (de Souza e Silva, 2006, p. 272)

Hybrid spaces have a different quality to the deliberate visit to the fixed computer workstation and the conscious dialling into the Internet via a modem that characterised digital media use in the 1990s. Linked to this practice was the idea of ‘cyberspace’ as an entity that could be ‘entered’, which implied leaving physical space behind and treating cyberspace as a sphere of its own, detached from the presumed entity of the physical space. This distinction was, and still is, regularly made salient by the terminological distinction between ‘virtual’ or ‘online’ and ‘real’ or ‘offline’ space. However, as emphasised in the introductory vignette, a dichotomous distinction between cyberspace/virtual space/online spaces on the one hand and physical environments/real space/offline spaces on the other does not capture the spatial arrangements constituted in connection with portable technologies and ubiquitous Internet access, as well as the human experiences within them.

Since the rapid proliferation of internet-enabled mobile phones, several terms have been introduced into academic discourse to describe the emerging spaces: “augmented (urban) space” (Manovich, 2006), “digiPlace” (Zook & Graham, 2007), “code/space” (Kitchin & Dodge, 2011), “augmented reality” (Bazzanella et al., 2014; Graham et al., 2013), or “layar-ed space” (Liao & Humphreys, 2015) - to name but a few. These terms are often used interchangeably. However, while they all cover spatial phenomena related to a growing interweaving of the physical environment with digital locative information through the use of mobile technologies, they have slightly different connotations and varying degrees of comprehensiveness. We use the term hybrid space for two reasons: Firstly, it is the most comprehensive term embracing “a variety of multi-layered constructions of space” (Argin et al., 2020, p. 1). As de Souza e Silva stresses “hybrid spaces are different from simply overlaying digital objects on physical spaces (as with augmented or mixed reality)” (de Souza e Silva, 2023, p. 60). The notion of hybrid spaces encompasses, but goes beyond concepts such as augmented, extended, and mixed reality, location-based games and sensing, etc. It expresses a higher order concept that entails all forms of sociability that

arise from the interconnection of physical and digital spaces through location-aware mobile technologies. Secondly, the term hybrid space refers “specifically to the social transformations of space that occur as a result of interacting with mobile technologies” (Glover-Rijkse & de Souza e Silva, 2021, p. 165). This is highly relevant because it emphasises people’s subjective imaginations, perceptions, and practices. The term thus represents a perspective that makes changes in spatial perception and the (re)production of spaces researchable as social processes. It is in this spirit that we use the term *hybrid space* (and not the less common term *hybrid place*)¹: Based on a relational understanding of space, we understand spaces as relational arrangements of social goods and living beings. Accordingly, we consider space and the social to be mutually constitutive. The concept of ‘place’ in turn describes a concrete, nameable and geographically markable area at which, in turn, a multiplicity of (hybrid) spaces can be constituted. A place is a distinct spatial arrangement characterised by uniqueness and historical significance (Löw, 2008, pp. 42, 2020).

While there is a certain amount of theorising on hybrid spaces with various disciplinary lenses, to date there is little research that studies the experience of individuals in hybrid spaces empirically. Although hybrid spaces obviously permeate our everyday lives, we have only scarce knowledge on how individuals perceive and practice hybridity. Liao and Humphreys (2015, p. 1419) characterise previous studies on user experiences of mobile AR applications only as “important early snapshots” but stress the lack of empirical research into how people’s use of mobile technologies and especially mobile AR influences their experiences of space. However, Lu (2024, p. 72) observes that the research field is gaining in importance and substance, stating that “the interest in the relationship between mobile media, spaces, and places peaked in the recent decade, with the emergence of extensive studies on mobile locative media”. Be that as it may, what makes it difficult to grasp the research field on experiences in hybrid spaces to date is that it is spread across several scientific disciplines and that few references have been established between different works to date. We therefore conducted a scoping literature review on experiences in hybrid spaces which is presented in this paper. The goals of the present literature review were (1) to identify existing empirical studies on experiences in hybrid spaces and to provide an overview over their aims and findings, and the methodological approaches they have taken, (2) to capture the research field on experiences of hybrid spaces as it has evolved since the early 2000 with its current state of knowledge and gaps, and (3) to synthesize the findings from the identified studies in order to derive new readings and conclusions. To our knowledge, no literature review on experiences in hybrid spaces has been conducted so far. This gap in the discourse is confirmed by Di Marino and colleagues who state: “The discourses on hybridity have not yet undergone a comprehensive or systematic review

¹ In spatial research, a distinction is made between the terms place and space—although there is by no means general agreement on the definitions of the two concepts. For a broader discourse see e.g., Casey, 1996; Duarte, 2018; Low, 2017; Tuan, 2020. Coming from a broad variety of disciplines, most of the papers in our sample do not define the terms space and/or place (although many papers explicitly deal with definitions of hybrid space) and the terms are often used interchangeably. We have based our analysis and synthesis on Löw’s definitions, according to which space is conceptualised as a “relational ordering of living entities and social goods” (Löw, 2008, p. 35; italics in the original). The constitution of spaces works along two concurrent processes: “First, space is constituted by the situating of social goods and people and/or the positioning of primarily symbolic markings in order to render ensembles of goods and people recognizable as such [...]. Spacing means erection, building, or positioning. [...] It is positioning in relation to other positionings. [...] Second, the constitution of space also requires *synthesis*, that is to say, goods and people are connected to form spaces through processes of perception, ideation, or recall” (Löw, 2008, p. 35; italics in the original). The term place, in turn, describes one of several “stable institutionalised spatial arrangements”, or “basic spatial figures” (Knoblauch & Löw, 2020, p. 265).

of the literature” (2023, p. 12).

Against this background, the particular added value of our scoping review is to synthesize a comprehensive understanding of subjective experiences in hybrid spaces. This is a topic of growing importance in contemporary societies since hybrid spaces are becoming increasingly prevalent due to the widespread adoption of mobile devices and the continual emergence and adoption of new technologies (e.g., smart watches, smart glasses) and new applications (e.g., ever new social media platforms, immersive games or economic platforms) in people’s daily lives. Glover-Rijkse and de Souza e Silva therefore stress:

“Understanding that we live in hybrid spaces means that we cannot address social interactions by looking exclusively to their happening in physical or digital spaces, because they occur in the merging of both. Hybrid spaces not only denote a different way of inscribing spaces with information; they represent a new logic of social conduct in these spaces.” (Glover-Rijkse & de Souza e Silva, 2021, p. 164).

By bringing together knowledge previously dispersed across various disciplines, we seek to explore how individuals perceive and experience hybrid spaces. Rather than focusing on specific technologies or applications, our approach encompasses the diverse media through which hybrid spaces are constituted and aims to provide a nuanced understanding of experiences within them. We pose the guiding questions: What do we know today about subjective experiences in hybrid spaces and how can we further advance this field of research?

The paper will proceed in the following way: First, we report and explain the scoping approach we followed for this review, guided by the general PRISMA-ScR guidelines for scoping literature reviews (Munn et al., 2018; Peters et al., 2020). We then provide an overview of the findings from the 28 studies included in the sample (section 3) and discuss the three major strands of the literature we observed: experiences of *place*, experiences of *mobility* and experiences of *social interaction* in hybrid contexts. Third, we discuss how mobile devices are impacting the meaning of places and stimulating spatial exploration, and how locative information influences urban functions on diverse scales. Finally, we consider how the concept of hybridity challenges fundamentals of our thinking about places and their designability and suggest future research avenues.

2. Method

Given the exploratory nature of this review, we have adopted a scoping approach (Munn et al., 2018; Peters et al., 2020) and followed the PRISMA-ScR guidelines for scoping literature reviews (Moher et al., 2009; Okoli & Schabram, 2012). Papers included in the review have been coded and categorised qualitatively, and an in-depth overview and contextualisation of the full-texts is provided.

2.1. Definition of search terms

The four authors conducted an initial unstructured pilot search and reading of the literature independently, and noted a broad variety in the way hybrid spaces were referred to across and within disciplines and closely related to this, a tendency to use ever more new neologisms to address spatial phenomena merging physical environments and digital spheres. Given this diversity, and following the discussion above, we decided to select our search terms according to two complementary approaches (see Table 1): On the one hand, we used common synonyms for ‘hybrid spaces’ derived from the initial unstructured literature search to be able to capture research on hybrid spaces from a variety of disciplines and schools of thought (e.g., augmented space and cyber-physical space). On the other hand, we used combinations of broader search terms that describe the range of topics at the interface between spaces and digital technologies or mobile devices (e.g. “spatial perception” OR “spatial experience” OR “spatial knowledge” AND smartphone OR “mobile device\$”). The literature search was conducted in October 2023

Table 1

Overview of search terms used for the review.

Search Terms	Scopus	WoS	Overall
“augmented space\$”	440	433	873
“cyber-physical space\$”	155	105	260
“hybrid space\$”	1048	942	1990
“hybrid spatialit**”	8	14	22
“phygital space\$“	5	2	7
portable AND “public space\$”	76	247	314
smartphone\$ AND “public space\$”	205	209	414
space AND constitution OR production AND smartphone OR “mobile device\$”	173	615	788
“spatial perception” OR “spatial experience” OR “spatial knowledge” AND smartphone OR “mobile device\$”	71	50	121
“technology use” AND “public space”	17	20	37
TOTAL	2198	2637	4835

using *Scopus* and *Web of Science* given their wide coverage of scientific disciplines and their complementarity (Chadegani et al., 2013; Mongeon & Paul-Hus, 2016).

2.2. Screening of records

Sources identified in the literature search were screened in Microsoft Excel in an iterative manner following the PRISMA methodology. All four authors participated in the screening process and coding was discussed and agreed upon after every step. First, we excluded records not written in English and duplicate records, leaving 3135 unique sources. Second, two authors each screened half of the records based on their title and excluded those which were not focused on hybrid spaces or human experience in physical and/or digital spaces. This screening was reviewed by a third author, and any discrepancies between the first and second coding were resolved in discussion (2725). Third, two authors each screened the abstracts of half of the remaining papers using the same criteria. This screening was reviewed by a third author and any discrepancies between the first and second coding were resolved in discussion, leaving 99 records that were sought for retrieval (one of which could not be retrieved as neither the title nor the DOI returned an existing source). Fourth, two authors each screened half of the full texts of these 98 records in-depth and suggested which papers to include and exclude. This screening was reviewed by the third author and the fourth author, and any final discrepancies were resolved in discussion. In this step, we excluded papers using a different conceptualization of hybrid spaces (11; e.g., places of cultural encounter, children’s imaginary play), papers focused on the development and trial of software or hardware (18), papers that did not report empirical work (29) or papers that reported empirical work not focused on experiences in hybrid spaces (12). The remaining 28 empirical papers on human experiences in hybrid spaces make up the data set for this review (see Fig. 1).

2.3. Categorisation of papers and data extraction

Data extraction was piloted during the full-text review round, and all authors made notes on the suitability of the papers and relevant observations. Based on this pilot, we then extracted sample size, sample country and city, as well as the methods of data collection (which were subsequently also categorised into qualitative, quantitative, or mixed-methods; see Appendix A). We then conducted a qualitative content analysis of the 28 full-texts with the aim of providing an overview over the various research strands and to categorise them into groups based on the type of experience the research was focused on (Mayring, 2015; Schreier, 2014). An initial round of inductive coding was done independently by two authors. Codes were reviewed and a coding scheme based on three key experiences featured in the sample was adopted: *Experiences of place in hybrid contexts*, *Experiences of mobility in hybrid contexts*, and *Experiences of social interaction in hybrid contexts*. Using this

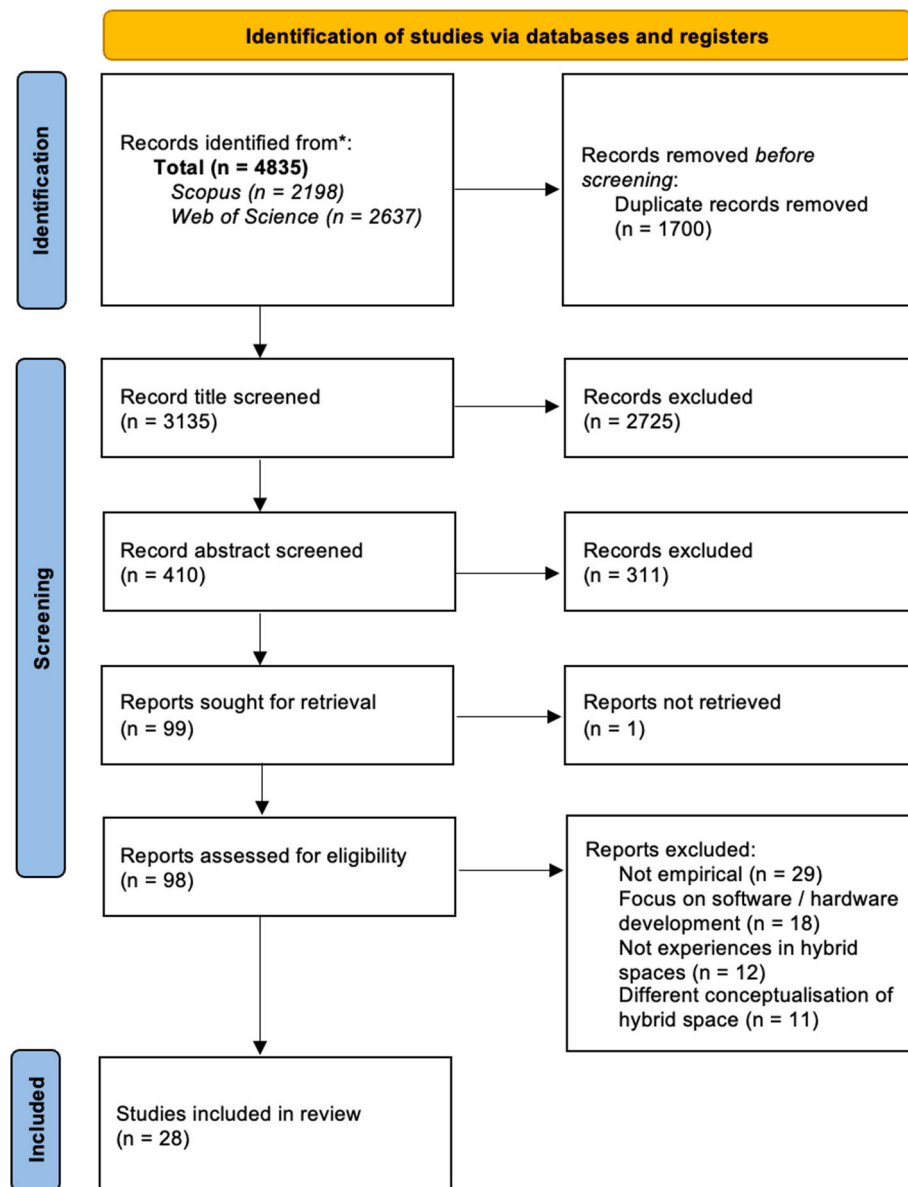


Fig. 1. Prisma Diagram for literature on experiences in hybrid spaces.

coding scheme for the second round, all papers were coded independently once more by all four authors. We find an initial inter-rater agreement of 72.6% using Krippendorff's α . Any remaining disagreements ($n = 8$) were resolved in discussion in the final, third round. The largest category with 13 papers is *place*, followed by *social interaction* with 8 papers and *mobility* with 7 (see Appendix B for the complete review and data extraction materials).

In response to the criticism that literature reviews tend to predominantly aggregate and do not sufficiently contain original analysis or interpretation with substantial findings (Castillo Ulloa & Schwerer, 2024; Noblit & Hare, 1988; Weed, 2005), we have developed a qualitative research synthesis of the findings presented in the 28 analysed studies. Following Doyle (2003, p. 335) we understand synthesis, in contrast to analysis, as "the movement from viewing the cases as parts of a collection to viewing the collection as a whole". We have taken an interpretive approach to synthesis that shall provide 'insights that are more than the sum of the parts' (Weed, 2005). Accordingly, the presented research synthesis will further our understanding of human experiences in hybrid spaces by systematically integrating the state of knowledge in the research field.

3. Findings

3.1. Descriptive overview

Since 2013 (the earliest year with an empirical publication on hybrid spaces), publications have been fairly consistent with 2.5 publications per year on average (ranging from 1 to 4 per year). This suggests that while there are efforts to study hybrid spaces empirically, these remain nascent mostly. Following our qualitative analysis of the full texts, about half of the papers in our sample (46%) are focused on the experiences of *place*, whereas the other half is distributed across papers focusing on *mobility* (25%) or *social interaction* (29%). Across these groups, the majority of papers followed a qualitative methodology to study experiences in hybrid spaces (16; 57%), with 7 papers choosing a mixed-methods approach (25%) and 5 relying on quantitative measures (18%, see Appendix A). The techniques used are wide-ranging and include case studies, interviews, surveys, spatial analyses, observational methods, videography, and UX trials. Data collection took place in a variety of countries, cities, and field sites around the world, and 6 papers collected data exclusively through digital channels (Iranmanesh et al., 2022;

Iranmanesh & Alpar Atun, 2018; Kang, 2017; Krajina, 2019; Sengupta et al., 2020; von Terzi et al., 2021).

3.2. Analysis of research themes

Based on our analysis, we have grouped the empirical studies on experiences in hybrid spaces in our sample into three categories: research into *how humans engage with and experience places, how they move around and navigate*, and *how they interact with each other* as digital technologies provide new means of communication and augment and alter the physical environment around them (see Fig. 2). In the following, we provide a more detailed analysis of each of these strands of research including a concise summary of the key findings from each study.

3.2.1. Experiences of place in hybrid contexts

The first and biggest group of papers focuses on how people perceive, experience, use, appropriate and make sense of diverse places in hybrid contexts. This includes research on how technologies shape or measure perceptions and uses of places, but also research on history, culture or urban infrastructure, as well as accessibility and participation in hybrid contexts.

The first thematic strand within this group focuses on the influence of technology - and more specifically experiences of augmented reality (AR) - on individuals' spatial perceptions and in consequence spatial meaning-making and place attachment (Kostopoulou et al., 2018; Nekoui & Roig, 2022; Schweiger et al., 2021; Sengupta et al., 2020). Two of the studies are specifically dedicated to gaming applications (Nekoui & Roig, 2022; Sengupta et al., 2020). The common assumption of these studies is that technology which fosters engagement with the environment could trigger processes of spatial meaning-making and, in consequence, have a positive impact on people's attachment to certain physical environments. Nekoui and Roig (2022) study children's spatial perception of and their interaction with augmented environments. Three different Augmented Reality (AR) games serve as case studies, namely *Magical Park* (a locative game which creates AR fantasy worlds in public parks as hybrid play areas for children), *Minecraft Earth* (a spin-off from the game *Minecraft* which allows to virtually build structures, geolocate and explore them hybridly), and *Geocaching* (a location-based treasure hunt with GPS technology which aims at hiding and seeking so-called *caches* (treasures) in physical environments). The authors analysed children's statements obtained from publicly available websites, categorising the activities the children reported into adventure, exploration, and collaboration. The study finds that through their engagement with physical outdoor places in the context of AR games, children's environmental learning increases, and they form memories attached to these places which may foster further engagement and increase place attachment. The authors conclude that "interestingly, the same technology that mostly hinders children's outdoor activity and makes them stay at home, can in its correct form be a tool that helps them find outside companions and communicate better with their city" (Nekoui & Roig, 2022, p. 154).

Sengupta and colleagues (2020) examine the impact of the

location-based mobile game *Ingress* on players' experiences and uses of their neighbourhoods and city in Manchester, United Kingdom. The researchers conducted participant observation by playing the game for three months, collecting field notes and (annotated) screenshots, based on which they describe how urban experiences are nowadays "hybridized" (Sengupta et al., 2020, p. 364), how spatial practices are altered, and how new spatial practices emerge through the game. Playing *Ingress* motivates players to explore their city and adapt everyday mobility patterns because the game requires being mobile visiting certain places. As players can input information on specific locations to be integrated in the game, their spatial knowledge is enquired and, through integration in the game, shared with others. The emerging intensive engagement with the city can lead to new interpretations of places, as well as processes of spatial meaning-making and place attachment (Sengupta et al., 2020).

Schweiger and colleagues (2021) research the influence of AR on spatial perception and spatial meaning-making through a holographic animation of a historic building which was destroyed in World War II on the central plaza in the city of Augsburg, Germany. Participants viewed the animation through AR glasses, answered a short questionnaire before and after the experience and shared insights into their experiences in a replay interview. Despite the short period of exposure to the animation, a significant influence on participants' sensual-aesthetic perception of the place and the individual meanings they ascribed to it was observed. The authors therefore suggest that AR holds great potential for participation in urban development processes as holographic animations could serve as medium of communication and as motivation for participation of residents (Schweiger et al., 2021).

Kostopoulou and colleagues (2018) explore users' experiences of augmented public spaces, plots and buildings that are annotated with textual, audible and/or graphical archival material on urban history. In (semi)controlled experiments, three prototype AR applications for three different settings (a town centre and university campus in Brighton and a High Street in London, United Kingdom) were tested in user walk-throughs and participants reflected their experiences through questionnaires, interviews and the think-aloud method. The authors argue that AR applications augmenting archival material on urban history in public spaces hold educational potential since they contextualise and situate historical knowledge. Experiencing locative information *in situ* also makes it more meaningful for users and can bring about processes of spatial meaning-making. The trials further indicated that the use of AR in public spaces can stimulate curiosity and interest in passers-by who may then engage with the place more intensely themselves (Kostopoulou et al., 2018).

The second thematic strand within the studies on experience of place relates to the influence of technology on spatial practices and changing uses of space on a micro-scale (Argin et al., 2020; Di Marino et al., 2023; Iranmanesh et al., 2022; Lu, 2024; Wang, 2022).

Wang uses the example of a shopping mall in Hong Kong, China to explore technologized shopping experiences and, thereby, study "digitally enhanced people-space interaction" (2022, p. 65) and "digitally enabled place-making" (2022, p. 67). Drawing on field observations and interviews, the author describes how digitalisation impacts the physical

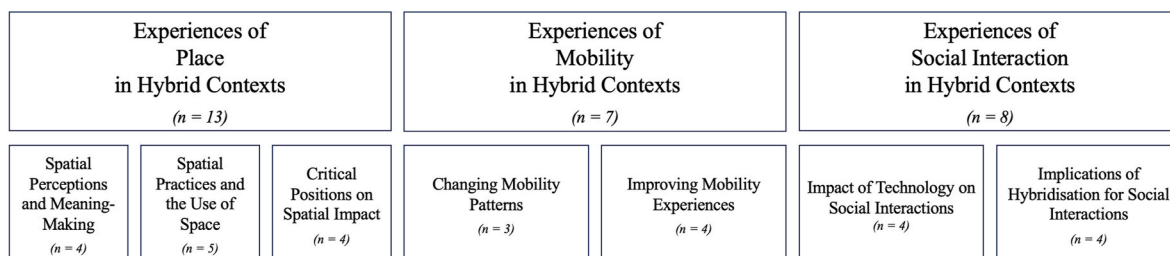


Fig. 2. Overview over the main themes of research that were identified during the coding process.

environment of the mall and how the emerging hybrid environments alter people's spatial perceptions and practices. The author suggests that digital means can increase the usability of places as individual interests and requests can be addressed more specifically. They also argue that through digital means, the shopping experience starts prior to the visit, for example when customers use the shopping mall's app to plan their trip, or to find parking. Accordingly, places beyond the mall's architecture (such as the home) are translocally connected with the shopping mall and the shopping experience (Wang, 2022).

Iranmanesh and colleagues (2022) use social media data to study urban land uses, their dynamics over time, and urban mobility on a micro scale in the city of Famagusta, Cyprus. With a strong methodological focus, the paper shows how geotagged X metadata allow to explore when and where a city is particularly busy, what actual land uses dominate, and when, where, and how people move through the city. Being able to detect transient practices and small-scale interweaving of activities, such as briefly visiting a café for relaxing while studying on university campus, the authors illustrate that the ongoing hybridisation of spaces and spatial practices changes urban land use patterns. While certain places might suddenly experience unknown vibrancy because of how users present them on social media, others are becoming less interesting for being less present on social media (Iranmanesh et al., 2022).

Di Marino and colleagues (2023) research hybridisation with a focus on New Working Spaces (NWS; e.g., coworking spaces, cafés or libraries) and the evolving links and interactions with their neighbourhoods. The authors develop a conceptual framework for analysing hybrid models of working based on the understanding that hybridity is constituted by the interaction between spatio-functional, social and digital features. The analytical framework is used to conduct an analysis of five NWS in the city of Oslo, Norway, including spatial analyses on the five neighbourhoods (using GIS), in-depth analyses of the features of the NWS, participant observations, and walking interviews with the NWS managers. The authors discuss how a New Working Space and a neighbourhood can intertwine hybridly along online and offline modes, for example by creating new and innovative spatial arrangements for socialising. They also discuss these findings and their conceptual model in terms of implications for urban planning practice (Di Marino et al., 2023).

Two further studies scrutinise the influence of technology on spatial practices on a micro-scale by exploring pedestrians' experiences of public spaces (Argin et al., 2020; Lu, 2024). Both studies are based on experiments with instructed walking tasks and use mobile eye-tracking. Argin and colleagues investigate the impact of smartphone use on pedestrians' "human-environment relationship" (2020, p. 240) by comparing flânerie (not technology-supported) and post-flânerie (equipped with a smartphone) on a central plaza in Ghent, Belgium. Participants conducted instructed walking tasks while focal points of their visual attention were recorded with mobile eye-tracking devices and their walking rhythm was mapped in a geographic information system (GIS) based on GPS-data from a smartphone carried on the person. The authors conclude that smartphones do not per se impact pedestrians' visual attention towards their environment. However, they observe that post-flâneurs' spatial experiences of their environment are frequently mediated by technology which impacts their spatial practices. Because the smartphone screen through which they increasingly see their environment offers a narrower angle than human view, post-flâneurs change their locations frequently to capture desired perspectives on their environment and document them in photographs (Argin et al., 2020).

In a similar vein, Lu (2024) explores the influence of smartphones on pedestrians' spatial experiences and their micro-level behaviours, their place-sensing and place-making practices. Participating residents of the city of Philadelphia, USA conducted walking tasks and data was gathered using mobile eye-tracking, smartphone screen-capture, think-aloud audio recording and shadowing by the researcher. The study "revealed

dynamic relationships between the visual input ('streets in the eyes'), the digital content ('streets on the screen'), and participants' existing spatial knowledge ('streets in the mind')" (Lu, 2024, p. 81). Smartphones are used to overcome physical and temporal barriers and explore places hybridly, e.g., by checking the menu and reviews of a restaurant while standing in front of the place, or for alternatives in walking distance. Accordingly, findings suggest that points of interest are shaped by digital locative information, and that online representations of places impact how people move through the city and what facilities they use (Lu, 2024).

Most of the papers in our sample reveal, either explicitly or implicitly, a rather optimistic attitude towards technological development, the proliferation of digital devices, and their ubiquitous integration into everyday life. However, the third strand of papers on experiences of places takes a more critical approach (Hatuka & Toch, 2017; Liao & Humphreys, 2015; Pucciarelli & Vannini, 2018; Silva, 2018). Hatuka and Toch (2017) probe spatial perceptions of publicness and privacy in Tel Aviv, Israel. For a three-week period, quantitative data on participants' spatial perception and practices were collected through online tracking and experience sampling. Before and after this, qualitative interviews were conducted with all participants. The majority of participants classified virtual space as public space. However, based on participants' perceptions and statements, the authors carve out three differences between public space and virtual space: (1) While public space is perceived by many participants as restrictive, virtual space is perceived as "an *enabling space*" (Hatuka & Toch, 2017, p. 995; italics in original) which is less limiting and more inclusive. (2) While public space is considered a context where individuals have little control over their visibility and exposure, virtual space is associated with control over self-representation (e.g., by curating texts and images or audience management) but also with little control over the use of (personal) data. (3) While visibility in public spaces was thought of as temporary, visibility in virtual spaces was regarded as unerasable and therefore durable. The authors critically highlight aspects of asymmetrical visibility and privacy as well as power asymmetries and control in hybrid spaces, pointing out that "the idea of urban public space as a place that provides relative anonymity is shrinking" (Hatuka & Toch, 2017, p. 996).

Silva (2018) offers a critical discussion of accessibility and inclusiveness of hybrid spaces in interactive digital storytelling. Focusing on non-fictional locative stories, two case studies were collected through a locative media training in the city of Austin, USA, and through ethnographic observations and interactions with local residents in the town of Monmouth, United Kingdom. The findings reveal how access to hybrid spaces is impacted by class, ethnicity, gender, age and other factors, as well as their intersectionality. Unequal access to hybrid spaces includes limitations regarding the use of technologies (and thus limited access to profits from technology use) as well as limitations in consuming and creating media content (and thus limited access to locative stories and limited opportunities to participate in interactive digital storytelling). It results in what the author calls the "spatial participation gap [...] defined as the unequal access to hybrid spaces and the inability, due to lack of knowledge or skills [...], or cultural constraints [...] to take advantage of, and benefit from, the hybrid space" (Silva, 2018, p. 573). As a consequence, the author suggests that segregated communities and neighbourhoods are less represented in locative stories and less involved in interactive digital storytelling, which can reproduce and reinforce disadvantages and a lack of representation (Silva, 2018).

In line with this, Pucciarelli and Vannini (2018) examine online and offline representations of the city of Douala, Cameroon. Local residents' perspectives and tourists' online descriptions were compared to carve out an understanding of Douala as a "hybrid city" (Pucciarelli & Vannini, 2018, p. 221). While local residents' narratives of Douala were collected through 39 interviews, a group discussion and ethnographic field notes; tourists' perceptions and experiences were captured through content analysis of user-generated content published on TripAdvisor over a ten-year period. The findings show how foreigners, in this case

tourists, shape an online representation of a place that differs significantly from the narratives of local residents. The authors relate this locative storytelling back to issues of the digital and access divide, stressing that many societies in sub-Saharan Africa are limited in or excluded from the consumption and production of online content. Tourists' online representations therefore influence which places in Douala are categorised as points of interest which, in turn, affects tourists' activities in the city with the corresponding effects on these places (Pucciarelli & Vannini, 2018).

Liao and Humphreys (2015) investigate everyday usage of mobile AR and the occurring practices of content creation and consumption, as well as emerging spatial perceptions and experiences, through semi-structured interviews with 12 early adopters of the mobile AR application *Layar*. *Layar* allows users to point a mobile device at points of interest in their physical environment and receive locative information such as textual and graphical annotations (organized in thematic layers such as shopping, gastronomy, or history). Users who create content in the mobile AR application *Layar* explained how their engagement with the app intensified their engagement with places in their neighbourhood and city (e.g., by thinking about ways to improve their usability and accessibility for a broader audience). Their spatial imagination also extends to future perspectives and possible developments for places, giving them a sense of empowerment about being able to change places through augmentation. A third distinct practice found among *Layar* users is the creation of political statements (e.g., (re) creation of memorials). By challenging dominant interpretations of places, users employ the symbolic power of AR in order to foster critical debate on matters of power (imbalances) regarding e.g., land ownership or territorial borders (Liao & Humphreys, 2015).

3.2.2. Experiences of mobility in hybrid contexts

The second group of papers focuses on how people navigate and move around in their environment, and how this is supported, measured, or altered by technology. To do so, papers have relied on in-depth interviews (Frith, 2013; Opromolla et al., 2019), a mix of GPS and tracking data with interviews, images, and other qualitative measures collected in the field (Ekizoglu & Mortamais, 2018; Hofmann & Mosemghvdlishvili, 2014; Wilkinson & Torun, 2022), and one paper has extracted location data from Tweets (Iranmanesh & Alpar Atun, 2018).

The first strand of papers within this group investigates the changing mobility patterns that emerge from the hybridisation of space (Ekizoglu & Mortamais, 2018; Iranmanesh & Alpar Atun, 2018; Wilkinson & Torun, 2022). Ekizoglu and Mortamais (2018) have tracked the journeys of 10 participants using a GPS app on their smartphone and collecting screenshots of app usage in contexts of mobility over a period of one week in Strasbourg, France. Looking at 70 individual journeys of participants and the smartphone use they engaged in, the authors observe two 'states' in which participants experience mobility in hybrid spaces: *action* and *inertia*. In the state of inertia, the authors suggest that participants followed the existing infrastructure and mobility systems, acting within the existing flow of movement and activities, but not necessarily in alignment with them. Activities and app usage of participants in the state of inertia are experienced as a pause (e.g., while waiting on the bus). In the state of action, participants were more agentic and actively contributed to the network of people using the hybrid space of Strasbourg, with their activities more closely associated to the specific goals of the respective journey (e.g., researching an artist while viewing their work in a gallery). The activities and smartphone use patterns associated with this state were naturally more varied across participants than in the state of inertia (Ekizoglu & Mortamais, 2018).

Wilkinson and Torun (2022) have asked two groups of participants to navigate across the city centre of Newcastle upon Tyne, United Kingdom, and to then draw a cognitive map of the route they travelled, one group being asked to not use technological tools, and one being explicitly instructed to do so. They find that participants in the hybrid condition completed the journey in less time, covered less distance

between the two points, and adhered more closely to the route predicted by researchers, thus making more use of pedestrian areas intended for walking. However, participants in the technology condition only recorded about half as many environmental features and used more generic statements to describe them than participants in the no-technology condition. The authors therefore conclude that while participants in the hybrid condition were more efficient at moving through the city, participants in the no-technology condition were more attentive to their environment and made more conscious choices in their travel (e.g. avoiding busy areas with other walkers). The authors thus point towards the complexity of wayfinding and suggest that it is not immediately clear whether hybridisation leads to more 'successful' journeys (Wilkinson & Torun, 2022).

Iranmanesh and Alpar Atun (2018) use over 50,000 Tweets to track and understand patterns of mobility in Lefkoşa, Cyprus, and make sense of how its inhabitants use urban space. They distinguish between to-movements, i.e., the accessibility of a space in the network, and therefore its possibility to be a destination and point of social encounter, and through-movements, i.e., the likelihood of a space being chosen as a part of one's passage through the city. Using this mapping of data, they show that spaces with higher to-movement are likely to facilitate moments of encounter and social interaction for more users, whereas spaces with high through-movement are only likely to engender social encounter for those with shorter and local journeys (likely to be carried out by foot) (Iranmanesh & Alpar Atun, 2018).

The second strand of studies within the mobility group presents both case studies of and design-exercises on how hybridisation can alter and improve mobility experiences (Frith, 2013; Hofmann & Mosemghvdlishvili, 2014; Opromolla et al., 2019; Soñez et al., 2019). Frith (2013) interviewed 36 participants from the US about their use of *Foursquare*, a location-based social networking app, focusing particularly on the impact of *Foursquare*'s gamification aspects on the mobility decisions of users. The app lets participants check in to locations they visit, with the possibility to earn *badges*, and the user most frequently attending a specific location becoming its *mayor*. The author finds that these elements led participants to experience a sense of "digital ownership" (Frith, 2013, p. 253) of places, e.g., by being the mayor of one's favourite restaurant, and also a sense of competitiveness to maintain or regain mayorship of places users cared about. Moreover, participants also reported that the possibility to earn badges led them to plan trips or nights out specifically so that they could collect them. The app thus rewarded users for mobility and turned cities into game boards users moved across. Frith suggests that the hybridisation afforded by *Foursquare* encourages exploration and adds elements of surprise and competition to how users engage with places, but also points out that many location-based social networks and games are aimed at increasing consumption and the commercialisation of places (Frith, 2013).

Hofmann and Mosemghvdlishvili (2014) asked three groups of differing levels of experience with using Augmented Reality apps to use an AR navigational app in Frankfurt, Germany. While the app presented a variety of points of interest participants were unfamiliar with, they generally perceived problems with the accuracy of the information displayed, and particularly regular users expressed frustration with outdated and incorrect results. Interestingly, frequent AR users felt more confused and disconnected from their surroundings after using AR apps, while casual users felt more connected with their environment. Participants also discussed issues of social desirability and reported being self-conscious of using AR apps in public, particularly as they were afraid of appearing like they are recording others around them (Hofmann & Mosemghvdlishvili, 2014).

Soñez and colleagues (2019) interviewed elderly residents of Santa Fe, Argentina, to better understand their transport needs and to incorporate WHO recommendations on improving mobility within cities with the goal of making public spaces more accessible for them. Based on the interviews, the authors adopt a UX-focused approach and identify both physical requirements for the built environment (e.g., the

sidewalk-street relationship, and vehicular movement), and for apps and other digital tools that facilitate transport in the local context of Santa Fe (Soñez et al., 2019).

Opromolla and colleagues (2019) report insights from a co-design exercise with young adults in Rome, Italy, centred around the optimisation of experiences with public transport services with the help of gamification. Together with participants, they looked at positive and negative experiences of public transport user at various steps of the journey. Beyond accessibility of information pertaining to schedule and connections, as well as punctuality and speed of services, participants reported their enjoyment of encountering unfamiliar places during their journeys. However, participants also emphasised the importance of making better use of time spent in transport. Together with the authors, participants then discussed various solutions to improve this experience using tools of gamification (Opromolla et al., 2019).

3.2.3. Experiences of social interaction in hybrid contexts

The third group of papers focuses on how humans interact with each other in hybrid spaces, or how technological mediation of human interactions creates hybridity in the first place. Research into social interaction in hybrid spaces has adopted interviews, diaries, and observational techniques (Humphreys, 2012; Morse & Emery, 2023; Shinohara & Wobbrock, 2016; Xu et al., 2023), social media analysis (Krajina, 2019) and surveys or online experiments (Hatuka & Toch, 2016; Kang, 2017; von Terzi et al., 2021).

The first strand of papers within this group comprises papers that investigated the concrete impact of technologies on experiences of social interaction (Hatuka & Toch, 2017; Kang, 2017; Shinohara & Wobbrock, 2016; Xu et al., 2023). Xu and colleagues (2023) have conducted 41 interviews with *Pokémon Go* (a location-based smartphone game) players to understand how they collaborate in the hybrid spaces generated by the app and their motivations to do so. The authors find a need for leadership activities as interactions become more complex in these hybrid settings and observe the spontaneous creation of hierarchies. Interestingly, this fostered the emergence of external tools and applications that help facilitation and coordination for both in-person and remote collaboration (Xu et al., 2023).

Kang (2017) has investigated how the hybridisation of public spaces can contribute to communication between citizens and freedom of speech, paying particular attention to places of speech and social encounter in urban environments, such as Speaker's Corner in London or the Lennon Wall in Prague. The study presents an opinion survey with inhabitants of Seoul, South Korea, on a digital adaptation of a "communication wall", a publicly accessible wall where individuals can leave notes and engage with each other. The author finds that participants were generally eager to see this type of augmentation of public space. They saw the wall as an opportunity to leave policy suggestions for the local government, and to learn about and interact with others' suggestions. Another focus expressed by participants was to share and view 'healing' messages that would help people feel better about themselves, and to cope with feelings of being isolated in the urban space (Kang, 2017).

Hatuka and Toch (2017) have surveyed 138 Israeli university students who either owned smartphones or basic mobile phones to understand their device usage patterns in public spaces. They find that smartphone owners used their phone twice as much in public spaces as those who use basic mobile phones. Inversely, those who owned a basic phone spent twice as much time resting and observing the environment around them or reading. In a similar vein, smartphone users appeared more detached from their surroundings, as they were significantly less bothered by other people and significantly more comfortable to engage in actions that may bother people around them. Finally, smartphone users felt that their phones afforded them a higher sense of privacy both in public and in private settings, and they reported higher levels of dependency on the device. Mobile and location-aware technologies thus enable new ways of social interactions that transcend limitations of

physical space and influence social norms around such interactions. The authors also find that these technologies lead users to pay less attention to their environment, and ultimately to a potential individualisation of the use and perception of public space. They admonish, however, that "this reduced attention does not indicate disattention but rather new ways of addressing the sensory stimulation of the city and personal technological devices. It is a process of reconstituting a psychic state, reformatting attention by, in a sense, fragmenting space" (Hatuka & Toch, 2016, p. 2200).

Shinohara and Wobbrock (2016) investigated perceptions of the use of assistive technologies for people with disabilities in public spaces. To do so, they asked both participants with and without sensory disabilities to keep diaries of their use or their observation of the use of assistive technologies in public spaces for four weeks, and interviewed participants based on these diaries afterwards. Participants with disabilities described how the successful use of assistive technologies increased their feelings of competence and self-efficacy and reported increased feelings of technical competence and social inclusion when they were able to share with others how assistive technologies worked. On the other hand, they discussed experiences when assistive technologies failed, which led to both frustration as they could not participate in their everyday activities as usual, and embarrassment as this sometimes drew additional attention to them and their disability. In the diary entries of participants without disabilities, perceptions of others that used assistive technologies in public space focused mainly on the technology itself, or the context that it was used in. The authors suggest that assistive technologies are surrounded by social negotiations for both users and observers. For people with disabilities, being seen as competent and not drawing attention to themselves as they used technologies was key. For participants without disabilities, the main concern was to not offend others or to not contribute to a situation in which technology was failing (Shinohara & Wobbrock, 2016).

The second strand in this group of papers focus the broader implications of hybridisation for social interactions (Humphreys & Hardeman, 2021; Krajina, 2019; Morse & Emery, 2023; von Terzi et al., 2021). Humphreys and Hardeman (2021) observed smartphone use in public spaces in Philadelphia, USA to understand its impact on everyday social interactions, as well as the social norms around its use. They replicate an early study on mobile phone use where crosstalk, one person mediating between a physically co-present person and another person on the phone, was examined. They note that since the original study, the capacity of phones has increased and the number of calls participants receive has reduced significantly. Instead of replicating a *caller hegemony*, where phone calls took precedence over local interactions, the authors now report a *notification hegemony*, where the phone frequently draws in people's attention for a moment and they then decide whether to fully immerse themselves in a mediated interaction, or to remain engaged in the ongoing physical interaction. They also find that people engage in *parallel mediated crosstalk*, where both parties of an interaction unilaterally or both withdraw from physical co-presence for a moment and interact with their phones (Humphreys & Hardeman, 2021).

Krajina (2019) examined a public collection of photos and social media posts depicting racist and/or xenophobic assaults and messages in the wake of the 2016 Brexit referendum in the United Kingdom to gain a deeper insight into the technological mediation of urban encounters. Through an in-depth reading of these posts and the interactions they generated, the author examines the impact of being able to share and document such messages on the transience of street encounters. On one hand, documenting occurrences of urban life makes them more salient and permanent, allowing more members of the community to engage with and reflect on their content. On the other hand, digital mediation of such encounters allowed users to distance themselves from the (in this case troubling) reality of some of these encounters. Taken together, the author suggests that this transfer of events occurring in urban spaces to the "networked, and pacifying, surveillance of the mediated city" have become a constitutional feature of contemporary urbanity (Krajina,

2019, p. 5365).

Von Terzi and colleagues (2021) looked at the impact of social context on the experience of technological mediation and the satisfaction of general psychological needs associated with various contexts. In an online survey with 184 participants, the authors examined differences in perceptions of positive experiences of technology use that took place either in public or in private. They find that participants feel higher levels of relatedness and popularity during technology use in public spaces, but no difference between public and private for feelings of competence, security and autonomy. They further find that an imagined change of context (i.e., adding other people to situations that were private, or removing others from situations that were public) led to a lowered positive affect of participants towards the situations they experienced. The authors thus argue that the positive experience of technological mediation depends on the interplay between the concrete use of the technology and the context it takes place in. They further suggest that for technology use in public spaces, how users relate to and are perceived by others around them is crucial for the satisfaction of individual needs and an overall positive user experience (von Terzi et al., 2021).

Finally, Morse and Emery (2023) conducted walking-interviews with participants in the UK's Duke of Edinburgh Award scheme, which requires groups of teenagers to engage in an outdoor expedition without using their smartphones. They find that while some participants experienced feelings of FOMO and social isolation since they did not have their phones, they reported a higher and more natural sensory engagement with their environment as they were less focused on photographing or posing for photos. Participants also reported experiencing deeper and more meaningful connections with members of their group and the environment around them, particularly to engage with general social, political, and moral questions, as well as further opportunity for self-reflection. The authors thus highlight the importance of shared experiences that enable a deeper sensory engagement with the physical (natural) environment for self-reflection and relating to wider social and moral-political questions. They also suggest that the increasing hybridisation of spaces, and particularly the mediation of spaces via smartphones, may create environments that are less likely to allow for such experiences to take place (Morse & Emery, 2023).

4. Discussion

4.1. The state of the literature - general notion of the discourse and inherent flaws

Our analysis suggests that the extant literature on human experiences in hybrid spaces focuses on three key areas: place, mobility, and social interaction. The literature on experiences of place in hybrid contexts sheds light on how people's perceptions and uses of places in urban contexts are changing with the increasing use of mobile devices and especially ubiquitous internet access. Several studies focus on individuals' experiences of augmented reality (AR), exploring how AR can positively affect spatial meaning-making and place attachment (Kostopoulou et al., 2018; Nekoui & Roig, 2022; Schweiger et al., 2021; Sengupta et al., 2020). Another set of studies looks at the influence of technology and specific applications on spatial practices on a micro-scale, revealing changing uses of space (Argin et al., 2020; Di Marino et al., 2023; Iranmanesh et al., 2022; Lu, 2024; Wang, 2022). Few studies take a decidedly critical view of the implications of a ubiquitous integration of digital devices into everyday life (Hatuka & Toch, 2017; Liao & Humphreys, 2015; Pucciarelli & Vannini, 2018; Silva, 2018), highlighting aspects of the digital and access divide, representation, and power imbalances.

A second group of studies has focused on understanding the impact of hybridisation on experiences of mobility. One strand of studies has looked at how ubiquitous internet access and location-based technologies influence (and alter) the way in which people navigate and engage

with physical spaces as they move through them (Ekizoglu & Mortamais, 2018; Iranmanesh & Alpar Atun, 2018; Wilkinson & Torun, 2022). A second strand provided case studies of apps that change the way users engage with their environment in situations of mobility (Frith, 2013; Hofmann & Moseghvdlshvili, 2014), or design exercises on how user experiences in these situations can be improved (Opromolla et al., 2019; Soñez et al., 2019).

Finally, a third group of papers in the literature has looked at the consequences of hybridisation for social interaction. Several studies have done so by looking at the concrete impact of a specific technology on interactions with others in public space (Hatuka & Toch, 2017; Kang, 2017; Shinohara & Wobbrock, 2016; Xu et al., 2023), while others have investigated more broadly what the implications of hybridisation for social interactions in public spaces (Humphreys & Hardeman, 2021; Krajina, 2019; von Terzi et al., 2021), or the absence of such technologies (Morse & Emery, 2023), are.

Although the notion of hybrid spaces was coined almost twenty years ago (de Souza e Silva, 2006), we find that the empirical literature is still nascent. This can potentially be attributed, firstly, to the fact that the literature on hybrid spaces is scattered across a variety of academic disciplines, with different traditions and heterogeneous terminologies. This is further reflected in the variety of methodological approaches used. It thus appears that researching hybrid spaces poses a double challenge for researchers: On one hand, because they are fast-paced, ever-changing and complex spaces that raise questions which are inherently interdisciplinary and intersectional in nature. On the other hand, because there are no simple 'off the shelf', 'tried and tested' methodological solutions available to researchers that can help them with the already complex nature of the object of study. We observe that this has led to the parallel development of similar and overlapping methodological approaches and conceptualisations across disciplines that, fortunately, produce similar outcomes (therefore strengthening their validity) but have, unfortunately, hardly been connected yet.

Secondly, given the complexity of hybrid spaces, and the dearth of methodological precedence, many papers show a clear dedication to new, exploratory, or speculative research methods, and to methodological development. We observed that about 85% of studies included in this review worked with qualitative methods (60% exclusively), which can be partially attributed to the fact that the technologies that enable hybridisation are still developing and maturing, as well as to the lag of broader societal adoption and the associated development of user behaviours. Further contributing factors are that the research designs adopted in the reviewed papers often involve time-consuming *in situ* data collection and analysis, resulting in smaller sample sizes.

The individualised, parallel, and unconnected research agendas across disciplines have led to the duplication of foundational work and an evident lack of generalising approaches to studying hybrid spaces. Considering the significant methodological effort that has been carried out already, we echo the sentiment that "too little use is made of existing research in the social sciences" (Weed, 2005), and especially so across disciplines. Further quantitative and particularly confirmatory approaches as well as qualitative studies taking bolder steps towards theoretical generalisation will be required as the field matures. Furthermore, while we acknowledge that different disciplines have different traditions when it comes to methodology and the reporting of research methods, design, and procedures, we observe vast differences in the quality and detail of reporting. Several studies in our sample miss crucial information about data collection and analysis, making it difficult to evaluate, compare, and contextualise the findings that were obtained, or to attempt to replicate them.

It is important to note here that we observed a generally technophile, optimistic and, at times, uncritical attitude of researchers towards both the technological development and proliferation of digital devices, and their integration into daily life, as well as the use of high-tech research technologies (wearable eye-tracking, AR apps, etc.). We therefore question whether this general optimism is warranted and perhaps

necessary for an initial examination of human behaviour in hybrid spaces, or whether a more critical approach should be adopted. While the lack of diversity in early empirical studies on hybrid spaces can be partially attributed to the use of convenience samples given the methodical challenges that researchers are facing, it is nonetheless quite striking how the debate lacks critical investigations regarding unequal access and participation in hybrid practices as well as studies scrutinizing risks of increasing hybridisation.

We further observed a clear bias towards the Global North and urban samples: Only two papers research hybrid spaces in the Global South (Pucciarelli & Vannini, 2018; Soñez et al., 2019), and only one paper focused on rural settings (Morse & Emery, 2023). Moreover, few papers explicitly researched the experiences of marginalised groups in hybrid spaces (Shinohara & Wobbrock, 2016; Soñez et al., 2019), hint at the emergence of a spatial participation gap in the context of hybrid spaces (Silva, 2018), or discuss issues of power imbalances and representation (Liao & Humphreys, 2015; Pucciarelli & Vannini, 2018; Silva, 2018). Addressing the lack of studies not only about, but ideally also from the Global South, is necessary in a sense of decolonising research (Marguin et al., 2021). Despite this general observation which accounts for most fields of research, the topic of experiences in hybrid spaces calls for research from the Global South for two reasons: Firstly, mobile internet use is more widespread in the Global South than stationary technologies (Ceci, 2024), making research into hybridity particularly relevant. Secondly, different cultures of internet use can be observed across contexts (de Souza e Silva, 2006) which renders studies in under-researched contexts as well as comparative studies all the more important to understand varieties of hybrid spaces and experiences of them.

Finally, we can make the seemingly basic observation that hybrid spaces have become an everyday reality. Physical environments are nowadays populated with digital technologies and deeply entangled with digital locative information, which in turn influences spatial perceptions and practices. The new emerging spatial arrangements and practices cannot be conceptualised and researched as a mere overlapping of online and offline spheres but produce unique characteristics and qualities that the studies analysed in this review aim to understand. Accordingly, the question of how people perceive, experience, use, appropriate, move through, and make sense of these spaces, as well as how they interact with each other in them, can only be understood taking into account the concept of hybridity.

4.2. Hybridisation of spatial experiences - how mobile devices are impacting the meaning of places and stimulating spatial exploration

A dominant notion related to the increasing dispersion of digital technologies and internet connectivity is that media usage draws people inward, both physically and socially. The proliferation of personal computers was accompanied by dystopian images of deserted public spaces, a focusing of human life on the stationary computer, and a complete immersion in cyberspace. Especially for the geographies of childhood and youth we, indeed, find evidence for a growing degree of domestication since the late 1960s which was clearly intensified, but by no means driven solely by home-based technology (Castillo Ulloa et al., 2024). However, the findings from the reviewed papers draw into question the continuation of this trend. Indeed, we observe a more ambiguous picture of the impact of hybridisation of spaces on human activity.

In the context of spatial exploration and place-making, digital technologies, and especially location-based applications and locative information, can change people's spatial practices and foster their engagement with the physical environment e.g., by motivating mobility or encouraging exploration of and engagement with places. Spatial perceptions are also impacted by augmentation of physical environments through mobile devices such as smartphones or AR glasses which encourage exploration of unknown, and new spatial practices in known environments. The studies in our sample exemplify this with regard to

diverse digital games such as *Magical Park*, *Pokémon Go*, *Minecraft Earth*, *Geocaching*, and *Ingress* but also the holographic animation and augmentation of physical environments such as buildings. As a consequence, location-based applications and locative information impact place attachment, spatial meaning-making, and place-making. Even temporal and volatile experiences of virtually augmented environments show significant influence on people's sensual-aesthetic perception of places and the individual meanings they ascribe to these places. Furthermore, the studies show that increased outdoor activities and engagement with the environment can foster environmental learning as well as acquisition and exchange of spatial knowledge.

Following the literature, it is therefore evident that to simply equate hybridisation to an increased engagement with online spheres within the private sphere of the home, and a lowered engagement with outdoor environments, especially public spaces, would be an over-simplification. There are several qualifications that we can make to this finding: Firstly, the diversification and proliferation of mobile devices (as opposed to home-based technology), and in particular locative applications that encourage spatial exploration and outdoor activities, can challenge individual and collective trends towards domestication. Secondly, hybridisation can initiate processes of spatial meaning- and place-making and promote place attachment. In this sense, our review supports the discussion around new forms of localism (Roudometof, 2019). Thirdly, while these studies look specifically at how technology use affords hybridisation, there is no discussion how much our lives are mediated through technology overall. In other words, does hybridisation indicate that our engagement with the physical and the digital sphere is becoming more fluid, or does it mean that the few remaining moments in which human experiences were primarily scaffolded by physical spaces are becoming colonised by technology as well (e.g., Morse & Emery, 2023)?

4.3. Hybridisation of spatial practices and uses - how locative information are impacting urban functions on diverse scales

How people navigate and move through the city, where they spend time and what facilities they use, and how they coordinate and interact with both familiar and unfamiliar others are strongly impacted by digital locative information. Several studies highlight how this hybridisation of spatial practices, in turn, is changing our cities and their patterns of spatial use. Online representations of places (e.g., websites of stores or cafés) as well as user annotations to specific places (e.g., online reviews, social media entries, virtual locations in apps such as *Layar* or *Four-square*) influence the use of these places. Points of interest are shaped by digital locative information. Certain places become (less) interesting because of how they are presented online, leading to a double honeypot effect regarding locative media and the sharing of locative information online: (1) *In situ* the use of locative media can trigger interest for passers-by, (2) online representations of places can be a source of attraction (or aversion) to them. Accordingly, hybridisation is changing the use and functions of urban spaces. Social media and trace data allow for accurate analyses of when and where the city is particularly busy and vibrant, what land uses dominate when and where, and also how people move through the city. This in turn allows users to navigate towards, or to circumvent certain spaces, and it influences how and why people make these navigational decisions. Against this background, research also critically discusses how public discourse and conviviality in spaces are documented and shaped by digital storytelling and practices, and how this can lead to inclusivity or segregation of communities and neighbourhoods.

Hybridisation further leads to a flexibilisation of the use of spaces: By using a shopping app your living room can be transformed into a shopping mall. At the same time, digital communication or entertainment can transform a shopping mall into your living room, and user perceptions of what constitutes personal or private space is significantly influenced by hybridisation. It has, thus, been suggested that a clear

attribution of urban functions to certain places might eventually dissolve because highly specialised areas lose their importance, and spatial uses are generally becoming more flexible: „To some extent, technology can be flexibly used and appropriated by people to meet diverse needs that are normally satisfied in other more specific environments. In this sense, not only the spatial scale but also its functional typology has been transformed by digital technology. It is now the digital technology rather than physical form that plays an increasingly critical role in determining the everyday functions of space.“ (Wang, 2022, p. 74)

Accordingly, our synthesis suggests threefold: First, the advancing hybridisation of spaces and spatial practices impacts spatial uses and urban functions at multiple levels. At the micro level, locative media can trigger interest in particular places and influence, for example, which café a person drops in. At the meso-level, locative information influences, for example, how people navigate the city when moving from one place to another. At the macro level, the phenomena described shape patterns of urban use by, for example, generating interest in neighbourhoods, attracting people to them, and driving the vibrancy of a neighbourhood. The emerging flexibilisation of spatial uses described above could even lead to a major rethink of how we discuss and negotiate urban functions and spatial uses. Second, some studies raise the question how hybridisation impacts the quality of experience (e.g., Lu, 2024; Soñez et al., 2019; von Terzi et al., 2021; Wang, 2022; Wilkinson & Torun, 2022). For example, mobile navigation technologies can make traveling faster and more efficient and provide entertainment along the way. But does this lead to a more valued individual or social experience (and use) of space? And if hybridisation does indeed lead to optimisation, there must also be the question for whom experiences become optimised and to what end. This leads to the third and final aspect, which revolves around the relationship of hybridisation and capitalism more broadly, and the underlying commercial interests that providers of the technology that facilitates it (both hardware and software) may have. Regardless of the benefits of hybridisation, research must therefore concretely ask how much hybridisation contributes to or is a means towards the commercialisation and commodification of space (for a more detailed discussion see e.g., Canpolat, 2021; Gazzard, 2011) and who benefits from and loses out due to its impacts.

4.4. Implications of hybridisation - concept of hybridity challenging fundamentals of our thinking about places and their designability

Another point of discussion which is raised rather peripherally in several papers is the question how ‘designable’ or ‘plannable’ hybrid spaces are, and the implications of an increasing hybridisation of spaces for spatial planning and design disciplines (Argin et al., 2020; Iranmanesh et al., 2022; Schweiger et al., 2021; Sengupta et al., 2020; Soñez et al., 2019; Wang, 2022). Only one paper has a more dedicated focus on hybrid spaces from a spatial planning perspective (Di Marino et al., 2023). Argin and colleagues (2020), for example, raise the question what implications smartphone use in public spaces holds for spatial planning and urban design and how hybrid public spaces can and should be designed. They postulate that the proliferation of interconnected mobile devices “requires the (re)conceptualization of the future of the public space and its design as a hybrid construct through which the users co-exist in and simultaneously shift between the interconnected virtual and the physical spaces” (Argin et al., 2020, p. 247). Similarly, Schweiger and colleagues (2021) highlight the potential of AR animations for increasing resident participation in urban planning and development processes. However, while these studies suggest that hybridisation of spaces requires reactions from the planning and design disciplines, they primarily convey uncertainty with regard to its implications for planning and design practice. This demonstrates the need for in-depth discussion and pioneering projects here.

Beyond the uncertainty regarding planning in the light of hybridisation, several studies challenge the fundamentals of our thinking about

places and, accordingly, their designability. Liao and Humphreys start from the common “assumption [...] that physical space is immobile and finite” (2015, p. 1432), but point out how this is challenged by spatial augmentation which allows for the co-existence of infinite alterations of a place. With this seemingly simple observation, the authors open the floor for daring thoughts about places, their design and, especially, the conflicts around both. In urban contexts in particular, discourses revolve around land being a scarce, expensive, and exclusive commodity. Hybridisation could somewhat delimit these discourses - although some studies quite rightly remind us of the digital and access divide (Hatuka & Toch, 2017; Liao & Humphreys, 2015; Pucciarelli & Vannini, 2018; Silva, 2018) which must be taken into account in order to avoid being blind to issues of unequal representation, power, and resources.

Other studies (Kostopoulou et al., 2018; Schweiger et al., 2021) extend the argument of multiple co-existing augmentations to the temporal dimension. Spatial augmentation allows not only a multiplicity of present representations of a place to co-exist at the same time but can also embrace past and possible future representations of it. There is a lack of clarity as to how best deal with this simultaneous diversity, variance and designability open to all, and what this implies for spatial planning. Does spatial planning have to react to this or is this area of co-production of hybrid environments inaccessible or even irrelevant to institutionalised spatial planning? This topic needs to be addressed more explicitly and emphatically in the future.

4.5. Future research avenues—Some recommendations on how to further develop the research field of experiences in hybrid spaces

Our scoping review revealed that the field of empirical research on experiences in hybrid spaces is in the making, but there remains significant scope for further exploration. Based on our findings, we conclude by highlighting possible avenues for the development of the field. We will differentiate between content-related suggestions regarding research topics and subjects and more structural recommendations to advance the research field.

4.5.1. What and whom to investigate - future research topics and subjects

From our literature review we deduced thematic strands and research directions which characterise the research field on experiences in hybrid spaces so far. However, from our synthesis we see thematic gaps that should be addressed to advance our understanding of hybrid spaces.

Research the everyday more than the extraordinary: Current research on experiences in hybrid spaces predominantly focuses on research-induced situations and settings, such as UX trials of augmentations or instructed walking tasks. Though these studies provide valuable insights, there is a notable gap in understanding how hybrid spaces are constituted and experienced in mundane situations. While results might turn out to be less spectacular at first sight, shifting the focus towards everyday practices and environments will enable us to gain a deeper understanding of the role of advancing hybridisation in people’s lives.

Focus broad user groups: The reviewed studies tend to concentrate on experiences of “‘hyperconnected’ digital media users” (Parisi, 2015, n. p.) such as “early adopters” or the “early majority” (Rogers, 2003, p. 283f) while experiences of less inclined, sporadic, and sceptical adopters of digital technologies and applications (the so-called “late majority” and “laggards”; Rogers, 2003, p. 284–285) are given little consideration. Including a broader range and more diverse array of users would allow us to understand experiences in hybrid spaces across different demographics, backgrounds and milieus and could thus enrich the discourse.

Investigate hybrid spatial practices in co-presence: The current body of research - even the studies on social interactions in hybrid contexts - tends to focus on social interactions *practiced online*. This overlooks hybrid practices involving both physical co-presence of individuals and simultaneous online activities. However, precisely these situations

appear as particularly deep entanglements of physical and digital spheres and therefore seem highly relevant for understanding the unique characteristics and experiences of hybrid spaces. Given the initial evidence on how technologies affect and alter how we play, interact, and sometimes are in conflict with each other in hybrid contexts (e.g., Humphreys & Hardeman, 2021; Krajina, 2019; Xu et al., 2023), as well as social and pop-cultural phenomena such as ‘phubbing’ or ‘smartphone zombies’, we further need to understand how hybridisation impacts social norms in online, offline, and hybrid contexts (Heitmayer & Schimmelpfennig, 2023).

Explore experiences of privacy and publicness: While some studies already investigate experiences of privacy and publicness in the context of hybridity and observe a shift in the perceptions of spaces as either private or public, further engagement with it might hold the potential to gain a more nuanced understanding of new realms and blurring boundaries of privacy and publicness.

Scrutinise gains and losses in processes of hybridisation: The discourse on experiences in hybrid spaces generally lacks more critical stances, particularly with regards to the examination of potential gains and losses associated with hybridisation. Multi-perspective research into which applications of digital technologies are perceived as an improvement of everyday life, in which areas, and by which groups, as well as to what extent exaggerated improvements or even loss of quality are perceived, could enrich the discourse and spark debate in the generally technology-optimistic field.

Focus planning practice and designability of hybrid spaces: Future research should address the prevailing uncertainties regarding the potential impact of the hybridisation of space for planning and design principles and engage with the roles and responsibilities of spatial planning more intensely. Research into whether and how planning could, and should, intervene in the design of hybrid spaces could further our understanding of experiences in hybrid spaces and inform planning practice and policy-making. In this sense, it seems interesting and promising to extend the field towards practice- and policy-oriented research.

4.5.2. How to research - suggestions for structural advances of the research field

Our review illustrates the added value of consolidating disparate research, reading between studies and integrated analysis. Our recommendations therefore generally emphasise the importance of connecting research on experiences in hybrid spaces across disciplines and the merit of enabling a more coherent development of the field.

Consolidate the disparate research field: Future studies should aim to integrate the diverse strands of research on experiences in hybrid spaces and connect work from different disciplines that has been carried out simultaneously but independently. This requires a concerted effort to align terminologies and conceptual frameworks. To date, most studies reference the seminal work by de Souza e Silva (2006), but hardly refer to more recent empirical studies. Researchers should engage more in building a comprehensive understanding that bridges past and current insights.

Practice interdisciplinarity more rigorously: Experiences in hybrid spaces are being studied by a variety of academic disciplines. Collaborative efforts between fields such as media studies, psychology, urban studies, sociology, and geography - to name but a few - can yield richer insights. We strongly believe that integrating discourses, perspectives, and methodologies will help to advance the field.

Lead methodological discourse and establish procedures: A variety of tried and tested approaches to study experiences in hybrid spaces is evolving. While these techniques were often developed independently, many seem to converge, suggesting a shared outlook on what is required. A more dedicated methodological dialogue will enable the further development and establishment of procedures and thus contribute to the consolidation of research. It will also make it easier for researchers interested in hybrid spaces to enter the field.

Diversify the research field: The research field should be diversified both in terms of research subjects and researchers. There is a need for incorporating perspectives from and on varying demographics, socio-economic backgrounds, and geographical contexts. The field mainly consists of studies from and relating to the Global North, with marginalised groups only occasionally considered. Diversifying the research field, and especially research voices from the Global South, would advance the field and could uncover differences or similarities across backgrounds and contexts, enhancing the generalisability of findings and theory building.

Take a critical stance: The research field is currently dominated by technophile and technology-optimistic approaches and perspectives. Critical research is underdeveloped and there is a clear need for it. Issues of accessibility, participation, representation, ownership, and power (inequalities) should be more fully addressed, and aspects of inter-sectionalities should be brought to the fore. In this sense, hybrid spaces should be re-conceptualised not only as forms of commodification and commercialisation but also as opportunities for decolonisation and critical interrogation.

Contribute to theory building: So far, most research on experiences in hybrid spaces has been exploratory. The research field lacks sound contributions to theory building. We see a need for more systematic research aimed at quantitative or theoretical generalisation.

4.6. Limitations of this study

The first limitation of this study relates to the way the literature search has been carried out. We have chosen to search *Scopus* and *Web of Science* given their wide coverage of scientific disciplines and their complementarity (Chadegani et al., 2013; Mongeon & Paul-Hus, 2016), but other databases could have uncovered further sources and in particular grey literature (e.g. via Google Scholar). We have also chosen to limit our search to records written in English. The rationale for these two choices, beyond obvious limitations of language, was to create a sample of reliable and peer-reviewed sources that would be easily accessible and useable for a general research audience interested in the field. Of course, more localised, context-specific studies written in other languages than English may have been overlooked in this way, which adds a caveat to our finding that studies focusing local contexts, diverse populations, and particularly voices from the Global South are pending.

A second limitation of our literature review concerns the selection of search terms. As mentioned at the beginning, we used various synonyms for ‘hybrid space’, for example augmented space and cyber-physical space. However, as there are a large number of terms for conceptualizing spatial phenomenon merging physical environments and digital spheres (and also a tendency in the literature towards ever new neologisms), the use of further specific search terms might have led to further studies to be included in the review. We addressed this problem by using not only specific synonyms for hybrid spaces as search terms, but also broader combinations of search terms that describe the range of topics at the interface between space and digital technologies or mobile devices (e.g. “spatial perception” OR “spatial experience” OR “spatial knowledge” AND smartphone OR “mobile device\$”). We are optimistic that this has enabled us to find a good breadth and diversity of studies.

A third limitation to take into consideration is the positionality of the author team. While an interdisciplinary team of urban planners and social psychologists from China, Germany, and the United Kingdom, the authors are based in traditional European institutions and researching with an able-bodied and Western gaze. Beyond the choice of databases and study language, this comes with a specific mindset, and with a certain way of life which creates a subjective and specific view on processes of hybridisation and its impact on spaces and cultures. This view is by no means the only view, nor is it representative or prescriptive for other contexts. It is for this reason that we emphasise calls for varied research approaches, cross-disciplinary, cross-contextual, and cross-cultural validation of findings, and for a more inclusive research

agenda that focuses marginalised populations in hybrid spaces. The authors further acknowledge that, from their disciplinary backgrounds, they take a more critical stance on the impacts of hybridisation and therefore raise questions that focus on the social sustainability and justice of the processes are underway. By no means is this to imply that more optimistic and technology or design-focused approaches are less valid or naïve, nor is this to diminish the contribution of research into technological innovation.

5. Conclusion

This paper presents a comprehensive overview of the state of research on human experiences in hybrid spaces. Based on a scoping literature review following the PRISMA-ScR guidelines, research evidence from 28 empirical studies on hybrid spaces has been presented, and three overarching areas of research in the extant literature have been identified: place, mobility, and social interaction. The in-depth analysis of the texts has revealed that many disciplines and traditions take interest in studying hybrid spaces with varying research aims and agendas. We also observe a variety of methodological approaches with a general focus on exploratory research and novel research methods. At the same time, the empirical study of hybrid spaces appears nascent still and the field lacks convergent and consolidating approaches. This leads to an overall disparate and unconnected state of research across disciplines and the duplication of foundational work. We observe this absence of a coherent discourse and unifying methodological approaches as the main barrier for a broader development of the field. We therefore provide concrete guidance for future research on what and whom to investigate, as well as how to do so.

Nonetheless, the synthesis of the findings from the empirical studies allows us to draw some conclusions that advance the state of research: While digital technologies have so far been associated with processes of domestication and a diminishing importance of places, our study shows that mobile devices and especially AR applications can draw people outside and foster spatial meaning-making and place-making. Our synthesis also illustrates the pervasive influence of hybridisation on our cities and everyday lives. Hybrid spatial practices change spatial uses and produce new patterns of urban functions at multiple levels. Moreover, reading across studies reveals how hybridisation challenges some of our fundamental notions of place, as spatial augmentation allows for the coexistence of multiple past, present, and possible future representations of a place. What we gain and lose in this development remains an

open question for further investigation.

"Similar to how the industrial revolution changed the physical form of the city, the mobile digital revolution is transforming the urban socio-spatial landscape" (Iranmanesh et al., 2022, p. 2594). It is therefore imperative to focus research efforts on creating a unified discourse and a validated methodological toolkit to be able to better understand, plan, and design for the hybridisation of space, and, where necessary, help mitigate the shift in how we live and interact with each other it has set in motion.

CRedit authorship contribution statement

Anna Juliane Heinrich: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Maxi Heitmayer:** Writing – review & editing, Writing – original draft, Visualization, Supervision, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Eva Smith:** Writing – review & editing, Investigation, Formal analysis, Data curation. **Yifan Zhang:** Writing – review & editing, Investigation, Formal analysis, Data curation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A

Authors	Title	Theme	Type of Data Collection	Sample Size	Sample Country
Argin et al. (2020)	Through the Eyes of (Post-)Flâneurs: Altering rhythm and visual attention in public space in the era of smartphones	1	<i>In Situ</i> Video	10	Ghent, Belgium
Di Marino et al. (2023)	Hybrid cities and new working spaces-The case of Oslo	1	Case Study, Interviews	5	Oslo, Norway
Ekizoglu and Mortamais (2018)	Smartphone and Mobile Territories - Technical Knowledge Transformed into an Object Producing New Territorial Layers: An Experience in the City of Strasbourg	2	Geodata Analysis & Photo Voice	10	Strasbourg, France
Frith (2013)	Turning life into a game: Foursquare, gamification, and personal mobility	2	Interviews	36	Various Cities, USA
Hatuka and Toch (2016)	The emergence of portable private-personal territory: Smartphones, social conduct and public spaces	3	Field Observation & Survey	138	Tel Aviv, Israel
Hatuka and Toch (2017)	Being visible in public space: The normalisation of asymmetrical visibility	1	Smartphone-logging, Interviews	51	Tel Aviv, Israel
Hofmann and Moseghvdlishvili (2014)	Perceiving spaces through digital augmentation: An exploratory study of navigational augmented reality apps	2	Interviews, Field Experiment	15	Frankfurt, Germany
Humphreys and Hardeman (2021)	Mobiles in public: Social interaction in a smartphone era	3	Field observation, Interviews	8	Philadelphia, USA
Iranmanesh et al. (2022)	Reading urban land use through spatio-temporal and content analysis of geotagged Twitter data	1	Social Media Analysis (Tweets)	10822	Famagusta, Cyprus

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(continued)

Authors	Title	Theme	Type of Data Collection	Sample Size	Sample Country
Iranmanesh and Alpar Atun (2018)	Exploring patterns of socio-spatial interaction in the public spaces of city through Big Data	2	Social Media Analysis (Tweets)	7266	Lefkoşa, Cyprus
Kang (2017)	Can digital signage in subway stations serve as a valid communication platform for citizens?	3	Survey	53	Seoul, South Korea
Kostopoulou et al. (2018)	Mediated spatial narratives experiencing archival material and shared memories in urban space	1	Interviews, UX trials	87/9	Brighton & London, UK
Krajina (2019)	Understanding Encounters for Urban Media Studies: Civic Intercourse, Screen Technologies, and Cultural Difference	3	Social Media Analysis	138	UK
Liao and Humphreys (2015)	Layar-ed places: Using mobile augmented reality to tactically reengage, reproduce, and reappropriate public space	1	Interviews	12	Various, USA
Lu (2024)	Streets as experienced through the body, mind, and screen: The smartphone and the pedestrian's engagement with an urban public space	1	<i>In Situ</i> Video	17	Philadelphia, USA
Morse and Emery (2023)	Avoiding the 'easy route': Young people's socio-spatial experience of the outdoors in the absence of digital technology	3	Participant Observation, Walking Interviews	27	West Midlands, UK
Nekoui and Roig (2022)	Children and the Mediated City. Place Attachment Development Using Augmented Reality in Urban Spaces	1	Case Study	3	New Zealand
Opromolla et al. (2019)	Co-designing game solutions for hybrid urban spaces. How game elements can improve people experience with the mobility services	2	Field Observations, Workshops	.	Rome, Italy
Pucciarelli and Vannini (2018)	Douala as a hybrid space: Comparing online and offline representations of a sub-Saharan city	1	Interviews, Social media Analysis	39	Douala, Cameroon
Schweiger et al. (2021)	Augmenting the City. The photo-realistic animation of a historic building and its influence on spatial perception and meaning	1	Survey, AR UX Trial	78	Augsburg, Germany
Sengupta et al. (2020)	The hybrid space of collaborative location-based mobile games and the city: A case study of ingress	1	Netnography	.	.
Shinohara and Wobbrock (2016)	Self-conscious or self-confident? A diary study conceptualizing the social accessibility of assistive technology	3	Interviews, diaries	25	Washington, USA
Silva (2018)	Spatial participation gap: Towards a conceptual perspective on locative storytelling creation	1	Case Study	2	Texas, USA, & Wales, UK
Soñez et al. (2019)	Interdisciplinary design guidelines of an interface-device for a more accessible urban space	2	Interviews	25	Santa Fe, Argentina
von Terzi et al. (2021)	Technology-Mediated Experiences and Social Context: Relevant Needs in Private Vs. Public Interaction and the Importance of Others for Positive Affect	3	Online Experiment	184	Germany
Wang (2022)	A Study of Digitally Enhanced People-Space Interaction: A Place-Centric Perspective	1	Field Observation, Survey	.	Hong Kong
Wilkinson and Torun (2022)	The Effect of Using Technological Tools on Urban Navigation: A mixed-methods study on wayfinding behaviour in Newcastle Upon Tyne, UK	2	UX Trial, Case Study	8	UK, Newcastle
Xu et al. (2023)	Understanding Social Interactions in Location-based Games as Hybrid Spaces: Coordination and Collaboration in Raiding in Pokémon GO	3	Interviews	41	Mainly USA

Data availability

Data has been attached; see file "Appendix B"

References

- Argin, G., Pak, B., & Turkoglu, H. (2020). Through the Eyes of (Post-)Flâneurs: Altering rhythm and visual attention in public space in the era of smartphones. In *Proceedings of the international conference on education and research in computer aided architectural design in europe* (Vol. 1). <https://doi.org/10.52842/conf.eacaade.2020.1.239>
- Bazzanella, L., Roccasalva, G., & Valenti, S. (2014). Phygital public space approach: A case study in volpiano. *Interaction Design and Architecture(s)*, 2014(20). <https://doi.org/10.55612/s-5002-020-002>
- Canpolat, E. (2021). Smartphones and exploitation in the age of digital capitalism: Ordinary aspects of the transformation of everyday life. *TripleC*, 19(2). <https://doi.org/10.31269/TRIPLEC.V19I2.1269>
- Casey, E. (1996). How to go from space to place in a fairly short stretch of time: Phenomenological prolegomena. In S. Feld, & K. H. Basso (Eds.), *Sense of place* (pp. 13–52). School of American Research Press.
- Castillo Ulloa, I., Juliane Heinrich, A., Million, A., & Schwerer, J. (2024). The evolution of young people's spatial knowledge. In *The evolution of young people's spatial knowledge*. <https://doi.org/10.4324/9781003099727>
- Castillo Ulloa, I., & Schwerer, J. (2024). Qualitative meta-analysis. In A. J. Heinrich, M. Séverine, A. Million, & J. Stollmann (Eds.), *Handbook of qualitative and visual methods in spatial research* (pp. 327–337). Transcript Verlag.
- Ceci, L. (2024). Mobile internet usage worldwide - statistics & Facts. *Statista*. <https://www.statista.com/topics/779/mobile-internet/#topicOverview>.
- Chadegani, A. A., Salehi, H., Md Yunus, M. M., Farhadi, H., Fooladi, M., Farhadi, M., & Ale Ebrahim, N. (2013). A comparison between two main academic literature collections: Web of science and scopus databases. *Asian Social Science*, 9(5). <https://doi.org/10.5539/ass.v9n5p18>
- de Souza e Silva, A. (2006). From cyber to hybrid: Mobile technologies as interfaces of hybrid spaces. *Space and Culture*, 9(3), 261–278. <https://doi.org/10.1177/1206331206289022>
- de Souza e Silva, A. (2023). Hybrid spaces 2.0: Connecting networked urbanism, uneven mobilities, and creativity, in a (post) pandemic world. *Mobile Media and Communication*, 11(1). <https://doi.org/10.1177/20501579221132118>
- Di Marino, M., Tabrizi, H. A., Chavoshi, S. H., & Sinitsyna, A. (2023). Hybrid cities and new working spaces – the case of Oslo. *Progress in Planning*, 170. <https://doi.org/10.1016/j.progress.2022.100712>
- Doyle, L. H. (2003). Synthesis through meta-ethnography: Paradoxes, enhancements, and possibilities. *Qualitative Research*, 3(3). <https://doi.org/10.1177/1468794103033003>
- Duarte, F. (2018). *Space, place and territory: A critical review on spatialities*. Routledge.
- Ekizoglu, E., & Mortamais, E. (2018). Smartphone and mobile territories - technical knowledge transformed into an object producing new territorial layers: An experience in the city of Strasbourg. In M. Schrenk, V. Popovich, P. Zeile, P. Elisei, C. Beyer, & G. Navratil (Eds.), *Proceedings of REAL CORP 2018* (pp. 379–389). CORP.
- Frith, J. (2013). Turning life into a game: Foursquare, gamification, and personal mobility. *Mobile Media and Communication*, 1(2). <https://doi.org/10.1177/2050157912474811>
- Gazzard, A. (2011). Location, location, location: Collecting space and place in mobile media. *Convergence*, 17(4). <https://doi.org/10.1177/1354856511414344>
- Glover-Rijkse, R., & de Souza e Silva, A. (2021). Evolving geographies of mobile communication. In *Routledge handbook of media geographies*. <https://doi.org/10.4324/9781003039068-12>
- Graham, M., Zook, M., & Boulton, A. (2013). Augmented reality in urban places: Contested content and the duplicity of code. *Transactions of the Institute of British Geographers*, 38(3). <https://doi.org/10.1111/j.1475-5661.2012.00539.x>
- Hatuka, T., & Toch, E. (2016). The emergence of portable private-personal territory: Smartphones, social conduct and public spaces. *Urban Studies*, 53(10), 2192–2208. <https://doi.org/10.1177/0042098014524608>
- Hatuka, T., & Toch, E. (2017). Being visible in public space: The normalisation of asymmetrical visibility. *Urban Studies*, 54(4). <https://doi.org/10.1177/0042098015624384>

- Heitmayer, M., & Schimmelpfennig, R. (2023). Netiquette as digital social norms. *International Journal of Human-Computer Interaction*. <https://doi.org/10.1080/10447318.2023.2188534>
- Hofmann, S., & Mosemghvdlishvili, L. (2014). Perceiving spaces through digital augmentation: An exploratory study of navigational augmented reality apps. *Mobile Media and Communication*, 2(3). <https://doi.org/10.1177/2050157914530700>
- Humphreys, L. (2012). Connecting, coordinating, cataloguing: Communicative practices on mobile social networks. *Journal of Broadcasting & Electronic Media*, 56(4), 494–510. <https://doi.org/10.1080/08838151.2012.732144>
- Humphreys, L., & Hardeman, H. (2021). Mobiles in public: Social interaction in a smartphone era. *Mobile Media and Communication*, 9(1). <https://doi.org/10.1177/2050157920927062>
- Iranmanesh, A., & Alpar Atun, R. (2018). Exploring patterns of socio-spatial interaction in the public spaces of city through big data. <https://doi.org/10.4995/isuf2017.2017.5254>
- Iranmanesh, A., Cömert, N. Z., & Hoşkara, Ş.Ö. (2022). Reading urban land use through spatio-temporal and content analysis of geotagged Twitter data. *GeoJournal*, 87(4). <https://doi.org/10.1007/s10708-021-10391-9>
- Kang, M. (2017). Can digital signage in subway stations serve as a valid communication platform for citizens? *Advances in Intelligent Systems and Computing*, 483. https://doi.org/10.1007/978-3-319-41661-8_59
- Kitchin, R., & Dodge, M. (2011). *Code/Space: Software and everyday life*. The MIT Press. <https://doi.org/10.7551/mitpress/9780262042482.001.0001>
- Kostopoulou, E., Javornik, A., Koutsoulampros, P., Julier, S., & Schieck, A. F. gen (2018). Mediated spatial narratives experiencing archival material and shared memories in urban space. *ACM International Conference Proceeding Series*. <https://doi.org/10.1145/3284389.3284395>
- Krajina, J. (2019). Urban media Studies| understanding encounters for urban media studies: Civic intercourse, screen technologies, and cultural difference. *International Journal of Communication*, 13.
- Lettkemann, E., & Schulz-Schaeffer, I. (2021). Lokative Medien. Inklusion und Exklusion in öffentlichen Räumen. In T. Döbler, C. Pentzold, & C. Katzenbach (Eds.), *Räume digitaler Kommunikation* (pp. 72–103). Halem-Verlag.
- Liao, T., & Humphreys, L. (2015). Layar-ed places: Using mobile augmented reality to tactically reengage, reproduce, and reappropriate public space. *New Media & Society*, 17(9). <https://doi.org/10.1177/146144814527734>
- Löw, M. (2008). The constitution of space: The structuration of spaces through the simultaneity of effect and perception. *European Journal of Social Theory*, 11(1). <https://doi.org/10.1177/1368431007085286>
- Low, S. (2017). *Spatializing culture: The ethnography of space and place*. Routledge.
- Löw, M. (2020). Re/figure(e)ation. An Essay on Space and Boundaries in Late Modernity. In K. Grosse (Ed.), *It wasn't us. Ausstellungskatalog. Hamburger Bahnhof, Museum für Gegenwart* (pp. 170–177). Hatje Cantz Verlag.
- Lu, W. (2024). Streets as experienced through the body, mind, and screen: The smartphone and the pedestrian's engagement with an urban public space. *Mobile Media and Communication*, 12(1). <https://doi.org/10.1177/20501579231197304>
- Manovich, L. (2006). The poetics of augmented space. *Visual Communication*, 5(2). <https://doi.org/10.1177/1470357206065527>
- Marguin, S., Haus, J., Heinrich, A. J., Kahl, A., Schendzielorz, C., & Singh, A. (2021). Positionality reloaded: Debating the dimensions of reflexivity in the relationship between science and society: An editorial. *Historical Social Research*, 46(2). <https://doi.org/10.12759/hsr.46.2021.2.7-34>
- Mayring, P. (2015). Qualitative content analysis: Theoretical background and procedures. https://doi.org/10.1007/978-94-017-9181-6_13
- Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. In *BMJ (online)* (Vol. 339). <https://doi.org/10.1136/bmj.b2535>, 7716.
- Mongeon, P., & Paul-Hus, A. (2016). The journal coverage of Web of science and scopus: A comparative analysis. *Scientometrics*, 106(1). <https://doi.org/10.1007/s11192-015-1765-5>
- Morse, A. L., & Emery, S. B. (2023). Avoiding the 'easy route': Young people's socio-spatial experience of the outdoors in the absence of digital technology. *Geoforum*, 141. <https://doi.org/10.1016/j.geoforum.2023.103727>
- Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology*, 18(1). <https://doi.org/10.1186/s12874-018-0611-x>
- Nekoui, Y., & Roig, E. (2022). Children and the mediated city. Place attachment development using augmented reality in urban spaces. *Interaction Design and Architecture(s)*, 52. <https://doi.org/10.55612/s-5002-052-008>
- Noblit, G., & Hare, D. (1988). In *Meta-Ethnography: Synthesizing qualitative studies - george W. Noblit, R. Dwight Hare - Google books*. Sage Publications.
- Okoli, C., & Schabram, K. (2012). A guide to conducting a systematic literature review of information systems research. *SSRN Electronic Journal*. <https://doi.org/10.2139/ssrn.1954824>
- Oleksy, T., & Wnuk, A. (2016). Augmented places: An impact of embodied historical experience on attitudes towards places. *Computers in Human Behavior*, 57. <https://doi.org/10.1016/j.chb.2015.12.014>
- Opromolla, A., Volpi, V., & Parente, G. A. (2019). Co-designing game solutions for hybrid urban spaces. How game elements can improve people experience with the mobility services. *Interaction Design and Architecture(s)*, 40. <https://doi.org/10.55612/s-5002-040-001>
- Parisi, L. (2015). Where 2.0." Exploring the place experience of "hyperconnected" digital media users. *Sociologica*, 9(3). <https://doi.org/10.2383/82483>
- Peters, M. D. J., Marnie, C., Tricco, A. C., Pollock, D., Munn, Z., Alexander, L., McInerney, P., Godfrey, C. M., & Khalil, H. (2020). Updated methodological guidance for the conduct of scoping reviews. *JBIM Evidence Synthesis*, 18(10). https://journals.lww.com/jbisrir/fulltext/2020/10000/updated_methodological_guidance_for_the_conduct_of.4.aspx
- Pucciarelli, M., & Vannini, S. (2018). Douala as a "hybrid space": Comparing online and offline representations of a sub-Saharan city. *Semiotica*, 2018, 223. <https://doi.org/10.1515/sem-2017-0017>
- Rogers, E. M. (2003). In *Diffusion of innovations* (5th ed.). Free Press.
- Roudometof, V. (2019). Recovering the local: From globalization to localization. *Current Sociology*, 67(6). <https://doi.org/10.1177/0011392118812933>
- Schreier, M. (2014). *The SAGE handbook of qualitative data analysis qualitative content analysis*. The SAGE Handbook of Qualitative Data Analysis. <https://doi.org/10.4135/9781446282243>
- Schweiger, M., Wimmer, J., Nagler, G., & Schlagowski, R. (2021). Augmenting the city. The photo-realistic animation of a history building and its influence on spatial perception and meaning. *International Journal of Film and Media Arts*, 6(2). <https://doi.org/10.24140/IJFMA.V6.N2.07>
- Sengupta, U., Tantoush, M., Bassanino, M., & Cheung, E. (2020). The hybrid space of collaborative location-based mobile games and the city: A case study of ingress. *Urban Planning*, 5(4). <https://doi.org/10.17645/UP.V5I4.3487>
- Shinohara, K., & Wobbrock, J. O. (2016). Self-conscious or self-confident? A diary study conceptualizing the social accessibility of assistive technology. *ACM Transactions on Accessible Computing*, 8(2). <https://doi.org/10.1145/2827857>
- Silva, C. (2018). Spatial participation gap: Towards a conceptual perspective on locative storytelling creation. In *Lecture notes in computer science (including subseries lecture notes in artificial intelligence and lecture notes in bioinformatics)*. LNCS, Article 11318. https://doi.org/10.1007/978-3-030-04028-4_67
- Sóñez, L., Tosello, M. E., Martín, E. S., & Longoni, A. (2019). Interdisciplinary design guidelines of an interface-device for a more accessible urban space. In *Proceedings of the international conference on education and research in computer aided architectural design in europe* (Vol. 1). https://doi.org/10.5151/proceedings-ecaadesigradi2019_098
- Tuan, Y.-F. (2020). *Space and place: The perspective of experience*. The University of Minnesota Press.
- Valori, I., Jung, M. M., & Fairhurst, M. T. (2024). Social touch to build trust: A systematic review of technology-mediated and unmediated interactions. *Computers in Human Behavior*, 153. <https://doi.org/10.1016/j.chb.2023.108121>
- von Terzi, P., Tretter, S., Uhde, A., Hassenzahl, M., & Diefenbach, S. (2021). Technology-mediated experiences and social context: Relevant needs in private vs. Public interaction and the importance of others for positive affect. *Frontiers in Psychology*, 12. <https://doi.org/10.3389/fpsyg.2021.718315>
- Wang, W. (2022). A study of digitally enhanced people-space interaction: A place-centric perspective. *Space and Culture*, 25(1). <https://doi.org/10.1177/1206331219881352>
- Weed, M. (2005). "Meta interpretation" A method for the interpretive synthesis of qualitative research. *Forum Qualitative Sozialforschung*, 6(1).
- Wilkinson, M., & Torun, A. O. (2022). The effect of using technological tools on urban navigation: A mixed-methods study on wayfinding behaviour in Newcastle upon Tyne, UK. In *Proceedings 13th international space syntax Symposium, SSS 2022*.
- Xu, J., Papangelis, K., Dunham, J., Boulanger, C., Lee, J. H., Lalone, N., & Saker, M. (2023). Understanding social interactions in location-based games as hybrid spaces: Coordination and collaboration in raiding in Pokémon GO. *Conference on Human Factors in Computing Systems - Proceedings*. <https://doi.org/10.1145/3544548.3581544>
- Zook, M. A., & Graham, M. (2007). Mapping DigiPlace: Geocoded internet data and the representation of place. *Environment and Planning B: Planning and Design*, 34(3). <https://doi.org/10.1068/b3311>