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The built environment in Social Media: towards a Biosemiotic Approach

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Abstract

The paper presents a biosemiotic approach to the study of the built environment, its representations and practices in social media. First, it outlines the main developments that make semiotics hold a significant position in the study of urban space and the built environment. It then goes on to overcome the limitations of the binary opposition paradigm: in particular, nature/culture is reconsidered as a category in which the two terms are in a relation of mutual participation rather than being exclusive to each other. Following this, the paper explores three participatory categories that can be useful for the study of the built environment and its social media representations and practices: (a) life/semiosis, (b) natural environment/built environment, (c) text/practice. Finally, it identifies five main topics representing the interplay between the natural and built environment: the interaction of nature and architecture, urban parks, urban agriculture, digital environmentalism and ecotourism.

Keywords Built environment · Social media · Urban space · Representations · Practices · Participatory categories

The semiotic study of the built environment: towards a Biosemiotic Approach

Starting from the late 1960s, semiotics moved beyond its traditional research objects, i.e. literary and written texts, and began to analyse sign and sign-using behaviour in

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everyday objects, advertisements, newspapers, television broadcasts, design, music as well as social practices and cultural processes. Hence, branches in the field of semiotics such as semiotics of space, semiotics of architecture and urban semiotics began to explore topics such as space, place, landscape, the city and the built environment. In the late 1960s, architectural semiotics was the first attempt to propose a semiotic approach to the built environment investigating the processes through which architectural built forms convey meanings (Barthes, 1970; Eco, 1986; Lotman, 1987) proposed a semiotic conceptualisation of architecture as a system of signs made of spatial signifiers, denotative and connotative signifieds. He argued that architectural objects were not designed to communicate, but function; they communicated through their form and function accordingly.

In the second half of the 1980s, semiotics shifted to a broader level, urban space, creating a specific field called urban semiotics (Gottdiener & Lagopoulos, 1986). Scholars in this field undertook analyses of existing urban spaces and their representations to reveal power relations, social and cultural values underlying them. Several semiotic analyses have recently appeared providing a range of approaches to the semiotic aspects of the city (Marrone & Pezzini, 2006, 2008; Pellegrino, 2007; Marrone, 2009; Volli, 2009; Pilshchikov, 2015; Lagopoulos, 2020). Scholars in semiotics have also analysed urban peripheries (Cervelli, 2005), urban districts (Montanari, 2008) and wider urban spaces such as the post-Socialist city (Czepczyński, 2009) and the post-war city (Mazzucchelli, 2010).

Urban semiotic research and the semiotic analysis of the built environment have provided a methodological basis for the analysis of the signifying aspects of urban space, grounding itself on different paradigms. First, the semiological paradigm based on de Saussure has described urban spaces as sign systems, systems of values and, more generally, essential instruments through which meanings are articulated. This line of research aimed to identify the principles governing the significance of urban space, using text and language as metaphors for explaining social relations within urban life. Second, some semioticians applied to urban space the generative model of Greimas, according to which texts can be divided into three levels of signification, each level representing a step further into a process that moves from the abstract to the concrete and finally producing the text. The generative model of urban space aimed to investigate the configuration of these layers both within and outside the textuality of the city, including settlement space (e.g. Lagopoulos & Boklund-Lagopoulou 1992; Hammad, 2010; Lagopoulos & Boklund-Lagopoulou, 2014) and architecture (e.g. Muntañola, 1991; Tchertov 2002; Juodinytė-Kuznetsova, 2011). Third, the Tartu-Moscow Semiotic School largely investigated the semiotic aspects of urban space. Lotman & Uspenskij (1975) outlined the fundamentals for the semiotics of the cultural space and the topological tools of spatial modelling to investigate cultural texts in terms of internal-external binaries, borders, points and directions. Grounding this perspective, Remm (2016) used semiotics of culture to map the interpretive and social communicative practices of urban space and planning. Fourth, semiotics investigated space in broader terms so as to establish an essentially semiotic theory of space (e.g. Pellegrino 2020). Theories drawing on Peirce's model of semiosis explicitly investigated the relationship between space-time configurations and the human understanding of them. Lindström et al., (2014: 120) explained that "the Peircean

approach allows for an analysis of the interrelations between the constituent physical and mental elements in respect to the sign user and contextual information". Guerri et al., (2016) used this approach to build an operating model, the Semiotic Nonagon, to carry out the analysis of different conceptual objects, including architecture and the built environment.

Semiotic research has recently investigated representations, power relations, social structures and memory in landscapes, including urban landscapes. Delving into the relationship between culture and space, Lavrenova (2019) has examined the power of cultural landscapes in the context of cultural philosophical research. Lindström et al., (2014) contributed to the formation of landscape semiotics envisioning the potential of the concept of landscape for semiotic analysis, as well as for practical planning and management policies. The authors argued that the semiotic study of landscapes can prove useful to understand the dialogicity and meaning-making process in everyday landscapes. Lindström et al., (2014: 113) also explained that "landscape is shaped in time and is necessarily a historical phenomenon" that preserves "traces of what has been or is important" in both the natural and the cultural heritage. Tarasti (2000: 156) asserted that "landscape is a cultural fact" and, as such, "it is a humanisation of nature, and above all, the transformation of nature into culture". According to this view, landscapes - including urban landscape and the built environment - realise the relationship between nature and culture (see Sect. 2).

All this research has contributed to advancing the understandings of the interpretation and the meaning-making of urban space and the built environment, beyond historical, architectural and socio-economic aspects alone. However, a biosemiotic approach is still lacking, with a few notable exceptions mostly developed within *The Gatherings in Biosemiotics*, annual meetings on semiotic biology (Rattasepp & Bennett, 2012: 5). These meetings have occasionally included biosemiotic papers focusing on urban space and the built environment that evolved in several original contributions to biosemiotic scholarship (Mäekivi, 2016; Magnus & Remm, 2018; Steckner in Lacková et al., 2020; Delahaye 2021). Another exception is represented by Ireland & Garnier (2018) that proposed an interdisciplinary approach connecting biology and architecture to discuss the information contents of architecture and structures built by humans and non-humans. They claimed that a semiotic perspective is necessary to assess the influence of built structures on human and animal behaviour. In the next few years, biosemiotics will become increasingly important for the study of urban space and the built environment, as a post-human and multispecies vision of the future is growing in the humanities and the social sciences:

> [...] I would claim that the modern temporal configuration is challenged by a new vision of the human condition, both from an ecological and from a technological perspective. In our age of the Anthropocene, human and nonhuman agency are no longer distinguished, we are trans-corporeal subjects, enmeshed in the Earth's biophysical processes and entangled in technological developments. (Tamm, 2022: 133)

This paper takes a step in this direction by exploring biosemiotic categories that are useful for studying the built environment. Biosemiotics connects biology and semiot-

ics and it is concerned with life, signs, meaning-making and interpretative processes of living systems, all interconnected (Emmeche et al., 2002). It aims "to show that semiosis is a fundamental component of life, i.e., that signs and meaning exist in all living systems" (Barbieri, 2009: 221). Biosemiotics takes signs, rather than molecules, "as fundamental units for the study of life", so "biology becomes a semiotic discipline" (Hoffmeyer, 1995: 16).

In this paper, biosemiotic concepts are used to provide insights into the human relationships with the natural and built environment. Urban life is characterised by both prelinguistic (biosemiotic) and linguistic (cultural) processes (Maran & Kull, 2014: 41). To this, the growing digitalisation of urban space and life has to be added. This process begins with the telecommunication revolution at the end of the 1990s and grows exponentially with the digital revolution in the mid-2000s, when digital technologies expanded from private to public external spaces (Languillon-Aussel, Forthcoming 2021). Having outlined the main developments that ensure a significant position for semiotics in the study of urban space and the built environment, the next section aims to overcome the limitations of the binary opposition paradigm in general and to reconsider nature/culture as a category in which the two terms are in a relation of mutual participation specifically.

Bridging the Nature/Culture opposition

Binary oppositions are deeply embedded in human categorisation and cognition. The first logical operations of children (Jakobson & Halle, 1956) are taken for granted by members of a culture, helping them to grasp the complexity of social and cultural life (Martinek, 2007). Structural linguistics explored opposition as a principle governing the structure of language (e.g. Jakobson et al., 1928). In structural anthropology, Levi-Strauss (1972) argued that oppositions are at the core of the classificatory system of cultures. He aimed to detect and codify them in cultural phenomena such as myths and kinship.

Binary opposition has been a founding principle in structural semiotics (Danesi, 2009), whose analysis mainly aimed to reveal the basic oppositional structure in texts. Binaries have been applied also to the semiotic analysis of pop culture texts: for example, Eco & Del Buono (1965) identified a series of binaries as the basis of the success of the 007 sagas: Bond/villain, loyalty/disloyalty, chance/planning, West/Soviet Union and so on. Floch (2001) applied them to visual images, as in his analysis of the visual rivalry between IBM and Apple. The semiotic square of Greimas (1966) has often been used as a dyadic construction representing a relation between two contrasting terms which, in turn, creates two other relationships: contradiction and implication.

Contemporary semiotics has already clarified that binary oppositions work only within a semantic micro-universe - e.g. a specific text - while they are unable to address the dynamic complexity of the social and cultural world. Paolucci (2010) explained this through the opposition man/woman, that only works within the semiotic square of gender when there is the need to differentiate a male from a female, without considering other non-binary gender identities. In all other cases, man/woman

opposes an unmarked, generic term to a marked, more specific one: in the sentence "men are intelligent animals", the extensive term "men'" also includes its opposite "women", as well as other contradictory and complex terms (Paolucci, 2010: 54). Some classical semiotic research already demonstrated this: for example, Hjelmslev (1935) claimed that the elements of semio-linguistic systems cannot be defined in exclusive relations. However, most semiotic analysis of structural foundations has often relied on oppositional binaries typical of language, wherein the meaning of man is defined in contrast to the meaning of woman. Paolucci (2010) used the terms' participant oppositions to describe categories in which the two terms are in a relation of mutual participation rather than being exclusive to each other: the former term participates in the values of the latter and vice versa. Participative oppositions can better describe the complexity of social and cultural processes, including the multiple meanings embodied in the built environment.

Nature/culture is another founding opposition underlying structuralist thought. The binaries identified by Lévi-Strauss (1969) in myths were seen as originating and reflecting upon this fundamental category: for example, in the cross-cultural category raw/cooked, he considered raw as natural and cooked as cultural, while cooking marked the transition from nature to culture. Biosemiotics has contributed to a more participative relationship between nature and culture, conceiving them as in a mutual relation able to define, from context to context, something as natural and something else as cultural. Human reality is all imbued with culture and thus "nature is, in a sense, also an element of culture, which is why semiotics of culture can also successfully deal with the issues of nature" (Machtyl, 2019: 107).

Lotman and the Tartu-Moscow Semiotic School have previously contributed to overcoming the opposition nature/culture. In the preface of *Universe of the Mind* (1990), Lotman claimed that nature and culture are related as they feature similar arrangements. An example is offered in the comparison between nervous system and culture, defined by Lotman as isomorphous semiotic mechanisms. According to this view, the nervous system regulated the activities of the body as culture maintained the complex organisation of a society. Lotman's idea of biological and cultural diversities as closely interdependent is revealed also in the semiosphere, whose reference comes from Vernadsky's biosphere, i.e. "namely the totality and the organic whole of living matter and also the condition for the continuation of life" (Lotman, 1990: 125). Later, Kull (1998) highlighted the potential biological aspects of the semiosphere exploring the relations between nature and culture within it. While doing so, he indicated four types of nature according to humans: Zero nature is nature in its complete wilderness; First nature is the natural environment as perceived and interpreted by humans; Second nature is nature created by humans in its materiality, including managed urban green spaces; finally, Third nature consists of the virtual and abstract representations of nature in art and science; to the latter, digital representations of nature have to be added.

While exploring the cultural implication of biosemiotics, Cobley (2016) aimed to bridge the boundary between living nature and culture and thus that between the sciences and the humanities. Ingold (2000) has also taken a step in this direction while exploring the relationship between people and their environment. He established two perspectives: the building and the dwelling. The building perspective assumes that

people consciously build their own environment before they act within it. Instead, Ingold (2000: 179) explained that "worlds are made before they are lived in […] acts of dwelling are preceded by acts of worldmaking". According to the dwelling perspective, people already have ideas on the world they dwell in and are in an "'inescapable condition of existence' within the environment, the world continuously coming into being around them, and other human beings becoming significant through patterns of life activity" (Ingold, 2000: 153). This view further helps to overcome the opposition between biology and culture.

Drawing on these theories, this paper presents a holistic approach, according to which nature and culture influence each other through continuous mediations. Built forms are surrounded by and consist of natural elements. In some cases, they are dug into the landscape (see Sect. 5); more commonly, there are cases of "culturisation of nature" - or naturalisation of culture - such as urban parks, urban gardens, urban reforestation practices and landscape design (Maran & Kull, 2014: 45). Treating these natural and built environments as equal elements of the city (Kos, 2008), a biosemiotic approach can advance the understanding of social and cultural life within them and its growing digital dimension, by overcoming unnecessary oppositions that have characterised much of structural epistemology.

Useful participatory categories for the study of the built environment, its Representations and Practices

Biosemiotics, arguably, has made the greatest contribution to bridging the opposition nature/culture and subsequent binary oppositions by proposing a more holistic approach to the meaning-making of the natural and built environment. In particular, there are three participatory categories that can be useful for the study of the built environment and human practices within it: (a) life/semiosis, (b) natural environment/built environment, (c) text/practice; b) and c) are general categories, while life/semiosis is more closely connected to the domain of biosemiotics.

a.   Life/Semiosis.

Life and semiosis are "coextensive" and "organisms rely heavily on semiotic processes both in their internal regulation and the relations in which they are involved" (Maran & Kull, 2014: 44). Positioning human culture into the broader context of biological semiotic processes can advance the understanding of the relationships between living organisms, their interpretations and practices within the built environment.

Uexküll (1982) proposed the theory of Umwelt, i.e. the individual and species-specific biological capacities of living organisms to perceive the world and fill objects with meanings. An Umwelt defines a living organism's environment based on its specific modelling devices (Cobley & Randviir, 2009). According to this theory, the experience of environment varies for all living organisms. Two Umwelten interacting create a semiosphere, i.e. the semiotic space within which, in case of humans, different languages and cultures variously interrelate with each other (Lotman, 2005). The

semiosphere is deeply related to the natural environment, despite it has been primarily used for the analysis of cultural phenomena (Kull, 1999; Patoine & Hope, 2015).

Humans, like every living organism, have their own Umwelten as well as their natural limitations. To go beyond them, humans create technological tools to amplify their experience and perception of reality. Among them, the built environment provides shelter as well as shapes and manages cultural practices (Ireland & Garnier, 2018). Digital technologies and the growing bio-digital convergence[1] are increasingly designing and delivering augmented experiences (e.g. Leone 2020; Bankov, 2019).

Humans, like every living system, are "meaning-making systems" (Maran & Kull, 2014: 41), i.e. they use communicative systems to actively share their experiences with each other, also through the use of digital technologies. Biosemiotics can prove useful to exploring how the interactions between humans and the environment influence humans' cognitive, axiological, emotional and pragmatic dimensions (Greimas, 1970, 1983). The cognitive dimension refers to the knowledge people have about the built environment. The axiological dimension considers personal opinions and evaluations of built forms; the question is whether people have positive or negative attitudes towards them. The emotional dimension identifies emotions and feelings elicited by built forms. The pragmatic dimension concerns how people act and interact within the built environment. Interpretation of the environment and interactions within are based on perception, recognition and arousal. The needs, practices and habits are largely shaped by the environment and by the perceptual field of the agents.

b.   Natural Environment/Built Environment.

In Siena's *Palazzo Pubblico*, the medieval seat of the city government, there is *The Allegory of Good and Bad Government* (1338–1339), a series of frescoes painted by Ambrogio Lorenzetti. The series consists of six scenes representing the effects of good and bad government in the city and in the country. The *Effects of Good Government in the City* depicts a peaceful cityscape of the 14th century, with citizens involved in trade, political, religious and leisure activities. There are beautiful buildings, a school and shops for traders and merchants. In the *Effects of Good Government in the countryside* peasants enter the city gates with mules and goods. A group of noblemen on horseback is going past the walls heading for a picnic or to hunt in the open air. In the countryside, the atmosphere is relaxed and peasants are working in the fields. The view widens to the distant horizon over the hills near Siena, demonstrating the vastness of its possessions. Conversely, in the frescoes of the *Bad Government*, the city is falling into ruin and the streets are full of robbers and ruffians. In the country there is only war, death and destruction with villages burned to the ground. The fields are bare and no one cultivates the land. What is striking in these frescos is the sharp division between city and country, the natural and built environment. This is a classi-

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[1] Bio-digital convergence is the combination of digital technologies and biological systems. Over the past decades, wearable and implantable Internet of Things devices have been used to supplement or repair deficiencies in the human body. Over the next decade, technologies such as artificial organs and skin, brain wave technologies, RFID and NFC implants are likely to be introduced in many aspects of our lives.

cal division that has characterised much of landscape painting in the Renaissance and beyond. The city is the location of political, economic, social and cultural life, while the country is the culturised place of nature and land subjugated to the city, providing food for the citizens and a leisure space for noblemen.

Hence, a distinction between the natural and built environment has characterised modern thought until contemporary planning that considered the relationship between city and nature as a subject-object opposition, reducing nature to a "symbolic surrogate" that satisfies the human ancestral need for real nature. In this sense,

> Nature in the city is part of the cultural (built) environment and as such only represents nature. One does not have to be a deep ecologist to conclude that "urban green spaces" are only a kind of mimicry of nature, which has very little in common with nature as an autopoietic, self-generating, and self-regulating entity. Nevertheless, this surrogate has performed its function with relative success, and in spite of its obvious reductionism has satisfied the basic need of city dwellers for nature for many years (Kos, 2008: 129).

Drawing on participatory oppositions, city and nature can be seen as dynamic concepts engaged in a complex relationship: nature is not an object that can replace the city as well as the cultural space of the city cannot replace nature in full (Kos, 2008). Nature merges into the built environment as natural landscape is perfused with culturised, built objects. A biosemiotic approach treats natural and built environments as equal elements of the city, helping urban managers to move beyond the ancient antagonism between nature and built forms, thus offering the opportunity to create sustainable urban development.

c.   Text/Practice.

Post-structural perspectives in geography, as well as the semiotics of text, grounded themselves in a textual paradigm, associating concepts of space, place, landscape and built environment with text. Geographers have associated landscape and text to uncover the hidden, dominant discourses of nationalism, power, ethnicity, gender within landscape representations (e.g. Duncan & Duncan 1988). These approaches used text as a metaphor or a model to define a methodological perspective on the complex fabric of meanings through which agents make sense of the world. From the mid-1980s, post-structural geographers refashioned the notion of landscape as text, gathering around the slogan "there is something outside the text" (Peet, 1996: 23). They argued that the textual paradigm neglected the material processes and social relations in which texts were interpreted and produced (Duncan & Ley, 1993).

Non-representational theories emerged as a critique of those perspectives which reduce "naturally present reality" into representational models (Thrift, 1996: 7). They proposed to shift from text to context, i.e. "a necessary constitutive element of interaction, something active, differentially extensive and able to problematise and work on the bound of subjectivity" (Thrift, 1996: 3). As opposed to the concept of text, practices were seen as "open and uncertain" and thus changing according to time and spatial settings (Thrift, 1996: 7). Practices were embodied in a space that is "a practi-

cal set of configurations that mix in a variety of assemblages thereby producing new senses of space" (Thrift, 1996: 16). Rather than being made up of representations, the world was seen as "made up of all kinds of things brought into relation with one another by many and various spaces through a continuous and largely involuntary process of encounter" (Thrift, 2007: 8). Non-representational theories conceptualised objects as actors involved in various performances and in complex relations with other humans and non-humans. The human body was not counted as separate from the world: bodies "co-evolve with things, taking them in and adding them to different parts of the biological body to produce something which […] resemble[s] a constantly evolving distribution of different hybrids with different reaches" (Thrift, 2007: 10). In biosemiotics, Hoffmeyer developed a similar epistemological view while investigating the relationship between living organisms and their environment:

> Living organisms are inscribed in their environments much like patterns woven into a carpet. The two cannot get apart and yet there seems to be a distinct asymmetry in their relation. From the point of view of the organism the environment is everything outside of it, while from the point of view of the environment organisms are encapsulated packages having appeared inside it like an infection (Hoffmeyer, 1998: 35).

The proposal of non-representational theories was to focus attention on practices, as opposed to texts. Traditional semiotic research erected a great boundary between the concepts of text and practices. As products of prior utterances, texts were traditionally considered as immutable, coherent systems of signification (Floch, 1990). In consequence, texts were delimited within a temporal structure that necessarily included a beginning, an elaboration and an end. Recently, semiotic research has expanded to study human practices proposing models and methods for an analysis of daily, individual and social practices (e.g. Fontanille 2008). As opposed to texts, practices were defined as ongoing processes, continuously developing and changing in situations of social interaction. Nevertheless, human practices can be completely stable and stereotypical (Paolucci, 2010). The open nature of practices does not make them more peculiar than texts: practices often assume the form of stable "scripts" or "frames" (Eco, 1984: 71), which are coherent systems of experiential knowledge that describe how actors usually behave within social situations. For instance, the practice of going to a restaurant develops similarly for different actors: calling the restaurant to book a table, reaching the restaurant, reading the menu, making a choice on the food to order, waiting to be served, eating and finally paying the bill. No doubt human practices can be altered by unusual circumstances, but when this occurs they degenerate into something else.

Hence, contemporary semiotic research has progressively shifted to the concept of textuality to reconsider the traditional notion of text as a closed product with fixed borders and defined by internal coherence. At the methodological level, textuality allows the researcher to periodically redefine the borders of the texts and thus to open new perspectives considered as relevant for the analysis (Stano, 2015). Focusing on the textuality of the natural and built environment can help to better define the objects and the interpretative processes under investigations, including representa-

tions, interpretations, cultural context and social practices. Considering the category text/practices as participative, biosemiotics can effectively explore "how texts relate to particular cultural and environmental settings, how they emerge, inspire action and if and how they are applied back to the environment" (Maran & Westling, 2017: 26). This back-and-forth process can be used to analyse how social media representations affect human practices and behaviour within the built environment (see Sect. 5).

The Digital and the built environment

Digital transformation, i.e. the change related to the application of digital technologies in many aspects of human society, has had a great impact on cities. This impact manifested both at the individual level - due to a dramatic growth in the incorporation of citizens' lives into a digital dimension over the past two decades - and at the institutional level with many Smart City projects and policies. Under the paradigm of the Smart City, governments across the world have designed urban data platforms as key tools to make cities more efficient, sustainable and inclusive (Mora et al., 2017). Urban data platforms have supported the delivery of various Smart City initiatives, that can be grouped in the following categories and solutions:

1. Sustainable mobility: traffic management and recognition, transportation analytics, smart parking, smart safety, smart intersection, vehicles auto-diagnosis, license plate recognition.
2. Smart environment: air quality/pollution monitoring, soil moisture sensors, sprinkler system optimization, prevention of illegal dumping, fire forest detection.
3. Energy efficiency: smart building, smart trash, smart grid, smart lighting, energy/water management, water leakages.
4. Smart government: civic engagement, public administration transparency, e-government, online voting.
5. Smart health: order entry, e-prescribing, follow-up care, patient-data repository, health information exchanges.
6. Security: perimeter access control, alerts for accidents as they happen, radiation level, noise level, item location.
7. Smart tourism and entertainment: virtual tour, e-ticket, tourist beacons.

These projects were mainly based on open data policies, according to which data must be complete, updated, processable by a computer, available to anyone to be used according to their own wishes and needs. Moreover, their access must be free of charge without copyright control. Citizens and their organisations produce an incredible amount of digital data. According to *Digital 2021: Global Overview Report*, there are 4.8 billion people in the world using the Internet as of July 2021. Internet users are growing at an average of 700,000 new users each day. Over 92% use mobile devices to go online at least some of the time. 57% of the global population has a social media account, equating to around 4.5 billion users in July 2021. Floridi (2015) coined the term Onlife to describe the experience of a hyper-connected world where there is no clear-cut difference between online and offline life. Inter-

net and social media have increasingly entered all aspects of human life: finding information and reading how to do things, staying in touch with family and friends, keeping up to date with news, watching videos, tv shows and movies, listening to music, shopping, studying, researching on vacation and travels, managing finances, gaming, finding a partner and getting sexual arousal. Internet and social media are everywhere in human life and thus research cannot be underestimated as they affect "1. our self-conception (who we are); 2. our mutual interactions (how we socialise); 3. our conception of reality (our metaphysics); and 4. our interactions with reality (our agency)" (Floridi, 2015: 2). Of course, there is a difference between online and offline practices and interactions, even if they often intersect. Following Sects. 2 and 3, also the category online/offline can be considered as participatory, with the two domains increasingly merging into each other in our everyday life. This merging can be grasped also through effects on the human brain and behaviour: stimuli from digital representations influence interpretation processes causing responses in the endocrine system, emotions and feelings and meaning-making.

Social media highly influence offline interactions. Over the past decade, they have gone from being platforms where users mainly share representations of natural and built environments, that add up to the furthering of their Umwelt, to digital environments that change the user's relation or conception to the environment. Lefebvre (1995) developed a theory of space made of three perspectives: perceived, conceived and lived space. Perceived space is the physical and tangible space, empirically measurable, mappable and observable through human senses. This dimension has closed affinities with spatial practices that structure urban daily life, while ensuring social cohesion, continuity and specific spatial competences. Conceived space refers to the discourses on space as conceptualised by design professionals and experts, such as scientists, planners, urbanists, architects and social engineers. It is completely theoretical, made up of conceived geographies projected into the empirical world. Lived space is the space of everyday life, what users have in their mind, but it is also the space of resistance, creativity and re-creation. Lefebvre's three perspectives are distinguishable but dialectically interconnected promoting a concept of space that is "produced and productive: proposed by and made productive in a variety of practices and by various agents that cooperate, compete and struggle" (Stanek, 2012: 50). According to this, social media influence and revise the natural and built environment prompting an enlargement of, or elaborating, the users' Umwelten through digital multimedia practices and via AI-powered recommendations.

As Maran (2020: 6) suggested, a sign is a clue to make all the living organisms function together, as it "can glue together various entities and beings of the world into meaningful relations, thus embodying a huge ecological potential to reconnect, to heal". In this view, social media representations are multimedia communicative tools used to interact with and act within the environment. Change is a constant in social media, encouraging the users to provide always new representations and practices. This leads to the recognition of new features of the natural and built environment and to the creation of new interpretations and behaviour patterns within it.

Social Media Practices and representation of the built environment

Representations of the built environment on social media affect how the built environment is perceived, interpreted, evaluated and used, thus affecting the users' cognitive, axiological, emotional and pragmatic dimensions. The biosemiotic approach provides a holistic view to analyse the human-environment interaction and its representation on social media. It can prove particularly useful to explore social media representations and practices of the five topics explored below, identified through a qualitative digital ethnography (Wang & Liu, 2021) based on day-to-day observations of social media. Instagram and Facebook were chosen because they have many users from all ethnic and age groups, gender identities, education levels and professions. The analyses were carried out through the authors' personal accounts from February to September 2021. Data analysis focused on the relationship between the natural and the built environment on social media representations and practices:

- **The integration of nature and architecture**. Integrations of nature and architecture can be found in both traditional and contemporary architecture and are a common topic on social media. An example of the first is provided by the original settlement of Matera, Italy, with its built forms carved out from two canyons. The original settlement of Matera became a subject of the law in 1952, when approximately 15,000 citizens were moved to a new district due to its dismal poverty. Named a World Heritage Site by UNESCO in 1993, today the original settlement mainly performs the function of a tourist site adjusting to the needs of the many visitors. In Matera, tourists get their pictures taken from the several *belvederi* (Fig. 1), viewpoints on the original settlement, that has become a typical tourist representation and practice to be shared on social media.

In contemporary architecture, a case of integration of nature and architecture is represented by urban reforestation practices, i.e. creating green spaces and planting trees in architecture. For example, *Bosco Verticale* (Vertical Forest) by Stefano Boeri, a pair of residential towers inaugurated in 2014 in Milan, containing more than 900 trees. The project has helped to change the character of an entire neighbourhood, attracting more affluent residents and businesses, while encouraging citizens to turn their balconies into green spaces. Leisure and recreational practices are reflected in social media through pictures and videos having the towers in the background. Sport activities in front of them such as yoga, jogging, biking, picnic are highly documented. These social media representations have contributed to introducing new meaning and practices to the neighbourhood, turning it into a cultural quarter bringing together sport, recreational, leisure and tourism practices. Thanks to this, the towers are becoming a new symbol of Milan that can be seen as a material synecdoche, i.e. a built form used to identify an entire city, often used in tourist communication and city branding (Bellentani, 2021).

Urban parks. Urban parks are examples of second nature (Kull, 1998) able to provide environmental services, as well as social and psychological benefits for citizens. As such, they have an impact on the sense of community. Recreational, leisure, educational and socialisation activities in urban parks are highly documented on social

Fig. 1 A view of Matera's old town. Available at: https://www.instagram.com/elmundoendosmochilas [accessed: 21.09.2021]
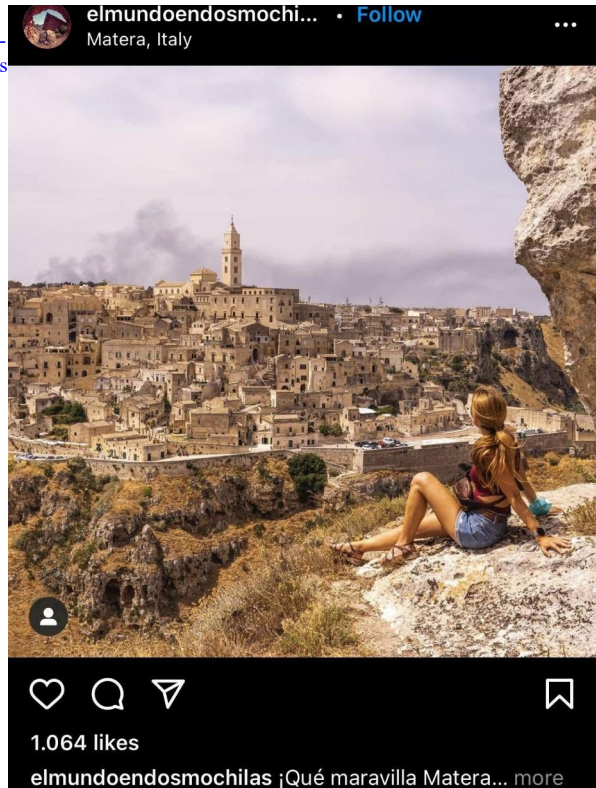
media. Some urban parks become an asset for the city's tourism, often including tourist sites, monuments and memorials. Pet owners post about their pets on social media, sometimes with a dedicated profile specifically for them (Fig. 2). Finally, social media representations include flora and fauna from the parks outside the presence of people.

Urban agriculture. Urban agriculture includes practices such as urban gardens and farms, urban horticulture, animal husbandry, aquaculture and beekeeping. Its general aim is to maintain and improve urban areas, as well as to create communities and social movements founded on a shared ideal of urban sustainability. These communities can evolve in formal institutions becoming integrated into urban planning policies and practices, as well as being present on social media raising awareness of the need for a more sustainable agriculture and lifestyle. In social media, urban agriculture communities share the results of their activities and their meetings around the gardens (Fig. 3).

Digital environmentalism. Grassroots environmental movements have highly used social media to raise awareness on urban sustainability. Some researchers explored digital environmentalism highlighting potential limitations and recommending new practices (Sullivan & Xie, 2009; Hannigan, 2020). This research explained that digital technologies ease the possibility to act on environmental issues. Social media can provide a fast way to raise awareness and call for action at a broader, global

scale (Lichtenthaler, 2021). However, action is often taken only by individuals who were already involved in environmental organisations. This issue is going to be less and less relevant, as the lines between the physical and digital world are blurring (see Sect. 4). Greta Thunberg, for example, has galvanised millions of followers around the globe raising awareness on climate change, nature and environmental loss through social media and civic disobedience practices such as school strikes (Fig. 4). Other environmental organisations challenge their social media communities to clean up their neighbourhood and to collect trash. Most of these practices are represented on social media pictures or videos.

Ecotourism. Tourism has a great environmental impact on the environment and local cultures (e.g. Seetanah 2011). Ecotourism aims to provide solutions to this through sustainable transport, care for the environment and local communities. Its practices are shared on social media to raise awareness on the need for sustainable travel. Ecotourism also calls for the involvement of governmental institutions and the tourism industry. Smaller islands are not resilient to mass tourism: for example, Bali accommodates from 3.5 to 6.5 million of visitors per year, to add to the 4.2 million popula-

Fig. 3 A woman with a basil plant grown in an urban garden. Available at: https://www.instagram.com/cherry_groove [accessed: 21.09.2021]

tion (Bali Hotels Association, 2020). For this reason, tourism industry facilities are now providing the opportunity for a more sustainable stay including eco-friendly commodities (Fig. 5). As in digital environmentalism, social media can be used to raise awareness on solutions for a more sustainable tourism.

Conclusions and Future Research

This paper aimed to overcome unnecessary oppositions that have characterised much of structural epistemology through a biosemiotics approach. Among its major contributions, biosemiotics has removed barriers between nature and culture by considering them in a relation of mutual participation rather than being exclusive to each other. Against this background, this paper provided an approach to the meaning-making of the natural and built environment and their growing digital dimension. In particular, this approach has been useful to analyse the human-environment interactions and its representations on social media. Social media representations and practices can

change the way humans observe, understand and interact with the natural and built
environment, thus affecting their Umwelten extensively on the cognitive, axiologi-
cal, emotional and pragmatic dimensions. Five main topics representing the interplay
between the natural and built environment emerged from a digital ethnography con-
ducted on social media: the interaction of nature and architecture, urban parks, urban
agriculture, digital environmentalism and ecotourismBiosemiotics can prove useful
in addressing the impact social media representations and practices have on percep-
tion, arousal, interpretation, practices and habits of the agent. Future research will
more specifically address these topics.

This research can be improved using quantitative techniques to study representa-
tions and practices in social media and other online communities. The integration
of qualitative and quantitative methods can offer advantages in terms of the number
of social media data that can be observed. Future studies can also explore digital
art practices such as computer animated 3D and animated imagery representing the

Fig. 5 An eco-friendly hotel in Bali. Available at: https://www.instagram.com/adisitumorang [accessed: 21.09.2021]

interplay of the natural and built environment and social media communities of digital artists involved in these.

Statements and Declarations

This paper has been written in equal parts by the two authors. For formal attribution, the parts 1, 2, 3b and 3c can be attributed to Federico Bellentani and the parts 3a, 4, 5 and 6 to Daria Arkhipova.

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