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RESEARCH ARTICLE

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Place and city: Operationalizing sense of place and social capital in the urban context

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Abstract

The academic interest in social concepts in city contexts, such as sense of place and social capital, has been growing in the last decades. We present a systematic literature review that confirms the strong relationship between sense of place and social capital, from a social sciences point-of-view. It also reveal that little attention has been paid to their spatial dimensions at the urban level, thereby missing the chance to exploit socio-spatial knowledge to improve the day-to-day life in and functioning of the city (e.g. in planning processes, citizen participation, civic engagement). We therefore examine sense of place and social capital from a Geographic Information Science (GISc) viewpoint, and present a formal conceptualization and initial theoretical framework which explicitly describes both concepts, and the relation between them, within the context of a city and from a spatial point of view.

1 | INTRODUCTION

Seventeen years have passed since Robert Putnam (2000) pointed out the potential of understanding social capital (SC) as a geographical concept. Since then, more authors have recognized the urgency of a better spatial understanding of the environmental psychological concept "sense of place" (SOP) (Jorgensen & Stedman, 2011; Stedman, 2003). Currently, governments and cities are starting to see the importance of the ability of citizens, firms and organizations to manage and be aware of their spatial footprint in the city (Roche, 2014). On the other hand, in Geographic Information Science (GISc), the importance of place seems to have grown with the development of new concepts such as Volunteered Geographic Information (VGI) (Goodchild, 2007), geosocial applications, Geoweb 2.0 and other related concepts. Hence, interesting and potentially useful connections are emerging between social science concepts (SOP and SC) and cities from a GISc point of view, that, nowadays, we are not able to operationalize. Fortunately, the surge of smart cities, with associated Information and Communication Technology (ICT) research and tools, allows new ways to manage the urban environment, which enables new channels of communication. Moreover, geospatial technologies are omnipresent in these new tools, thus demonstrating the growth of interest in the spatial dimension of social concepts. Furthermore, in many cases, a smart city is considered a technological paradigm, where technological solutions

are often disconnected from society's needs and aspirations (Calzada & Cobo, 2015; Vanolo, 2016). The spatial inclusion in the urban context of citizens' social aspects, such as our feelings, perceptions, and behaviors, form the path toward citizen-centric models and frameworks based on a social-spatial view of a city; that is, it provides an understanding of the social domain (SOP and SC) and its spatial dimensions. Furthermore, we emphasize that GISc can help in compensating for this pervasive lack of social-spatial analysis, by providing theoretical foundation and practical tools to represent and map subjective feelings and experiences.

Nowadays, cities use their hierarchical administrative boundaries to deliver their policies and actions. For instance, participatory processes in planning decisions or decision-making processes about communal spaces are framed and regulated in administrative boundaries. The underlying reason is the availability of census and socioeconomic data in those areas (Dietz, 2002). We are setting up participatory processes in predefined spaces without knowing whether those are the suitable places to successfully apply them. Furthermore, usually not all citizens are aware of or identify with a whole parish or neighborhood. They are linked to places that are meaningful to them for some reason, or they are settlers of geographically located communities, whose boundaries may or may not coincide with administrative ones. We are using administrative boundaries instead of functional ones; in other words, we are using old boundaries to tackle contemporary social problems, simply because our understanding of alternatives is limited and alternatives are not readily available, or are more complicated to implement. The formalization of the spatial relations between citizens and cities can clarify citizens' actual geographic boundaries and attachments, thus creating alternative local citizen-defined spatial clusters. Researchers have recognized the need to be able to identify new boundaries that respect the city interactions based on a socio-geographic approach for social issues (Foster & Hipp, 2011). These boundaries, for instance, can take into account geographic proximity, and citizens' passive and active interactions and engagement (for more information see t-communities in Grannis (2009). Therefore, it makes sense to wonder if our cities are considering the appropriate areas to develop local community initiatives and participatory processes, and if the low rates of participation in developed countries (Aricat & Ling, 2016) can be attributed to the use of inappropriate boundaries. Along the same line, Foster and Hipp (2011) argue that administrative boundaries cannot be valid aggregate measures of neighborhoods. Our innovative method to achieve a truly citizen-based social view on a city is focused on how citizens perceive their spatial surroundings, with respect to: (1) the relationship that an individual has toward a certain geographical area (i.e. SOP) (Jorgensen & Stedman, 2001); and (2) the *"social relations between individuals and about what happens within these linkages"* (Rutten, Westlund, & Boekema, 2010, p. 3), for instance, trust, reciprocity, and cooperation (i.e., SC). Both concepts (SOP and SC) play an important role in citizen participation (CP) and civic engagement (Jorgensen, 2010; Mihaylov & Perkins, 2013). SOP and SC concepts and their dimensions are highly related, although little attention has been paid to their spatial aspect. Moreover, most researchers dealing with the spatialization of social concepts through GISc tools are taking the administrative boundaries of physical space as reference (Coulton, Korbin, Chan, & Su, 2001; Foster et al., 2015), losing variability on measurement (Jorgensen, 2010). Hence, we question whether administrative boundaries are an adequate tool for covering SOP and local SC of citizens in a particular area.

There are several types of research about people's relation to a place and their degree of attachment, but we do not know enough about where exactly these meaningful relationships and places are (Lewicka, 2011b). We are talking about dynamic areas that collect our feelings and perceptions, as opposed to static places in which researchers have already found emotional relationships, such as sacred sites or burial grounds. Consequently, the urban context encompasses a vast amount of information about our perceptions and feelings, yet city authorities, and smart cities in general, are incapable of processing them. For example, at the city level we are missing techniques to spatialize information about environmental psychology concepts (Stedman, 2003). Therefore, this research attempts to create citizen-defined areas in the urban domain, by embedding the spatial dimensions of citizens' SOP and SC. Simultaneously, it proposes a conceptualization and theoretical framework based on citizens' cognitions, feelings and behaviors towards city places and meaningful human relationships embedded in them. The resultant SOP and SC areas will hereby also be influenced by preconceived mental maps of the city that contain physical characteristics: paths, edges, districts, nodes and landmarks (Lynch, 1960). The proposed framework thus recognizes the human perception and organization of social interactions fostered through geographic place(s), citizen-defined areas that move beyond mere administrative boundaries. At the same time, we show

that GISc provides an appropriate context in which to develop suitable spatial tools and map-surveys for the spatialization of concepts from social science (SC) and environmental psychology (SOP). The article starts (Section 2) with the review of SOP and SC concepts, and their dimensions from a non-spatial perspective. The article then covers the spatial approach to SOP and SC, building the basis of our theoretical framework and its exploration (Section 3). This is followed (Section 4) by a discussion on the contributions, remaining gaps and limitations of this research.

2 | BACKGROUND: THE NON-SPATIAL APPROACH

SOP and SC cover a considerable number of basic environmental and community psychological dimensions between citizens and city, respectively. To date, researchers have emphasized the classic approach, which mostly lacks an explicit spatial focus. However, place itself seems to be a central issue in place attachment (PA) and SOP (Hidalgo, 2013; Lewicka, 2011b; Scannell & Gifford, 2010) and an important dimension of SC (Jorgensen, 2010; Jorgensen & Stedman, 2011; Rutten et al., 2010). Place maintains its importance in a globalized world and it is an object of strong attachment (Lewicka, 2011b). People still identify their attachment with physical space (Westlund, Rutten, & Boekema, 2010) and use space in different manners in their daily life. These uses shape how they conceive the world and their location in it (Foster, Pitner, Freedman, Bell, & Shaw, 2015), influencing how individuals perceive themselves (Gotham & Brumley, 2002) and influence our social relationships (Simms, 2008). Place definition, usually applied by geographers, comprises the SOP dimension. SOP explains the cognitive, affective, and behavioral dimensions of the relationship that an individual has with a certain geographical area (Jorgensen & Stedman, 2001). This relationship can clearly be influenced also by the dwellers of target-attachment place (Bernardo & Palma-Oliveira, 2016). On the other hand, SC refers to the relationships between human collectives (social networks) and the interactions that arise as fruits of these connections through, for instance, trust, reciprocity, and cooperation. SC describes social network structures (structuralist perspective) and behaviors within these relationships (interactionist perspective) (Rutten et al., 2010). SC is essential for collaborative purposes, success within communities and civic actions (Johnson, 2016; Lewicka, 2005), while a positive SOP implies greater engagement in participation processes (Perkins, Brown, & Taylor, 1996) and can promote a better quality of life (Harris, Werner, Brown, & Ingebritsen, 1995).

The dimensions considered for SOP and SC (Figure 1), crucial to understanding their relationship, are based on the conceptualization of Jorgensen and Stedman (2001) and Perkins and Long (2002), respectively. SOP (Jorgensen & Stedman, 2001) has its basis in the attitude theory (Fishbein & Ajzen, 1975). Jorgensen and Stedman (2001) created an analogy relating PA (feelings and emotions toward a place) with the affective perspective of the attitude theory; the cognitive approach with place identity (PI) (thoughts and beliefs according to a place) and behavioral attitude with place dependence (PD) (acts and behaves toward a place). Furthermore, this article contributes to the field applying the attitude theory (Fishbein & Ajzen, 1975) also for Perkins and Long's (2002) conceptualization of SC dimensions. Our relationships can also be the target of feelings, beliefs, and acts. Hence, sense of community (SOC) can be encompassed as

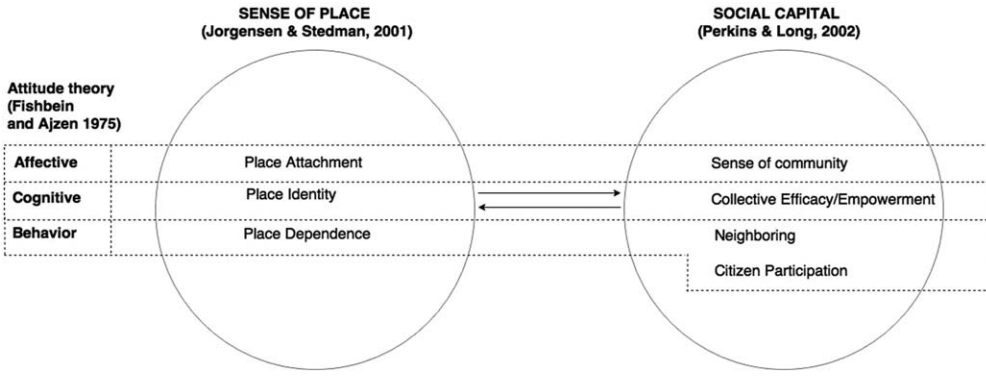


FIGURE 1 Theoretical framework that encompasses the background of this article

a feeling or emotion toward groups to which you belong, collective efficacy/empowerment (CE/E) as the belief and thought of the potentiality of acting together and, finally, both neighboring (N) and CP enclose the actions and behaviors of citizens to a group or society. Place and people can be understood as an object that covers an attitude, following an evaluative approach in which their dimensions are attitudinal expressions toward objects or people. Thereby, in the same line as our conceptualization of a citizen-centric social city approach, the main concepts of this research, SOP and SC, are based on citizens, especially on attitudes, perceptions, and behaviors related to places and people, respectively. The different dimensions and related definitions encompassed in both main concepts (SOP and SC) show the holistic view that this article embraces. We are dealing with several human interactions in the urban context to define a new perspective of and for citizens. Table 1 shows the definitions of each dimension to better understand the magnitude and scope of both concepts: SC and SOP. An elaborate explanation of these dimensions (Table 1) is beyond of the scope of this article. However, their interaction and relationships are critical to understanding: (1) their possible connection in the non-spatial approach; and (2) their feasible spatial relationship and footprint in the geographical domain. In turn, to be able to explain these two points, we performed a systematic literature review with two queries. Figures 2a-b and 3 summarize the relationships between the main concepts (SOP and SC) and their relationships based on the systematic literature review. This review only considers articles that were published or indexed after 2001 and before May 2016. The former year was selected since the conceptualization of SOP (Jorgensen & Stedman, 2001), presented in this research, was first proposed in 2001. The latter date is the period in which the procedure for selecting the studies for this review was conducted. Appendix A shows the methodology followed for the systematic literature review. Two search queries were used on a set of academic databases, and the same procedure was performed on the output of both queries:

1. *Search query 1 (SQ1).* We started by searching all dimensions and main concepts by pairs, based on the initial conceptualization articles of SOP (Jorgensen & Stedman, 2001) and SC (Perkins & Long, 2002), in the title in two academic databases (Science Direct and ISI Web of knowledge), which resulted in 296 publications. Subsequently, the

TABLE 1 Definitions of the dimensions for social capital and sense of place

Dimensions (SC/SOP) Ons	**Definition**
Sense of community (SOC)	is the feeling of membership or belongingness to a group, containing possible emotional connection on a shared history, common interests, or concerns (Perkins & Long, 2002).
Collective efficacy/Empowerment (CE/E)	"*or trust in the effectiveness of organized community action, is closest to the concept of empowerment among all the social capital dimensions and their predictors.*" (Perkins & Long, 2002, p. 295)
Neighboring (N)	*"Neighboring is the help we informally provide, and receive from, neighbors."* (Mihaylov & Perkins, 2013, p. 69), or the ordinary social interactions with neighbors (Perkins et al., 2002).
Citizen Participation (CP)	*"Individual and community participation in grassroots voluntary associations (e.g., civic and faith-based organizations, local environmental groups) and other mediating structures is determined by both residents' capacity to respond to environmental hazards individually and collectively and local institutions' capacity for responding to those affected and involving them in making decisions."* (Mihaylov & Perkins, 2013, p. 69)
Place Attachment (PA)	*"place attachment means emotional bonds which people develop with various places"* (Lewicka, 2011b, p. 219).
Place Dependence (PD)	refers to the useful value (services, aesthetic) that a place has in comparison to other places to satisfy an individual's specific goals and desired activities (Stedman, 2002).
Place Identity (PI)	*"physical world socialization of the self"* (Proshansky, Fabian, & Kaminoff, 1983, p. 57) such as *"this place is part of my identity [. . .] this place is part of how I want to others to think of me"* (Trentelman, 2009, p. 200)

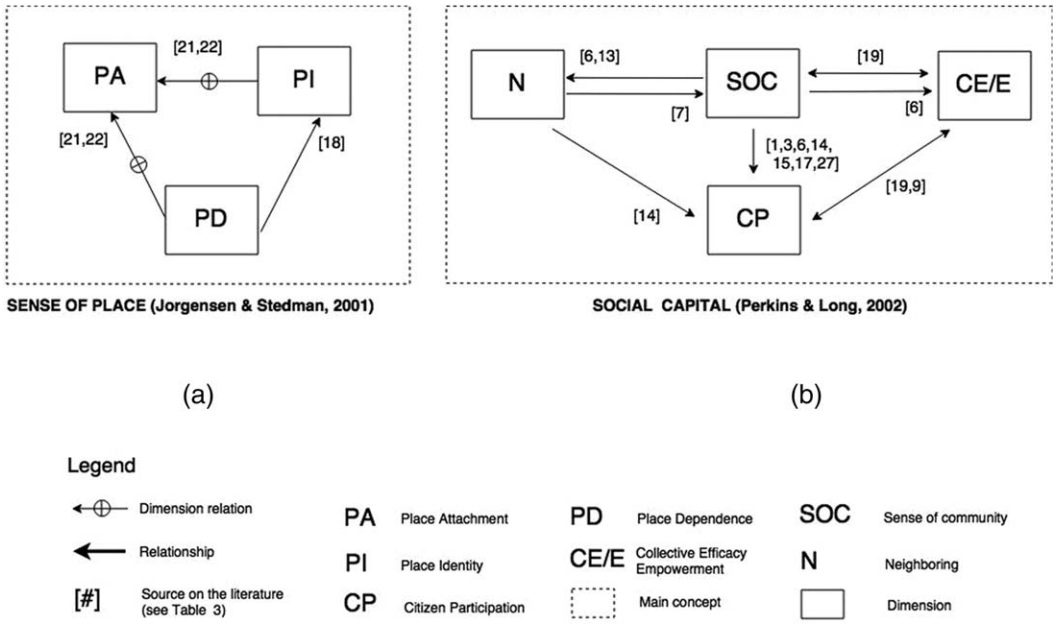


FIGURE 2 Relational schema of the dimensions for each concept: sense of place and social capital. Each relation (arrow) is supported by the literature, the respective references indicated by numbers are listed in Appendix B

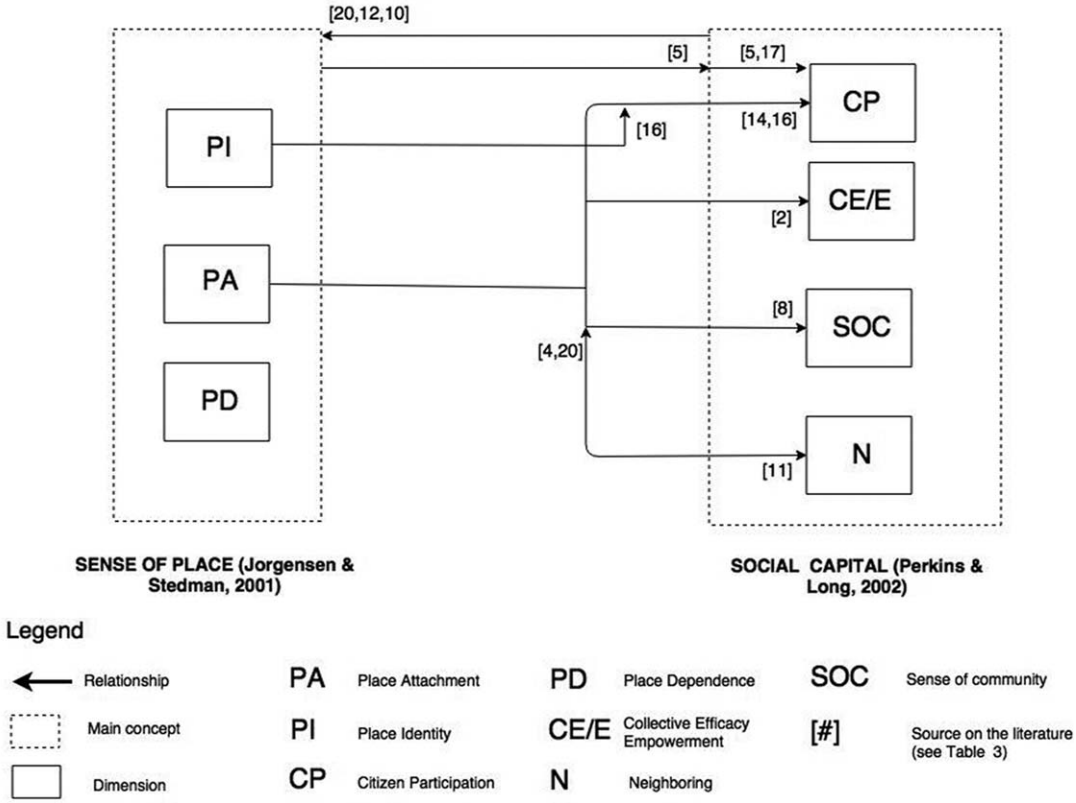


FIGURE 3 Schema showing the relationships between sense of place and social capital dimensions. Each relationship (arrow) is supported by the literature, the respective references indicated by numbers and listed in Appendix B

results from the two databases were merged, and duplicate studies were removed. This left us with 234 publications. Then, we manually went through the titles of the remaining studies, removing those articles not relevant to our goal. This reduced the number of potential studies to 108. The next step was to scan the abstracts manually for relevance, which reduced the number of studies to 47. Finally, we went through the full-text of the studies, applying our rule (a), which was: we only considered an article if it explicitly connected or related one dimension (PA,PD, PI,SOC,N,CE/E,CP) or main concept (SOP,SC) to another. This resulted in eight studies.

2. *Search query 2 (SQ2)*. We performed a procedure identical to the previous one. SQ2 searches for all matches between dimensions and main concepts AND the following words: "mapping", "spatial dimension" and "spatializing" in the same academic databases. We obtained 54 none-duplicate results (from 68 articles). Then we manually proceeded through the titles, reducing the amount to seven articles, before manually scanning the abstracts, obtaining four articles. Finally, we revised the full-text of the remaining studies, applying the rule (a), resulting in one study.

Afterward, we performed an expansion step checking if any reference in the nine obtained studies follows rule (a). Duplicates were eliminated. We obtained eight articles that fulfill rule (a), hence they were included in the final set. Concretely, from *SQ1*, Talò et al. (2014) is a meta-analytic review that offered five suitable articles, and the article from Lewicka (2005) cited research conducted by Mesch and Manor (1998) which also adheres to rule (a). Finally, from the considered study resulting from SQ2 (Brown, Raymond, & Corcoran, 2015) we also consider two articles referenced in it. The final set of 18 articles, including the SC conceptualization from Perkins and Long (2002) described in Appendix B, complies with rule (a). Jorgensen and Stedman (2001) is not included as it does not comply with rule (a).

Figures 2a and b show the relational dimensions for each main concept (SOP and SC) that summarize and generalize the connections between the dimensions for SOP and SC. It is clear that PA (Figure 2a) and SOC (Figure 2b) are the most significant and related dimensions for SOP and SC, respectively. CP is the main response dimension of SC while there is no relationship between N and E, in accordance with Perkins and Long (2002). CP is in all of the cases a responsive dimension, except with collective efficacy/empowerment (CE/E) that is, simultaneously, a cause and an effect (Figure 2b). SOC stands out as being the central dimension of SC as it can affect the other dimensions. Indeed, the connection between SOC and CP is the relationship most often cited in the related literature (see Figure 2b), highlighting the important role of SOC in participatory processes (for more information please see (Talò et al., 2014)). On the other hand, Figure 3 depicts the connections found between the dimensions of SC and SOP.

Figure 3 summarizes the relationship between SOP and SC as extracted from the literature review. We highlight that not all authors notice the relationships between the concepts of this research. The analysis of Figure 3 shows the relationships between the main concepts of this research based on the aforementioned citations and depicts literature-based evidence that SOP and SC are strongly related. Overall, the PA dimension of SOP is the dimension most related with all the dimensions of SC. Furthermore, almost all the dimensions of SOP (PA and PI) are also pointing to CP and CE/E. Therefore, based on the literature reviewed, in the non-spatial perspective both concepts (SOP and SC) show a strong connection between them and their dimensions.

Our conceptualization of SOP and SC based on Jorgensen and Stedman (2001) and Perkins, Hughey, & Speer (2002), respectively, and founded on attitude theory (Fishbein & Ajzen, 1975; Figure 1), creates a suitable environment to relate the concepts in both the theoretical and geographical domain. While the theoretical relationships between the SC and SOP dimensions are well documented and studied, the spatial relationship – or even just spatialization – of each concept remains unclear. Few attempts to explicitly gather theoretical knowledge of the spatialization of SOP and SC have been undertaken. That is, to transfer the non-spatial knowledge on SOP and SC to the geographical domain. We argue for the importance of understanding and knowing where these areas are at the city level for creating an alternative to administrative boundaries, for instance, in participatory processes. Simultaneously, these new areas are the arena for the first step to achieve a citizen-based social environment in the urban context.

3 | REASONING FOR A SPATIAL APPROACH

In the non-spatial perspective (Figure 1), both concepts (SOP and SC) have a strong connection between them and their dimensions (Figures 2a-b and 3). However, to the best of our knowledge, this is the first study attempting to analyse SOP and SC's spatial relationship considering them as independent spatial dimensions at the individual level. There are distinct approaches to measure SOP. Map-based methodologies for measuring landscape values and SOP for scales larger than a neighborhood have been developed by Brown and his colleagues (Brown & Raymond, 2007; Brown et al., 2015; Raymond & Brown, 2007; Raymond, Brown, & Weber, 2010). Furthermore, there have been some attempts to draw cognitive and affective (Brown et al., 2015; Syme, Nancarrow, & Jorgensen, 2002) maps. Recently, Jenkins, Croitoru, Crooks, and Stefanidis. (2016) merged twitter data using social networks analysis (SNA) and volunteered geographic information (VGI) from Wikipedia to spatialize a collective SOP, being the first research merging SNA and VGI to define SOP. On the other hand, the spatial measurement of SC is related to the spatial delimitation of geographical based social networks from a structuralist perspective (Rutten et al., 2010). There are distinct approaches to measure the spatial dimension of SC. The SC spatial dimension can be embedded in the cognitive neighborhood (Foster et al., 2015) or extracted from SNA (Andris, 2016; Valenzuela, Park, & Kee, 2009) from a structuralist point of view. There are some methodologies that are potentially common for both concepts. The empirical model "attitude-based evaluative mapping" (Jorgensen, 2010), attempts to spatialize SC through SOP (Jorgensen & Stedman, 2011). Brown et al. (2015) performed the first research on mapping PA through an Internet-based Public Participatory Geographic Information System (PPGIS) application. This study can be extended to SOP and SC. Brown and his colleagues measure the spatial dimension of PA based on the idea of home range in ecology (Powell & Mitchell, 2012). While there are some attempts to directly map SOP or PA through spatial methods, the spatial measurement of SC was always performed using its dimensions or using a moderator. On the other hand, we propose to explicitly and directly spatialize social capital (structuralist perspective) using GISc techniques and conceptualizations. Currently, the surge of ICT is allowing new ways for interactions to gather both SOP and SC spatial dimensions, encouraging researchers to develop new spatial techniques and tools based on web and mobile environments. We are currently witnessing an increase of interest in the categorization of social relationships, people's perceptions and feelings toward places. The combination of ICT with a GISc framework and analytical tools are enabling new possibilities to gather psychological and social concepts from a geographical perspective. However, one of our contemporary hurdles, in this issue, resides in the few and limited tools and guidelines to explicitly spatialize our affective/cognitive/behavior attitudes toward both a place (SOP) and our geographical based social networks (SC). Moreover, the GISc-based online tools and techniques to spatialize social concepts are at a very early stage of development.

SOP is suitable to be measured as a spatial concept since its affective bonds, cognitive perceptions and behaviors are toward an area (Altman & Low, 1992; Stedman, 2003). Likewise, SC inherits the spatial dimension of social relationships between humans (Rutten et al., 2010). However, their explicit spatial relationship is still unknown. Due to the nature of the concepts, their possible spatial relationships should follow the research of Egenhofer et al. (1994), who defined eight topological relationships between two regions with connected boundaries. Figure 4 applies these relationships to the concepts of SOP and SC.

3.1 | Building the foundations for the spatial relationship of sense of place and social capital

Citizens are spatially sticky (Westlund et al., 2010) and they create ties and social networks in which they carry out their daily tasks (Lewicka, 2011b) in the city context. The relationship with the place where one develops one's activities and the interaction with one's social networks draws important interest to the comprehension of the daily citizenship context. This article relies on the social aspect of the urban context and presents a novel perspective for a more citizen-centric social view on a city assuming that:

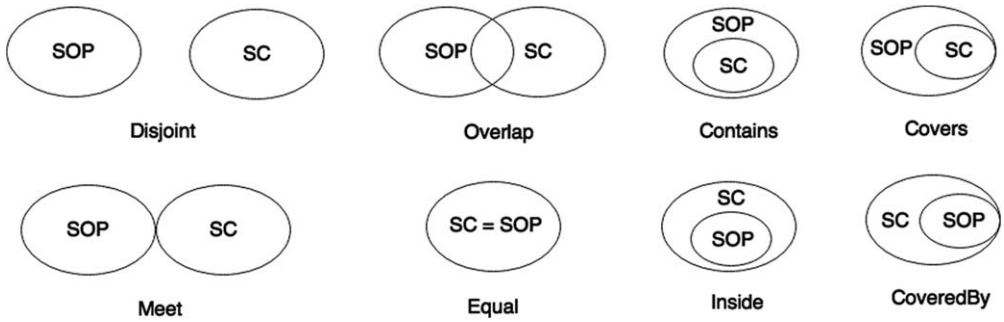


FIGURE 4 The eight topological relationships between two regions with connected boundaries, adapted from Egenhofer et al. (1994). This figure encompasses either a non-existing relationship (disjoint) or an existing spatial relationship (meet, overlap, equal, contains, inside, covers, and covered by) between the two concepts (SOP and SC)

- For each citizen, at least one meaningful place with emotional connections exists (Scannell & Gifford, 2016) in a given city; and
- For each citizen, there is at least one geographically based social network he/she belongs to in a given city. A citizen is intrinsically a social creature (Toole, de Montjoye, González, & Pentland, 2015) with associated social networks (Rutten et al., 2010).

In the geographical domain, let X be the surface of a given city and C the set formed by its citizen s c_i. Furthermore, we define geographical sense of place ($GSOP_i$) and geographical social capital (GSC_i) as the spatial dimension of SOP and SC for a citizen c_i, respectively. Then, we claim that for each citizen there exists a set of individual SOP and SC areas being both subsets of the city surface:

$$\forall\ c_i :\ \exists\ GSOP_i \subseteq\ X \wedge \exists\ GSC_i \subseteq\ X \tag{1}$$

where

$$GSOP_i = \bigcup_{j=1}^{N} GSOP_{ij} \tag{2}$$

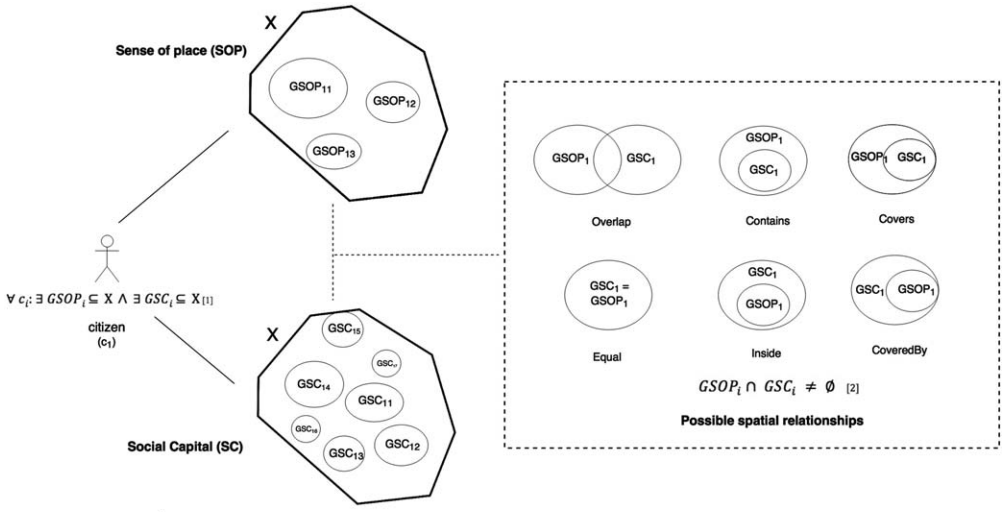
$$GSC_i = \bigcup_{k=1}^{M} GSC_{ik} \tag{3}$$

and c_i is a citizen;
i is an integer number between 1 and n, and n the total number of citizens of a given city;
N and M are positive integers, representing the total number of SOP and SC areas, respectively, for a citizen c_i;
$GSOP_i$ is the union of all individual Geographical Sense of Place(s) $(GSOP_{ij})$ for a citizen c_i;
GSC_i is the union of all individual Geographical Social Capital(s) (GSC_{ik}) for a citizen c_i; and finally,
X is the surface of a given city.

We are seeking to define the spatial dimensions of meaningful places (SOP) and social networks spatially situated (SC) for citizens through an approach that will allow the addition of a spatial dimension to SOP and SC. Place maintains its importance in a globalized world and people typically identify their attachment with a physical space (Lewicka, 2011b). The manner in which individuals perceive themselves depends on how they make use of their daily places (Gotham & Brumley, 2002), influencing, simultaneously, their social relationships. Social networks within a place can be an important source of place meanings, and vice-versa (Jorgensen, 2010). Hence, SOP can be understood as a concept related to SC, in which place is a catalyst for both. Therefore, we claim that, for each citizen c_i, there is a spatial relation between the spatial dimension of SOP and SC at the city level:

$$GSOP_i \cap\ GSC_i\ \neq\ \varnothing \tag{4}$$

There are areas that encompass citizens' meaningful places and geographically based social networks (Statement 4) where some authors argue that our communities dwell (Baerenholdt & Aarsaether, 2002; Foster et al., 2015). There are areas that can facilitate SOP and SC, or in other words, areas defined by meaningful places and fruitful relationships



where:

c_i is a citizen

i is an integer number between 1 and n, and n the total number of citizens of a given city

$GSOP_i$ is the union of individual Geographical Sense of Place $(GSOP_{ij})$ for a citizen c_i

$IGSC_i$ is the union of individual Geographical Social Capital $(iGSC_{ik})$ for a citizen c_i

X is the surface of a given city

FIGURE 5 Overview of article schema. The example shows possible $GSOP_{ij}$ and GSC_{ik} areas in a given city X and the right part represents all the possible spatial relationships based on Statement 4

at the individual level, and a potential environment of cooperation, participation, empowerment and collaboration at the community level.

3.2 | Exploring the foundations

We study the spatial relationship between SOP and SC concepts based on statements in the literature to attempt an independent spatialization of SOP and SC for each citizen. Then we claim the existence of a spatial relationship between them (Statement 4). All the SOP and SC zones from a citizen create two sets of areas; Geographical SOP (GSOP) and Geographical SC (GSC). Both sets define respectively the meaningful areas and fruitful geographical social networks for a citizen in a given city (see Figure 5).

To support the Statements 1 and 2 of this article, some current GISc methods can be applied. The main methodological restriction of this article is to gather SOP and SC measurements and spatial dimensions from the same citizen. The use of a map-based survey assures that both essential sources of data are answered by the same citizen. Through an Internet map-based technique (Brown et al., 2015) based on Public Participation Geographic Information Systems (PPGIS) (Sieber, 2006), or a geo-questionnaire (Jankowski, Czepkiewicz, Młodkowski, & Zwoliński, 2016) it is possible to obtain: (1) the measurement of SOP and SC dimensions, providing a multicomponent analysis of the different dimensions and, simultaneously, proving the multidimensional nature of primary concepts (SOP and SC); and (2) to gather the spatial dimension about SOP and SC directly. Here, our approach intersects with "attitude-based evaluative mapping" methodology (Jorgensen & Stedman, 2011), defining beforehand SOP and SC geographic areas to measure their dimensions within. Due to the nature of the data collected, this article is aligned with the SoftGIS methodology (Rantanen & Kahila, 2009), as we assemble environmental psychology data, local experiences and everyday behavior (Kahila & Kyttä, 2009). In consequence, information obtained via GISc tools can be used to determine new geospatial

citizen-defined areas based on the spatial relationship between SOP and SC, providing an ideal environment to achieve familiar and recognizable areas that elucidate important social phenomena.

4 | DISCUSSION

This research attempts a conceptualization and first formalization of the spatial relationship between SOP and SC, embedded in the urban context. This opens the door to better understanding the city's social realm through the spatialization of individual SOP and SC. In the literature, the former has been extensively studied and related with engagement and CP as well as environmental protection actions, while the latter mainly became popular because it is operationalized as a solution for social problems, being the "glue" that holds us together (Johnson, 2016). However, despite this extensive and enriching research, we currently do not fully realize the potential of being aware of SOP and SC associations because, to some extent, the places that embed these individuals' SOP and SC perspectives are unknown. The few attempts to spatialize both (SOP and SC) highlight the long way to go and the possibilities for new studies. Researchers have tended to focus on measuring and conceptualizing SOP and place attachment, rather than to spatialize it (Lewicka, 2011b). Moreover, the spatial dimension of SC has received little attention in the literature so far. Recently researchers have identified the importance of the SC spatial dimension that Putman (2000) foresaw. In psychological and social disciplines, researchers have studied quite extensively how and how much interaction regarding SOP and SC occurs, but relatively little about where these interactions are occurring. Therefore, despite the growing interest in SC and SOP conceptualization and correlation with other concepts, few attempts to explicitly spatialize this theoretical knowledge have been undertaken, that is, to transfer the non-spatial knowledge on SOP and SC to the geographical domain. Even more, to the best of our knowledge, no research so far has attempted to merge or relate the spatial dimensions of individual SOP and SC. Although some authors point out the spatial relationship between the concepts (Jorgensen, 2010), a previous independent spatialization to relate the two concepts has not been attempted, nor a study of their spatial connections and similarities. The omission of this important spatial information reduces our understanding of different important social synergies in the city. This spatial perspective to social concepts might be the pivotal aspect to embed them into the urban context.

Furthermore, current research and tools overvalue the importance of administrative boundaries (e.g., neighborhoods, parishes) to encompass SOP and SC. Most researchers use these spatial administrative containers to measure SOP and SC. However, we can wonder if the whole administrative boundary covers the SOP and SC of all its dwellers or, conversely, if citizens' SOP and SC are enclosed in dynamic, fuzzy areas at a given space and time. This article advocates omitting the mention of political-administrative areas for the measuring of SC and SOP individual spatial dimension, since, to some extent, this can bias the expected outcomes. We argue throughout the article for the better understanding of the spatial relationship between SOP and SC. It seems reasonable to assume a central role of place in both SOP and social networks territorial-based SC and, a high correlation when they share the same geographic domain.

By examining how GISc can offer a unique perspective for a better understanding of SOP and SC spatial relations, we are signifying, simultaneously, the suitability of GISc tools to study the spatial components of social science (e.g., SC) and environmental psychology (e.g., SOP) concepts. However, researchers are waiting for proper mechanisms to carry out spatial measurements of these processes. Moreover, many authors directly relate the SOP and SC with surrounding areas to "home" (Foster et al., 2015; Perkins & Long, 2002). Yet in a globalized world and a society in constant movement, it seems too restrictive to encompass citizen SOP and SC in only those areas. The knowledge and management of areas that contain our SOP and SC create a milestone providing: (1) fruitful social spatial data for a better citizen-centric social view on the city; (2) rendering space as a subjective place that covers the people's feelings toward places and relationships; (3) setting up a new precious ground to tackle city social issues; and (4) creating a suitable environment for better cooperation and collaborative synergies between people who share more than just a space. Regarding the last point, this research can be understood as the starting point to achieve a community of place,

considering our commonalities regarding relationships and place perceptions as assets to achieve a sense of community.

This research argues for the importance of recognizing the spatialization of SOP and SC in the urban context. We identify the spatial dimension of SC explicitly, that is, to spatialize where individuals forge meaningful social bonds. Likewise, we contend its relationship with other spatial dimensions (SOP) and how their operationalization can create a suitable environment of citizen-based areas in the city. Furthermore, acknowledging this spatial relationship can lead to the discovery of new approaches to deal with current lines of study about hierarchy and levels of SC (Westlund et al., 2010) and different types and predictors of SOP (Lewicka, 2011a). In this line, there is a long way to go to identify and characterize the relations between individuals and their social networks, i.e. in weak and strong ties, that is, bridging and bonding SC, respectively. It is interesting to learn where the strongest and weakest social places are for citizens at the city level, and foresee emerging social hotspots at the community level. As was mentioned, this is the first step to achieve those common areas of engagement based on the appropriation and understanding of our meaningful surrounding, thereby increasing the awareness of our commonalities with our fellow citizens. Hence, we can wonder how to take advantage of those new areas for a common benefit, and how the performance of participatory processes in those new areas of social interaction will be.

Transferring these areas of interaction (SC) and environmental perception (SOP) to the urban domain, we are setting up new meaningful areas of contact between all the stakeholders in the city and, simultaneously, creating a comprehensible social layer that the city, nowadays, lacks. Indeed, we are currently not able to recognize our common spatial footprint in the social (SC) and psychological (SOP) domains, and thus, the spatial social layer that exists and where citizens are the central pillar is omitted. There is a lack of free spatialization methods and tools for psychological and social concepts that are deemed to be relevant for citizens' daily tasks and interactions, such as participation in decision-making processes. Consequently, we use administrative boundaries instead of more functional ones for city issues, disregarding natural social processes and mechanisms that might not be contained in the former ones. In this sense, this article highlights the role of GISc and its related tools in taking another step forward to satisfy this pervasive demand for citizen social information. Therefore, the joint study of SOP and SC can contribute a better understanding of social synergies in the urban context and their spatialization can transfer their information to other areas of knowledge. This article contributes through GISc and its related tools to satisfy the pervasive demand of citizen social information at the city level, postulating the first formalization of the spatial relationship between SOP and SC at the individual level.

5 | ROADMAP FOR FUTURE RESEARCH

This is the first article in a line of research that aims to describe, conceptualize, formalize and study the spatial dimension of social concepts (SOP and SC) in a city (Figure 6). This first work explores the field through a comprehensive systematic literature review, and subsequently focuses on the first theoretical cornerstone of our research: spatializing and formalizing SOP (Jorgensen & Stedman, 2001) and SC (Perkins & Long, 2002) at an individual level, and the spatial relations between them. The next step in our research agenda is to better understand the spatial relations between social concepts, by studying how bonding and bridging social capital (Putnam, 2000) and civic engagement fits in our proposed spatial framework (Statements 1 and 4). Once a spatial theoretical framework for SOP and SC at the individual level is established, researchers will dispose of a robust theoretical framework ready to build other socially-oriented conceptualizations or applications on top of it. Furthermore, and as a second future research avenue, the framework serves as a basis to explore community level interactions as well as to identify communities of place. Through the definition of suitable experiments, and real-world gathered citizens' data, the theoretical framework can be used to spatially explain or predict social behavior in cities, and be employed to better understand and guide social processes, such as citizen participation, planning processes or citizen engagement. We also expect that our theoretical foundations for the spatialization of social concepts in

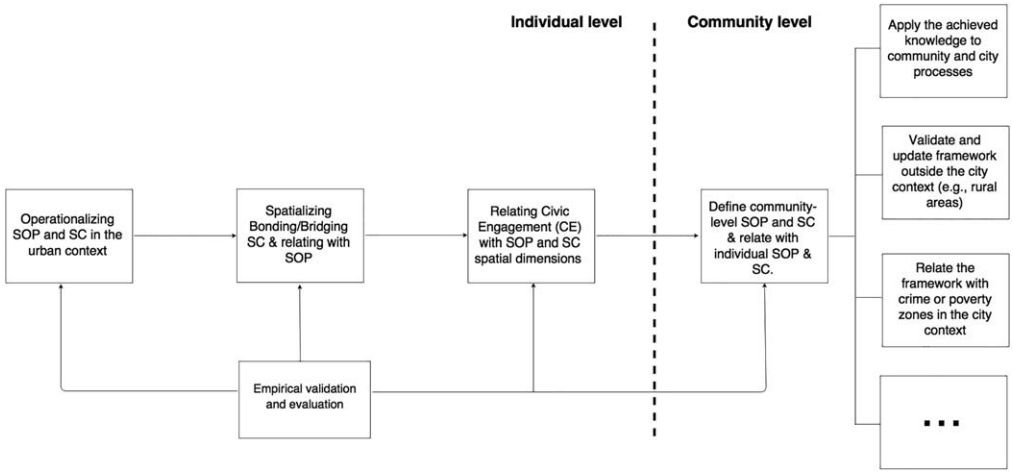


FIGURE 6 The schema for future research. Each box symbolizes a step in our research. The first box on the left is the current article, followed by the intended steps for our future line of research

cities, both at individual and community level, will promote their understanding, and may spark various other research avenues, e.g., in relation to crime, poverty, social inclusion/exclusion, etc.

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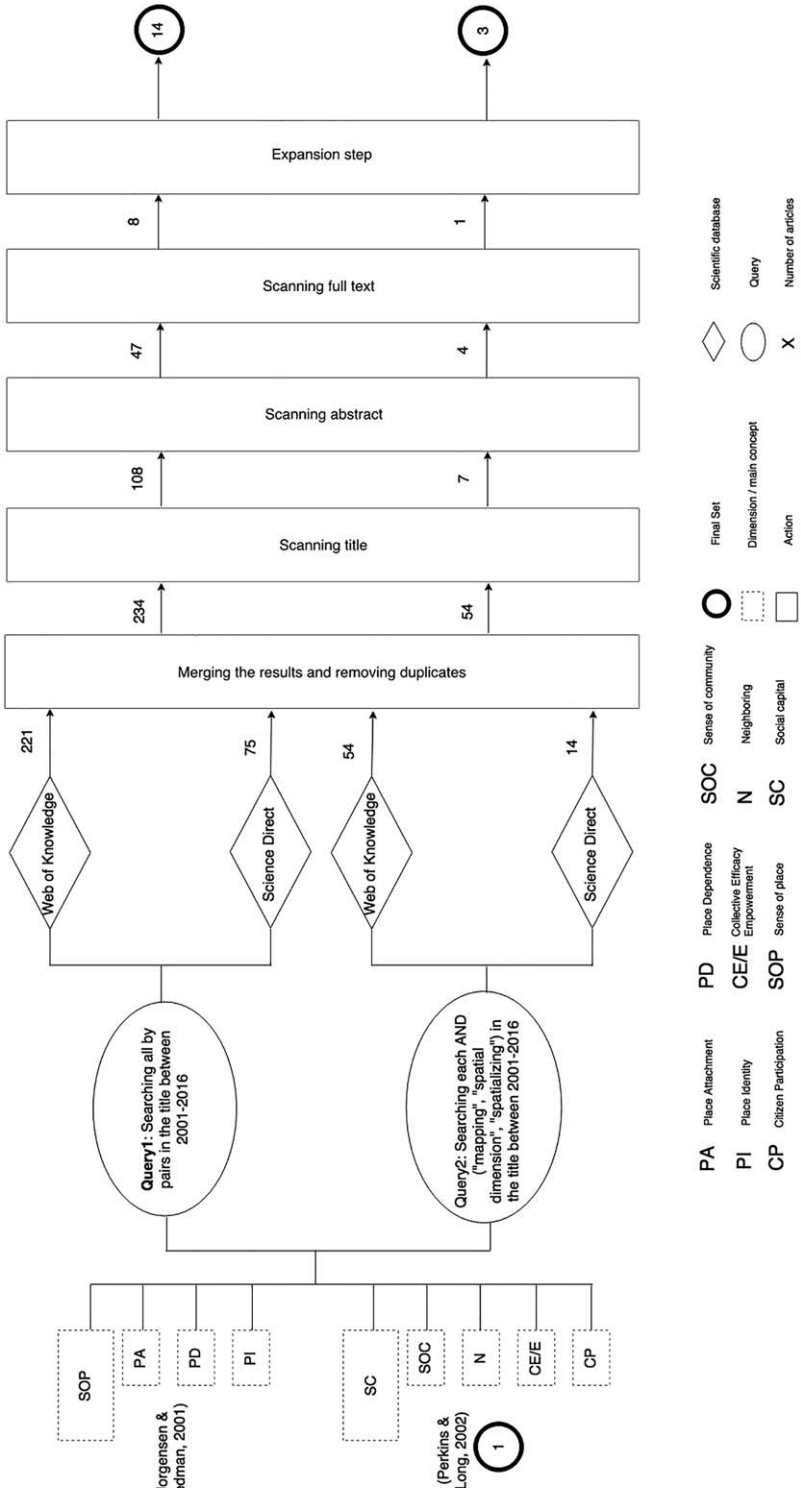
APPENDIX A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Query2: Searching each AND ("mapping", "spatial dimension", "spatializing") in the title between 2001-2016
Web of Knowledge
Science Direct
Web of Knowledge
Science Direct
221
75
54
14
Merging the results and removing duplicates
234
54
Scanning title
108
7
Scanning abstract
47
4
Scanning full text
8
1
Expansion step
14
3
SOP
PA
PD
PI
SC
SOC
N
CE/E
CP
(Jorgensen & Stedman, 2001)
(Perkins & Long, 2002)
1
PA Place Attachment
PI Place Identity
CP Citizen Participation
PD Place Dependence
CE/E Collective Efficacy Empowerment
SOP Sense of place
SOC Sense of community
N Neighboring
SC Social capital
Final Set
Dimension / main concept
Action
Scientific database
Query
Number of articles
X

APPENDIX B Relationship between numbers in Figures 2a-b and 3 and authors

Number in Figures 2a-b and 3	Citation	Author
1	*"The results showed that the SoC-participation relationship is significant, positive and moderately strong for forms of participation in the adult population and specific cultural" contexts."*	(Talò et al., 2014, p. 1)
2	*"the literature suggests that processes of collective action work better when emotional ties to places and their inhabitants are cultivated."*	(Manzo & Perkins, 2006, p. 347)
3	*"The findings through survey questionnaire showed that there are significant relation between sense of community and level of participation for local tourism development."*	(Aref, 2011, p. 20)
4	*"Finally, it is important to notice that despite the already existent plethora of studies on place attachment and its correlates or predictors,[. . .]. Scale of place, type or size of housing, length of residence or even strength of neighborhood relations are predictors [. . .]."*	(Lewicka, 2010, p. 49)
5	*"a commitment to places [. . .] motivates civic participation [. . .] and social capital"*	(Jorgensen, 2010, p. 565)
6	*"Sense of Community emerged as the strongest and most consistent predictor (at both levels) of the other dimensions of Social Capital [. . .] having higher individual sense of community [. . .] was related to more collective efficacy, more neighboring, and more participation in block organizations."*	(Perkins & Long, 2002, p. 308)
7	*"The strongest predictor of sense of community is neighborhood relations, although years of residence, being married, group participation, and area of residence are also significant factors."*	(Prezza, Amici, Roberti, & Tedeschi, 2001, p. 29)
8	*"We suggest that attachment (emotional and behavioral commitment) is related to having a sense of community (cognitions of affiliation and belonging within the community)."*	(Pretty, Chipuer, & Bramston, 2003, p. 276)
9	*"At the individual level, empowerment predicts participation, thus creating a mutually reinforcing change process."*	(Perkins et al., 2002, p. 39)
10	*"To the extent that trusted social relationships, and the shared norms that regulate these relationships, underpin valued place meanings, attachments and behavioural commitments to a place, they can contribute to a sense of place, and one might well expect members of the same social network to share conceptions of place"*	(Jorgensen, 2010, p. 564)
11	*"It is otherwise known that place attachment and neighborhood ties show consistent positive links."*	(Lewicka, 2005, p. 384)
12	*"It seems reasonable to assume that the development of social networks and social capital are important sources of place meanings."*	(Jorgensen, 2010, p. 565)
13	*"that people with SOC (sense of community) are more likely to help their neighbors".*	(Perkins & Long, 2002, p. 312)
14	*"This review suggests that feeling a sense of community, attachment to community and neighbouring relationships can increase the feeling of [. . .] civic participation [. . .]"*	(Mahmoudi Farahani, 2016, p. 1)
15	*"Sense of Community is positively correlated with social participation in all three samples"*	(Cicognani et al., 2008, p. 97)

(Continues)

APPENDIX B (Continued)

Number in Figures 2a-b and 3	Citation	Author
16	*"Consequently, place attachment, place identity, and sense of community can provide a greater understanding [. . .] or improve their community and participate in local planning processes."*	(Manzo & Perkins, 2006, p. 347)
17	*"Social capital and sense of community are very important in predicting elderly participation in community improvement activities. . ."*	(Liu & Besser, 2003, p. 343)
18	*"Analysis reveals that place identity can best be predicted by [. . .] and their level of place dependence."*	(Moore & Graefe, 1994)
19	*"At the individual level, psychological empowerment was most strongly related to individuals' participation levels, sense of community, and perceptions of a positive organizational climate."*	(McMillan, Florin, Stevenson, Kerman, & Mitchell, 1995, p. 699)
20	*"The higher the number of close friends and neighbors that are known and live nearby, the higher the attachment to the neighborhood"*	(Mesch & Manor, 1998, p. 504)
21	*"the two dimensions of place attachment, dependence and place identity"*	(Williams & Vaske, 2003, p. 838)
22	*"Our spatial measure of place attachment included a symbolic component of place identity and a functional component of place dependence."*	(Brown et al., 2015, p. 43)