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Spatial navigation and place imageability in sense of place☆

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A B S T R A C T

This study aimed to increase understanding of sense of place by investigating how spatial navigation and place imageability may associate with it in urban neighborhoods. Questionnaires, protocol analysis, and cognitive sketch maps were used to examine these connections. Participants used more egocentric and allocentric strategies during cognitive map navigation when sense of place was stronger. Cognitive sketch maps revealed that experiencing a strong level of sense of place is associated with recalling more of its physical features, especially paths and landmarks. When sense of place is strong, individuals find it simpler to recall and select memorable places in their cognitive maps and to describe them verbally to others. Social scientists and urban planners may benefit from these results when they respond to human spatial needs while attempting to facilitate residents' sense of attachment to, identity toward, and compatibility with city spaces.

1. Introduction

In parallel to social science research, urban planners are capturing local knowledge and place meanings (Kruger & Hall, 2008). A multidisciplinary body of research has defined sense of place (SOP) as a composition of beliefs, emotions, and behavioral commitments that manifest as a feeling of specialness for a physical setting (Jorgensen & Stedman, 2006). However, more can be learned about SOP, including how physical attributes affect its formation and the ways in which city dwellers experience it. With more people residing in cities worldwide, questions about which attributes in an urban fabric offer people a positive, healthful, and stimulating experience – a 'sense of place' – are timely and prudent.

Humans perceive places not only as spatial locations (Creswell, 2004), but as social zones where meaningful representations of, and emotional connections to, people and settings can be formed (Kearns & Gesler, 1998; Wilson, 2003). Spatial behavior, such as navigation, is more effective in urban environments when particular physical attributes have meaning for the navigator (Ramadier & Moser, 1998). As Kevin Lynch noted in *The Image of the City* (1960), environmental quality can be partially determined by imageability. When a place can be easily mapped in one's mind, one relates to, and uses, that place in positive ways (Ford, 1999). This provides a rationale to deepen understanding of the role of the physical environment in the SOP experience.

Knowing more about the diversity in which individuals perceive SOP in urban places is also theoretically important and practical for decision-making and public policy related to urban planning (Eisenhauer, Krannich, & Blahna, 2000). By considering the construct of SOP from the viewpoints of several disciplines, a better understanding of neighborhood dynamics may emerge. Given the interdisciplinary nature of the present study, it may do as Manzo and Perkins (2006) suggest by offering "a richer understanding—not only of how planning impacts our experience of place, but also how emotions, cognitions, and behaviors can impact community planning and development" (p. 336). For example, planners who learn that residents of a neighborhood with an abundance of imageable built features feel strong levels of SOP may better understand the risks of minimizing particular attributes of that neighborhood. Similarly, urban land and infrastructure management may affect the material landscape that serves as the basis for peoples' place meanings (Stedman, 2003).

More interdisciplinary SOP research may also assist planners and environmental psychologists alike to predict who will become involved in neighborhood change initiatives and why (and why others might resist these efforts) (Manzo & Perkins, 2006; Nanzer, 2004). Residents' willingness to address local problems have been shown to be affected by their emotional connection to local places (Manzo & Perkins, 2006) and these bonds are essential to the wellbeing of neighborhoods because they motivate residents to participate, improve, and protect their communities (Brown, Perkins, & Brown, 2003). Indeed, policies that run counter to residents' attitudes are less likely to gather public support and, in turn, fail in its objectives (Nanzer, 2004).

Arguably, strategies appealing to residents' levels of SOP can be employed by planners to develop or augment particular public attitudes

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or behaviors (Nanzer, 2004). But although numerous environmental psychological studies have offered attitudinal and behavioral insight for planners, decision-makers, and legislators to apply, many others have failed to make place-based psychological links to urban planning (Manzo & Perkins, 2006). Therefore, one aim of the present study is to explore, using protocol analysis methodology, whether a statistical association exists between spatial navigational (SN) strategies and SOP by integrating knowledge about how humans perceive environments with respect to meaning and spatial cognition. Another aim is to further connect the disciplines of environmental psychology and urban planning by examining how the elements of Lynch's (1960) place imageability (PI) framework are related to the experience of SOP using a cognitive mapping technique. Depending on which imageable features associate well with SOP, the proposed conceptual framework may allow planners to conceptualize spaces and places that support how people use egocentric and allocentric strategies. Doing so may better afford the development and experience of SOP in urban settings. The design of this study may also serve as a guide for those doing exploratory research concerning SOP and imageability by working with both quantitative and qualitative data as they consider human psychology and social science methodologies. Indeed, the discipline of urban planning is moving toward participatory decision-making processes; methods, along with the theories, used in the field of environmental psychology may help planners understand and accommodate the needs and preferences of individuals, as well as different groups of people (Churchman, 2002). Because of its mixed-methods approach merging quantitative and qualitative data in its analyses, this study may offer further evidence of the validity of measuring SOP in an urban context.

1.1. The concept of sense of place

SOP is a multidimensional attitude that describes an emotional connection to a physical environment but it also includes values, symbols, and cultural meanings ascribed to the place (Jorgensen & Stedman, 2001, 2006, 2011; Relph, 2008; Shamai, 1991; Stedman, 2003; Tuan, 1980). Developing SOP is an internal, personal experience. First, something about the place is understood to be important via one's association with it, followed by the interpretation of this experience as meaningful when, finally, a 'sense of place' is felt (Stokowski, 2008).

Jorgensen and Stedman (2001, 2006) advanced a three-dimensional model of SOP that treats places as attitude objects, differentiating between their cognitive, affective, and conative aspects: place attachment, place identity, and place dependence. Although these three dimensions appear to describe the complex psychological construct, Jorgensen and Stedman (2006) include only one aspect of the physical environment (i.e., level of property development) in their model. Acknowledging this, they state that adding more physical predictors to the model may "account for variation in … the specific environmental features that individuals and groups identify with, are attached to, and hold a behavioral preference for" (p. 326).

Although navigational strategies and meaningful physical attributes may inform SOP (Williams & Stewart, 1998), potential spatial and physical components of SOP have not been fully explored (Cuba & Hummon, 1993; Jorgensen & Stedman, 2006; Stedman, 2003; Syme, Nancarrow, & Jorgensen, 2002). Urban settings contain stimulating areas for human movement that can engage the spatial perceptions of users (Hopsch, Cesario, & McCann, 2014) and research has begun to connect self-reported place-bonding with landscape attributes using survey and map-based methodologies (e.g., Brown, 2005). For example, quantitative and qualitative spatial mapping approaches have been used to investigate which landscape elements best predict place identity and place dependence (e.g., Brown & Raymond, 2007; Lowry & Morse, 2013). Indeed, Jorgensen and Stedman (2011) have recently proposed an attitude-based evaluative mapping technique to research SOP in regions of personal importance. While these studies support augmenting a conceptual model of SOP to include physical factors, none examine the variables of SN and PI specifically.

1.2. Sense of place and spatial cognition

The human brain is capable of using spatial information to encode and interpret emotional reactions to meaningful places – places toward which persons have formed a SOP. Because particular aspects of a physical environment (e.g., landmarks) seem to influence one's construction of cognitive maps, studying the experience of SOP, as it relates to spatial cognition, is practical.

The three dimensions of SOP proposed by Jorgensen and Stedman (2001, 2006) are fundamentally based on how a setting relates to one's self and one's body in a physical location. When individuals move between settings, they interact with the natural and architectural features of each place, along with the people and nearby social contexts. This interface involves the flow of information from physical places to the cognitive representational apparatus in the brain (Gifford, 2014). The resulting sensory engagement can allow people to bond with places and deepen their sense of orientation (Hopsch et al., 2014).

A meta-analysis by Lengen and Kistemann (2012) found that studies of SOP published during the 40 years before their work revealed associations with place memory, perception, orientation, attention, emotion, and behavior at the neuronal, structural, and regional levels of the brain, as well as at the neural network level. These associations suggest that spatial cognition is involved in the development and experience of SOP (Lengen & Kistemann, 2012; see also Nadel, 2013; Tolman, 1948). Indeed, both cognitive maps and SOP appear to be outcomes of spatial learning — each develops during physical movement through an environment and incorporates spatial memories and meaning (Hay, 1998; Hoffman, 2012; Johnson, 2007; Nadel, 2013; Tolman, 1948).

1.2.1. Sense of place and spatial navigational strategy

Two cognitive processes that underlie SN are egocentric and allocentric strategies (Livingstone-Lee et al., 2011; McNamara, 2013; Zhong & Kozhevnikov, 2016). Research on spatial behavior (Burgess, 2006; Mou, McNamara, Valiquette, & Rump, 2004; Sholl, 2001; Wang & Spelke, 2002; Xiao, Mou, & McNamara, 2009) and neurophysiology (Andersen, Snyder, Bradley, & Xing, 1997; Matsumura et al., 1999; Snyder, Grieve, Brotchie, & Andersen, 1998) indicate that both egocentric and allocentric reference systems are utilized to understand an environment's spatial structure (Burgess, Becker, King, & O'Keefe, 2001; Mou et al., 2004; Sholl & Nolin, 1997; Waller & Hodgson, 2006; Zhong & Kozhevnikov, 2016).

The egocentric navigational strategy employs a self-to-object representational system to encode spatial information whereas the allocentric navigational strategy involves an object-to-object system (Kozhevnikov, 2013; Zhong & Kozhevnikov, 2016). The egocentric strategy executes associations between proximal landmarks and body-based responses (Iaria, Petrides, Dagher, Pike, & Bohbot, 2003; Jeffery, 2003; Livingstone-Lee et al., 2011; Zhong & Kozhevnikov, 2016). Put another way, the egocentric strategy specifies location by using an individual's eye-, head-, or body-based coordinates (McNamara, 2013). For example, individuals who employ an egocentric strategy might describe the location of their residence relative to their current (or remembered) position in space.

In contrast, the allocentric navigational strategy relies on distal cues and involves moving in a particular direction for a certain distance, depending on vectors understood to be between an individual's current position and the destination (Iaria et al., 2003; Jacobs & Schenk, 2003; Klatzky, 1998; Livingstone-Lee et al., 2011; McGregor, Good, & Pearce, 2004; Zhong & Kozhevnikov, 2016). This strategy allows individuals to understand the location of one object relative to another object. For example, someone using an allocentric strategy might recall that "the bicycle is behind a fire hydrant" whereas someone using an egocentric strategy may remember the location of the bicycle relative to their own location in space (e.g., "the bike is to my right") (Waller & Nadel, 2013).

The modern conceptualization of SN emphasizes this two-system model of egocentric and allocentric representation, outlining their complementary roles for affording spatial updating and orientation behavior (Burgess, 2006; Nadel, 2013; Zhong & Kozhevnikov, 2016). Despite the correlated nature of the two strategies, they have distinguishable characteristics that can influence cognitive map formation and real-world performance differently (Burgess, 2006; Kozhevnikov, Blazhenkova, & Becker, 2010; Zhong & Kozhevnikov, 2016).

Although both strategies help to incorporate place-based memories and meanings into cognitive maps, one strategy may be used more frequently when remembering places for which one feels a strong SOP. Given that the egocentric navigational strategy may be thought of as a 'first person' perspective, in that it uses self-to-object associations (Siegal & White, 1975; Werner, Krieg-Bruckner, Mallot, Schweizer, & Freksa, 1997; Zhong & Kozhevnikov, 2016), spatial memories recalled about places for which one feels a strong SOP may be verbalized using a greater number of egocentric strategies than places for which one's sense of place is minimal.

1.3. Sense of place and place imageability

Physical attributes of urban settings, and ways in which they are organized, seem to encourage a stronger SOP and sense of community among residents (Brown & Cropper, 2001; Gifford, 2007; Kim & Kaplan, 2004; Lee, 1968; Pendola & Gen, 2008). Modern planning trends pay attention to place meanings (Ramadier & Moser, 1998) because, in part, ignoring symbolic meanings of physical urban elements by focusing only on spatial legibility can result in under-stimulating surroundings that affect users' cognitive representations (Evans, 1980; Kaplan, 1983; Ramadier & Moser, 1998). In particular, uniform urban landscapes (often characterized by a lack of landmarks) have been shown to impact peoples' overall images of the city, as well as their SN (Abu-Ghazzeh, 1996). Only when physical codes and signs (i.e., nodes, paths, landmarks, and so on) are imageable do spatial representations of a city become more coherent, and sociable urban behaviors more numerous (Ramadier & Moser, 1998). Lynch's (1960) notion of PI, with its five key elements (paths, edges, districts, nodes, and landmarks), may serve as a predictor of how meaningful physical features in neighborhoods associate with SOP because it assists individuals in forming a strong and useful city image. Therefore, measured together or separately, the five elements that best afford an imageable city may suggest ways for planners to shape urban neighborhoods and, perhaps, influence peoples' sense of place formation and subsequent experience (Evans, Smith, & Pezdek, 1982; Gifford, 2007).

For example, placing visible, distinctive landmarks at major decision points in a road system (especially in homogeneous districts) may aid residents' and visitors' formations of a city image, as well as affect SN and SOP. Planners may wish to ensure that primary roads coincide with functional district boundaries that reinforce edges (Evans et al., 1982; Gifford, 2007), as well as preserve buildings that currently serve (or have the potential to serve) as landmarks within a district that is undergoing redevelopment (Evans et al., 1982; Gifford, 2007). Given that scholars do not have a complete understanding of how humans experience places spatially, or emotionally, the present study's investigation into the links between SOP, SN, and PI is important.

1.4. Conceptual framework and study hypotheses

By presenting an exploratory conceptual framework of SOP that includes variables concerning SN and place meanings (via PI), this study takes from Jorgensen and Stedman's (2006) model the rationale to include physical variables (both environmental and spatial) as possible associates with SOP to further understand the physical environment's role in SOP experience, as well as the role of SOP in how we navigate and perceive urban spaces and places (Fig. 1).

The extent to which individuals incorporate personal experiences, meaning, and significant physical features about a setting into their spatial memory is arguably stronger when SOP is stronger. Therefore, although both allocentric and egocentric strategies help to incorporate place-based memories and meaning into one's cognitive map, our first hypothesis is that individuals will verbalize, during a protocol task, more egocentric strategies as they describe their cognitive maps of urban settings for which they have developed a strong SOP than places for which their SOP is weaker.

Second, many environmental details in cognitive maps may serve as reference points for one or both navigational strategies, and any number of allocentric phrases might be used in descriptions of cognitive maps. We predict that a significant relation will emerge between SOP and the number of allocentric strategies used to describe recalled urban settings during a protocol task.

Because individuals with strong feelings of attachment toward their community tend to identify more meaningful places near their neighborhood (Brown & Raymond, 2007), our third prediction is that the overall number PI features reported in a cognitive mapping task will be positively associated with strong SOP in recalled urban settings. Lynch (1960) offered qualitative evidence that even when several (or all) of the five PI features are apparent in a city, only some elements may form a strong urban image. Given his emphasis on the importance of paths for the city image, one may expect that without strong path imageability, SOP for a city (or part of it, such as a neighborhood), is less likely to be experienced strongly. Landmarks also influence construction of cognitive maps (Nadel, 2013) and organized paths and visible landmarks improve our spatial cognition of cities (Appleyard, 1976; Tzamir, 1975). Therefore, our final hypothesis is that positive associations will emerge between path and landmark recollection and the strength of SOP for recalled urban settings.

2. Method

2.1. Participants

Surveying individuals who represent a broader population is important for generalizability. Typically, samples from university subject pools yield data that are homogenous in culture, nationality, gender, education, and age (i.e., mostly females between the ages of 18–22 with 12–14 years of education) (Sansone, Morf, & Panter, 2004). To diversify our sample, undergraduate students enrolled in a psychology course at a mid-sized Canadian university ($n = 46$, 75% of the total sample) were recruited from the Psychology Research Participation System volunteer pool, as well as a small number of adult community members residing near the university ($n = 15$, 25% of the total sample) who expressed interest to the lead researcher in participating after having heard about the study through word-of-mouth. The students received extra credit toward their grade in return for participating. Community members did not receive an incentive.

Participants (17 males, 44 females) ranged in age from 18 to 82 years ($M = 23.84$, $SD = 10.59$) and were mostly female (72.1%). The most frequent ethnic background was Caucasian (67.2%) but a range of responses were given. The most frequent level of education was "some college, technical/vocational school, or university" (47.5%; see Tables 1 and 2).

2.2. Measures and tasks

There were no missing data for any variable, probably because participants completed the study in the presence of a researcher. Each continuous variable was tested for normality based on recommendations by Kline (1997). All items met the criteria for acceptable skewness (values between + 3 and − 3) and kurtosis (values between + 8 and − 8).

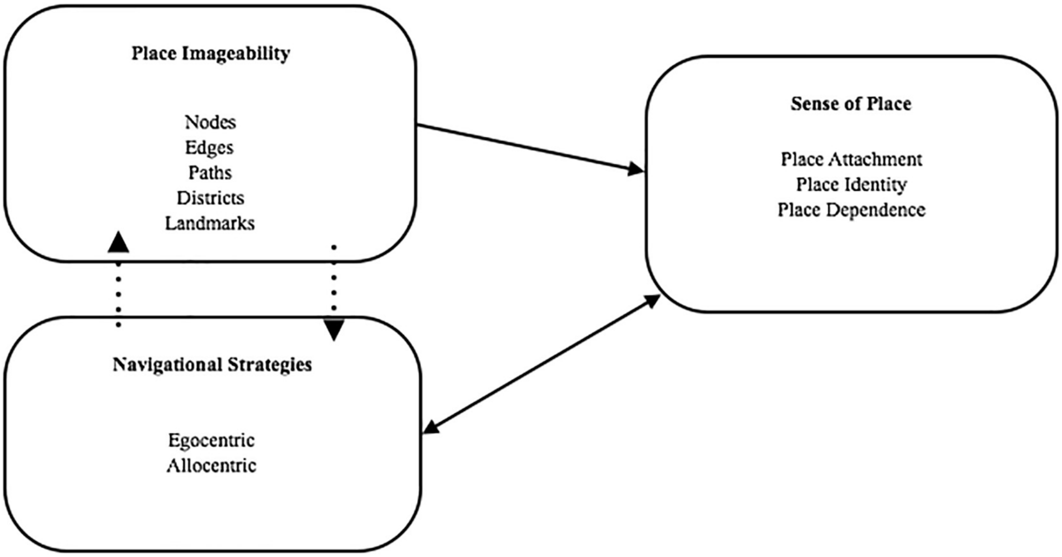

Fig. 1. Conceptual framework of SOP.

Table 1
Frequencies for categorical demographic variables.

Variable		n	Percent
Gender	Male	17	27.9
	Female	44	72.1
Ethnicity	Caucasian	41	67.2
	Half black-half white	1	1.6
	North American Indian	2	3.3
	Chinese	3	4.9
	Asian	6	9.8
	Unidentified	1	1.6
	South Asian	1	1.6
	Mixed race	2	3.3
	Bulgarian	1	1.6
	East Indian	2	3.3
	Middle Eastern	1	1.6
Education	Some secondary	2	3.3
	Secondary school	11	18.0
	Some college, technical/vocational school, or university	29	47.5
	Bachelor's degree	10	16.4
	Some post-bachelor	8	13.1
	Master's degree	1	1.6
	PhD or professional degree	0	0
Exposure type (strong SOP)	Lived there	58	95.1
	Visited there	3	4.9
	Worked there	0	0
	Passed through	0	0
	Combination	0	0
Exposure type (weak SOP)	Lived there	16	16.2
	Visited there	27	44.3
	Worked there	12	19.7
	Passed through	5	8.2
	Combination[a]	1	1.6
Exposure type (neutral SOP)	Lived there	14	23.0
	Visited there	30	49.2
	Worked there	13	21.3
	Passed through	4	6.6
	Combination	0	0

Note: SOP = sense of place.
[a] "Played sports there."

Table 2
Descriptive statistics for continuous demographic variables.

Variable	*M*	*SD*
Current age (years)	23.84	10.59
Length of experience (months) (strong SOP)	111.71	79.86
Length of experience (months) (weak SOP)	43.87	61.10
Length of experience (months) (neutral SOP)	45.45	58.56
Age at first contact (years) (strong SOP)	8.87	8.84
Age at first contact (years) (weak SOP)	13.20	8.10
Age at first contact (years) (neutral SOP)	12.70	8.70

Note: SOP = sense of place.

Table 3
Items in the Sense of Place Scale (revised from Jorgensen & Stedman, 2006).

Place dimension	Item wording
Place identity	Everything about this place is a reflection of me
	This place says very little about who I am (*reverse coded*)
	I feel that I can really be myself at this place
	This place reflects the type of person I am
Place attachment	I feel relaxed when I'm at this place
	I feel happiest when I'm this place
	This place is my favorite place to be
	I really miss this place when I'm away from it for too long
Place dependence	This place is the best place for doing the things I enjoy most
	For doing the things I enjoy most, no other place can compare to this place
	This place is not a good place to do the things I most like to do (*reverse coded*)
	As far as I'm concerned, there are better places to be than this place (*reverse coded*)

Note: Items asked on 7-point Likert scales ranging from "strongly disagree" to "strongly agree."

2.2.1. Measuring sense of place

Participants were asked to complete three sense of place scales (12 items; four items measuring place attachment, four measuring place identity, and four measuring place dependence). Each item was rated on a 7-point Likert scale ranging from "strongly disagree" to "strongly agree" (Table 3). The first scale asked participants to recall an urban neighborhood for which they had experienced strong SOP (i.e., "please think of a specific neighborhood about which you have strong memories or feelings of positive attachment, identification, or meaning"). The second and third scales were identical but asked about urban settings for which weak and neutral SOP were experienced.

SOP scales were based on the instrument developed by Jorgensen and Stedman (2006) that conceptualizes it as an attitude held by participants about some physical environment. We revised the instrument slightly from Jorgensen and Stedman's (2006) version by changing the words "my lake property" to "this place," allowing it to be relevant to a wider variety of settings than it was originally designed to measure. After reverse-coding three items, each scale's reliability was excellent (α = .89 for the strong SOP scale, α = .84 for the weak scale, and α = .86 for the neutral scale).

After participants completed the SOP scales they were asked about their gender, age, ethnicity, and highest level of education. They were also asked to write, in open-ended form, the place they visualized while responding to each scale.

2.2.2. The protocol task

Phenomenological analyses offer an understanding of the world in the terms that people themselves use (Sommer, 1983). Thus, after completing the SOP scales, a protocol task was employed to gather information about participants' SN strategies in each of the three settings they chose to recall while responding to the SOP scales. Protocol analysis involves instructing participants to verbalize their thoughts "in a manner that does not alter the sequence and content of thoughts mediating the completion of a task and therefore should reflect immediately available information during thinking" (Ericsson, 2006, p. 227). This allowed us to analyze expressed thought processes, imagery (cf. Duncker, 1945; Ericsson, 2006), and spatial understanding (Montello, 2015).

Although behaviors are overt actions, reading linguistic expressions is also considered a form of behavioral observation (Montello, 2015). For example, Ward, Newcombe, and Overton (1986) coded verbal directions given by college students and compared them across genders. Allen (1997) coded the features included in participants' verbal descriptions of settings to describe how they varied among individuals. Because the protocol analysis method requires participants to "think aloud" while reasoning (e.g., Passini, 1992), it serves as a logical method of gathering information about navigational strategies used in urban environments, and about the imageable features recalled within them.

The protocol task was designed so that participants could remember each setting "out loud" from a particular starting point (e.g., a coffee shop) and then "walk through" their memory while verbally answering structured questions about how they would move from one location to another. The egocentric strategy is suited for spatial updating and recall of short distances, districts, or neighborhoods as opposed to larger areas (e.g., Zhong & Kozhevnikov, 2016). Therefore, participants were instructed to "walk through" their cognitive maps in order to keep their places of reference at a smaller scale and to allow egocentric navigational strategies to be verbalized.

Eleven questions were asked: six concerned the identification of self-reported important places and five concerned how to navigate between them (Table 4). For example, after choosing a neighbor's house as an important location in response to the first item, one participant responded to the subsequent item as follows:

> "*I would turn to my left and walk down the main road toward my house and through my backyard and then I'd turn right. I step onto a ledge that would let me step over the fence next to the shed. Then I would walk straight toward the house until I got there.*"

Beyond gathering information about the number of times each navigational strategy was used in a recalled setting, each location participants reported as important was interpreted using Lynch's (1960) notion of imageability. At the end of the protocol task, participants were asked on a 5-point scale, ranging from "extremely easy" (1) to "extremely difficult" (5), to rate how challenging it was to recall places in each of the settings they described, as well as how challenging it was to navigate through their cognitive maps.

2.2.3. The cognitive sketch mapping task

A cognitive sketch mapping task was employed to extract visual representations of participants' spatial knowledge of places about which they experienced various levels of SOP. Participants were asked to draw

Table 4
Items in the protocol analysis task.

Item wording
Can you describe the behavioral focal point you've chosen, please? What noticeable or meaningful physical (e.g., natural, architectural, structural, and so on) features can you remember about it?
Please think about another nearby place that is important to you, or has some meaning in the context of the urban setting. What are some of the physical features that stand out at this place?
Please describe to me, step-by-step, how you would walk from the first behavioral focal point place to this second place? Think of yourself slowly navigating from one place to another while describing to me the actions you would take to arrive on foot (note: you may use spatial, directional terms).
Now, please think about another, different nearby place that is important to you, or has some meaning in the context of the urban setting. What are some of the setting's physical features?
Can you describe to me, step-by-step, how you would walk from the previous place to this new place?
Again, please think about another nearby place that is important to you, or has some meaning in the context of the urban setting and tell me some of the physical features that stand out at this place.
Please describe, step-by-step, how you would walk from the previous place to this new place.
Now, recall another nearby place that is important to you, or has some meaning in the context of the urban setting. What are some of the physical features that stand out at this place?
Describe, as before, how you would walk from the previous place to this new place.
One more time, please think about another nearby place that is important to you, or has some meaning in the context of the urban setting. Tell me some of the physical features at this place.
Finally, please describe, step-by-step, how you would walk from the previous place to this new place.

on paper their recalled representation of each of the settings they thought about while they were responding to the SOP scales. They were instructed to "walk through" each setting by sketching memorable features, such as buildings, natural points of reference (e.g., streams, parks), and other attributes perceived as important. They were encouraged to draw freely while letting their memories of each setting guide their map. After they were finished drawing, participants rated on a 5-point scale ranging from "extremely easy" (1) to "extremely difficult" (5) how challenging it was to navigate their cognitive maps.

2.3. Procedure

Student participants took part in a designated room on campus; those in the community sample participated in a local coffee shop or library. Each participant was given an informed consent form to sign before the study began to fulfill the requirements of the institutional ethics board. No time limit was set. Both written and verbal instructions were given to participants before each task began.

First, a research assistant (for undergraduate students), or the lead author (for community members), provided participants with the three SOP scales to complete. Next, the protocol task took the form of a structured interview while verbal responses were recorded by hand. Finally, during the sketch mapping task, participants were provided three sheets of blank paper for drawing.

2.4. Response coding

2.4.1. Coding navigational strategies from protocol data

Statements made in response to the five navigational items during the protocol task were coded by a rater as containing egocentric navigational strategies (self-to-object spatial representations relating directly to head, eye, or body axes, such as left, right, straight ahead) and allocentric navigational strategies (object-to-object spatial representations independent of the observer using salient features of the environment for orientation). For example, "I would turn to my left at the blue house" would be coded as an egocentric navigational strategy, whereas "I would walk to the house that is behind the school" would be coded as an allocentric response.

2.4.2. Coding place imageability from cognitive sketch map data

Counting clockwise from the top of each sketch map, two raters assigned a code to each hand-drawn object based on the type of imageable feature it resembled. For example, depending on context, a road would be coded as a path, a building as a landmark, a reference to the ocean as an edge, and so on. Raters counted the total number of each code, as well as the total number of imageable features overall, in each SOP condition (i.e. strong, weak, neutral).

Using Lynch's (1960) definitions as a guide, raters coded nodes as "focal points for numerous people, intersections, or public loci (taking into context density, people, interactions, and vitality expressed in the map)," edges as "perceived boundaries such as walls, buildings, and shorelines (taking into context how a participant expresses whether he or she can go beyond the feature)," and paths as "the streets, sidewalks, rail lines, trails, waterways, and other channels in which people travel (taking into context how it is related to other features expressed in the drawing)." Raters attended to whether a path was actually an edge (at the end of a map or denoting a place in which a person cannot pass) and, if so, counted it as both an edge and a path.

Landmarks were defined as "readily identifiable objects that serve as external reference points mentioned as separate buildings or objects (taking into context how it is related to other features expressed in the drawing)" and districts as "relatively large sections of the setting distinguished by some identity or character (taking into context how it is related to other features expressed in the drawing)." Raters were instructed that districts may be drawn with an associated name (e.g., "inner harbor" written around a large area of a sketch).

Disagreements in raters' judgments were resolved where possible. Cohen's (1960) kappa was used to assess inter-rater reliability for each imageable feature. No disagreements occurred for two of the five categories. Kappa values were all above moderate levels (cf. Altman, 1991) (Table 5).

Table 5
Inter-rater reliabilities per place imageable feature-type.

Place imageable feature-type	Inter-rater reliability (κ)
District	1.0
Edge	0.56
Landmark	0.62
Node	1.0
Path	0.73

3. Results

3.1. Descriptive statistics for sense of place variables

The average score for the strong SOP scale was moderately high ($M = 5.00$, $SD = 0.95$). That for the neutral condition was lower ($M = 2.82$, $SD = 0.96$), and that for the weak condition was yet lower ($M = 1.87$, $SD = 0.91$) (Table 6). Thus, participants visualized urban settings appropriately in the strong, weak, and neutral SOP conditions.

Table 6
Descriptive statistics for continuous sense of place variables.

Variable	*M*	*SD*
Sense of place (strong condition)	5.00	0.95
Sense of place (weak condition)	1.87	0.91
Sense of place (neutral condition)	2.82	0.96

3.2. Descriptive statistics for navigational strategy variables

The number of times participants used each navigational strategy in their responses to the protocol task was very similar for each SOP condition. In the strong condition, the mean number of times egocentric navigational strategies were used was 12.16 ($SD = 6.19$). The number of allocentric strategies verbalized was quite similar ($M = 11.03$, $SD = 6.20$). This pattern also occurred in the weak and neutral sense of place conditions (Table 7).

Table 7
Descriptive statistics for navigational strategy variables.

Variable	*M*	*SD*
Egocentric strategy (strong SOP)	12.16	6.19
Egocentric strategy (weak SOP)	7.82	5.48
Egocentric strategy (neutral SOP)	8.03	4.45
Allocentric strategy (strong SOP)	11.03	6.20
Allocentric strategy (weak SOP)	7.69	4.25
Allocentric strategy (neutral SOP)	8.15	4.25

Note: SOP = sense of place.

3.3. Descriptive statistics for place imageability in the sketch mapping task

The average number of imageable features contained in sketched cognitive maps was highest in the strong SOP condition ($M = 15.52$, $SD = 6.21$) and fewest in the weak condition ($M = 11.82$, $SD = 6.99$). The neutral condition had a mean value in between the strong and weak conditions ($M = 12.74$, $SD = 6.55$) (Table 8).

Cognitive maps drawn for places about which participants reported strong SOP had, on average, the greatest number of four of the five imageable features (i.e., nodes, paths, edges, and landmarks) (Table 9). Although drawings in the neutral condition contained more districts overall ($M = 0.13$, $SD = 0.39$), compared to strong ($M = 0.08$, $SD = 0.28$) and weak conditions ($M = 0.05$, $SD = 0.22$), these differences were not significant, $t(60) = -1.00$, $p > .05$, and $t(60) = -1.40$, $p > .05$, respectively.

Maps drawn when participants recalled places about which they experienced weak SOP had the least number of three of the five imageable features (i.e., nodes, landmarks, districts). However, compared to the neutral condition, maps sketched while remembering settings about which participants experienced weak SOP contained more paths and edges. These differences were not significant, $t(60) = 0.41$, $p > .05$, and $t(60) = 1.18$, $p > .05$, respectively.

3.4. The relations between sense of place and navigational strategy

Because a priori predictions were made about how conditions would differ, paired-samples *t*-tests were conducted using Bonferroni-adjusted alpha levels of .02 per test (.05/3) to reveal whether the number of egocentric strategies (and allocentric strategies) reported during the protocol task differed across three SOP scenarios (cf. Rosenthal & Rosnow, 1991). Our first hypothesis was supported: on average, significantly more egocentric navigational strategies were verbalized during recollections of places for which participants experienced strong SOP than weak SOP, $t(60) = 5.59$, $p < .01$, $d = 0.72$. Similarly, significantly more egocentric strategies were verbalized in the strong condition than the neutral condition, $t(60) = 6.05$, $p < .01$, $d = 0.77$.

Table 8
Descriptive statistics for overall place imageability.

Variable	*M*	*SD*
Strong SOP condition	15.52	6.21
Weak SOP condition	11.82	6.99
Neutral SOP condition	12.74	6.55

SOP = sense of place.

Table 9
Descriptive statistics for independent place imageability variables.

Variable	*M*	*SD*
Strong sense of place		
Edges	1.03	1.41
Districts	0.08	0.28
Landmarks	7.13	2.73
Nodes	0.64	1.38
Paths	6.77	4.21
Weak sense of place		
Edges	0.69	0.85
Districts	0.05	0.22
Landmarks	5.44	2.66
Nodes	0.31	0.70
Paths	5.82	5.72
Neutral sense of place		
Edges	0.52	0.77
Districts	00.13	0.39
Landmarks	5.90	3.55
Nodes	0.44	0.92
Paths	5.57	4.18

No significant difference was found between weak and neutral conditions, $t(60) = -0.32$, $p > .05$.

Analogous results were found for the number of allocentric strategies verbalized across the three SOP conditions. Significant differences between strong and weak conditions were found $t(60) = 5.12$, $p < .01$, $d = 0.66$, as well as between strong and neutral conditions, $t(60) = 3.96$, $p < .01$, $d = 0.51$. No significant difference occurred in allocentric strategy use between weak and neutral conditions, $t(60) = -0.75$, $p > .05$.

No significant differences occurred within conditions between the number of egocentric and allocentric cues verbalized during the task: $t(60) = 1.53$, $p > .05$ for the strong condition, $t(60) = 0.17$, $p > .05$ for the weak condition, and $t(60) = -0.16 > .05$ for the neutral condition.

3.5. Examining place imageability during the protocol task

In addition to examining the number of egocentric and allocentric strategies verbalized during the protocol task, words and phrases concerning physical attributes of each setting were categorized as imageable features (Table 10).

Table 10
Frequencies and percentages of navigational categories for settings.

Variable	Frequency response	percent
Strong sense of place (n = 351)		
Edges	35	10
Districts	0	0
Landmarks	86	24
Nodes	45	13
Paths	186	53
Weak sense of place (n = 274)		
Edges	29	11
Districts	0	0
Landmarks	58	21
Nodes	53	19
Paths	134	49
Neutral sense of place (n = 256)		
Edges	28	11
Districts	1	1
Landmarks	64	25
Nodes	21	8
Paths	142	55

3.5.1. Place imageability during navigation in strong sense of place settings

For urban areas about which participants reported strong SOP, paths were mentioned significantly more often (53% of responses) than landmarks during cognitive map navigation [24%; χ^2 (1) = 35.90, $p < .01$], nodes [13%; χ^2 (1) = 84.48, $p < .01$], and edges [10%; χ^2 (1) = 101.35, $p < .01$]. No districts were noted during mental navigation.

The most frequently used word in the strong condition was "street" or "road" (66% of all paths). "Home" was used 10 times in verbalizations (12% of landmarks). In addition, more words and phrases were verbalized in this condition (n = 351) than in weak [n = 274, χ^2 (1) = 9.49, $p < .01$], and neutral conditions [n = 256, χ^2 (1) = 14.89, $p < .01$].

3.5.2. Place imageability during navigation in weak sense of place settings

For settings about which participants reported weak SOP, paths were mentioned significantly more often (49% of responses) during navigation than landmarks [21%; χ^2 (1) = 30.08, $p < .01$], nodes [19%; χ^2 (1) = 35.09, $p < .01$] and edges [11%; χ^2 (1) = 67.64, $p < .01$]. Again, no districts were mentioned by participants in this portion of the protocol task.

As in the strong condition, the most frequently used word during navigation when recalling weak SOP was "street" or "road" (73% of all paths). Participants did not use the word "home" in the weak condition.

3.5.3. Place imageability during navigation in neutral sense of place settings

For settings about which participants reported neutral SOP, paths were, once again, most frequently mentioned during navigation (55% of responses), and were noted significantly more often than landmarks [25%; χ^2 (1) = 29.53, $p < .01$]. In contrast to the strong and weak conditions, edges were the next most frequent features (11%), followed by nodes (18%). However, paths were still mentioned significantly more often [χ^2 (1) = 76.45, $p < .01$; χ^2 (1) = 89.82, $p < .01$, respectively]. Another result distinct from the other conditions was that one district (1% of responses) was reported in the neutral condition (i.e., "ghetto").

Again, the most frequent word used during navigation in the neutral condition was "street" or "road" (68% of all paths) and the word "home" was not verbalized in this condition.

3.6. Testing relations between sense of place and place imageability

3.6.1. Overall place imageability

Paired samples *t*-tests conducted using Bonferroni-adjusted alpha levels of 0.02 per test (0.05/3) revealed that the average number of imageable features drawn in the three cognitive maps was significantly greater in the strong SOP condition than in the weak, $t(60) = 4.34$, $p < .01$, $d = 0.56$, and neutral conditions, $t(60) = 3.72$, $p < .01$, $d = 0.48$. This result supports our hypothesis that the amount of imageable features is positively associated with stronger SOP experiences in urban settings.

The most frequently included imageable feature in cognitive maps in the strong condition was landmarks ($M = 7.13$, $SD = 2.73$), while the second-most common feature was paths ($M = 6.77$, $SD = 4.21$), supporting our final hypothesis. No significant difference was found between the average number of features drawn overall between the weak and neutral conditions, $t(60) = -1.14$, $p > .05$.

3.6.2. Specific imageable features

Several significant differences were reported between the number of each imageable feature drawn among conditions. Maps sketched in the strong condition had significantly more edges, $t(60) = 2.60$, $p < .01$, $d = 0.33$, paths, $t(60) = 3.15$, $p < .01$, $d = 0.40$, and landmarks, $t(60) = 2.57$, $p < .01$, $d = 0.33$ than those drawn in the neutral condition (using Bonferroni-adjusted alpha levels of .01 per test; .05/5). However, maps in the strong condition did not have significantly more

Table 11
Frequencies for simplicity of recall.

Condition	Option	*n*	Percent
Strong ($M = 1.85$, $SD = 0.91$)	Extremely easy	25	41.0
	Mildly easy	25	41.0
	Neither easy nor difficult	6	9.8
	Mildly difficult	5	8.2
	Extremely difficult	0	0
Weak ($M = 3.43$, $SD = 1.19$)	Extremely easy	4	6.6
	Mildly easy	12	19.7
	Neither easy nor difficult	10	16.4
	Mildly difficult	24	39.3
	Extremely difficult	11	18.0
Neutral ($M = 3.05$, $SD = 1.06$)	Extremely easy	4	6.6
	Mildly easy	17	27.9
	Neither easy nor difficult	15	24.6
	Mildly difficult	22	36.1
	Extremely difficult	3	4.9

nodes, $t(60) – 1.45$, $p > .05$, or districts, $t(60) = -1.00$, $p > .05$, than maps drawn in the weak condition.

Maps in the strong condition contained significantly more landmarks, $t(60) = 4.16$, $p < .01$, $d = 0.53$, and nodes, $t(60) = 2.01$, $p < .01$, $d = 0.24$, than maps drawn in the weak condition. No significant differences were found between the number of edges, $t(60) –1.89$, $p > .05$, paths, $t(60) = 1.46$, $p > .05$, and districts, $t(60) = 0.70$, $p > .05$ between strong and neutral conditions.

3.6.3. Simplicity of recall for locations during the protocol task

On average, participants reported that remembering and choosing locations during the protocol task was easy in the strong condition ($M = 1.85$, $SD = 0.91$). They also reported that remembering how to navigate between recalled locations was easy in the strong condition ($M = 1.90$, $SD = 1.01$).

Among places for which participants experienced a weak SOP, they reported that it was not particularly easy or difficult to choose places during the task ($M = 3.43$, $SD = 1.19$), or to navigate between them ($M = 3.20$, $SD = 1.34$). This response was similar in the neutral condition ($M = 3.05$, $SD = 1.06$ and $M = 3.00$, $SD = 1.27$, respectively) (Tables 11 and 12).

3.6.4. Simplicity of recall during the cognitive sketch mapping task

Participants reported, on average, that remembering and navigating their cognitive map was easy in the strong condition ($M = 1.48$, $SD = 0.79$). For places that participants experienced a weak SOP, they reported that it was "neither easy nor difficult," on average ($M = 3.30$, $SD = 1.23$). This response was similar in the neutral condition ($M = 3.11$, $SD = 1.19$) (Table 13).

Table 12
Frequencies for simplicity of navigation.

Condition	Option	*n*	Percent
Strong ($M = 1.90$, $SD = 1.01$)	Extremely easy	26	42.6
	Mildly easy	23	37.7
	Neither easy nor difficult	4	6.6
	Mildly difficult	8	13.1
	Extremely difficult	0	0
Weak ($M = 3.20$, $SD = 1.34$)	Extremely easy	6	9.8
	Mildly easy	17	27.9
	Neither easy nor difficult	11	18.0
	Mildly difficult	13	21.3
	Extremely difficult	14	23.0
Neutral ($M = 3.00$, $SD = 1.27$)	Extremely easy	9	14.8
	Mildly easy	13	21.3
	Neither easy nor difficult	16	26.2
	Mildly difficult	15	24.6
	Extremely difficult	8	13.1

Table 13
Frequencies for simplicity of cognitive mapping.

Condition	Option	*n*	Percent
Strong ($M = 1.48$, $SD = 0.79$)	"Extremely easy"	40	65.6
	"Mildly easy"	16	26.2
	"Neither easy nor difficult"	2	3.3
	"Mildly difficult"	3	4.9
	"Extremely difficult"	0	0
Weak ($M = 3.30$, $SD = 1.23$)	"Extremely easy"	5	8.2
	"Mildly easy"	14	23.0
	"Neither easy nor difficult"	13	21.3
	"Mildly difficult"	16	26.2
	"Extremely difficult"	13	21.3
Neutral ($M = 3.00$, $SD = 1.27$)	"Extremely easy"	5	8.2
	"Mildly easy"	16	26.2
	"Neither easy nor difficult"	15	24.6
	"Mildly difficult"	17	27.9
	"Extremely difficult"	8	13.1

4. Discussion

One aim of this study was to increase understanding of SOP by examining whether SN and PI play a role in its experience at the urban neighborhood level. Egocentric navigational strategies use first-person, self-to-object associations in space and rely largely on environmental cues proximal to an individual for spatial information. We predicted that cognitive maps described using this strategy would be more strongly associated with greater levels of SOP than with cognitive maps of places for which individuals experienced lower levels of SOP. This prediction was fulfilled: although no significant differences occurred between egocentric and allocentric strategy use across the three conditions (indeed, the two strategies were verbalized similarly in all conditions), significantly more egocentric strategies were used when SOP was experienced strongly than at weak and neutral levels.

Individuals also used more allocentric strategies as they recalled urban settings in which they experienced stronger SOP compared to weaker or neutral settings. Apparently, when we describe aloud an urban setting for which we have developed a strong SOP, we think about it in more detail, using words and phrases that contain more egocentric and allocentric strategies, than when we remember places for which we feel a weaker SOP.

The lack of significant differences between allocentric and egocentric strategy use *across* conditions indicates that individuals verbalize a similar number of egocentric and allocentric strategies when describing cognitive maps of urban settings. Although this result supports the modern conceptualization of cognitive maps as being dynamic representations of both egocentric and allocentric cues (Burgess, 2006; Nadel, 2013), a frequency count of words and phrases may not afford a full interpretation of one's navigational strategy choices.

As predicted, significantly more PI features were present in cognitive maps drawn while remembering urban settings for which individuals experienced strong SOP. And, participants found it simpler to remember and navigate cognitive maps of urban settings for which they had experienced strong SOP. SOP often develops in settings where memorable or important events have occurred (Lynch, 1960; Manzo, 2005) and where more "special, meaningful places" are perceived (Brown et al., 2003). This study's results provide support for the notion that individuals who feel a strong SOP for an urban environment also tend to recall more physical features that make it meaningful and memorable—imageable.

Another expectation was confirmed when cognitive maps drawn in the strong SOP condition contained significantly more landmarks and paths than the weak condition, as well as significantly more landmarks than the neutral condition. These results bolster the idea that paths and landmarks in an urban landscape are linked to SOP and cognitive map construction, as well as the general body of literature suggesting that

Lynch's (1960) framework of imageability influences our interpretations and expressions of cognitive maps.

4.1. A note about nodes and districts

More nodes were drawn in maps for settings about which participants reported a strong SOP than weak and neutral SOP. This result, combined with others showing that memory formation, consolidation, and retrieval may be strengthened in "places of pause" (Hoffman, 2012), suggests that urban nodes may be optimal points for SOP development, as well as for navigational strategies to be utilized. Places of pause are settings where mammals stop to assess their surroundings and plan their route (Hoffman, 2012). Lynch (1960) also noted a link between nodes (when they are breaks in transportation), attention, environmental perception, and spatial cognition. Further research on urban places of pause, such as intersections or public squares, may increase understanding about the extent to which nodes are a psychological signal for people to linger, navigate, and communicate with others (versus streets and other path types that alert people to move, as per Gehl, 2010) and, in turn, develop SOP.

Finally, one map drawn in the neutral condition differed from the others in that it contained a district. Districts are defined as moderately-sized areas of a city that residents identify as having a specific theme or common character (Gifford, 2007; Lynch, 1960). Size may have kept districts from being recalled during participants' "walk-throughs" of their cognitive maps. However, Lynch (1960) noted that residents of cities with confusing path patterns sometimes use districts as dominant imageable elements. Because numerous paths were recalled during the protocol analysis task, the need to note districts may have been minimized.

4.2. Implications and future research

A number of studies have suggested that considering SOP from the viewpoints of several disciplines may offer a better understanding of urban dynamics. For instance, Manzo and Perkins (2006) state that adopting a holistic perspective is "critical for successful planning and community development efforts since community phenomena happen at all of these levels simultaneously" (p. 336), and that more work should be undertaken to connect urban residents' experiences of place 'on the ground' with urban planning practices. Ramadier and Moser (1998) also state the importance of refining tools that measure the structure of environmental meanings to understand individual and social urban issues. Hull (1992) suggests that planning efforts address image congruity and place attachment by manipulating environmental features. Therefore, the present study's conceptual framework, and the methodologies used to explore it, may be helpful for planners when understanding SOP and the variables that associate with its development and experience.

For example, because paths and landmarks were more strongly associated with settings about which participants had formed a greater level SOP, future research could focus on discovering which types of landmarks and paths matter most to residents and how to enhance their clarity in the urban landscape. In the future, studies utilizing Geographic Information System (GIS) technology may help accomplish this and other goals by enhancing our ability to discern whether a relationship exists between PI, SOP, and SN in different urban settings around the world that contain similar combinations of PI features and SN cues found to be closely related to the experience of SOP.

The actions of urban planners can influence meanings for the public in numerous ways (Stedman, 2008), and considering SOP as a variable in research has allowed public decision-makers to explore urban challenges with more explanatory power (Cantrell & Senecah, 2001; Zia, Norton, Metcalf, Hirsch, & Hannon, 2014). The protocol analysis and cognitive mapping methodologies used in the present study may add to a planner's 'tool box' during consultations with individuals about how they experience SOP and interpret imageable attributes, especially if a change to a setting is being proposed. Urban land and infrastructure management can affect landscapes that serve as the basis for city dwellers' place meanings. Knowing more about urban residents' experiences of SOP may augment what is known about the social acceptability of change, activism, and cooperation among neighbors (Manzo & Perkins, 2006).

The fields of environmental psychology and planning differ: while environmental psychologists often consider research questions at the level of the individual, planners usually think in terms of aggregations of people (Churchman, 2002). By adding to the knowledge base about variables that associate with SOP, the present study may aid planners in considering people less abstractly while understanding stakeholder engagement and attitudes toward changes to physical attributes in urban environments. Because SOP positively associated with a setting's overall imageability, planners may wish to consider the amount and diversity of imageability in urban neighborhoods, especially paths and landmarks. Results may also assist planners as they refer to Lynch's notion of imageability to encourage SOP development, and maintain spatial cues for navigation, in urban environments. Finally, the significant associations revealed between these variables can initiate future research to refine the conceptual framework in the present study to test the extent to which imageability, and navigational strategy, affect the likelihood that SOP will develop in a place, and whether that development affects the use of a particular navigational strategy over another.

4.3. Limitations

Protocol analysis provides valid verbalizations of thought processes (Simon & Kaplan, 1989), but descriptions sometimes do not contain enough information about mediating cognitive processes (Ericsson, 2006). The task required participants to engage in reconstructive recall which creates the potential for memory errors. However, most spatial cognition studies include this limitation simply because cognitive processing is often erroneous and generally varies from person to person (Gifford, 2014). Future research relating SN to SOP might profitably use methods that employ real-time walk-throughs in situ while participants' navigational strategies are recorded.

Similar limitations exist when using a cognitive mapping task because data derived are, in part, subjective representations of experience and memory. Nevertheless, cognitive maps are a reliable way to reveal what an individual perceives as salient in an environment (Sommer & Sommer, 1997). In general, paper-and-pencil measures of spatial cognition are valid measures of wayfinding (e.g., Baskaya, Wilson, & Ozcan, 2004; O'Neill, 1991) and often mirror space syntax analyses of places (i.e., how physical attributes affect human movement) (Kim & Penn, 2004).

All participants were exposed to the strong SOP condition first before the weak, and then neutral, conditions. An order effect seems unlikely because of how participants' responses differed in the first condition compared to the second and third conditions. For example, simplicity of recall was, on average, better in the strong condition and worse in the weak and neutral conditions. If an order effect was present, participants may have been expected to recall features progressively better, with practice, as they moved through the conditions (or progressively worse if they had experienced fatigue with the tasks).

Finally, SOP is undoubtedly established through, and affected by, cultural mechanisms (Gifford, 2007). The physical structure of a neighborhood is often shaped by the various cultural backgrounds of its residents, and how those residents express their identity through architecture and use of urban space (Manzo & Perkins, 2006). Our study was conducted in a western culture and the majority of participants were Caucasian (although a few participants identified themselves as being of non-North American ethnicity, such as Bulgarian, South Asian, and Middle Eastern). In the future, asking additional questions about cultural identification may help to generalize results.

4.4. Conclusions

Environmental psychologists and urban planners alike continue to investigate how individuals perceive the places they encounter and what makes them memorable. This study investigated whether SN and PI associated with the psychological construct of SOP at the urban neighborhood level. Both egocentric and allocentric strategies were used more often when participants recalled settings that they associated with a strong SOP, and cognitive maps of these places were simpler to recall and navigate. The strength of SOP for an urban location and how easily we remember how to navigate it appear to be strongly connected. A cognitive mapping task reinforced the notion that those with a strong SOP for an urban environment also tend to recall more of that environment's imageable features. Our findings confirm existing literature that paths and landmarks are integral to urban imageability. By explicating relations between SOP, SN, and PI, this study's results should stimulate interdisciplinary research on the ways in which SOP can be used to better understand how people experience, remember, and navigate urban environments.

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