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Places as Fuzzy Locational Categories

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Abstract: This paper offers a new way of considering places as special types of categories, in human cognition of larger-scale environments. This may provide an explanatory cognitive model for a range of known phenomena from environmental psychology and human geography - notably places' semantic salience and vague, unstable boundaries. Using such a model to apply suitable classification approaches may enhance geographic information (GI) for key public-facing users, such as emergency services and planners. Two empirical studies confirmed that a spatially extended place (e.g., suburban locality or neighborhood) may be stored as a category whose exemplars are memorable individual locations or scenes. Using a questionnaire-based method to partly replicate key findings from the semantic memory literature (Barsalou, 1985; Lynch, Coley and Medin 2000), the studies tested the relevance to such places of known semantic memory phenomena including graded membership, typicality versus ideals, expertise and context effects. The discussion considers the link between semantic and spatial vagueness of places.

Keywords: place; semantic cognition; categorical reasoning; graded membership; expertise; vagueness

PsycINFO Classification Code: 2343 Learning & Memory

1. Introduction

In 2015, a journalist named Nigel Chiwaya asked residents of New York City to draw the boundaries of what they thought of as their 'neighborhood' (named urban or suburban locality) on a map. New York is of course a typical New World city in many ways, with a planned regular and systematically numbered grid of streets, so we might expect relatively neat and clear boundaries within it. Instead, the results were spectacularly vague and disputed. Writing a summary of the results six weeks later, by which time over 12,000 city residents had responded, Chiwaya concluded that "while there's broad consensus over the heart of neighborhoods — everyone agrees that North 3rd Street and Bedford Avenue is Williamsburg — borders are very much open to interpretation." (Chiwaya, 2015).

Across the world this vagueness occurs in people's understanding of urban neighborhood boundaries - and of other kinds of place such as forests, villages and named areas of natural beauty) - though it often seems to surprise journalists and residents of 'new world' cities (Anonymous, 2007; Coleman, 2015; Grynbaum, 2012; Mason, 2017; D. Smith, 2009). It is deeply problematic for those who develop and maintain geographic information systems (GIS), which mostly depend upon crisp vector data for modelling spatial phenomena (Waters & Evans, 2003). Failure to define neighborhoods consistently thus impacts on emergency services, urban and social service planners, and other GIS users who need to relate 'hard' data and pinpoint coordinates back to residents' apparent idea of their city as a collection of vague neighbourhoods (Davies, Holt, Green, Harding, & Diamond, 2009).

Some researchers have tried to automatically harvest and model vague and vernacular place information (Brindley, Goulding, & Wilson, 2018; C. B. Jones, Purves, Clough, & Joho, 2008; Kauko, 2009), but to date there is little understanding of the factors creating and predicting such issues. Indeed, some authors (e.g., Fisher 2000; Smith and Mark 2003) have raised the question of the Sorites paradox (in which there is effectively no clear point, and no way to decide, when you are definitively in/on the vaguely bounded entity). Smith and Mark (2003) even questioned whether a vaguely bounded entity can be said to exist, arguing that it might have to be represented only within an ontology since it had a common-sense semantic reality, but not a separate reality from continuously varying 'fields' (measurement values) in spatial data.

Meanwhile, in social and environmental psychology and human(istic) geography, the vagueness, semantic richness and changeability of place have long been used to justify taking an entirely qualitative, humanistic approach to the topic (Cresswell, 2014; Withers, 2009). This has made it very hard for the insights from such research to be used to inform quantitative analyses and hence computational models of place, although some theoretical and practical efforts have been made to bridge the gap (Rantanen & Kahila, 2009; Sui & DeLyser, 2012).

However, vague or 'fuzzy' boundaries between named categories of stuff have been familiar since the early 1970s to cognitive scientists studying semantic memory (Lakoff, 1973). This paper examines a key question for cognitive science concerning place: Is it possible to view places as simple cognitive categories - groupings of individual locations and addresses - so that their semantic characteristics might partly explain and model their vague (spatial) boundaries? In other words, does a person's understanding of places behave just like their knowledge of semantic categories, under conditions of varying uncertainty?

Consider this analogy: a fashionably wide coffee-shop teacup can nowadays be as wide as a cereal bowl, but the presence of a handle and its usage as a drinking vessel constrain its definition. Similarly, the neighbourhood next door to mine may be equally residential in nature, but the presence of a school catchment boundary or a disparity in housing type (e.g., houses versus apartment blocks) may, for some people in some

contexts, create an apparent boundary at one point rather than elsewhere. The boundary is spatial, in the same sense that the cup-bowl distinction is supposedly about physical shape. But the boundary point is decided by semantic, *non*-spatial factors, not by the metric distance from some geometric centroid or the degree of difference from a 'perfect cup' prototype. In both cases, the position of the boundary may change when the item (cup or neighbourhood) is considered for different purposes (e.g., serving a stew or planning a bus route). Thus spatial and semantic fuzziness and flexibility are often closely linked.

If we can show that places can behave *as semantic categories* by replicating known empirical findings on how categories behave, we could speculate that the same underlying semantic memory mechanisms may be involved. Then places are no longer awkwardly unexplained features of spatial cognition, but are typical semantic cognitive phenomena which happen to link closely to spatial knowledge. Personally recognised scenes and locations within a place may be stored as semantically related *exemplars* of it, not just as contiguous points in space.

This may imply that we can apply half a century of research-driven insights about, and hence also our computational models of, human semantic categorisation to enable us to model places more realistically in GIS. The spatial vagueness exhibited by places such as an urban neighbourhood may then be at least partly predictable, by considering (1) how some of its semantic characteristics change 'fuzzily', and (2) how one clearly-bounded characteristic might change at a different rate than another.

This would help to expand our understanding of how semantic memory mechanisms are used in multiple domains. It could also finally help us to bridge the qualitative-quantitative divide in psychology and human geography research into place. Indeed, the need for such unifying conceptual frameworks has previously been highlighted by researchers into place identity (Devine-Wright & Clayton, 2010).

1.1 Scope and previous work

At this point it should be made clear that this paper is not about the *concept* of 'place' or 'placeness' in itself. Rather, we can consider as a category any *particular* place that extends over a physically extensive area - i.e., in topological terms, a certain *region*. Such a place may vary greatly in size, at spatial scales from the learnable-by-local-navigation scale which Montello (1993) classified as 'environmental', to the even larger (country or large region) scale which he called 'geographic'.

The question is whether, for any such place, we can treat it as a coherent category made up of single location exemplars (e.g., addresses, buildings, objects, landmarks, sections of streets, city blocks or even larger geographic landscape features), in exactly the same way that the cognitive science literature considers a semantic category (e.g., 'birds') as having many individual exemplars which we may also classify into subgroups. Previous studies have suggested that individual locations, scenes or 'vistas' in our navigable environment are privileged information (Meilinger, Riecke, & Bülthoff, 2014; Tversky, 2000), but the idea that larger places serve to *categorize* such locations (semantically as much as spatially) has not been previously explored. As a city contains dozens or hundreds of stored scenes and locations, organizing structures such as neighborhoods might increase our cognitive efficiency when we think about it. The physical world itself does not invoke or require such structures (B. Smith & Varzi, 2000), but we might need them.

Of course, the boundaries of a location or scene are themselves vague, although this is out of scope of the current paper. For the present discussion we will assume that an exemplar can be any geographic feature or scene, typically only metres or tens of metres across. It usually includes at least one relatively fixed and mappable object in

the outdoor world, such as an intersection, building or landmark. These scenes or features are referred to as 'locations' below. The containing place in which people seem to collect such locations will be called either a place or a neighborhood[1], depending on context. The place may not necessarily have a name (a toponym), but often toponyms do develop spontaneously within local populations over time (Cardoso & Meijers, 2016) - possibly even in robot communication (Schulz, Wyeth, & Wiles, 2011).

Some previous research has suggested a role for cognitively categorizing visible spaces, from tabletop arrays of objects to world maps, usually to explain distortions in people's memory for items located within them (Holden, Newcombe, & Shipley, 2014; Kerkman, Friedman, Brown, Stea, & Carmichael, 2003; Lansdale, 1998; R Lloyd, Patton, & Cammack, 1996; Tversky, 1981). Such studies show that people tend to cluster or group points and items together, but have not explored the properties of those groupings - e.g., whether they may be fuzzy, predictable or context-dependent. At larger scales, logically it may be expected that people might again cluster local urban and suburban elements together. However, we do not know whether semantic categorization phenomena such as fuzziness and typicality, or gradedness against ideals, may apply to such inherently spatial groupings.

Seeing a region as a coherent class of locations is also not new within geography (Montello, 2003). However, until now the cognitive features and implications of such regions have not been systematically tested, apart from a few studies on vague generic constructs such as 'downtown' (Montello, Goodchild, Gottsegen, & Fohl, 2003) and relational terms like 'near' (Worboys, Duckham, & Kulik, 2004).

As implied earlier, geography as a discipline invokes many ontological complications surrounding the notion of 'place' itself. However, this paper will not discuss that debate. Instead we will focus on human place cognition, starting to empirically test people's informal understanding of what local named places are and where they extend to, and how far we can apply category theories and models.

1.2 Graded structure

Not all members of a category are equal. In cognitive psychology, following seminal studies by Rosch and colleagues (Rosch, Simpson, & Miller, 1976), the prevailing 1970s view of a typical semantic category, such as 'bird', was that it had a *graded* structure in which some exemplars were deemed to belong better (i.e., to be more 'typical') than others. This notion was clearly supported by evidence from a range of categorisation tasks (Barsalou, 1987).

A well-known study by Barsalou (1985) focused on what else might determine graded structure other than nearness to an imagined prototype, and what might even cause the structure of a category to vary with context. Barsalou tested four possible determinants of graded structure:

- central tendency (family resemblance to an average or prototype);
- ideals (the properties most required for the concept to serve an intended purpose);
- frequency of instantiation (how often the person has understood the exemplar to fall within the category);
- familiarity with the exemplar itself.

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[1] The usual geographic term for urban districts is 'locality', but 'neighborhood' will be used to aid comprehension in this paper, to contrast more clearly with 'location'.

Using a range of items and categories, Barsalou correlated participants' exemplar ratings on all four of these dimensions with ratings of the exemplar's 'typicality' within the category. The determinants of typicality were seen to vary with context and type of category, not stemming from a single source.

If typicality is graded with respect to places as it is with non-spatial categories, then we should expect some of the locations within a place (neighborhood) to be consistently rated as more typical of that place than others. Barsalou noted that people could make discrete decisions to categorise items even when they accepted that the category boundaries were vague - and of course, this is also seen with the wider use of binary tasks such as card-sorting in other categorisation studies. Similarly, previous research into place boundary perception (e.g., Montello, Goodchild, Gottsegen, & Fohl 2003) has suggested that despite believing that a specified area had imprecise boundaries, people were willing to make discrete judgements when asked to delineate it. Thus the analogy to Barsalou's work seems plausible.

The major dimension linking a place's exemplar locations together is obviously physical spatial nearness, the most basic aspect of geography. (At this scale of space, of course, spatial relations between locations are not all viewable from a single vantage point; thus 'spatial' no longer automatically implies a *perceptual* attribute as it does within a single array in visual cognition.) Nevertheless, semantic features often come into play in distinguishing one place from the next - such as residents' demographics, or functions such as residential or industrial estates. These features often tend to be characteristic but not uniquely defining: they may be necessary or sufficient or neither for distinguishing one place from the next. For instance, a residential neighborhood may also include some businesses, and a mixture of socioeconomic groups. Similarly with non-geographic categories, the possession of wings is a necessary common feature for birds, but not a sufficient one to distinguish the category from bats.

What is as yet unclear about places, however, is whether people do actually see a given place as showing graded structure and a sense of 'typicality'. As most studies have simply collected and collated data across participants, effectively creating vagueness from disagreement, it is unclear whether or when the 'fuzziness' which is known to exist at the edges of places is due to an *individual* awareness of such gradedness, and thus an inherent 'wobbliness' about 'belonging' (see Hampton, 2007).

1.3 Category structure types

Barsalou (1985) was also the first to distinguish two types of category structure: common taxonomic (e.g. fruit, vehicles, and clothing) and goal-derived (e.g. birthday presents and camping equipment). He found that the determinants of graded structure were different according to the category type, with central tendency accounting for more variance in typicality for common taxonomic categories than for goal-derived categories, while ideals and frequency of instantiation were important determinants for both. Common taxonomic categories tend to reflect a strong perceptual similarity among members. Central tendency is more important for categories that represent similar *information* in the environment, because it helps with classification. Goal-derived categories are less reliable for classification; their members are often perceptually and functionally quite dissimilar (e.g., "things I need to take on holiday").

If places are categories then they clearly provide some information about the structure of the environment, but we often assume that the information is primarily spatial (based on physical proximity), not taxonomic. Except where there is a clear physical bounding feature (such as a highway or railroad or river), we often cannot create a taxonomic definition that reliably predicts a place's boundaries. Places often also show far fewer consistent perceptual attributes across their extent (due to variations in the purpose, age and style of buildings, for instance) than do categories like ‘fruit’ and ‘birds’. So places

might often be more like Barsalou's goal-derived categories than taxonomies or those based on central tendency (closeness to a central or prototypical location or item). Nevertheless we might still expect to see graded structure, in the sense that typicality ratings of locations might vary across a specific place.

In this view, we might expect a large influence of goal-based *ideals* - related to function more than proximity - on people's place boundary judgments (Consider, for example, a house lying between a largely residential suburb and an industrial area, or between a higher- and a lower-income neighborhood.)

It may not make much sense to talk about all places as having a specific functional 'goal' that its attributes fulfil for people who have no personal interaction with it (e.g., the suburbs where you do not happen to live, work, shop or otherwise pursue a personal interest). However, it is still possible to imagine such places having an *ideal* feature or function which is distinct from its physical centre, and yet which is still important in defining that place. Ideals could include aesthetics such as 'modern', 'scruffy' or 'leafy', or age, desirability, or a key function that 'says something' about the place. Thus Harrods department store might be the ideal embodiment of Knightsbridge, the famous London suburb, despite being unique within it. Ideals may also be temporary and task-specific, such as deciding which households to leaflet in a campaign on a local issue, or considering desirable streets in which to live.

Thus overall, in investigating people's understanding of places in their familiar home area, we may see one of three patterns:

(a) If places are not processed cognitively as semantic categories, there may be no variation in typicality ratings, and boundaries will be crisp and not systematically influenced by task or contextual factors.

(b) If places are processed like conventional taxonomic categories, then we may see gradedness of structure emerging from measures such as typicality ratings of exemplar scenes or locations, but typicality may be entirely predictable from physical and/or spatial attributes of individual locations or scenes. There will be no reason to expect the boundaries to be 'fuzzy' *within* a given individual: the classification of a given scene or address will not be changed by task or contextual factors once a person is familiar with the local area.

(c) If places are at least partly goal- or ideal-related, then people will be generally more fluid about the relationship between typicality and category membership. We may find that they can be influenced in their categorisation judgements by contextual variables such as a decision they are asked to make, or rule-based domains requiring expertise.

The following two experimental studies were designed to distinguish these three possibilities, and thus to establish how far places demonstrate the same cognitive phenomena as semantic categories.

2. Study 1: Testing for Graded Structure

Can a place be shown to have a graded structure like a semantic category, so that some exemplars (locations or scenes) belong more than others? What would this gradedness involve? We might first expect it to relate to the judgement of each location's 'goodness of example', and/or to personal familiarity, as much as to physical or spatial typicality, just as with some object categories (Barsalou, 1985). Thus the goal of Study 1 was to partially replicate Barsalou's classic 1985 study by asking participants to rate locations

on typicality, familiarity and 'goodness of example', and examining the variations and correlations between these variables.

However, an arguable flaw in Barsalou's original 1985 paper was its use of a between-participants design. Different participants rated the items on different variables (goodness of example, fit to an ideal, etc.). As discussed above, a key question for place is whether gradedness exists *within* an individual's thinking about its locations. Thus the present study was designed as within-participants instead: the same participants would be asked to rate a set of locations within each urban neighborhood (picked after showing good recognition in a previous pilot study) on goodness of example, personal familiarity and fit to an ideal (again derived from pilot participants' descriptions of the neighborhoods).

Barsalou's original variables included similarity and frequency of instantiation. These make some sense for categories where items are clearly delineated individual objects. They are less conceptually clear, however, where individual elements are vaguely bounded locations or scenes. Here even a clarifying photograph would contain a number of items, and a potentially wide variety of different interpretations as to what is meant by either 'similar' or 'frequently occurring' (e.g., a similar photographic angle or viewshed; inclusion or exclusion of infrastructure features such as a roadway; choosing one or another item that stands at that street intersection; etc.). The present study, therefore, focused on Barsalou's less ambiguous variables, just testing the notions of gradedness and of ideals, and the influence of personal familiarity.

Barsalou found no effect of familiarity when naming generic items as potential category members, but this may be because his participants were actually rating generic *concepts* of items rather than specific exemplars (e.g., the concept of 'suitcase' rather than 'this particular battered brown case with a broken handle'). Familiarity would be expected to play more of a role when actual exemplars were being shown, as found in object concept studies (Hannah & Brooks, 2009).

As above, the main experimental hypotheses were that people would show some degree of systematic variation in their ratings of all locations within a place (not just lower ratings at the periphery), and that consistency with an 'ideal' would also be related to this if places were goal/ideal-based to some extent. It was also expected that with the locations being specific exemplars instead of generic concepts, personal familiarity would also influence people's goodness-of-example ratings.

2.1 Participants

Forty-two adult participants (21 females) aged between 18 and 70 took part in the study. They had varying lengths of residence (mean = 20.4 years, s.d. = 15.7, min = 1, max = 59) of the southern English city of Southampton (population about 300,000), where they were tested. All participants had responded to local advertising posters to recruit research participants for a range of studies. Participants were paid £10 plus travel expenses for taking part; the sessions took less than half an hour.

2.2 Materials and Procedure

After consent and briefing, participants were given a randomly assigned version of the booklet described below, and asked to work through it at their own pace.

A printed booklet of questionnaires was developed, containing an instruction page and three sections. Five versions of the booklet were prepared, counterbalancing the order of the three sections described below and of the neighborhoods within each section. The 'familiarity' section first asked participants to rate on a scale of 1-9 their personal familiarity with five urban neighborhoods (localities) within Southampton. Picked from pilot study data for their generally high levels of recognition and knowledge among

residents, these five neighborhoods were chosen to be non-contiguous and distinct in their character, varying in socioeconomic as well as functional characteristics. Within the same 'familiarity' section, participants then had to similarly rate their familiarity with 68 individual locations, grouped by neighborhood; the order of both the neighborhoods and the locations within them had been randomly determined. Each locality or location was presented next to a 9-point scale on which 1 was labelled *not at all familiar* and 9 was labelled *very familiar*.

Another section, entitled 'Goodness of example', was designed to assess how typical each location was of its corresponding locality. Participants were presented with the five sets of locations grouped by neighborhood, with each neighborhood again presented on a separate page. Participants rated each location on a scale of 1-9 as to how good an example of that place each location was. The endpoints for the scale were labelled 1 for *poor example* and 9 for *excellent example*. (For convenience and following common practice, this variable is called 'typicality' below.)

To obtain judgements about locations' contribution to a neighborhood's 'ideal', the procedure was similar to the above, except that this time an 'ideal' description of each neighborhood's commonly agreed characteristics (collated from pilot studies asking participants to provide one) was presented beneath its name; participants were asked to rate how far each location contributed to that description of the place. The end points for the rating scales were labelled 1 for *very low amount* and 9 for *very high amount*.

Figure 1. The top-typicality-rated image for each of the five neighborhoods (left to right, top: Shirley, Bedford Place, Highfield. Bottom: Ocean Village and St Mary's).

For each version, an accompanying booklet called 'Locations' was provided which presented captioned photographs of all 68 locations, grouped by neighborhood and listed in the same order as in the questionnaires, to facilitate their recognition by participants. Instructions within the questionnaire booklet asked participants to view the photographs in parallel with the questionnaires as needed. (Examples of the photos and of the captions are shown in Table 1 and in Figure 1 below.)

Finally, participants were briefed, thanked and paid.

2.3 Results

2.3.1 Descriptives

Participants were clearly willing to discriminate among locations within neighborhoods, with a similarly substantial standard deviation across all of them (see Table 1). An examination of the mean typicality scores for each location shows which kinds of locations were more readily associated with particular neighborhoods, and how strongly. Table 1 shows the top three typicality-rated locations within each neighborhood, and their mean typicality score; Figure 1 shows the accompanying photographs of the first (top-scoring) location in each case.

Highest-rated Locations	Mean (sd) Typicality Score	Lowest-rated Locations	Mean (sd) Typicality Score
Shirley - overall mean 6.46 (1.31)			
Shirley High Street	8.21 (1.28)	Betting Shops	5.88 (2.44)
Charity Shops	7.37 (1.86)	Detached Houses	5.40 (2.54)
Shopping Precinct	7.26 (1.88)	Schools	5.02 (2.33)
Bedford Place – overall mean 6.61 (1.33)			
Large Town Houses	7.62 (1.78)	Offices	6.05 (2.47)
Main Street	7.40 (1.86)	Co-op (supermarket)	5.24 (2.30)
Georgian Buildings	7.33 (1.87)	Sainsbury's (supermarket)	5.12 (2.55)
Highfield – overall mean 6.15 (1.58)			
University	7.52 (1.67)	Semi-Detached Houses	5.10 (2.43)
Expensive Houses	7.07 (2.36)	Flats	5.00 (2.36)
Highfield Church	6.79 (2.32)	Shops	4.62 (2.12)
Ocean Village – overall mean 6.93 (1.21)			
Marina	8.47 (1.03)	Offices	6.51 (1.99)
Calshot Spit Light Vessel	7.86 (1.46)	Car Park	5.09 (2.85)
Harbour Lights Cinema	7.77 (1.59)	Shops	4.98 (2.74)
St Mary's – overall mean 5.97 (1.31)			
Stadium	7.12 (2.43)	Flats	5.35 (2.39)
St Mary's High Street	7.02 (2.17)	Jury's Inn (hotel)	4.93 (2.70)
St Mary's Church	6.65 (2.32)	Charlotte Place Roundabout	4.93 (2.67)

Table 1. Mean typicality scores for each locality's top three locations; and across all locations.

The three main shopping streets for Shirley, Bedford Place and St Mary's were all rated as strong exemplars of those localities, along with distinctive landmarks or constructions like the stadium in St Mary's or the university in Highfield. (In reality, most of each locality is residential; images of *actually* typical residential buildings were also presented in each case, but were less highly rated except in Bedford Place, which is unique in its streets of elegant Georgian terraces.) The highest mean typicality scores overall were for Shirley 'High Street' (not its official name), and for the marina in Ocean Village. Both are actually very distinctive, *non*-typical, features of the respective localities.

Unsurprisingly, given that all of the locations were picked based on previous descriptions and recognition scores, none of the locations were rated as particularly bad examples of the localities. The lowest mean typicality score was 4.62, for a commonplace-looking corner shop in Highfield (usually considered the most upmarket neighborhood in the city), with the highest in that locality being 7.52 for the building at the entrance to the university campus (which covers a large area of the neighbourhood). By contrast, the lowest mean 'ideals' score across participants was only 2.79, for the fire station in St Mary's (a working-class locality with a 'rough' reputation, where the highest 'ideal' score was 6.93 for some terraced houses).

2.3.2 Correlations

The Pearson correlation between mean scores on typicality and on ideals was moderately large and significant, $r(68) = 0.46$, $p<0.001$, CI 95%[.25,.63], suggesting that 21.1% of the variance in typicality was predictable by the variance in ideals. The correlation between typicality and familiarity was even stronger: $r(68) = 0.60$, $p<0.001$, CI 95%[.43,.74], with 36.5% of typicality variance being predicted by the variance in familiarity. Figure 3 shows two scatterplots of these two relationships. However, the correlation between mean scores on ideals and mean scores on familiarity was much weaker with $r(68) = 0.18$, $p = 0.132$, CI 95%[-.06,+.40], thus explaining

only 3% of the variance.

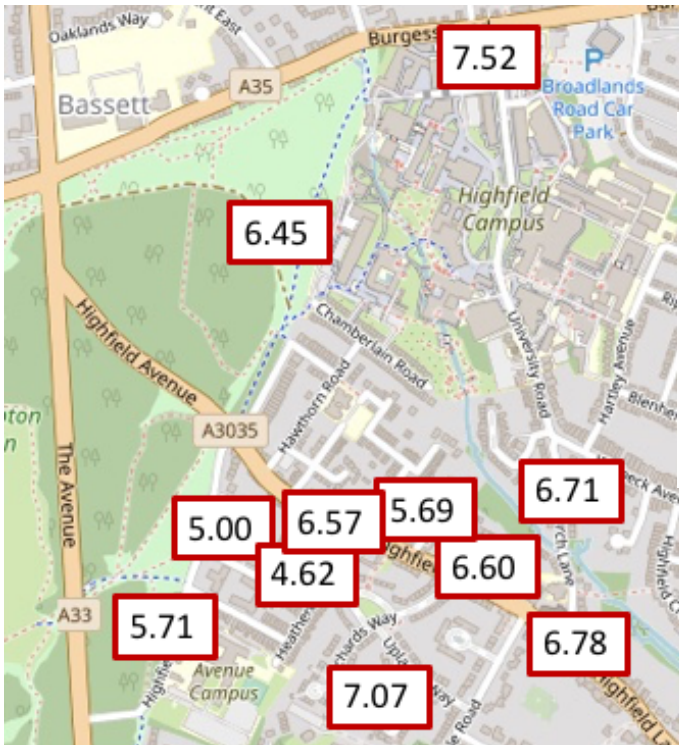

Figure 2. Mean typicality at various Highfield locations. Neither central tendency nor vague boundaries are evident here; however, no images were included from more locally disputed areas to the east and south of this map. Highfield's 'ideal' is high-end housing around the university campus; low-rated scenes showed more commonplace buildings such as a cornershop.

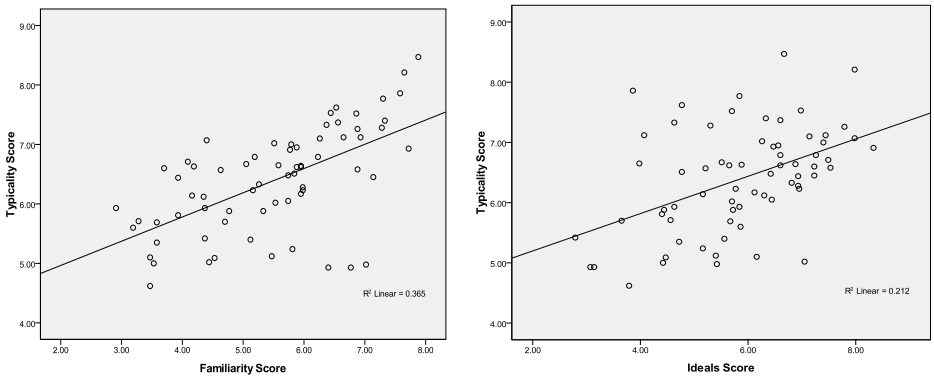

Figure 3. Scatterplots to demonstrate the relationship between typicality and the two variables: ideals and familiarity

Partial correlations were computed to assess the unique predictive power of both ideals and familiarity on typicality. The resulting findings were that neither of the correlations or variance estimates changed by a large amount. When familiarity was partialled out, the correlation between typicality and ideals was still $r\ (65) = 0.445$, $p < 0.001$, CI 95%[.23,.62]. The unique variance in typicality that could be explained by ideals on its own was thus estimated at 19.8%. Partialling out ideals made almost no difference at all to the correlation between typicality and familiarity: $r\ (65) = 0.60$, $p < 0.001$, CI 95%[.41,.73], accounting for 35.4% of the unique variance in typicality. It therefore seems that the effects of familiarity and ideals on the goodness-of-example ratings were strongly independent.

An OLS regression analysis suggested that together, familiarity and ideals explained

47% of the variance in typicality: adjusted $R^2 = .47$, $F(2,67) = 31.2$, $p < .001$. Checks showed that the data met all assumptions of multiple linear regression concerning outliers, residual normality and collinearity.

2.4 Discussion

The idea that locations may make a greater or lesser contribution to the 'sense' or 'ideal' of a place, which was intuitively reasonable but previously untested, clearly made sense to participants in this study. Unsurprisingly, goodness of example was also strongly dependent on participants' own familiarity with the individual locations - a reminder that places are bound to have individual meanings depending on people's experiences within them.

The results show that for different neighborhoods, all of which contained some housing, shops and other facilities as one might expect in a city, different types of feature were considered 'good' examples despite being in each case a unique item within the neighborhood. This thus seems to hint at a strong role for goals or ideals in people's thinking about each place, rather than general principles such as spatial centrality or genuine representativeness. Table 1 also shows that variability of ratings (standard deviations) was consistently higher for the lower-ranked locations than at the top. This would be consistent with the notion that certain locations are iconic and viewed by many as the neighborhood's 'ideal', whereas other locations are more or less well recognised by different individuals – as opposed to a consensus based on central tendency (distance from a core).

An anonymous reviewer of this paper raised the concept of salience as an explanation for the focus on visually atypical scenes. In the context of cognition of scenes in one's local environment, it is usually argued that salience itself splits into visual salience, structural salience (useful for navigation) and semantic salience (relevance to goals) - see Raubal and Winter (2002) and many subsequent studies based on the same distinctions. The second and third of these dimensions are arguably closely linked to the notion of goal-focused graded membership, and thus support the idea that people are not always judging purely by spatial constraints. In the context of rating typicality of exemplars, visual salience is linked closely to familiarity when participants have high local knowledge as they did here (see e.g. Johnson, 2001), because inevitably the most visually distinctive items will also subjectively feel the most familiar. Thus the various potential roles of salience may suggest that the scenes were being judged as category members, rather than merely for their spatial contiguity.

From the perspective of treating places as categories of locations, clearly this result is encouraging. However, there are limitations to these findings. Firstly, the 'ideals' were imposed on participants as descriptions emerging from other people's views, although in all cases the participants were relatively long-term residents of the city, and would thus have had similar local understanding. Secondly, the study is correlational and, given that participants were being asked about the same locations three times in short succession, some degree of similarity of answers might be expected.

Nevertheless, participants' ratings could have varied far less between locations, interpreting the questions simply as "is this in the place or not?" and giving neutral or high responses to all but the most peripheral items. As shown by the results above, however, this was apparently not their understanding of the task.

In his 1985 paper, Barsalou also tried to show that his 'ideals' influence on typicality was not a case of simple central tendency. He did this by correlating items' typicality scores with the *difference* between each item's ideals score and its category's ideals score - i.e., its distance from the most common degree of 'idealness'. The correlation was very low, suggesting that the items which were most similar to others on ideals

(the 'average' ones) were not the most typical. However, in the above data (and possibly in Barsalou's) we already know this to be likely, because obviously the correlation above suggests strongly that the *highest* scores on the ideal were the most typical. Also, if it had been the middling ideals scorers that were most typical, then the graph in Figure 1 would have had a parabolic shape, not a linear one. Barsalou's test was arguably not a good logical test of the extent to which central tendency might be relevant, since it might work independently of the role of ideals.

3. Study 2: Roles of Ambiguity, Expertise, Context and Ideals

From the evidence suggested by Study 1 above, and the previous geographical literature on urban neighborhoods and localities (e.g., Aitken, Stutz, Prosser, & Chandler, 1993; Coombes, 2000; Schnell, Benjamini, & Pash, 2005), it seems that many residents in many situations will apply at least partly goal-derived or heuristic models of place, rather than taxonomic ones like administrative defintions. Furthermore, locations considered to be 'good examples' may sometimes tend towards a characterization (e.g., fulfilling a specific function) rather than a spatial or semantic centre. Having established tentative evidence that places may thus work like semantic categories of locations, the next question is what aspects or criteria of similarity might be involved, particularly when judging the membership (or not) of borderline cases.

If individual locations can be judged as more or less good examples of a larger place, a further question is what happens at the edges where vagueness is already known to occur. Could peripheral locations sometimes be 'in' but in other contexts 'not in' the place at all, as apparently happens with categories (McCloskey & Glucksberg, 1978; Verheyen, Hampton, & Storms, 2010)? This experiment was designed to test this aspect of categorisation, again as applied to locations within larger neighbourhoods.

Hampton (2007) hazarded three potential ways in which categorization of an instance (e.g. an object) might vary with context within the same individual: changes occurring in either (a) the representation of the instance; (b) the representation of the category; or (c) the threshold of similarity required to categorize the instance into it. Hence the same person could classify the same entity differently due to circumstance – sometimes into one category, and sometimes into another – creating the effect of vagueness. Hampton also argued that if people consider vagueness acceptable, perhaps reflecting social constraints, then the same person may be aware that they could classify a given instance as both "X and not X" – a result which he claimed was difficult to represent in the fuzzy logic often used to model vaguely bounded entities.

Clearly, any such uncertainty or instability in the overlap between places is a crucial outcome for any attempts to map what is often termed *vernacular* geography - the places known to and named by local people, but not recognised within administrative digital data. A non-overlapping and non-context-sensitive data model is unlikely to reflect local people's reality if individuals' place classifications even vary *within themselves*. We need to be know whether to build an understanding of contextual factors into predicting a location's place classification.

Meanwhile, semantic memory research since the 1980s has also suggested that, if anything, we may use ideals for more types of categories than Barsalou predicted – sometimes even for natural-kind categories that are obviously taxonomic such as trees or birds (Burnett, Medin, Ross, & Blok, 2005; Lynch et al., 2000). Furthermore, certain types of expert in those studies seemed to rely on ideals (fitness for purpose rather than similarity) much more than the novice student participants used in many laboratory studies. Yet different types of expert (e.g., professional landscapers versus taxonomists) will apply different ideals, and at the highest expertise levels personal familiarity may have a greater impact than any central tendency (Johnson, 2001).

However, professional expertise is typically applied only within a professional context. Experts may be able to think more as non-experts do within everyday contexts. Thus we might expect to see within- as well as between-subjects differences in the effects of expertise on place judgments, when contexts change.

Therefore, this second study tested the location-within-place decisions of the same group of formally trained geographic experts under different circumstances, to see whether changes of context and role could indeed affect 'in' versus 'not in' place decisions for even these professionally constrained individuals. If participants showed substantial variations in their decisions under different circumstances, then this would suggest that places' spatial vagueness relates both to inter-individual differences, *and* to variations in judgment within each person. If a person is professionally trained, they might be expected to make more consistent decisions than others might, so using surveyors was a 'hard' test of this hypothesis.

This time, to avoid the potential artifacts or demand characteristics created by imposing pre-specified places, locations and descriptions upon participants, expert participants were asked to imagine places they knew well themselves. They were to place themselves in varying imaginary role and task contexts, while considering the criteria they might use to judge a location's neighborhood membership.

Our first experimental hypothesis was that a more formal expertise-demanding scenario - having to define the boundaries of a suburb so that it could be labelled appropriately within official national mapping data - would alter the relative weighting of the criteria used for individual location-categorizing judgments: the experts might then be swayed by more formal factors than when judging a location for informal or personal reasons. This within-participants finding might thus echo previous between-participants findings (Bailenson, Shum, Atran, Medin, & Coley, 2002) concerning expertise effects in categorization of birds. Thus we expected an interaction between the effect of varying scenarios and decision motivations on the relevance of different criteria to place decisions.

However, our second hypothesis was that, across the scenarios, certain potential criteria for naming a location would always be preferred over others. If assigning locations to a place is like semantic categorization, then the latter literature predicts that some category features will be prioritised over others even though all might sometimes be relevant. Thus we would expect a significant main effect of differences among criteria in their relevance to surveyors' judgments, regardless of the scenario (judging placement professionally versus for personal usage), and regardless of whether the decision aimed to include or to exclude locations from a place. If we were instead to see little consistency in criterion preferences across scenarios and decision types, then it would be difficult to apply standard categorization models to geographic knowledge. Instead, it would imply that different contexts (tasks and populations) would invoke very different choices about the same places. This would fit with previous findings concerning categorization of natural kinds (Medin & Atran, 2004; Medin, Lynch, Coley, & Atran, 1997), but would make it hard to model any consistent sense of local places.

Third, if Hampton was correct, then people could categorise the same item (location) both as 'in' *and* 'not in' a category (locality) depending on circumstance and based on flexible weightings of relevant factors. Thus we might see different criteria prioritised when one was motivated to *include* a given location in a place, than when one was considering reasons to *exclude* it - i.e., an interaction of decision type with criterion - which could even be a three-way interaction if these choices also depended on the task scenario. If not, then simultaneous 'in and not in' judgements may be less feasible; people may after all be fairly consistent in locational categorization decisions.

3.1 Participants

22 professional field surveyors working for Ordnance Survey, the national mapping agency of Great Britain, took part in the experiment. These surveyors (19 male, 1 female and 2 undisclosed; median age group 45-54 years) worked mostly from home and were spread geographically across the country.

Although formally authorising and recording place names and extents is no longer a part of this role (and the importance of the role itself is shrinking over time relative to other forms of data collection), all but one of the surveyors were experienced enough (mean experience=28.5 years, s.d.=9, range 8-38 years) to remember having had to do it formally in the past, and/or to have more recently done it informally as part of general updates of mapping data. Most of them also used the questionnaire to express their views and ideas on the organisation's ongoing issues with, and potential means of collecting, place information. This was therefore a highly motivated, as well as deeply expert, participant sample.

3.2 Materials and Procedure

A paper questionnaire was distributed via organisational channels, which participants completed in their own time and mailed back to the researcher. Following initial briefing and instructions, the questionnaire booklet had three independent sections, whose order was counterbalanced between participants - making six versionst. Each section had a page of context-setting (mostly open-ended) questions, then two sets of Likert rating-scale items. Participants were instructed not to look back to previous sections while completing later ones.

The 'Work' section's first page focused on the surveyor's work context, asking questions about their role, length of experience, current and previous geographical regions, and experience and views concerning collecting place names and extents. The participant was then asked to name a town where they had done some surveying, but which they did not know very well, and asked whether they had ever had to collect placename information there.

On turning over the page, they were asked to imagine that they were trying to decide if a certain location in the town fell within a particular named neighborhood. 13 potential criteria were then listed, beside Likert rating scales[2] from 0-5 where 0 was labelled "Not at all" and 5 was labelled "A lot". Participants had to circle a number for how much each criterion would help them decide that the location fell within the neighborhood. (Participants could also write in and rate their own criteria although few did so[3].) The next page asked them which of the criteria (now in a different randomised order) would help them to decide that another location was *not* in the neighborhood.

The 'Home' section was similar, except the initial questions referred to the surveyor's own home area, asking them to name their town, state their length of residence there, and name a neighborhood within it that they knew very well either from living or visiting it. They were asked to think of and name two locations or features near the

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[2] Piloting had suggested that a longer scale would not be meaningful, and would be too fatiguing for this many questions.

[3] 9 of the participants added (at the most) one or two extra criteria for one of the scenarios – too few to analyse. They included (no. of participants): local government officials' views (2); local residents' views (2); neighborhood names appearing on streetname signs, as in some post-war UK 'new' towns (2); the location being visibly dominant or spatially central within the neighborhood (3); thematic groups of related street names (1); being on a different bus route from the rest of the neighborhood (1).

edge of that neighborhood, not necessarily near each other. For each location the participants indicated their confidence (0-10) that the location was within the neighborhood, and the percentage of local people whom they thought would agree that it was. Then, similarly to the 'Work' section, the next two pages asked participants to rate different criteria for their usefulness if one wanted to argue to include one location within the neighborhood, and again if arguing to exclude the other location.

The 'New Area' section asked the participant to imagine moving home to a new area, and to consider the problem of evaluating what estate agents told them about a given house being within a desirable neighborhood. Participants were initially asked how recently they had moved home; in the 'in' and 'out' criteria-rating pages they were asked to imagine firstly trying to find evidence that a house did fall within a desired neighborhood, and secondly that an estate agent was 'stretching the truth' about another house that was not within it. Once again, the same 13 randomly-ordered criteria were presented for rating in each case. After the above three sections were presented in a randomised order, a final page debriefed participants as to the study's purpose, and invited additional comments.

The questionnaire thus represented three independent within-participant variables: 'Scenario' (work, home or new area); 'Decision' (in versus out of a given neighborhood); and 'Criteria' (the 13 potential factors that could be used to decide how to place the located house or other feature). The dependent variable throughout was the rating given by participants on the Likert scales.

3.2.1 Criteria

The 13 criteria for judging neighborhood membership were described in full sentences within the questionnaires, but are presented in slightly shortened form here for ease of reference:

A. Right/wrong side of a physical barrier e.g. road or embankment
B. Same/different administrative, electoral or school district
C. Neighborhood name does (not) appear in Royal Mail official address
D. Named this way (or not) by real estate agents or property developers
E. Always/never referred to this way by local people
F. Mentioned (or not) using this name in the local media, tourist or other local information
G. Name (dis)similar to that of the neighborhood
H. Close to/far from a key feature e.g. shops, church, park, main street
I. Close to/far from the placement of the name on maps
J. (Dis)similar visual appearance to the rest of the neighborhood
K. People in this neighborhood like (or don't like) to be associated with it
L. Same/different function/use as the rest of the neighborhood
M. Age or other sense of belonging to/differing from it

These criteria partly reflect the known literature on place cohesion (S. C. Aitken & Prosser, 1990; Beguin & Romero, 1996; T. Lee, 1968; Martin, 2003; Schnell et al., 2005; Talen & Shah, 2007), and partly known (and partly British-specific) issues which had been identified in previous research (Davies et al., 2009). These included the Royal Mail's use of some locality names in their official address designations, and people's

frequently stated reliance on Ordnance Survey (OS) maps for reference as an assumed 'correct' source.

It will be noted that criteria A-C imply crisp and definitive 'in/out' factors, and thus preclude any sense of graded membership. As suggested earlier, we might expect formal geography experts to prefer these criteria, particularly when working within their professional context. Criteria D-G are dependent on potentially variable use of the neighborhood name by other people, generally in non-definitive contexts, and thus evoke Barsalou's (1985) idea of 'frequency of instantiation': the more often the location is nominally included within the neighborhood by other sources, the more this inclusion may be assumed. Items H and I concern central tendency: potential distance from an imagined spatial core or prototype. Items J-M involve non-spatial factors that evoke some kind of 'ideal'. For example, as seen in Study 1, a beautiful historic house, church or monument may be seen as the epitomy of an older neighborhood, without actually being at all typical of it.

3.3 Results

A three-way (3 Scenario x 2 Decision x 13 Criterion conditions) repeated-measures ANOVA[4] was conducted using SPSS, applying Huynh-Feldt correction for non-sphericity (Abdi, 2010; Haverkamp & Beauducel, 2017).

Criterion	Marginal mean rating (standard error)	95% CI lower bound	95% CI upper bound
A. Physical barrier	3.56 (0.15)	3.25	3.87
G. Name match	3.24 (0.13)	2.96	3.51
B. Administrative district	3.20 (0.24)	2.70	3.69
F. Media, tourist or other information sources	3.10 (0.19)	2.70	3.50
I. Map name placement	3.10 (0.21)	2.66	3.54
H. Close to key feature	3.04 (0.16)	2.70	3.39
C. Royal Mail address	3.06 (0.19)	2.66	3.45
E. Local people's usage	2.98 (0.19)	2.59	3.38
D. Property (real estate) agents/developers	2.81 (0.18)	2.43	3.19
K. Local desirability	2.62 (0.18)	2.25	2.99
M. Age/belongingness	2.58 (0.20)	2.16	3.01
J. Visual appearance	2.31 (0.20)	1.89	2.74
L. Function/use	2.30 (0.19)	1.90	2.70

Table 2. Marginal mean estimates for the thirteen criteria, across scenarios and decisions.

The largest effect in the analysis was the main effect of Criterion, which was significant as hypothesised: $F(5.2,108.9) = 5.92$, $p < .001$, $_p\eta^2 = 0.22$. This implies that the 13 criteria apparently did vary in their perceived relevance, irrespective of the scenario and whether the decision was motivated to include or exclude the location - see Table 2. The largest marginal mean difference in ratings between any two criteria was between the relatively highly-rated criterion A (physical barrier) and the relatively

[4] Careful consideration was given to the analysis approach. Although occasionally authors argue that Likert-scaled data is best suited to non-parametric analysis (Liddell & Kruschke, 2018), others show that where the scale implies continuous incremental measurement rather than separately named ordinal categories, and at least 5 scale points, parametric approaches can still be suitable (De Winter & Dodou, 2010; Harpe, 2015). Mixed linear modelling was also considered, but this is considered unreliable for small samples with relatively large numbers of repeats (Haverkamp & Beauducel, 2017).

low-rated criterion L (function/use), with a mean difference of 1.26, s.e. = 0.22, p = .001, CI 95% [0.36, 2.16].

The other two main effects, of Scenario and Decision, were small and non-significant overall. For Scenario, $F(2, 42) = 1.14$, $p = .33$, $_p\eta^2 = 0.05$. For Decision, $F(1, 21) = 1.54$, $p = .23$, $_p\eta^2 = 0.07$. Similarly, the two-way interaction between Scenario and Decision, disregarding Criterion, was also non-significant: $F(1.73,36.32) = 3.06$, $p = .07$, $_p\eta^2 = 0.13$.

However, there were significant two-way interactions between Criterion and Scenario ($F(16.52,346.94) = 4.23$, $p < .001$, $_p\eta^2 = 0.17$, see also Figure 3) and between Criterion and Decision ($F(12,252) = 3.26$, $p < .001$, $_p\eta^2 = 0.13$). The three-way interaction was also significant as hypothesised: $F(13.85,290.96) = 2.83$, $p = .001$, $_p\eta^2 = 0.12$.

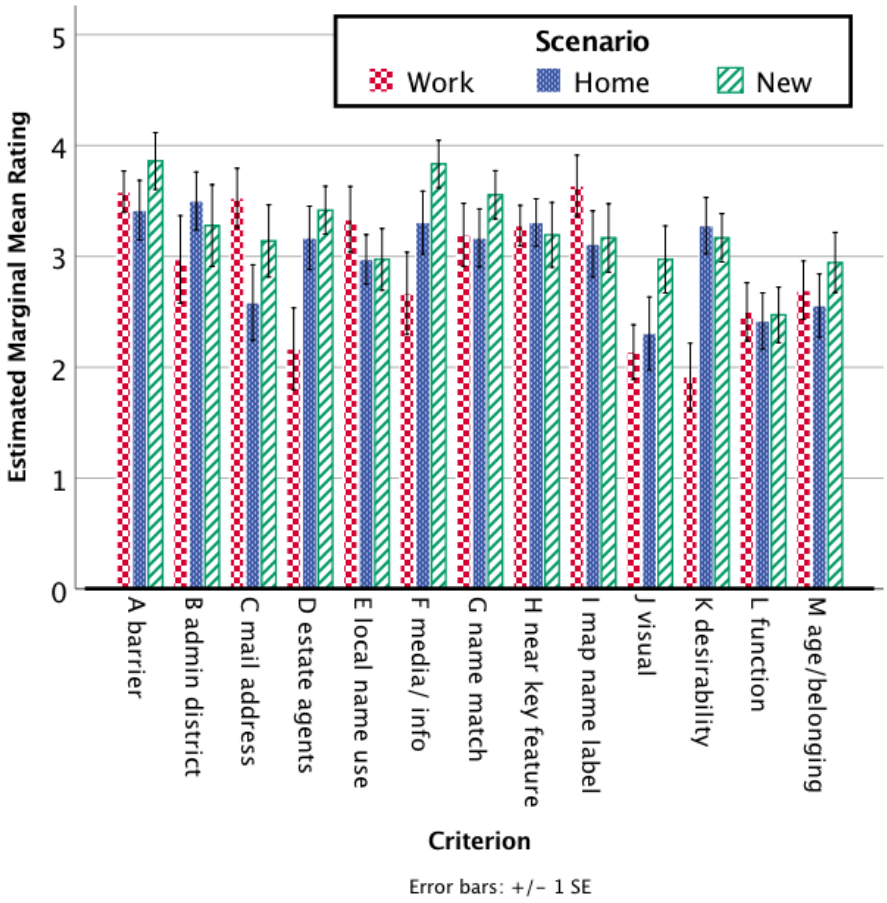

Figure 3. Variations in mean criteria ratings for the three scenarios, disregarding decision focus. (Error bars represent 1 standard error.)

As an illustration of the complex three-way variations in the data, Figure 4 shows separate Scenario x Decision (raw) mean graphs for the three criteria whose mean rating varied the most between conditions. These were criteria C (Royal Mail postal address), E (locals' tendency to include the location) and K (matching perceived desirability). The three graphs vary considerably in profile, while the error bars (again showing 1 standard error) remind us that there were also quite wide individual

differences among the surveyors[5].

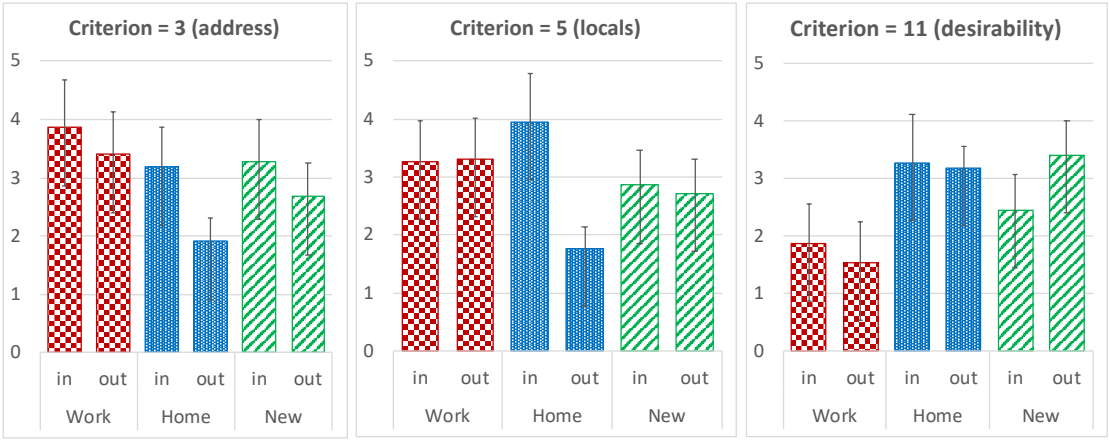

Figure 4. Graphs showing the variations by Scenario and Decision of the three criteria with the widest range of mean scores. (Error bars again represent 1 s.e.)

3.4 Discussion

Clearly, despite the surveyors' homogeneous roles and formal professional training, they displayed a clear recognition that a building or location can be included into a larger neighborhood based on of varying criteria, and similarly excluded when so motivated. Table 2 and Figure 3 show that in general, across scenarios, this participant sample tended to prioritize crisp boundary information (criteria A to C) and centrality (criteria H and I) in deciding about a given location. This makes particular sense within their 'work' context, given a professional concern with creating clear cartographic information.

Figure 3 shows quite clearly that the criteria which might be thought of as representing a neighborhood's 'ideal' (J to M) were among the lowest rated across decisions and scenarios, thus differentiating this participant sample from the non-expert local residents of Study 1. For this context, then, expert categorisation does not seem to lean on ideals so much as on more formal and authoritative definitions. This is unlike the experts studied by Lynch et al. (2000) but more similar to tree taxonomists and US (but not native-culture) bird experts (Bailenson et al., 2002; Medin et al., 1997).

At the same time, the relatively high ratings of criteria F and G showed that information from external sources, such as a common name or a media reference, could also influence the categorization. This fits our general understanding of categorization in other domains: e.g., people accept that tomatoes are defined as a fruit based on expert instruction, despite using them mostly in savoury meals.

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[5] There were just six (apparently random and accidental) missing ratings out of 1716 item responses. Given the unavoidably small size of our expert sample, and the way that SPSS drops participants 'listwise' in repeated-measures ANOVA, we imputed the missing values with the series mean to avoid losing data. Meanwhile, participant 7 circled all zeroes for the 'new home - out' condition, commenting that he would care more about the house than its non-membership of a neighborhood. The ANOVA was rerun three times, to exclude the imputed missing values or participant 7 or both. In every case the pattern of findings was exactly as above, except that excluding participant 7 made the two-way Scenario x Decision interaction reach significance: $F(1.46, 29.18) = 7.90$, $p = .004$, ${}_p\eta^2 = 0.28$.

The chief overall finding is that the relative importance of different criteria did vary greatly across contexts, even though the participants were having to merely imagine those contexts rather than actively perform a categorization. From Figures 3 and 4 it is clear that the professional task of identifying the neighborhood to which a landmark or location belonged involved weighting various criteria quite differently than the two more personal scenarios. For 'work' but not for 'home' contexts the surveyors prioritised physical and formal sources of information above more subjective criteria, such as an area's visible character and perceived desirability. Similarly, trying to establish a location as within a neighborhood seems to have been viewed differently from the decision to exclude it, although again this varied with criterion type and the imagined scenario.

In Victorian times locality names and boundaries were obtained through surveyors asking only relatively well-educated locals to define them - which created most of the present cartographic labels on British maps (Harley, 1971), However, the present results suggest that this approach may have resulted in cartographic name labels that never represented ordinary locals' knowledge of their neighborhoods, but only those of the far rarer educated professionals. Even with digital online data collections, this representativeness problem - who has contributed to the data and who has not - still has important implications for modern-day data capture and modelling of places (Caquard, 2014; Purves, Edwardes, & Wood, 2011). Of course, it is also important to replicate key findings like those above, before using them to guide the choice of theoretical and computational models of place categorization.

4. General Discussion

These two studies' findings imply that urban neighborhoods - and perhaps by extension other places such as cities themselves or distinctive rural areas - may indeed be treated cognitively as semantic categories of locations, complementing (and sometimes contradicting) their spatial definitions, and helping to explain why the latter tend to be vaguely bounded. The two studies between them illustrate several of the same features of categorization as earlier studies of natural and non-natural kinds of object. Obviously, much more needs to be done to figure out the (potentially varying) structures of place categories under different circumstances, but there is exciting potential to apply insights from the human semantic memory literature to place understanding.

Two important limitations of this set of studies concern (1) our inability to abstract general principles from these findings to the conceptualisation of *all* places (rural, wilderness or urban places of different size and type such as whole cities); and (2) the fact that the above has demonstrated only certain aspects of categorization and category structure. Regarding (1), geographical information (GI) research has partly validated the current approach by showing that in both online and offline text sources, the names of vaguely-bounded places tend to co-occur with the names of specific landmarks or locations within those places' bounds, for both urban and rural or wilderness places (Edwardes & Purves, 2007; C. B. Jones et al., 2008; Purves, Clough, Joho, & Jones, 2005). 'Grounding' named places as collections of member locations with distinct semantic characteristics can thus offer a (literally!) conceptual model for the work on place in environmental psychology and in human(ist) geography (Devine-Wright & Clayton, 2010; Purves & Derungs, 2015).

Regarding our second limitation (2), although these findings omit some key aspects of categories such as hierarchical structure and the presence of a 'basic level' in place categories (Murphy & Lassaline, 1997), various work in geography and GI has long suggested the presence of both phenomena (Edwardes & Purves, 2007; Hirtle &

Jonides, 1985; Lloyd et al., 1996). Certainly, from the above evidence we can tentatively conclude that places are locational categories which are fuzzy, influenced by context and expertise, and at least sometimes driven by functional 'ideal' concerns as much as by central tendency or physical/spatial similarity.

Therefore, these initial results suggest that we name and categorize areas of large-scale space into places, in the same way as we group objects and other phenomena. Presumably this occurs for exactly the same obvious reason: it greatly simplifies our reasoning and language. In large-scale space, precise metric measurement is impossible without technology. Before that existed (and whenever it is absent, as in everyday life until very recently), humans have had to cope with approximations of distance and direction, and to organize and communicate about space partly through grouping and naming key locations. This required fuzziness and flexibility in spatial reasoning and language, supplementing our internal spatial coordinate systems - such as place and grid cells - with our far vaguer notions of place.

Arguably, as with physical objects, our categorisation of space is also largely socially learned via exemplars rather than sharply defined: somebody tells us that a certain building is "in Ashwood" and "not in Birchfield", just as we learn (as children) that Mrs Brown's poodle is a dog but our brother's hamster isn't. Inevitably, this learning via exemplars often fails to define a sharp, unambiguous line between two categories or places, despite encountering occasional disagreements and more formal distinctions. Places such as neighborhoods are thus *semantically* vague in people's minds just like many other concepts. People can name fairly consistent characteristics of a place (e.g., features and functions, types of people and experiences), as our pilot participants did prior to Study 1, yet this often would not sufficiently differentiate it from others even if those characteristics' spatial distributions were fully known (and of course, some are unknowable).

Of course, places are often also *spatially* vague. This can occur because of the above semantic vagueness, making it hard to pin down what a placename means to each person - let alone across individuals. It may also occur because the distributions of even the characteristics which *do* differentiate neighbouring places (e.g., poverty, housing density, aesthetic considerations) often change gradually rather than sharply across the space. Thus a place may be subject to Sorites' Paradox in two ways at once – semantically and spatially (Fisher, 2000). Yet a place such as a neighbourhood might still appear spatially vague even if all its key characteristics were to change sharply, but did so at slightly different boundary streets or other points so that people's spatial delineation could change with perspective, knowledge, context or task - as we saw above that it can indeed do.

Thus many familiar places are both semantically and spatially defined to some extent, yet are bound to remain vague in both respects. However we achieve it, the key application challenge is to use these cognitive insights to build more humanly realistic place understanding into predictive spatial models, finally relating them back to the humanistic literature on concepts and meanings of place.

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