Spatial familiarity as a variable in cognitive mapping

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Abstract

Cognitive mapping and spatial familiarity are intuitively intertwined. Cognitive mapping refers to our knowledge about the world around us, and the methods we use to store and use such information. The places we are most familiar with are inherently likely to be those best remembered. Spatial familiarity is though more multifarious than simply 'how well a place is known' needing surrogate measures to become operational. These surrogates include name identification, locational knowledge, interactional experience, visual recognition and knowledge about places. Because of these definitional and operational problems the using spatial familiarity as a variable in cognitive mapping research is more complex than originally thought. This paper explores this potential multidimensional nature to discover how best to make spatial familiarity operational for cognitive mapping studies.

Cognitive Mapping

One of the fundamental human needs is the need to know about the world around us. To do this we need to organise in our minds an understanding of the world in which we live. Each individual possesses a unique comprehension of the world around them and the cognitive mapping abilities to organize and interpret their knowledge. Cognitive mapping concerns the study of these abilities; how we consciously and more commonly sub-consciously acquire, learn, develop, think about and store data relating to our everyday geographic environment, and the actual knowledge we acquire.

Liben (1981) uses three terms to describe cognitive mapping. Spatial representation refers to our cognitive map knowledge base and reflects the world around us as we believe it to be. It is a synthesis of different types of information (visual, auditory, olfactory and kinaesthetic) and experiences. This knowledge base can be divided into three main categories: Declarative knowledge is the mental database of specific spatial features; procedural knowledge are the rules used to synthesize this knowledge into information to facilitate and action; and configurational knowledge is the associations between, and relative locations of places (Golledge 1992). The cognitive map (spatial thought) is a hypothetical mental construct (Kitchin, 1994) and is the cognitive map knowledge currently being used in working memory to perform a task. The externalized representation of this knowledge, either as spatial behaviour or in another form, is called the spatial product and may be different from the cognitive map because of our inability to communicate our thoughts and knowledge.

Cognitive mapping researchers by using controlled experiments aim to determine the constituent components and the amount information known; the factors that affect what is learnt and remembered; the processes used in thinking about geographically based tasks; how our knowledge is stored (structure) and in what form (e.g. images or words). Cognitive Mapping though, in recent years has become less popular as a geographic research area especially in Britain, as behavioral geography, its main theoretical anchor, has lost ground to other philosophical traditions. In psychology and planning it has remained a relatively productive research area. There are some quite persuasive reasons for geographers to study cognitive mapping not least its basic appeal to understand how and why we behave in space as we do. Other applications include the planning of environments that are easy to remember; improving the teaching of wayfinding and orientation skills and general classroom geographically based exercises such as map reading; improving geographic material so they are more easily understood; and improving the databases and interfaces of geographical information systems (GISs) (Kitchin 1994).

Spatial familiarity as a cognitive mapping variable

There nine main groups of variables that can affect cognitive mapping ability:

1. Environmental deterministic sources (unalterable) e.g. general physical topography, objective distance.
2. Environmental deterministic sources (alterable) e.g. number of turns or intersections along a route, urban structure.
3. Environmental interaction sources e.g. familiarity, mode of travel, travel time.
4. Social circumstances and interaction sources e.g. Education, Socioeconomic status, media, social/verbal mediation, experience of map use.
5. Perceptual filters, perceptual context and anticipatory schemata e.g. senses, current emotional state, what you expect to find.
6. Characteristics of the mapper (determined) e.g. age, gender.
7. Characteristics of the mapper (undetermined) e.g. inner organismic factors such as beliefs, needs, emotions, personality, self-confidence.
8. Cognitive style e.g. how a subject approaches a problem.
9. The form, function, structure and contents of the information in the brain.

My research focuses upon the effect of gender and spatial familiarity on cognitive mapping abilities, especially configurational knowledge. Intuition and previous studies suggest that familiarity will be a major variable in configurational knowledge. You are much more likely to know where a place is in relation to other places if you are familiar with that place.

Spatial familiarity is a poorly defined term in the geographic literature and has received relatively little research attention. Intuitively spatial familiarity is interpreted as simply 'how well a place is known' (Chalmers and Knight 1985). It is though more complex in nature; difficult to identify and measure because it contains spatial and aspatial components. Familiarity, goes beyond just an awareness of a place as it also contains affective components such as feelings of warmth, safety and security which complicate its meaning. Some people claim to be familiar with a place if they know its name, others if they recognize images of it, others if they have visited or passed through a place frequently, and others if they know about a places geographic position or history. Due to this complex nature spatial familiarity is thought to be multidimensional (Gale *et al.*, 1990).

It is this potential multidimensional nature which makes spatial familiarity difficult to study and operationalize to use as a variable in other studies. Gale *et al.*, (1990) hypothesised that there were four dimensions of familiarity which can be used to aid research design by making the term operational. The first of these is the ability to identify a place by recognising its name. Knowing a place name though carries no spatial identity. Second is the ability to recognize a place when shown a picture of it. This requires no locational reference nor background information. The third type of familiarity is knowing where a place is located. This can be either egocentrically (in relation to one's self), topologically (relative to other places) or euclideanally (in relation to coordinates or another abstract system). Fourth, is being familiar through frequent interaction. A fifth dimension which Gale *et al.*, (1990) omitted is the familiarity gained through having additional knowledge about the place such as the history and current affairs and these can be acquired from secondary sources such as the media and education.

Testing the validity and reliability of spatial familiarity

In order to include this variable into cognitive mapping research its validity and reliability needed to be explored. Validity concerns the soundness, legitimacy and relevance of a research theory and its investigation. We have all asked the question 'is that a valid conclusion?'. What we are doing is asking whether what we are concluding is legitimate given the evidence. We are testing for validity.

In the case of spatial familiarity the construct validity needed to be tested. That is, determining whether the measurement techniques are measuring spatial familiarity as a whole, or slightly different components of a multidimensional construct. Reliability concerns whether something is consistent over time. In the case of measurement, a technique would be reliable if it produced a consistent result over a length of time. This does not mean it is a valid technique: it might not be measuring what it is supposed to.

Both Aitken and his associates (1990, 1993) and Gale *et al.*, (1990) have investigated familiarity treating it as a multidimensional concept. Gale *et al*'s., (1990) study, however, only used aggregated responses to compare the familiarity of different places. The current study further explored Gale *et al*'s., (1990) findings, examining issues of validity and reliability, variations and inter-dependence of responses across locations (i.e. when aggregated did places get the same ratings on all the tests) and individuals (i.e. did individuals alter their patterns of ratings on different tests), and individual response across all the measurement exercises (i.e. did individuals alter their ratings for the same locations across the tests). The tests were also examined to determine te existence of potential gender differences and the type of places mentioned. For the purpose of this paper only the issues of construct validity and reliability are discussed.

If spatial familiarity is a two dimensional construct then it would be necessary to use two sets of familiarity data (interaction and one of the combined dimensions) from respondents to determine the 'true' influence of familiarity upon configurational knowledge. The familiarity studies main aim was to determine if familiarity is multidimensional, but also to answer other questions regarding familiarity. First, are different surrogates measuring slightly different components of a multidimensional concept? Second, are the exercises reliable producing consistent results when compensating for time? Third, is there an aggregate continuous surface of familiarity across an area? Fourthly, do individuals living in a location for the same period of time have different levels of familiarity? Fifthly, what types of places are most familiar? Last, are there gender differences on any of the tests between how places are rated and individual familiarity, and the types of places mentioned on the free recall task? Only the first two questions are discussed because only these two questions need to be answered for the full study concerning configurational knowledge.

The study

The study used 150 first year undergraduate respondents, compromising of 77

males and 73 females resident in Swansea for a total of four months. Each respondent completed a set of five independently administered tests. In the first exercise respondents completed one of four tests which corresponded to one of the three familiarity operational surrogates (visual recognition, locational accuracy and interaction). All the respondents then completed all three of these tests repeating their first exercise test allowing the measurement of reliability.

The tests (table 1) followed the same format as the Gale *et al.*, (1990) investigation with a few minor alterations. In the Gale *et al.*, (1990) study the places used on the rating scales tests (2-4) were taken from test one (recall) using the places mentioned by more than 20% of the subjects. This provided the eleven best known places. For the purpose of this study 53 places were chosen by the author spread across the whole Swansea district (see figure 1) to represent a cross-section of the types of places (parks/beaches, pubs/clubs, civic buildings, entertainment related, sports related) mentioned by test one. The list deliberately contained places that it was thought would be well known, some that would be known by a proportion of the respondents but not all, and some that it was thought would be relatively universally unknown. This allowed a more complete study of familiarity rather than just places that were known to be familiar. This is important if we wish to truly understand the nature of spatial familiarity. The name recognition exercise was omitted because after completing the pilot study it was felt that respondents would recognize all the names from the previous ratings lists. The order of places in each exercise's listing were randomized to try and stop short term remembrance of the rating given on the previous exercise. This was thought necessary because we are interested in what each individual exercise is measuring, not that the respondent can remember the rating they had previously given. The rating scale consisted of a scale of 0 to 5, thus giving a choice of 6 categories. This scale was chosen because, firstly it is less than Miller's (1956) psychophysical category discriminability law (that is people can recognise seven categories +/- 2) allowing the data to be easily categorised. Secondly, there is no middle category thus reducing the tendency to use just the extremes and middle value. In the context of this paper the recall exercise is not discussed because it is not used in the configurational knowledge study where familiarity with specified places is required.

Are different surrogates measuring slightly different components of a multidimensional concept?

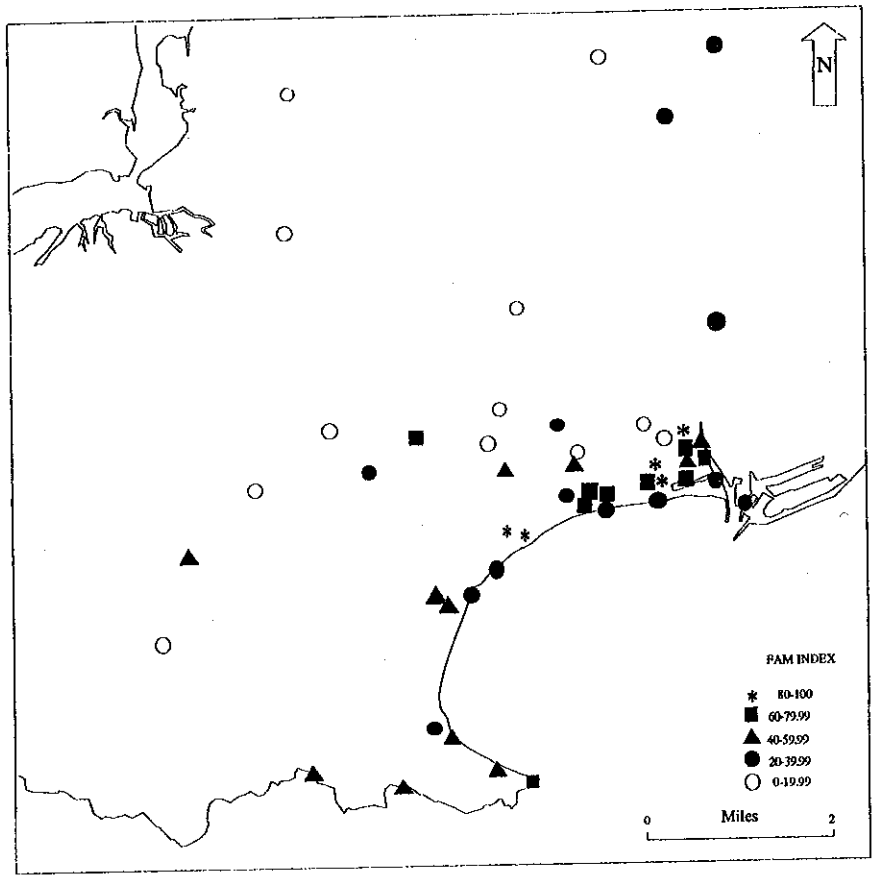
Gale *et al.*, (1990) found that when operational three of the operational surrogate were essentially collinear and were measuring similar dimensions. These were locational knowledge, visual recognition and name recognition. This means that

Table 1: The four exercises

	Exercise	Instruction
1.	Recall/Know Best (Recall)	List the twelve locations you believe you know best in Swansea (buildings, pubs, clubs, parks, beaches, shops, work place etc...). You can include anywhere you like. Do not list your residence.
2.	Visual Recognition (Visual)	On the scales below **indicate by circling** the appropriate number how easy it would be for you to recognize a photograph, picture or videotape sequence of the place at the left hand end of the scale. Award a value of 5 to the places you would recognize the **most** easily and a value of 0 to those that you **could not** recognize at all.
3.	Locational Accuracy (Map)	On the scales below **indicate by circling** the appropriate number how accurately you think you could place these locations on a map showing the outline of Swansea Bay. Award a value of 5 to those places you could locate **most** accurately and a value of 0 to all those places you have **no idea** where they are located.
4.	Experience/Interaction (Interaction)	On the scales below **indicate by circling** the appropriate number how much experience you have with the place listed at the left hand end of the scale. Experience refers to how frequently you see, pass by or visit the place. Award a value of 5 to those placed that are **most** experienced and a value of 0 to all of those places **never** experienced.

these measures are interchangeably and could be used to represent one and other. They concluded that there were two distinctive dimensions: interaction and a combined dimension. Aitken *et al.*, (1990, 1993) used these two dimensions of interaction and general familiarity in their investigation. They used an aerial

Figure 1: The locations used in the study and their place familiarity index



photograph superimposed by a transparent grid to estimate familiarity, asking respondents to estimate the number of times they visited (interaction), or how familiar they were (general), with each cell.

If spatial familiarity is a two dimensional construct as suggested by Gale *et al.*, (1990) and Aitken *et al.*, (1990, 1993) then it would be necessary to collect two sets of familiarity data (interaction and one of the combined dimensions) from respondents to determine the 'true' influence nature familiarity and for use in studies requiring a familiarity variable or control. To help determine whether

two measures were required tests 2-4 were coded and analyzed by constructing a familiarity index for each place on each test. This index used the ratings as weights, so that the more people that gave higher ratings the higher the index.

$$\textit{Familiarity Index of place } X=\sum\left(\frac{(W_1*R)+....+(W_n*R)}{N*W_n}\right)*100$$

where:

W	Weights corresponding to rating scale values of 0...n.
R	Number of respondents giving that rating.
N	Total number of respondents.

This index gives a value between 0 and 100 for each location regardless of the number of respondents and so makes it easy to compare the ratings given on each test. The indexes were ranked for each test and a Spearman's rank correlation test performed. Table 2 illustrates that places were consistent in rank across the tests and this is confirmed by the Spearmans rank correlation results where no correlation was below the value of 0.958 and all were significant at the 0.005 level (see table 3).

The Spearman rank correlation values indicate that there is a high association between the data and principal components analysis of the same data further reveals that for males 98.1% of the variance between the three exercises can be explained by one component. For females 97.5% of the variance is explained. This suggests that the three rating exercises although measuring slightly different facets of familiarity can be used interchangeably to give a basic measure of spatial familiarity. This means that only one of measure of familiarity has to be collected rather than two as suggested by Gale *et al.*, (1990).

Are the exercises reliable producing consistent results when compensating for time?

A sub-sample of 15 males who performed the map test in the first exercise ratings were compared to their ratings from the map test in the second exercise. It was thought that familiarity would not substantially increase in this time. The ratings between the top, middle and bottom ranked ten places were checked to see if they had significantly changed over the two week period. A Willcoxon ranked paired test revealed that there were no significant differences and thus it can be concluded that the exercise is a reliable test. A McNemar test of the data reveals though that of the data which had changed over the time period there was

Table 2: Rank of each place's familiarity indexes on each of the three exercises task.

MV	Male Visual Exercise	FV	Female Visual Exercise
MP	Male Place Exercise	FP	Female Place Exercise
MI	Male Interaction Exercise	FI	Female Interaction Exercise

Place	Tot	MV	MP	MI	FV	FP	FI
Geog. Dept.	1	1	1	1	1	1	1
Quad. Bus Stat.	2	3	3	2	2	2	3
Ritzy's Nightclub	3	2	2	3	4	3	2
Singleton Hosp.	4	6	4	5	5	7	6
Swan. Rail Stat.	5	4	8	4	6	6	7
UCI Cinema	6	7	7	10	3	4	5
Swan. Leis. Cent.	7	10	6	6	10	9	4
Student Village	8	8.5	9	11	7	8	8
Mumbles Pier	9	5	5	13	11	5	12.5
St. Helens Rugby	10	13	10	8	13	10	9
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
Dunvant Square	44	43	43	41	47	46	44
Dill. Leis. Cent.	45	42	48	45	45	45	45.5
Fairwood Hosp.	46	48	44.5	50	48	44	45.5
Ty-Coch Square	47	45	50	48	44	52	47
Swansea Sound	48	47	46	46.5	46	47	48
Cwmdonkin Park	49	49.5	49	43	53	51	51.5
Penyrheol Leis.	50	49.5	51	49	51	50	49
Cefn Coed Hosp.	51	52	47	51	50	49	51.5
Felindre Works	52	51	52	52	52	48	53
Lang. Country	53	53	53	53	49	53	50

Table 3: Spearman Rank Correlations of Place Familiarity Indexes

	Females r value	Males r value
Visual vs Map	0.977	0.972
Map vs Interaction	0.970	0.968
Visual vs Interaction	0.958	0.967

a significant change ($p > 0.01$) of rating from a lower to a higher value. This means that although the tests were reliable in those where there was a slight difference the familiarity rating was likely to increase rather than decrease as might be expected.

Testing the significance of spatial Familiarity

To test whether the spatial familiarity is a significant factor in configurational knowledge it was used a filter in conventional bidimensional regression of respondents configurational exercises. Respondents were asked to place 25 locations onto maps with varying information. This two dimensional data was then compared to the real world positions using bidimensional regression (see Kitchin 1993). This is a two dimensional equivalent to linear regression. Bidimensional regression was performed on all the respondents locations, and then on only those above a certain familiarity level. In this case 2 and 4. The r^2 values were compared to see if there was any significant difference using a 1 tailed t-test on paired data. The test revealed with 99% confidence that there is a significant difference when the familiarity filter was applied and that this change is from a lower to a higher r^2 value. Familiarity is therefore a significant variable. Only with extra analysis can it be determined if it is the most influential factor, but this seems likely.

Conclusion

The conclusions that can be drawn from this work is that spatial familiarity is a multifaceted concept which although difficult to define and operationalize can be successfully studied through the use of surrogate measures. These measures although measuring slightly different facets of familiarity are interchangeable and are valid and reliable measures of spatial familiarity. When used in cognitive mapping as a variable at a local scale spatial familiarity not unsurprisingly is a significant factor in determining how well the respondents performed in the configurational knowledge tests. Maybe more importantly though spatial familiarity can now be used as a control to test the significance of other variables such as gender and age. For example, if there was a significance difference between the sexes on the results gained from cognitive mapping exercise but not on the familiarity results then other factors must be influencing the cognitive map knowledge. Alternatively differences could be attributed to spatial familiarity if the sexes differed in this respect.

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What the Papers say: The effect of the media on perceptions of victimization and the fear of crime

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Abstract

This paper seeks to investigate the effect of the media on both the fear of personal crime and perceptions of which groups of society are at greatest and least risk from victimization. It is based on a questionnaire survey of more than 500 people undertaken in 1992 in Gloucester. As well as identifying any media effect, the influence of different forms of media was also considered.

Introduction: fear of crime and the role of the media

Following the 1967 US National Crime Survey, fear of crime was first identified as a separate issue from the incidence of crime. At its most basic level the fear of crime can be described as an emotional and physical response to threat (Maxfield 1984). It is considered to be related to a number of different factors, including gender and age (Hough and Mayhew 1983), and to previous contact, both direct and indirect, with crime. These factors shape an individual's perception of their own potential victimization and the potential victimization of others. Direct experiences usually take the form of personal experience, where the individual has been a victim. Conversely, indirect experiences are based upon secondary knowledge communicated through other individuals and the media. The fear of crime can affect our lives in many ways, for example our spatial behaviour. Valentine (1989), in her study of women's fear in Reading, noted that individuals integrate their knowledge, perceptions and experience of crime into their cognitive maps of an area, thus influencing their movement patterns.

The media acts as an important medium of 'indirect experience', providing us with secondary information concerning the risks which we expose ourselves to on a daily basis. The British Crime Survey (1982) suggested that fear of crime increases with the belief that crime is common place, and this is the impression that the media often portrays. The power of the media to influence fear of crime and perceptions of potential victimization, through biased reporting practices, has been recognised by the Grade Report (1989).

The media as an agent influencing fear of crime has been supported by Gerbner *et al.*, (1979) through empirical research. They conclude that 'the most significant and re-occurring conclusion of our long range study is that one