Navigation in Hypermedia and Geographic Space, Same or Different?

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Abstract: This paper presents both a theoretical analysis of differences between geographic and hypermedia spaces, and some experimental data comparing users' ability to navigate in hypermedia and in geographic space. Both the theoretical analysis and the empirical data suggest that navigation in hypermedia and in geographic spaces to a large extent are different kinds of tasks. In the final section some possible consequences for the design of interactive systems that follow from this analysis are presented, most importantly that since it has been shown that people differ both in their preference for presentation and representation of information, and in preferred cognitive strategies, designers of hypermedia information spaces should consider additional means of supporting users as a complement to present day map-like navigation aids.

Keywords: Navigation, hypermedia, cognitive abilities, cognitive styles

1 Introduction

With the growth of computer usage outside the universities engineering and computer science department and schools in the 80'ies, and especially with the advent of the Internet, a new user problem emerged. Users were 'lost in hyperspace'. In the new, large and widely accessible information spaces it was difficult to find the way around, to get back to previously visited pages again and so on. This was seen as a problem of *navigation*, similar to the problems we have when navigating geographic space. The basic assumptions behind the navigation metaphor was formulated by Kim and Hirtle (1995): "One approach to the problem, which we have found beneficial, is to compare navigation in the physical world with navigation in electronic worlds

This way of viewing the problem soon received widespread acceptance, and at CHI'97 a workshop was held on 'Navigation in electronic worlds" (Jul & Furnas, 1997). And while critical voices also were heard (e.g. Dillon and Vaughan, 1997), the navigation metaphor caught on, and today many web-sites support the users with 'site maps' and other tools inspired by this way of viewing the users' problems in large information spaces. And this has been of help to users. But, as pointed out by Lakoff and Johnson (1980), each metaphor hides more than it highlights. I therefore believe that the time is ripe now for taking a new look at the pros and cons of the navigation metaphor.

In this paper two aspects of the relation between navigation in geographic and hypermedia spaces are discussed. First, some similarities and differences between the two kinds of spaces are discussed, and second some results from empirical studies studying the relationship between users' navigation abilities in the two kinds of spaces is presented. It is concluded that the similarities between navigation in geographic and information space is not quite as large as has previously been assumed. In the final section some complementary aspects or views on users' problems in large information spaces are presented.

2 Geographic and electronic spaces

While most workers in the field stress the similarities between geographic and electronic worlds, it is as important to also note the differences. One important such difference is that geographic space has a stable Euclidean geometry, making spatial relations between objects stable and

permanent. Gothenburg will always be between Stockholm and Edinburgh. To a large extent this is true for VR systems, and especially immersive VR systems. This is not, however, true in a hypertext or hypermedia system, where new links can arbitrarily be created, making previously distant nodes adjacent to each other. In the following, I will only be concerned with hypertext and hypermedia spaces, and will not consider VR-systems.

For hypermedia spaces, we can note that the information in a hypermedia space is not limited to contents that have a natural spatial structure. There are at least three different cases here.

1. Information about geographic and similar information, e.g. tourist information about the hotels at a summer resort. Here there exists a real spatial structure that can be used by the users for structuring the information, and furthermore some of the information is inherently spatial in nature, e.g. the distance from the hotel to the beach.

2. Information about domains which are not real physical spaces, but which have some commonly agreed upon internal structure. Examples of this would be biological classification systems or educational systems (which often are described in terms of 'higher' and 'lower' education etc.).

3. Information about domains that do not have any commonly agreed upon internal structure. Examples of this are classification of different kinds of musical styles or classification of art.

It should be noted that for the last category there might exist consistent conceptual structures for sub-groups of users. And many competing such structures or worldviews can co-exist and even compete at the same time. In fact, the difference between the second and third category is very relative to a particular cultural perspective. All people that have received traditional Western schooling would probably agree upon at least the crude outlines of a biological classificatory system, but the Kaluli people on Papua New Guinea would probably not share this view. So in some sense we have not three but two distinct types. But the distinction between the latter two has an heuristic value when designing hypermedia systems for specific purposes, in making the designer forced to consider whether there exists a structure common to all the intended users, or if many different such structures need to be catered for in the design.

It is common to distinguish between the user's cognitive map of a design and its real structure. But for hypermedia systems we need also to distinguish between the inherent structure of the domain (in any of the senses described above) and the structure imposed by the designers of the system, or to put it differently, the *underlying structure* and the *presented structure*.

Another interesting classification is the one by Dourish and Chalmers' (1994) of three major modes of navigation, namely *spatial*, *social*, and *semantic*. Leaving the social navigation aside here, spatial organization, is obviously closely related to our ability to navigate in geographic space. The class called 'semantic' is based on conceptual and not spatial connections. But in many hypermedia systems, semantic connections are presented to the user partially using spatial connections, and even in those cases where this is not intentionally planned, the space presented on the screen has a spatial quality is can be used when the user navigates the space.

Electronic spaces usually lack one important feature of geographic space, namely the explicit or implicit information that we are progressing in the right direction. This is not only given us by route signs telling us that we have less distance left to our final destination. When walking in the forest in search for a good place to stay the night, preferably by some lake or river, we are presented with an abundance of cues possible to use for monitoring our task; the slope of the hill and whether we are walking up or down, but also the changes in the kinds of flowers growing on the ground, the kind of soil we are walking on etc., help the experienced hiker to find a way towards a suitable place for staying over night. But to what extent can something similar be used when navigating an information space? And if this cannot be done, how similar are really the two kinds of navigation?

3 Navigation and other activities

It is not only the space itself that is different between geographic and information spaces. Also the activities differ. If we are not geographers charting a new terrain, or if we are not tourists or for other reasons are out to familiarize ourselves with a previously unknown place which we want to learn more about, the task of navigation can in its purest form be seen as an activity to go from one place to another. And this activity is the same, regardless of the reason for reaching our goal; it makes no difference if we are going to the dentist or to the

movies or something else. The task of going from where we are to the goal remains the same.

But when navigating a hypermedia space, this is most often not true. If the reason for turning to e.g. a CD-ROM based encyclopedia is to find one particular fact (like the year of the first trip by man to the moon), the activities are rather similar. But in most cases of navigating hypermedia spaces, for instance when searching for information in preparation for writing a paper, we are more like the tourist or geographer in the examples above. It is not only the destination that is important, we are also interested in at least some of the information we find during the way. And in some cases it is even difficult to claim that there actually exist one particular goal in the space.

Some HCI-workers have tried to describe these different activities, e.g. Furnas (in Furnas & Jul, 1997) who distinguishes between two tasks (*searching* and *browsing*) and two tactics (*querying* and *navigating*).

4 How similar tasks?

Given these differences between geographic and hypermedia spaces, and between the activities in these spaces, we can ask ourselves how closely related are really the two kinds of navigation from a cognitive point of view, or, to put it differently, how good is the navigation metaphor for describing the users' activities?

If the two types of navigation are similar, we would expect a high correlation between the users' performance in the two tasks. And similarly, if the two types of navigation are similar, we would expect them to be using the same cognitive abilities in the users, and hence we would find performance in the two tasks to correlate with the same cognitive abilities. I would here like to present some data from two experimental studies addressing these issues.

3.1 Study 1

The primary focus of this study was to experimentally compare two kinds of navigation support, a verbal and list based versus a graphical and visuo-spatial one. But as part of the study, users' ability to navigate in the information space was compared with their ability to navigate in geographic space.

To measure geographic navigational ability, a revised version of a geographic orientation previously used by Gärling, Lindberg, & Mäntylä, (1983), and which has been shown to have a high correlation with actual geographic orientation ability in their and other studies was used. The participants were presented with the location of two well-known familiar places on the campus or in the city, and were then asked to indicate the location of a third place relative to these two. The dependent measure used was the distance from the given to the true position, since this combines both distance and angle information. Each participant received 5 such tasks.

The WWW-domain chosen for this study was the information site of the Swedish parliament (http://www.riksdagen.se). Three sub-sites were chosen (Information from the Parliament; How the Parliament works; The European Union). These three sites had a similar underlying structure, going four to five levels deep. The sites were downloaded on a local server to ensure minimal variations in time to display a new page on the screen for the users. Two dependent measures were used, time to find the required information, and the number of mouse clicks used to fulfil the task.

All users used all three versions in a repeated measures design. The correlation between geographic navigational ability was only significant in the no aid condition (time: $r = .53$, $p<.05$; clicks $r = .48$, $p<.05$). In the list condition the correlations were close to zero ($r = .003$, n.s. and $r = .16$, n.s.), and in the map condition they were non-significantly negative ($r = -.4$ n.s. and $r = -.37$ n.s.).

3.2 Study 2

The primary focus in this study was to study whether the often found correlation between spatial cognition and ability to navigate in hypermedia holds also for hypermedia spaces which does not have a natural or conventional spatial structure. In a repeated measures design, users performance in a visuo-spatial and graphical information space (a CD-ROM on ancient Egyptian history) and a verbal and list based information space (the help system of the FrameMaker word processor) was correlated with their spatial and geographic navigational ability. The dependent measure was in this case time to perform the task. As with the previous study, only the results from the correlations between users' navigation performance and their geographic navigation ability will be presented here. For measuring the geographic navigational ability, a method similar to the one in the first study was used.

The results on the orientation ability test did not show any correlation with the navigation in list based system. There was, however, significant correlations with navigation in visuo-graphical space (r=.316,

$p<.05$). In a separate analysis of the different tasks given to the users, the correlation was shown to be particularly strong in the task which put the largest strain on the users navigational ability ($r=.401$, $p<.01$).

Since there are possible intercorrelations between the orientation ability task and the users' spatial ability, their performance on the navigation tasks and the spatial ability tests used in the study were entered into a stepwise (forward) multiple regression analysis with time to solve the navigation task as dependent variables. The only variable entering the equation was the spatial test for image rotation ($R=.418$, $p<.001$), which suggests that when the spatial ability needed to perform the two tasks is factored out, no correlation between navigational ability in geographic and hypermedia space remains.

3.3 Summarizing the results

The overall result of these two studies can be summarized as follows: navigation in geographic space, at least as measured here, from a cognitive point of view, is to a large extent different from navigation in information spaces. There is no clear connection between peoples' ability to perform the two tasks. In the data presented here such a connection is only found in one of the cases.

If the information space is basically verbal and list-based, the two tasks seem completely independent of each other. And also in the case of visuo-spatial information spaces the correlations are not strong and, furthermore, seem to be dependent on a common underlying visuo-spatial factor.

5 Discussion

What the results from the empirical study as well as from the previous discussion of the similarities and differences between navigating in geographic and information paces seem to suggest, is that these two activities are not as closely connected as was previously believed. A corollary of this is that designers perhaps should consider also other ways of supporting users in addition to today's navigation support.

Space does not permit a lengthy discussion of possible ways of doing this here. But note that today's navigation support tools are adapted to users with high visual and spatial abilities, and hence users' performance in seeking information in hypermedia systems is correlated with the users' spatial ability (e.g. Dahlbäck, Höök & Sjölinder, 1996) and that work on cognitive styles (for an overview see e.g. Riding and Ranyer, 1988) suggest that one basic dimension that people differ on is whether they prefer to have the information presented and represented in a verbal or a visual/pictorial format.

Getting back to study 1, it is true that both the verbal and the graphical user support were effective in improving the users' performance, and that the graphical showed the best results. But note also that this is true for group averages, not necessarily for each individual user. And in fact, the rank order correlation between the participants performance with the two help tools showed no significant effect, suggesting that different users performed best with different support.

This, at least to the present author, suggests that it is time to consider the limitations of the navigation metaphor if we want to develop systems that are easy to use for all users, regardless of their cognitive styles and preferences, instead of 'just' supporting users with high visuo-spatial abilities.

References

Dillon, A and Vaughan, M (1997) "It's the journey and the destination": Shape and the emergent property of genre in evaluating digital documents. *New Review of Multimedia and Hypermedia*, 3, 91-106.

Dourish, P. and Chalmers, M. (1994) Running Out of Space: Models of Information Support. In *Proceedings from HCI'94*. Glasgow, August 1994.

Gärling, T., Lindberg, E., & Mäntylä, T. (1983). Orientation in buildings: Effects of familiarity, visual access, and orientation aids. *Journal of Applied Psychology*, 68, 177-186.

Jul, S., Furnas, G. (1997). Navigation in Electronic Worlds. *SIGCHIBulletin*, 29, 4 (Oct). New York: ACM Press.

Kim, H., & Hirtle, S. (1995). Spatial metaphors and disorientation in hypertext browsing. *Behaviour & Information Technology*, 14(4), 239-250.

Lakoff, George and Johnson, Mark (1980), *Metaphors we live by*. Chicago: The University of Chicago Press.

Riding, R.J. & Ranyer, S. (1998). *Cognitive Styles and Learning strategies.* London: David Fulton.