Chapter 1

Introduction: A Framework for Information Space, Personal and Social Navigation

Kristina Höök, David Benyon, Nils Dahlbäck, Rod McCall, Catriona Macaulay, Alan Munro, Per Persson, Marie Sjölinder, Martin Svensson

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This paper also serves as an overview of the other contributions in this volume.

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Abstract

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INTRODUCTION

Navigation seems to be a fundamental corner stone in many human-computer interfaces. We navigate among our files in our hierarchical file systems, we navigate in large information spaces such as the Internet, we navigate in MUD (Multi-User Dimensions) or VR (Virtual Reality) systems moving from ”room” to ”room”, etc. The purpose of this chapter in the PERSONA literature survey is to provide a framework for discussing various tools for navigation, both personalised and social tools, as well as discussing various aspects of the spaces where this navigation happens. This attempt at a framework will draw upon the definitions and discussions of all the other contributions to the literature survey, and will attempt to place those in a context. We shall start by providing some insights into what we mean by information space, and then discuss navigation in these spaces.

THE SPACE OF INFORMATION SPACES

We take the viewpoint that the concept of ”information space” covers a wide range of spaces ranging from the ”real” world, via augmented reality[1], VR, to hypermedia, hierarchical file systems, and databases, etc. These spaces vary along several different scales, and these variations will influence how easy or difficult it is for people to access, navigate, find pleasure, or work in them. The dimensions will furthermore influence what sorts of navigational or

[1] Augmented reality is when an information space is superimposed on the real world, as for example when we put up street signs or when we use route guidance systems in the car (see Höök, 1998, this volume). See also discussion in Dahlbäck, 1998, this volume.

orientation tools can be made available to users in the space. In summary, the dimensions we explore are:

- Euclidean properties
- Presentation of objects/relationships/people in the space
- Tasks allowed and performed in the space
- Pre-defined structure of the domain contained in the space
- Size and stability of the space
- Presence of other users and scalability
- Type of organisation of the space (spatial, social, semantic or narrative)
- Moderated versus non-moderated spaces
- Density, distribution, activity, occlusion, and accessibility
- Conceptualisation of objects/relationships/people in the space
- Activity space and information space

Let us discuss each of these dimensions in turn.

Euclidean properties

In the ”real” world, certain properties are more or less stable, which means that we can learn about the distances between locations, or relative positions of landmarks, and what we have learnt will not change (at least not rapidly). Stockholm will always be in Sweden – it will not move even if it might grow. This means that users of spaces with this property can make use of distance, direction and relative position. This is true not only for the real world, but works also, more or less in immersive VR, as well as augmented reality. In other spaces, such as hypermedia, relative position is not defined in terms of Euclidean distances, but will instead rely on other ways of measuring distance, relative position, etc. (see discussion in McCall, 1998, this volume). These ”made-up” measurements can be similar to distance (number of nodes traversed, etc.) but are different in that they must be learnt specifically for each of these spaces, and their organisation is not fundamental to our cognition in the same way Euclidean distances are. For a more elaborate discussion on Eucledian distances, turn to (Dahlbäck, 1998, this volume).

Presentation

Some spaces have a richer representation that may draw upon visual, auditory, and tactile properties, while others are poorer, and will only rely on abstracted representations that must mostly reside in the user’s mind. For example, in UNIX, users do not get any (visual, auditoriy or tactile) feedback on which file catalogue they are in at the moment unless they use a specific command to ask for the information. This means that users have to keep the structure of the file catalogues in their mind and remember where they are right now. Through externalising some of this information onto the interface (as shown in the work by Vicente and Williges, see (Höök, 1998 this volume)), users may be relived some of the burden of keeping track of where they are.

There are several ways by which information can be presented. As argued by Macaulay and colleagues (this volume), sound is one important channel that so far has been little used in the design of spaces and navigational tools.

As pointed out by Sjölinder (1998a, this volume) the space can be presented from three different perspectives: a *survey description* takes a perspective from above, *a route*

description takes the reader on a mental tour through the environment, and a *gaze tour* locates objects relative to other objects from a fixed outside point of view.

Tasks allowed and performed in the space

In some spaces, there is not much we can do, while others allow for a range of activities. For example, in a database space, we can search for information but not much more, while in a word processor we can produce information, organise it, etc. So in some spaces, navigation will be the most important activity undertaken by users, while in other spaces, navigation is just one aspect of what is going on.

Structure of the domain contained in the space

As discussed in (Dahlbäck, 1998, this volume), we must distinguish between three levels of organisation: the inherent structure of the domain, the structure imposed by the system designers, and finally the cognitive map the user has of the two and their relationships. In some spaces, it will be easy to make the domain structure also organise the whole space as presented to users of it, e.g. in an augmented space, the psychical location of objects can be used as places where the information associated with those locations will be superimposed. In other domains, it is not possible or desirable to make the two structures into one. Some domains might only have a very weak inherent structure, e.g. a collection of food recipes.

In (Persson, 1998a, this volume) the use of narratives as a means to organise and present information is proposed. Such an approach only works for domains that lends themselves to being structured in terms of a narrative.

In general, the domain properties are crucial in understanding how to organise an information space. Those properties are of course linked to why we approach the space, and the same domain may be organised in several different ways depending upon tasks, users, etc.

Size and stability of the space

The sheer size of an information space also determines how much it can be pre-processed or visualised in various ways (e.g. Ahlberg and Shneiderman, 1994). The stability of the space, how often it changes, is another important factor. Given a small, stable space, it is easy to invent maps, personalised guided tours, or have agents present the contents in an interactive way. But if the space is very large and keeps changing and very little can be known of how different parts of the space are and will be related to one-another, tools will have to look quite different.

Concerning Shneiderman's proposal that visualisation solves all our problems with information overflow, we would like to point at the fact that it relies on an assumption that the visual channel always is the most important one. But if we, for example, consider people who live in a jungle, they do not rely on sight – do not think in terms of overviews etc. They 'navigate' by attending visually to what is available visually, aurally to what is available aurally, using memory and narrative to construct spaces outwith the reach of senses or never before encountered. Pre-occupation with visualising means we want to try and take out temporality as an aspect of experiencing space. While when we experience a space through e.g. sound or via a narrative we are also experiencing it temporally. See discussion in Macaulay et al.

Number of users present

In some space, we are on our own. Still other users might have left information behind that we make use of. Munro (1998, this volume) argues that the organisation of a library is something given to us from people who have tried to make our search task easier. Svensson (1998, this volume) argues that indirect social navigation, for example, utilising social filtering, is another way other users may leave traces behind that helps us understand and navigate information spaces.

In some spaces, though, other users are more directly present together with us. Examples are MUD environments such as Palace, OnLive Traveler, etc. so-called inhabited spaces. Munro (this volume) discusses some properties of such spaces and how co-presence of users may enable/enhance subtle communication and coordination between users navigating the space of actions. Munro also discusses the issue of scalability when the space or number of users grows. This issue is also somewhat discussed by Svensson (this volume).

Type of organisation of the space (spatial, social, semantic or narrative)

In Svensson (this volume) and Persson (1998a, this volume) the organisation of a space is discussed. Drawing upon the definition by Dourish and Chalmers (1994), they find that spaces can be organised in three different modes: spatial, social, or semantic (this is also discussed by Dahöbäck (this volume)). Some systems embrace the *spatial* paradigm and structure the information according to some geographical, 'real space' notion. Another 'space' parameter that is attracting interest is *social navigation*, where the movement from one item to another is cued by the activity of another or a group of users. Probably the most common structure, however, is semantic organisation, where the objects in the environment are related through some semantic connection like *similar*, *alike*, *more/less general*, *associated*. To these three Persson (1998a, this volume) adds a fourth, namely a *narrative* organisation mode. The idea is that the nodes/islands of information are connected through a story that is communicated to the user.

This division may be likened to the differences in our cognitive understanding of instructions, as discussed by Sjölinder (1998a, this volume): semantic encoding and spatial encoding.

Moderated versus non-moderated spaces

Navigation – or rather the possibilities for supporting navigation – is strongly influenced by the extent to which the space has a coherent design, or whether it has grown without any control or moderation. In the former case, often called moderated spaces, it is possible for the careful designer to create cues helping the user to orient herself in the space, and being aware of the relationship between the present view and other locations. (See Persson, 1998b, this volume, for some interesting suggestions from cinema on this.) In non-moderated spaces, where no one is on control of the design of the individual nodes or places, nor of their interrelations, this is possible. In this case, navigators must construe their own understanding of the space, and the only possibility for doing so is often retrospective in nature. We should therefore be open to the possibility of design solutions only being applicable to one of these cases.

Density, distribution, activity, occlusion, and accessibility

Chen (1996) provide five different dimensions of spaces that describe how the objects are related to the space:

- density: amount of objects in the world

- distribution: spatial array of objects in the world
- activity: presence and mobility of objects in the world
- occlusion: visibility of objects in the world
- accessibility: whether subjects can reach the destination freely or if they are impeded in some manner.

Conceptualisation versus perception

But the presentation of a space only gives half the answer, as it is not concerned with the interpretation of the space. Missing form the traditional geographies is the failure to appreciate how environments are *conceived* by people as opposed to simply *perceived* by people, as discussed by Benyon (1998, this volume).

Activity space and information space

In Benyon (this volume) a distinction between activity and information space is made. Activity spaces, are the 'real' spaces of physical action, information spaces are those information systems (signs, etc.) that helps us plan, control, monitor and maintain the activity space[2]. We deliberately use the word 'view' instead of 'type' or 'kind' here, to emphasise that activity and information space are intrinsically related. In a socially inhibited world there is never one without the other.

The concept of and information space can now be understood by appealing to the notion of an information system – people, processes, events, activities, and information artefacts. An information artefact is "any artefact whose purpose is to allow information to be stored, retrieved, and possibly transformed" (Green and Benyon, 1996). They all employ symbols to provide information, and in doing so constrains and defines an information space. Thinking about information artefacts means concentrating on particular aspects of the object or device. You have to focus on what information is provided by the artefact and how that information is presented. We can also arrange information artefacts in a hierarchy of different viewports, i.e. windows to a particular sub-space or perspective of the information space.

NAVIGATION

Given our outline with the "space of spaces", we now have a better understanding for all the different situations in which navigation will happen, and the restrictions / possibilities that the properties of the space will give. But what do we mean by navigation? In the work presented here, we investigate two different approaches. One where we more narrowly define navigation (see also the discussion in Dahlbäck, this volume). The second approach takes a more overall perspective on navigation as a means to approach human – system communication in general, as discussed by Benyon (this volume).

Let us start by discussing the first approach.

NAVIGATION AS A SEPARATE ACTIVITY

Navigation is an *activity* undertaken by users in information space. This activity can be broadly divided into four different parts (following Downs and Stea 1973):

[2] Note that there is an interesting connection between the activity Vs information space and Dahlbäck's (this volume) action Vs interaction distinction. One is about the 'worlds', the other about the 'agents', but they seem to share at least large parts of an underlying perspective.

- orienting oneself in the environment,
- choosing the correct route,
- monitoring this route, and
- recognising that the destination has been reached.

This division covers a wayfinding activity, but as discussed by Benyon and Höök (1997), navigation is also comprised of *exploration* and *object identification.* When the destination is not known beforehand, the user is exploring the space. In that case, the ”destination” in the definition of Downs and Stea above can be thought of as an overall goal to explore the space. The user can undertake this exploration with a more or less definite goal in their minds, be it just for the pleasure of wandering in the space. In those cases, orientation will still be a relevant activity, as will monitoring the path travelled. In these cases there will not be a ”correct” route. Recognising that the destination has been reached will in an exploration task more be a matter of feeling that one has had enough. Sometimes exploration will turn into wayfinding, and vice versa.

In an object identification activity, the user is interested in the objects in the space, what they are, their layout relative one-another, or relative the overall space, etc. Again, out of the four activities outlined by Downs and Stea, orientation and monitoring of the route will be most interesting, while choosing the ”correct” route or recognising the destination are less important.

As noted by Höök and Svensson (this volume) a lot of research has focused on the activity of helping the user to choose the ”correct” route. More efforts should be spent on the layout of the space to allow for exploration and object identification. Orientation, recognition that the destination has been reached, as well as monitoring the route, are equally important activities. Sometimes a richer environment, including sound, tactile feedback, visual feedback, etc., would provide the user with more environmental clues supporting these activities, see (Macaulay et al, Munro, this volume).

Deciding on what the destination (or goal) is can be seen as a process going on between the user and the space (augmented with any tools to support the navigation). When seeing/hearing/feeling parts of the space the user can get a better grip of his/her own desires. As discussed in activity theory (Cole, 1996, Nardi, 1996), the tools mediate the users actions and the two should be studied together. Also, it is in the interaction between users, situations and space, that users attach meaning and understanding of space.

What is particular to navigation, that makes it different from other problem solving activities or in general interaction or dialogue with any system, is the activity of *moving* between locations/nodes (see discussion in Dahlbäck, 1998, Persson, 1998b, Svensson, 1998, all in this volume). Obviously, this will be an important aspect of many different kinds of interactions with the whole spectrum of information spaces (as discussed above). We navigate the action space of an application (see Benyon, this volume), we navigate a hypermedia structure, we navigate in a MUD environment, etc. But we also perform other tasks, such as building objects (documents, artefacts, etc.), solve problems (such as programming), etc., and in those tasks, navigation is but one aspect of our overall activity.

Sometimes it will be important that the user remembers the space after having used it, and then navigation entails recognition.

In summary, we view navigation as an *activity* where we *move* between *locations* / nodes. This activity may be subdivided into four different parts: orientation, route planning, monitoring the route, and recognising the destination. When the destination is known, the navigational activity is wayfinding, while exploration and object identification are navigational activities where the goal is not one particular destination.

So tools that support navigation should consider all these different activities. They should enhance the *quality* of the user's goal, be it getting to a destination, exploration or object identification, as well as *the pleasure / delight* induced by navigating the space (see also Höök and Svensson, this volume).

BEING LOST

So navigation is fundamental to our interaction with many computer applications as well as other information spaces. Unfortunately, navigation might be quite difficult: we get lost, it may induce spatial anxiety (see Sjölinder, 1998b, this volume), we sometimes cannot find whether the destination is even present at all in the space, some spaces keeps changing (such as the web), etc.

Furthermore we know that some people are ”more lost” than others (for a discussion on this, see Sjölinder, 1998b, this volume). These differences stem from individual differences (age, sex, cognitive abilities, personality traits) where some may be culturally dependant (see Sjölinder, 1998b, this volume, and Cole, 1996). Cultural differences in this context can be seen as individual differences arising out of different cultural (and socio-historical) experiences. As expressed by Frake (Frake, 1997):

”Culture provides principles for framing experience as eventful in particular ways, but it does not provide one with a neat set of event-types to map onto the world. […] Culture does not provide a cognitive map, but rather a set of principles for map-making and navigation. Different cultures are like different schools of navigation designed to cope with different terrains and seas. " (pp 44-45)

From a socio-cultural perspective we might also consider the view that there is no such thing as a stable entity ‘the individual’. Rather we might consider that individuals, cultural groups and differences are defined by context. Using this lens, human behaviour can only be understood in relation to its context (Cole 1996). Part of that context will arise from the socio-cultural-historical setting within which 'we' are situated. For example, feminist geographers have long considered the complex relationships between gender and space/place (Massey 1994).

AN EXTENDED VIEW ON NAVIGATION

This far we have, in line with current work by other researchers in the field, viewed navigation in electronic spaces metaphorically. We have just shown that there are a number of dimensions on which various geographic and electronic spaces differ, and which designers and evaluators of information system need to consider in their work. But instead of analysing the navigation metaphor, we can take a larger leap. If we go beyond the metaphor of navigation (Benyon, this volume), we see a potential for a radical re-thinking about human-computer interaction. Just as the paradigm shift in software engineering from a structured, functional approach to an object-oriented approach has brought significant changes to this discipline, so we may see a change in HCI. We shift from Direct Manipulation to Navigation in Information space. Direct manipulation places the user outside the computer system, distant from the domain. Navigation of information Space places the user inside the system, able to interact more naturally and more directly with the domain rather than the interface. We expect the philosophical implications of such a change to become clearer during the next phase of the project when we build and evaluate concrete examples of personal and social navigation and where we will look at the ramifications for both design and use of interactive systems.

SOCIAL AND PERSONALISED NAVIGATION

If we look at how users navigate in the real world, in cities, in finding information in libraries, in finding their way through buildings, in choosing which television program to see, in deciding which medical doctor to see, etc., we see that this is often done through *talking to other people*. For example, Streeter and Vitello (1985), found that travellers found their way to a destination by driving to the nearest gas station and asking for help. Jon O'Brien (pers.comm.) found that employees in an organisation found it more useful to search for persons than documents, despite having a nicely designed three-dimensional information space of all the documents. Andreas Dieberger (1997) analyses behaviour on the WWW in terms of following other peoples' advice and choices, for example through studying their bookmarks and assembled links. We name this strategy ”social navigation”, since it does not have to involve building a (mental) spatial model. Instead, social navigation relies on interactions with other people (for a more thorough discussion on this, turn to Dahlbäck this volume). Sometimes it means interacting with another person, sometimes it means studying what a large group of users does (see (Svensson, this volume) on direct and indirect social navigation).

There are several reasons why social navigation may be preferred over more spatially demanding methods. When we talk to someone else, the information we get back can be personalised to our needs. We are perhaps told a little bit more than exactly the information we asked for, or if the information provider knows us, the instructions may be adapted to fit our knowledge or assumed reasons for going to a particular place. The instructions are also adapted to the user in another sense in that they start from the point where the user is at, and is given in a sequential form (first go there, then go there…). Social navigation also has another quality, in that we can judge to what extent the directions given can be trusted depending upon the credibility of the information provider. If I am provided with information on how to find a particularly good definition of some concept from a well-known researcher in my field, I will probably follow the advice, while if the information is given by someone not in my field, I might not even bother to look it up. Yet another aspect of social navigation is the form in which instructions are given, it will frequently be given in a verbal, dialogue-driven form, rather than an abstracted spatial form (for a discussion on verbal versus pictorial/map descriptions turn to Höök, this volume).

Following groups of people, for example, going through an airport may also be considered as a form of social navigation, even if it does not pertain all the properties mentioned above. It does involve the matter of trust. It also provides the seeker with a sense of security: if all these people have chosen this route, it must be the right one. Awareness of other people and their actions may also be communicated and understood in a more subtle way as discussed by Munro (this volume).

The ideas for social navigation conform to what is known about cognition and interaction (see Sjölinder, 1998a, 1998b this volume).

DESIGN BASED ON SOCIAL AND PERSONAL NAVIGATION IDEAS

In the next phase of PERSONA we aim to design and implement some of the ideas around social navigation. Let us briefly present some of these design aspects.

Social navigation will not replace the need for well-designed information spaces and navigational tools that assists users in forming models of the space. It would be stupid to replace alphabetical order in a library with chaos just because there is a librarian that knows the way around the chaos, whom a book borrower can talk to. Furthermore, for some applications, the main task of the user might in fact be to understand the layout and

relationships in the space. Our goal is instead to broaden our view on the design space and include social navigation as one tool in the repertoire.

Underlying our design approach is that navigation should be a delightful experience, that part of navigation is goal formulation, and that we need to recognise the risk of making users anxious about getting lost or cognitively overloaded.

A design based on social and personal navigation ideas could take several different paths, e.g.:

- We can try to implement agents that provides users with advice and directions just as other people would (discussed by Svensson, 1998 this volume, and by Persson, 1998a this volume)
- We can design spaces so that we enable communication between users (as discussed by Svensson, this volume)
- We can draw upon some aspects of what makes social navigation successful and use those to build tools (discussed by Munro, this volume)
- We can adapt navigation using intelligent user interface techniques (discussed further in Höök and Svensson, this volume) (see also the discussion on individual differences in (Sjölinder, 1998b this volume)
- Awareness of other peoples activities, as discussed by Munro (this volume)
- Narrative organisation, as discussed by Persson (1998a this volume)
- Off-screen space, as discussed by Persson (1998b this volume)
- The use of soundscape for orientation, as discussed by Macaulay et al. (this volume)

Entertainment and navigation

The focus on narratives and entertainment is based on several tenets as well as reservations (Persson, 1998a, 1998b this volume). Trying to make the navigational experience more emotional, aesthetic or 'story-like' is of course a design end in itself. The, until recently, very 'toolish' conception of computers within the industry and public, is now more an more being replaced by the entertainment industry's notion of computers as 'pleasurable objects' (games, MUDs, chat environments etc.). But perhaps a turn to narratives and interface characters will also support those users with poor spatial ability, since story actions and emotional reactions will possibly be remembered better (than, for instance, spatial relations between landmarks). For sure, narratives and emotional experiences will disturb and hinder a user who has a clear goal and only want to use the computer as a tool. But not all users and situations are like that (think of the *wayfinding*, *exploration*, *identifying objects* distinction made in Benyon and Höök, this volume) We use computers for different purposes. Narratives and entertainment should not be conceived of as an alternative to traditional search engines and navigational tools, but as a parallel and optional alternative for particular occasions.

SUMMARY

We have attempted to place the contributions of the individual writers in this literature review in a context. The structure obtained, is our initial attempt at a framework for navigation.

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