

Navigating Information Space: Web site design and lessons from the built environment

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ABSTRACT

The Web is the archetypal information space but even on a well designed site it can be difficult to find all the information you need. It is impossible to design a site so that all the information needs of all the users of the site are satisfied on a single screen. Accordingly people have to pick up information from a variety of sources; they move through the information space to gather all the information that is required. This is generally called 'navigation'. Navigation is concerned with finding out about, and moving through, an environment. Of course there is a long history of designing for navigation in physical spaces. Architects, urban planners, geographers and others have studied navigation and learnt how to design physical spaces to help people find the place they are looking for, to enjoy exploration for its own sake, or to help find their way through a space to get somewhere else. The question arises as to whether we can leverage any of this knowledge for the design of information spaces such as Web sites. In this paper we review a variety of views on navigation of physical space to see how this knowledge might transfer to the design of information spaces. The example of using Gordon Cullen's serial vision theory to design a Web site map is used to show the transfer of knowledge from the design of urban space to the design of digital space. Guidelines for good Web site design and examples of how social navigation can be used within Web sites are provided.

Key words: *Navigation, information space, urban planning, built environments, environmental psychology, Web site design.*

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1. Introduction

The Web is the archetypal 'information space'; a combination of content and presentation that allows people to plan, monitor and control their activities (Benyon, 2005). However, even on a well designed site it can be difficult to find all the information you need. It is impossible to design a site so that all the information needs of all the users of the site are satisfied on a single screen. Accordingly people have to

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pick up information from a variety of sources; they move through the information space to gather all the information that is required.

This process is generally called 'navigation'. Navigation is concerned with finding out about, and moving through, an environment. Of course there is a long history of designing for navigation in physical spaces. Architects, urban planners, geographers and others have studied navigation and learnt how to design physical spaces to help people find the place they are looking for, to enjoy exploration, or to help find their way through a space to get somewhere else. Can we leverage any of this knowledge for the design of information spaces such as Web sites?

Of course there are important differences between physical and information spaces. Moving through a physical space requires a body. It can take advantage of the full range of human senses and proprioception. In information spaces people can easily jump from one part of the space to another; something you cannot do in physical space where the laws of physics constrain movement. But whilst the physics are different, the design principles may transfer more readily (Benyon, Turner & Turner, 2005). In this paper we present some principles of good design, learnt from the design of physical spaces, and applied to the design of Web sites.

We firstly review some views on navigation in physical spaces, drawing upon architects, designers and geographers to highlight the important concepts and key design issues. The following section provides a review of good Web design practice. This in turn is followed by an example of using urban design principles to design a Web site. A short conclusion ends the paper.

2. Navigation

There are many shades of opinion on exactly what activities constitute navigation. In an early review we identified three different but related activities (Benyon & Höök, 1997).

Object identification which is concerned with understanding and classifying the objects in an environment.

Exploration which is concerned with finding out about a local environment and how that environment relates to other environments.

Wayfinding which is concerned with navigating towards a known destination.

Although object identification is somewhat akin to exploration, the purpose is different. Exploration focuses on understanding what exists in an environment and how the things are related. Object identification is concerned with finding categories and clusters of objects spread across environments, with finding interesting configurations of objects and finding out information about the objects. For example when you look at a scene from a distance, say a viewpoint overlooking a city, you can explore the scene by trying to identify the different areas such as the river, the harbour and the city centre. You can also identify the objects – the cathedral, the skyscrapers and so on – and see how they are related physically and conceptually.

Navigation is concerned with both the location of things and with what those things mean for an individual. Landmarks are notoriously personal. How many times have you been told something like ‘turn left at the grocer’s shop, you can’t miss it’, only to drive straight past the supposed obvious landmark? Objects in an environment have different meanings for different people.

A lot of work in psychology has been done on how people learn about environments and with the development of ‘cognitive maps’; the mental representations which people are assumed to have of their environment (e.g. Tversky, 1993). These representations are rarely wholly complete or static. People do not store road maps in their head. They may be able to construct one when required, but cognitive maps are more patchy and people make use of much information ‘in the world’ as they move and navigate. Ecological considerations are concerned with the cues that people draw from the immediate environment as they interact with it. People develop knowledge of the space over time and through the experience of interacting with and within a space. There is still much debate about how much knowledge is ‘in the head’ and how much is ‘in the world’ (Norman, 1999).

Wayfinding is concerned with how people work out how to reach their destination. For Downs and Stea (1973) and Passini (1984) the process involves four steps; orienting oneself in the environment, choosing the correct route, monitoring this route, and recognising that the destination has been reached. To do this people use a variety of aids such as signposts, maps and guides. They exploit landmarks in order to have something to aim for.

Learning to find ones way in a new space is another aspect of navigation considered by psychologists (Kuipers, 1982; Gärling et al. 1982). First, we learn a linked list of items. Then we get to know some landmarks and can start relating our position with regards to these landmarks. We learn the relative position of landmarks and start

building mental maps (i.e. cognitive maps) of parts of the space in-between these landmarks. These maps are not all complete. Some of the 'pages' are detailed others are not, and more importantly, the relations between the pages are not perfect. Some may be distorted with respect to one another.

In the 1960s the psychologist Kevin Lynch identified five key aspects of the environment; nodes, landmarks, paths, districts, edges (Lynch, 1961).

Districts are identifiable parts of an environment which are defined by their edges.

Nodes are smaller points within the environment, those with particular significance may be seen as landmarks.

Paths connect nodes.

These concepts have endured, though not without criticism. The main issue is to what extent are features of the environment objectively identified. Other writers (e.g. Barthes, 1986) have pointed out that the identification of these features is much more subjective. It is also important to consider the significance and meanings that are attached to spaces by people. Different people see things differently at different times. Shoppers see shopping malls in a different way than skateboarders do. A street corner might feel very different in the middle of the day than it does at night. There are different conceptions of landmarks, districts, etc. depending on cultural differences such as race, gender or social group. The ship's captain can see many different landmarks in the ebb and flow of a river than the novice. Navigation in a wilderness is a wholly different activity from navigation in a museum.

In addition to the five features identified by Lynch, it is generally assumed that there are three different types of knowledge that people have of an environment; landmark, route and survey knowledge (Downs and Stea, 1973).

Landmark knowledge is the simplest sort of spatial knowledge in which people just recognise important features of the environment.

Gradually they will fill in the details between landmarks, linking them together to form route knowledge. With route knowledge the person knows how to get from one place to another, but does not know what goes on behind the paths they use.

As they become more familiar with the environment people will develop survey knowledge; the 'cognitive map' of the environment. This fills in details about the relationships between landmarks, routes and paths.

In the physical world, relative distances and direction are important. This process is familiar to anyone who has got to know a new city, university campus or even a large shopping mall. Reflecting on how to design to support this process is important.

Christian Norberg-Schultz was an influential architectural thinker of the later twentieth century. He describes what it is like 'to be somewhere'; a place has spatial and affective aspects. As a person navigates within a space they begin to create a schema of the environment based on an interpretation of the environment through a range of perspectives. The attributes of the person's 'existential space' is a combination of abstract topological information (e.g. proximity, distance, succession, closure, continuity) and concrete elements (the physical appearance of the environment e.g. a façade on a building). He argues that these aspects are derived from an individual's need to perceive space in relation to places, directions and paths. As part of the navigation process individuals seek to subjectively centre themselves in a space, attempting to reach a focus. The activity of attempting to find a centre results in the creation of places, which contain actions, activities and social interactions. These places are perceptually distinct and relatively static structures within the space.

These views of place and the importance of place (rather than space) are reflected in the works of Edward Relph (1976) and Yi-fu Tuan (1974). Also writing in the 1970s these authors explore the personal nature of people's interactions in spaces and how the meanings they make, the actions they take and the feelings they have develop spaces into places. Recently Edward Casey has shown how the concept of place has returned to the philosophical foreground (Casey, 1997; Casey 2001).

Edmund Bacon was an influential town planner responsible for the development of Philadelphia. He suggests that any experience we have of space depends on the form (shape, colour, location and other so on), the features that infuse character, space and time (each experience is based on partially those preceding it) and involvement. These all have an impact on navigation. For example if a person feels a feature of the environment is intimidating, lacks character or if the collective experience of the environment is unpleasant, they may be unwilling to continue exploring.

The guidelines and concepts provided in *Responsive Environments* (Bentley, Alcock, Murrain, McGlynn & Smith, 1983) focus how to make an environment responsive to the needs of the people undertaking activities. The book has been reprinted often suggesting that their organisation of design knowledge is long lasting. The guidelines aim to address a range of issues which affect the "choices people can make". These are:

Permeability. How the design of the environment affects where people can and cannot go.

Variety. The range of uses available to people.

Legibility. The ability of people to understand the opportunities afforded by the environment.

Robustness. The degree to which people can use a place for different purposes.

Visual Appropriateness. The detailed appearance of the environment and how this makes people aware of the available options.

Richness. The choice of sensory experiences afforded to the users.

Personalisation. The ability of the individual to customise the environment.

Permeability is critical to navigation. It is concerned with how the environment supports movement of individuals. The availability and use of paths depends both on their physical existence and their visual appearance. Permeability is also dependent on public and private space, the connectivity of routes and the nature of the environment. For example, physically separated spaces force people to take a certain path. A strict hierarchical space forces movement up and down, rather than across the structure.

The guidelines that Bentley *et al.*, come up with, such as to obtain maximum permeability the environment should contain the smallest block size and connect as many of the smaller routes as possible to the main routes are reminiscent of the architectural patterns of Christopher Alexander (Alexander, Ishikawa & Silverstein, 1977). These have become very influential as rich qualitative sources of good design advice. The principles behind patterns as a way of capturing design knowledge have spread into software engineering, human-computer interaction and Web site design (Graham, 2003).

Too much similarity between different areas of an environment can cause confusion. The design should encourage people to recognise and recall an environment, to understand the context and use of the environment and to map the functional to the physical form of the space. Another important design principle from architecture is the idea that to gain a gradual knowledge of the space through use, designers should aim for a 'responsive environment'. Such an environment would ensure the availability of alternative routes, the legibility of landmarks, paths and districts and the ability to undertake a range of activities.

Of course this is just a sample of the design advice that is available within architecture, urban planning and environmental science. But the issues of encouraging understanding, of realising that people need to attach meanings to spaces (to create

their places) and of designing to support the activities that people want to undertake are crucial.

Good, clear signposting of spaces is also critical in the design of spaces. There are three primary types of sign that designers can use.

Informational signs provide information on objects, people and activities and hence aid object identification and classification.

Directional signs provide route and survey information. They do this often through sign hierarchies with one type of sign providing general, 'global' directions being followed by another that provides local directions.

Warning and reassurance signs provide feedback or information on actual or potential actions within the environment.

Of course any particular sign may serve more than one purpose and an effective signage system will not only help people in getting to their desired destination, it will also make them aware of alternative options. Signage needs to integrate with the environment in which it is situated aesthetically so that it will help both good and poor navigators. Consistency of signage is important, but so is being able to distinguish different types of sign.

Maps can be used to provide navigational information and supplemented with additional detail about the objects in the environment, they become guides. There are many different sorts of map from the very detailed and realistic to the highly abstract and schematic. Maps are social things. They are there to inform and help people explore, understand and find their way through spaces. They should be designed to fit in with the signage system. Like signs there will often be a need for maps at different levels of abstraction. A global map which shows the whole extent of the environment will need to be supplemented by local maps showing the details of what is nearby.

A well designed environment with good signage and well designed navigational aids such as maps will be conducive to good navigation, but even in the best designed environment people will often turn to other people for information on navigation rather than use more formalised information artifacts. When navigating cities people will often ask other people for advice rather than study maps or follow signs; particularly when the signage system breaks down. Information from other people has a huge advantage over information on signs and maps because it is usually personalised and adapted to

suit the individual's needs. Often advice is accompanied by personal stories and experiences.

Even when people are not directly looking for information they use a wide range of cues from the behaviour of other people and the traces of their behaviours, to manage our activities. We might be influenced to pick up a book because it appears well thumbed, we walk into a sunny courtyard because it looks attractive or we might decide to see a film because our friends enjoyed it. We find our way through spaces by talking to or following the trails of others. The whole myriad of uses that people make of other people to help them navigate – whether directly or indirectly - is called *social navigation*.

3. Navigation design for Web sites

In information spaces people face similar problems and undertake similar activities as they do in geographical spaces. They may be engaged in wayfinding – searching for a known piece of information. They may be engaged in exploration of the space to understand its scope and overall content, or they may be involved in object identification; working out exactly what something is. They will move rapidly between these activities and they will pick up new information from the local environment. Indeed often they will rely on designers putting information in an environment to remind them of different functions and options that are available; what Pirolli calls 'information scent' (Pirolli, 2003). Information spaces such as Web sites have different districts, with nodes and paths linking the sections together. Landmarks will help people to recognise where they are in a space and hopefully help them to plan and monitor a route to where they want to go. People will have simple route knowledge of some information spaces and survey knowledge of others.

The essential thing about designing for navigation in Web sites is to keep in mind the different activities that people undertake in a space — object identification, wayfinding and exploration — and the different purposes and meanings that people will bring to the space. The practical aim of navigation design is to encourage people to develop a good understanding of the space in terms of landmark, route and survey knowledge. However, another aim is to create spaces which are enjoyable, engaging and involving. Design is about both form and function and how these can be harmoniously united.

Information architects design information spaces. According to Brinck, Gergle and Wood (2002), the design of navigation mechanisms is the second main pillar of information architecture. They add to the general ideas of navigation by identifying seven types of user navigation from the omniscient user ('they benefit from short, efficient paths') to the rote memorization ('use distinctive landmarks and orientation cues'). Along with Rosenfeld and Morville (2002) they identify three key features of a good navigation design for Web sites; labelling, navigation support and searching mechanisms.

Labels are the information space equivalent of signs in the physical world, providing information, direction and warning, or reassurance.

Navigation support will be provided through lists of links in addition to good labels that will enable people to find distant information from local 'information scent'.

Searching mechanisms should be based on a clear understanding of naming and alternative vocabulary.

Labels are used for internal and external links, headings and sub-headings, titles and related areas. Not all labels are text; iconic labels can be very useful if the context and design is clear. Paying attention to good, consistent, relevant labels is a critical part of information architecture. Information architects must develop a clear and unambiguous preferred vocabulary. All the principles of good signage design apply to Web sites. Signs need to be hierarchically structured to provide both an overview and the local detail. Maps need to be provided including the 'You Are Here' maps. The design language (colour, font, size, style, etc.) needs to be well thought out and consistent.

Of course many of the signs and labels on a Web site are deliberately placed in order to support navigation. It is common to have a navigation bar across the top of a site which points to the main, top level categories. This is often called the global navigation. Within each of these there will be sub-categories. These might be placed down the left hand side of the site or my drop down when the main category is selected. These are known as local navigation. It is a good design principle to have the global, top level navigation bar the same on every page so that people can easily jump back to the home page, to a frequently asked questions page or to one of the other main categories.

Other devices such as indexes and glossaries are helpful in assisting people find exactly what they are searching for. A site map should be made available that can be

called up when needed. The map displays the structure and content headers of the various categories. 'Breadcrumbs' (such as used by Hansel and Gretel to find their way back when they were taken into the forest) is a common way of showing people where they are.

Navigation bars – both local and global — are essentially signposts and landmarks, leaving the site visitor to pick their way through the site structure. Site maps and good feedback on where people are in the structure will also help. Another alternative is to provide a clear path through a part of the site. This is particularly important when a number of activities or pages have to be visited in sequence. A site 'wizard' can help here that guides people and explains what each activity is for. Often this is simply a succession of pages, such as when buying a ticket or booking a flight.

4. Applying urban design principles to Web site design

There are many good textbooks that provide advice on Web site design, but few provide a systematic approach in the same way that good (physical) architecture might guide the design of a city. One application of urban design principles to Web sites is described in Benyon and Wilmes (2003). Bettina Wilmes used the 'serial vision' theory of town planner Gordon Cullen to design a concept Web site that demonstrated a sense of location, place and included a dynamic site map that indicated the distance and direction of the other pages on a site.

Cullen's theory of serial vision was based on the gradual unfolding nature of vistas as one walked through an environment. Possibly the most famous example is the Taj Mahal in India where every step towards the monument reveals a new view. Taking Downs and Stea's (1977) concept of wayfinding and Cullen's view of townscapes as a basis, Wilmes identified five design objectives for Web navigation. Web navigation should aim to provide:

1. A sense of place (uniqueness)
2. Information on size and dimension (scale)
3. Information on closeness and distance (approach)
4. Information on direction and perspective
5. A sense of arrival

The process of wayfinding (Downs & Stea, 1977) is broken down into four steps: orientation, choice of route, monitoring of route, and discovery of the objective. Each of these steps requires a certain design quality of the space. In order to orientate oneself in an environment it is necessary that the space has a series of unique, distinguishable characteristics and features. A *sense of place* is often understood as something that is of significance to people. In a physical environment a sense of place is created by physical and landscape attributes as well as human activities. In a Web site the different categories can be designed to include characteristics, which are unique for that specific place, by using textures, colours and styles.

Golledge and Stimson (1997) argue that the concept of place generates strong psychological and emotional links between people and places, which depends on the range of experience that people have with places:

The sense of place incorporates not only the concepts of location and pattern but feelings of belonging, invasion, mystery, beauty, and fear. As time changes, cultures alter settings, and the sense of place, its symbolism, its meaning, its cultural significance, and even its boundaries, may change. (pp. 393)

It is this sense of place that we wish to engender in Web site design.

If transferring the concept of sense of place or uniqueness to the information space of a Web site, it is essential to aim for a distinguishable look and feel of the site including a clear-cut navigation strategy. Both Nielsen (2000), and Flanders and Willis (1996) promote the use of a well-designed home page as a tool for providing a sense of place and helping users to orientate themselves. This may assist the sense of arrival when coming from another Web site.

The next design objectives all derive from the navigation steps 'choice and monitor of route'; they are concerned with the actual extent of the space and associated spatial attributes such as closeness/distance, and direction/perspective. Although these spatial attributes are understood to be objective and can be measured by certain standards (e.g. the number of pages or the number of mouse clicks required to get from A to B), a person is likely to have an individual perception of the spatial dimensions of a site.

In order to decide on a sequence of movements from the current location to the desired destination, people need to know the dimensions of the space and which route is the most efficient one. Furthermore, it is critical that they are continuously provided with information on the remaining distance to the goal. This will give them a feeling for

approach throughout the entire movement. This can be seen, for example, in serial tasks such as completing an on-line booking when information such as 'step 2 of 5' is provided. When moving through the site, people's perspectives of the site changes constantly, with individual targets moving into the back- or foreground. People need to be aware of these changes, in order to adjust their path if required.

If aware of it, the interplay of changing perspectives or views, can add an interesting aspect to the Web navigation experience. Following Gordon Cullen's theory on 'Serial Vision', the Web space can be split into two elements: the existing view (i.e. the view of the current locations or page) and the emerging view (i.e. the view of locations or pages directly accessible from the current one). By moving through the Web site, the user is exposed to a chain of events experiencing a constant change of view. Ideally, the entering and leaving spaces (i.e. pages) in combination with the shift in views evokes a positive emotional reaction and the Web site is experienced at a much deeper level. This follows Gordon Cullen's theory on 'hereness and thereeness' and his claim that the designer needs to be aware of the existence of these two spaces. One could argue that if people know what is ahead of or immediately around them and are able to catch a glimpse of these, they may feel curious and intrigued to find out more and subsequently move to another space.

The final design objective, *sense of arrival*, derives from the final step in the wayfinding process, the discovery of the goal. Once people have arrived at their desired destination they need to be made aware of their arrival. It is not enough to provide a sign 'you have arrived' (which is in architecture and landscape architecture considered to be a design failure); it is here again that the sense of place becomes important. The designer should aim to create the 'space of arrival' in a way that it becomes obvious that the goal is reached, such as a countryside mansion located at the end of an avenue.

5. Social Navigation of Information Space

As we noted earlier, the design of the physical environment is important, but so are the other people who are in that space. People use a whole variety of socially-based techniques to help navigate environments. The social is something that is typically missing from information spaces.

Social navigation of information space aims to leverage techniques and designs that make people aware of others and of what others have done. *Designing Information Spaces: the social navigation approach* (Höök, Benyon & Munro, 2003) provides many detailed examples and reviews of techniques. Some designs such as on-line communities exist solely for the purpose of enabling people to maintain and build links with other people. Other systems are more concerned with making people aware of what others are doing and others with making aggregate knowledge of others available.

A direct form of social navigation is concerned with putting people in touch with other people (or with artificial agents). When we talk to someone else, the information we get back is often personalised to our needs and the advisor may offer information that changes what we want to do or how we might approach it, making us aware of other possibilities. People can judge to what extent the information given can be trusted depending upon the credibility of the information provider. Even if the information cannot be trusted, it may still be of value as people know where it is from.

In information spaces, using person to person communication is an important part of the information architecture that is often overlooked. Direct social navigation comes in many forms. At its most prosaic it consists of a link such as mail 'webmaster'. At least these impersonal connections suggest that there is a real person at the end of the line. Having individuals identified by name adds another level of personalisation (but creates difficulties if that person is not answering their mail for a few days). From such beginnings rich webs of direct social navigation support can be developed. There may be an instant messaging facility, video conferencing and so on.

Systems supporting direct social navigation can soon turn into fully fledged on-line communities where the whole basis of the information space is to support communication and exchange of information around a particular theme. On-line communities are springing up devoted to all manner of social and recreational questions. They combine e-mail lists, threaded conferences, chat rooms, message boards, diaries ('weblogs' or 'blogs') into a coherent structure to support some domain. Systems such as Geonotes (Persson, 2003) aim to augment the geographical world with virtual 'post-it' notes. Thanks to the advances in positioning technologies an electronic message can be left associated with a particular place. When another person (suitably technologically equipped) arrives at the place the system alerts him or her to the message. As Persson points out such attachments of information spaces to

geographical spaces goes back to the cave paintings and people continue to annotate places with graffiti, post-its and fridge magnets.

If other people are not around to provide help and advice then there are a number of systems that try to filter out uninteresting information and which point people to things that they will find relevant. Just as a newspaper editor filters news into a form that readers of that newspaper like, so content filtering systems aim to tailor information to people. (Conversely the newspaper or TV channel that we choose is selected because we like the way that news is filtered and presented).

In content based filtering the information is scanned for specific articles that match some criteria. Based on a statistical analysis the system rates the relevance of the information to the user. Usually keyword-matching techniques are used to filter the information. The user supplies a preference file to the system with keywords that the system should look for in documents. For example, an agent scans a newsgroup for documents that contain the keywords on regular basis.

Recommender systems make suggestions to people for information based on what other people with similar tastes like or dislike. Personal profiles are matched and the system creates clusters of people with similar tastes. Book recommendations from the Amazon sites are probably the best examples of a mature recommender system. People who subscribe to Amazon can have the system recommend books based on those that they have bought previously and on those that they rank and on those that others have bought. Konstan and Riedl provide a thorough review (Konstan & Riedl, 2003)

Another method of providing social navigation is to provide a tag so that whenever a person comes upon a new piece of information she can see what other people with similar interests as her think of that particular piece of information. Some sort of rating of the information pieces have to be done by the users of the system so the system can create and cluster personal profiles. The more people that rate items, the more accurate the system can group users. Ratings can be done either explicitly and/or implicitly. Implicit ratings are, for example, time spent reading an article. Explicit rating let people score information sources. Filtering needs some sort of input to work with, and explicit ratings of information is not all that simple. How do we judge ratings from someone who has created the information? Explicitly rating information is also an additional burden on people, so sometimes they will not bother. EBay is a great example of reading explicit ratings.

History Enriched Environments, or 'readware' is another technique for social navigation. What other people have done in the past can tell us something about how to navigate the information space. If we get lost in the woods and come upon a trail, a good idea is to follow that trail. People that take a certain path through the information space. Another familiar technique is to automatically change the colours on the links in a Web page when a person has visited that page. In some other systems this may be generalised based on usage of links. Perhaps the main example of this was the Footprints project (Wexelblatt, 2003) where ideas of interaction history are associated with an object.

Finally 'social translucence' is an approach is based on three core principles; visibility, awareness and accountability. The concept has been developed at IBM by Tom Erickson and Wendy Kellogg amongst others and has been implemented in a number of prototype systems. Erikson and Kellogg (2003) illustrate their concept by telling the tale of a wooden door that opened outwards in their office. If opened too quickly the door would smash into anyone who was walking down the corridor. The design solution to this problem was to put a glass panel in the door. This enabled the three principles of social translucence to be met. Visibility is achieved because people outside were now visible to those inside who were going to open the door. Of course the transparency of the window meant that people inside the office were also visible! Awareness was achieved because people could see what others were doing and could take appropriate action – opening the door carefully, perhaps. Accountability is particularly important. Not only are people aware of others but now they are aware that they are aware of others. If the person inside the office opens the door and smashes into someone in the corridor the person in the corridor knows that the office person knew this. Hence he or she has to be socially accountable for the action.

These principles have resulted in a number of 'social proxies'; software systems that capture the principles of social translucence. The best known of these is Babble – a social proxy for meetings, chat and e-mail. People are represented by 'marbles' and the space of discussion by the large circle in the centre of the systems. The more active people are the nearer the centre they are and the marbles gradually move towards the periphery if they do not participate in the chat for some length of time. Other details of the people can be seen in the panes around the edge of the system.

6. Conclusions

Navigation of Web sites - information spaces - is a key activity that people undertake. We can learn much from studying navigation in geographical spaces and indeed apply design principles from urban planning and architecture. This has already been suggested for virtual environments (Vinson, 1999). The principles of how we find our way in information spaces are the same as those in geographical spaces. The differences are that we have far less sensory cues in information spaces and the physics are different – we can jump to different parts of the space, fly over data landscapes and move through virtual walls. These differences notwithstanding, design principles transfer well from physical to information spaces.

But just as it took architecture time to migrate from the purely functional to the more aesthetic, so we see this in Web sites. Designers are often too focused on the information on the site and not enough on navigation; movement through the site. Web sites get overloaded. There is no pleasurable experience to be had moving through the site. Navigation is wholly cognitive, rather than intuitive. By looking to theories of physical space design that emphasise ease of movement and naturalness of interaction, such as Gordon Cullen, the experience of Web site navigation can be much more pleasurable and rewarding. Social navigation is also important and designers should seek to bring people, and the activities of people, into the dead space of information.

Navigation of information space is concerned with good design through the use of maps, labelling and signage. It is about helping people obtain a survey knowledge of the whole information space and enabling the three key activities of wayfinding, exploration and object identification. Providing assistance for social navigation – using other people and their activities - to help navigate the information space will ensure more effective and more enjoyable Web sites.

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