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Visually Representative Web History Browser

by Gray Hodgkinson

<http://www.designspace.co.nz/mdes.html>

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fulfilment for the degree Master of Design.

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Abstract: Visually Representative Web History Browser

The familiar computer graphic user interface (GUI) makes extensive use of visually representative devices such as folders and files. These symbols help the user deal with computer data and operations that otherwise have little or no physical form. The computer's underlying complexity is symbolised for the user, who is then able to manipulate the computer by interacting directly with the interface.

The early development of computer interface design was largely the domain of software and hardware developers. Many sound principles of user interaction and testing were established and provided essential guidance for new generations of interface designers. As computer technology and its tools became more widely available, a broader range of designers began contributing, including those from product design and visual communication.

This study is written from the point of view of a “visual designer” – a designer who began his career in graphic design and who has moved towards interface design out of curiosity and a desire to proffer a different attitude and approach to interface issues.

The study therefore will demonstrate a design process that many visual designers will be able to identify with. The process includes research, analysis, methodical progression and artistic inspiration. The artistic inspiration in this case comes from the Constructivist artist El Lissitzky, and will illustrate the significant contribution that art can make to interface design.

This art-influenced design process was presented at the 2005 Ed-Media World Conference on Educational Multimedia, (Montreal, 2005). The enthusiastic response and discussion provided encouragement to continue in this direction. In the following year another presentation, which included the working prototype, was presented as part of a keynote speaker presentation at the 2006 Siggraph Taipei Conference, National Chiao Tung University, Taipei.

The specific task chosen to work with in this study is that of Web browser history. As a user browses the Web the computer records a list of visited websites. The first few generations of browsers presented this information as a simple list, but this approach incorporated many flaws and caused problems for users. More recent browsers provide more options, but significant issues remain. This study offers solutions to several of these problems.

The resulting design prototype is named “isoBrowser”. It is the result of the alternative design process outlined above and offers alternative methods of visualising, organising and manipulating data. The prototype is not intended to be fully functional nor “live”. However, it is sufficiently operable so as to test interface interaction and user response. A fully functional version, operably and aesthetically complete, would be the subject of further development.



Part 1:

Theories and Methodologies

Background context: Visual designers discover the Web

As the World Wide Web (Web) steadily developed into a visual communication medium, it also attracted visual communication designers. Coming from print-based backgrounds, these designers applied their graphic design principles to the screen-based Web medium. In the desire to make Web pages look like their equivalent colour brochures from the print world, serious study of interface design and user interaction were generally ignored. The 1990's witnessed a proliferation of these "brochure-ware" sites: websites that were simply screen versions of printed publications.

However, this was not as serious a problem as it could have been as the Web authoring environment imposed a certain amount of standardisation. The browser program and its various navigation controls were always present. Regardless of the designer's work on the page, a fixed amount of navigation standardisation was always available.

As Web design programs evolved, however, designers gained more control over the design of the interface and the browser. Not only could they dictate the look and feel of the page, they could now control the method of the user interaction. Gone were the ever-present browser buttons. Sites began to appear devoid of the usual underlined blue links, back buttons, and other Web navigation tools. Designers were experimenting with concepts of navigation and interface, often paying little attention to well-established user interface principles and certainly ignoring standard Web navigation convention.

The Web visual design community adopted this new multimedia design with great excitement. The new designers promoted interface individuality and proceeded to explore the possibilities, share knowledge freely, establish on-line communities, and generally celebrate a new way of designing Web interfaces. The most talented authors found themselves leading a digital design style that was aesthetically driven and challenging of interface conventions. In the early 2000's, Web interface design became cool.

Reaction from the computer science community

This interface design freedom provoked a vigorous response from the computer science community, who were to become the new advocates of Web usability and standardisation. With arguments based on human-computer studies, logic and practicality, these proponents of Web usability advocated standardisation, user needs, and elimination of aesthetic indulgence. Papers were presented, books were published, and websites were criticised and deconstructed for all to see. Their argument was that individuality, aesthetics and visual design emphases were at the expense of function and usability.

Jakob Nielsen: a wake up call

In January 2000, Jakob Nielsen published *Designing Web Usability*. Unlike previous books on Web design, this one did not advocate visual style. Rather, it focused on navigation standards, usability and user-centred operation.

Nielsen followed this with vigorous comment on his well read website www.useit.com where he increased criticism of Web interface design. With such articles titled *End of Web Design*, and *Flash: 99% Bad*, he soon gained the attention of the Web design community. Many of his comments seemed to be completely at odds with the visual designer's urge to personalise websites and to create individual, memorable experiences.

Jakob Nielsen's Alertbox, August 22, 1999:

Jakob's Law of the Web User Experience: Users spend most of their time on other sites. Thus, anything that is a convention and used on the majority of other sites will be burned into the users' brains and you can only deviate from it on pain of major usability problems.

Jakob Nielsen holds a Ph.D. in user interface design/computer science from the Technical University of Denmark. His website's Alertbox column on Web usability, published on the Internet since 1995, has a readership of 9 million page views per year. He is a User Advocate and principal of the Nielsen Norman Group which he co-founded with Dr. Donald A. Norman (former Vice President of research at Apple Computer). Until 1998 he was a Sun Microsystems Distinguished Engineer.

It should be noted that the usability argument is focused on information rich sites and by implication, holds that all or most websites are, in fact, information driven. There is little concession given to the desire for visual appearance; for sites that are concerned with first impressions, individuality, branding, and how the site's visual appearance affects the attitudes of the user.

However, the new confidence of the visual design community was not so easily shaken, as demonstrated by the reaction to Nielsen by Val Cassey, Creative Director of Frog Design:

There's no merit to focusing entirely on usability. There has to be more to design than that. There's this mythology around information design. In the Web industry, there are self-appointed "experts" who end up reinforcing certain design conventions. Some of these conventions [become] confining and counter-productive dictums, and following them doesn't necessarily result in an optimal "digital experience." Anyone can be an information designer if they have the time to think, plan, and execute with empathy based on the challenge at hand, not on a predetermined list of usability rules.

Macromedia, with their leading Web authoring program Flash receiving bad press, made an effort to reconcile the two camps with this announcement in early 2002:

Macromedia and Usability Guru Jakob Nielsen Work Together to Improve Web Usability.

..."There continues to be tremendous innovation in the designer and developer community around creating the best user experiences using Macromedia Flash," said Kevin Lynch, chief software architect, Macromedia. "We're thrilled to be working with Jakob Nielsen to turn these experiences into best practices as we all learn about building rich Internet applications. Our ultimate goal is to make these 100 percent good."

"Macromedia has obviously taken steps toward better usability with Macromedia Flash MX," said Nielsen. "The product enables users to create content and

applications more easily that follow traditional usability and accessibility guidelines. In particular, the addition of standardized interface components will finally help put an end to design inconsistencies.”

Regardless of the eventual commitment and its outcomes, these events became a very public wake up call for the visual designers, and prompted an increase in the appreciation of usability and designer responsibility to the user.

From the computer scientist’s camp, the usability proponents also made some concessions towards the appropriate use of aesthetics, image branding, and other aspects of visual culture. However, these concessions still remained somewhat guarded and were firmly based in site functionality. Aesthetic content continued to be seen as a device to aid the function of the site, rather than being an integral component of the design.

Nielsen’s comments were also perceived by many to be a threat to the diligent advancement of a significant area of design, and echoed old fears that visual designers cannot be taken seriously, as described by Alan Cooper, (1999):

Programmers have been successfully bluffing their way through the design process for so long that they are conditioned to disregard its value. When a trained interaction designer is finally hired, the programmer naturally treats their work dismissively.

Jakob Nielsen seems to reluctantly admit the place of user emotional involvement, though it could be interpreted that he belittles its significance with such comments as “subjective whim and user satisfaction”.

<http://www.useit.com/papers/seductiveui.html>

by Jakob Nielsen, 1996

This performance-obsessed approach to usability led many early user interface experts to condemn the popular term “user friendly” with the argument that users didn’t need “friendly” computers, they needed efficient designs that let them complete their tasks faster. I was as guilty as any of this bias, even as recently as the 1994 edition of my book Usability Engineering.

Today, computers are used for many purposes in which the main goal is to please the user rather than maximize transactions. The dual victories of home computing and the World Wide Web last year have emphasized this lesson. However, even in business it is becoming common to cater to subjective whims and user satisfaction.

Many business applications rely on so-called discretionary use, where employees have alternative and often more expensive ways of achieving the same goal. Although window systems design is still focused on traditional usability, frivolous elements like wallpaper and customized color schemes creep in to provide enhanced pleasure for users – even though excessive fiddling with customization options is a time sink and often results in reduced readability.

The term “seductive user interface” was coined by Tim Skelly (with Microsoft Research at the time) to describe designs that aim at pleasing and attracting users. Unfortunately, not much is known about how to make software seductive; typical advice these days suggests you try to learn from computer games.

Because we are in the very early stage of discovering systematic methodologies for making user interfaces attractive, no hard guidelines are available. We do know that we must attack the problem with more empirical studies involving real users so we can determine what they like rather than design with our own biases in mind.

However, more recent writings from Nielsen demonstrate a deeper understanding of where the new visual designers may have been heading, whether they were aware of it or not.

Jakob Nielsen's Alertbox, November 25, 2002:

Flash and Web-Based Applications

Although it's possible to provide Web-enabled applications through standard Web pages and the traditional browser interface, doing so neglects twenty years of GUI advances and harkens back to the asynchronous interaction style last seen in the '70s on IBM 3270 terminals. It can be done -- and it has been done -- but it's not good for usability.

The alternative? Embed the new functionality within a GUI, as with traditional shrink-wrapped software for the Apple Macintosh or Microsoft Windows. Flash offers designers a way to create GUIs for Internet applications, making interaction styles that support functionality beyond reading and browsing possible.

This possibility sounds good. However, in the usability field, we've learned that more technical capabilities and a broader set of design options usually translate into more rope for hanging the users. Designers almost always use new features to excess, and it takes some time to discover the most appropriate way of applying new technology to suit human needs.

Whether or not the new visual designers realised that they were "developing applications", it would seem that now they are a part of software GUI development.

Though Nielsen's final comments are dismissive of "designers", he has recognised that Web-based application design has indeed spread out of the hands of programmers into a wider creative environment.

User interface design, in this context, is now an open, visible process, with many more designers involved. It encompasses a much wider, richer depth of experience and opinion, some informed, some not, and potentially capable of producing a broader, more creative range of results. This is the real significance of these developments, which Steven Johnson (1997) calls "the democratisation of interface design".

Concepts of visual culture

The excitement being experienced by the new visual designers was not about the information content of sites. Rather, the realisation that designers, in their own personal style, could talk to an international audience. Designers could ask users to come in and experience their creations, in a way similar to an invitation by an artist. Their concept of an ideal interface included the aesthetic experience, integrated with the information content and adding to the overall interactive experience.

It is interesting to note that this development was taking place in the late 1990's, a time when young adults were discriminating about the graphics on their clothes, and began to feel ownership of their own labels and visual culture. A similar event happened on the web. The new tools enabled visually skilled designers to grab some ownership of the visual culture of the web, which had belonged in general so far to computer oriented developers. "Techno" was more than a street label style, it was also a Web design style.

This "democratisation" of interface design, is described by Steven Johnson (1997):

Nothing will propel the interface toward the status of art more quickly than the development of a functional interface subculture – small pockets of designers working in opposition to the mainstream (p224)

In the days of Xerox PARC, you needed an entire research department to dabble in interface design, and finding an audience for your new information space required prodigious distribution resources. On the Web, the latest visual metaphors can find their way into circulation for a tiny fraction of the cost, which means that more experimental forms – forms more interested in pushing the envelope than pleasing the masses – will naturally prosper in this environment. Much has been said about the self publishing revolution made possible by the Web, the egalitarian dream (or nightmare) of a nation populated by millions of living-room pundits. But the real revolution unleashed by HTML may well be the democratisation of interface design. (p225)

It is significant to also note that interface concepts explored through this process of seemingly uncoordinated investigation, also began to appear in the interfaces of the latest mainstream operating systems. The Web was fulfilling a new function of an open, freely visible test bed for interface ideas.

Cybernetics and Usability Theories

Cybernetics: Human machine interaction

Cybernetics can be seen as the parent field of theory for human interface interaction. Concepts central to cybernetics are *systems*, *change over time*, *control* and *goals*. Paul Pangaro (1990) offers a useful description:

The field of cybernetics came into being when concepts of information, feedback and control were generalized from specific applications to systems in general, including systems of living organisms, systems of self-reference and systems of language. Fundamentally an applied philosophy, cybernetics has taken on problems of subjectivity in science while still addressing how to make intelligent artifacts. It stands today as a major influence on biology, cognitive and computation science, and epistemology.

Historically, cybernetics was applied to mechanical systems, though application to a broader, human behavioural base was suggested as early as 1956 by Ashby:

Cybernetics, too, is a “theory of machines”, but it treats, not things but ways of behaving. It does not ask “what is this thing?” but “what does it do?” (p1)

It is thus essentially functional and behaviouristic. Cybernetics started by being closely associated in many ways with physics, but it depends in no essential way on the laws of physics or on the properties of matter. Cybernetics deals with all forms of behaviour in so far as they are regular, or determinate, or reproducible. (p1)

Pask puts cybernetics into a strong context of human behaviour with “The Cybernetic Psychology of Pleasure” (1968). He also uses a phrase familiar to modern designers, that of “problem solving”.

Man is prone to seek novelty in his environment and, having found a novel situation, to learn how to control it. Let us develop and qualify this cybernetic statement. In the symbolic domain which constitutes the most important aspect of the human environment, ‘novelty’ inheres in events or configurations that appear ambiguous to a given individual, that engender uncertainty with regard to his present state of knowing and pose problems. ‘Control’, in this symbolic domain, is broadly equivalent to ‘problem solving’ but may also be read as ‘coming to terms with’ or ‘explaining’ or ‘relating to an existing body of experience’.

Pask goes on to explain how we use conceptualisation and abstraction to communicate, to interface with the world and to solve problems.

Pangaro (1999) describes cybernetics as a method of describing and designing a process, be it mechanical or human, and places this in the context of computer interaction design.

- When a system has a goal, cybernetics offers definitions of “information,” “feedback” and “interaction.”
- When interaction includes a person, cybernetics offers useful models of “personalization,” “learning” and “understanding.”

When software is in the way of understanding (between person and person, or person and machine), cybernetics may open the flat interface into a semantic space; develop a history of clicks into a relationship; and transform a computer into a partner with a shared goal. (Pangaro 1999)

Cybernetic concepts are further refined into workable theory by several human interface and usability authors.

Refinement: Cognitive psychology, human machine relations

Some of the most influential writings on usability and associated theory come from Donald Norman. Norman places the emphasis on the user by describing the stages of action required when using a system (1998, p46):

- Forming the goal
- Forming the intention
- Specifying an action
- Executing the action
- Perceiving the state of the world
- Interpreting the state of the world
- Evaluating the outcome

The first four items can be seen as clear cybernetic principles. The last three are moving towards the realm of cognitive theory, and though they can also be treated as cybernetic processes, we need to be aware that cognitive knowledge theory is also a subset of epistemology, the branch of philosophy that studies knowledge. This point of view helps us to remember that the user is a human being, with complex behaviour based on more than systematic logic.

From these seven stages Norman introduces the context of *cycles of action and evaluation*, which in turn lead to *The Gulf of Execution* and *The Gulf of Evaluation* (1998 p50). In short, we do something (execution), then evaluate the outcome.

Norman refines his seven actions to provide fundamental principles appropriate to product design:

- *Visibility*. By looking, the user can tell the state of the device and the alternatives for action.
- *A good conceptual model*. The designer provides a good conceptual model for the user, with consistency in the presentation of operations and results and a coherent, consistent system image.
- *Good mappings*. It is possible to determine relationships between actions and results, between the controls and their effects, and between the system state and what is visible?
- *Feedback*. The user receives full and continuous feedback about the results of actions.

(Norman 1998, p 53)

Norman goes on to discuss how the user brings their personal knowledge to the interaction, and discusses “The tradeoff between knowledge in the world and in the head” (p79).

Elsom-Cook also describes knowledge theory that leads to the structuring of interactive information. He refers to an external knowledge that is shared by all within the defined community (p51), tracing the reference back to Plato, or Platonic knowledge. This is compared to a belief theory, where shared knowledge is seen as mutual belief. Elsom-Cook finishes with a working definition, *Socially Defined Platonic knowledge* (p61). This definition allows us to:

... use an idea of knowledge as though it was absolute, provided that we acknowledge that this is only a working assumption which will sometimes be incorrect. This also allows us to include a model of belief of an individual, and how that may change over time with respect to the deep knowledge of the group.

Elsom-Cook goes on to describe methods of knowledge representation using two models, *declarative* and *procedural*. Together these form an appropriate basis for organising information and users’ actions in the computer interface environment. The two terms *declarative* and *procedural* also have a parallel in the structure of computer programming coding, with its *statements* and *actions*.

In comparison to Norman’s “knowledge in the head and in the world”, Elsom-Cook discusses “Background and foreground knowledge” (p93), and gives examples in the computer multi-media context. In essence, background knowledge is the knowledge which the user possesses before they come to the system, independent of the system’s content. This can include level of language, comprehension and computing skill. Foreground knowledge is what the user knows about the system itself – eg, in the case of a Web browser, this would be the knowledge the user already has of Web browsing.

If it is possible to identify exactly what the users know of the foreground when they begin to use the system, and what their needs and objectives are, then it is in principle possible to totally individualise interaction adjusted to those needs. (p94)

Elsom-Cook continues to further divide knowledge into *Cognitive, Conative and Affective*, and further illustrates the combination of Cybernetic and Cognitive theory.

Cognitive knowledge:

Declarative and procedural, reasoning processes, intellectual ability. The things the user knows and brings to the system.

Conative knowledge:

Motivations of the user. Wants, needs, desires. Rather than just achieve a goal, in what manner is this goal to be achieved? High usability websites assume a results oriented user – their need is to get at the information. A children’s educational website may be more visually stimulated and encouraging. The final results may be similar, but the conative knowledge of the users are quite different. This can also be easily misjudged, as many proficient users will testify when commenting about annoying cartoon animated help systems.

Affective Knowledge:

“Affect is the technical term relating to the emotional state of the user” (p96) – excitement, boredom, enthusiasm etc. Though in general, a computer cannot be aware of the emotional state the user brings to the computer, the interaction with the computer can certainly affect

the user's mood. This could be as simple as an attractive interface, or as uplifting as an interface that satisfies all of the user's requirements.

In some situations, prior knowledge of the user's emotional state must be assumed, such as for an emergency device. Long, hard to read, detailed instructions may be quite inappropriate for someone who is under stress. As discussed in the SIGCHI newsletter in the next chapter, recognition for social relevance of computer interfaces is increasing, and this recognition must include attention to the emotional states of the users as well.

When combined with background and foreground knowledge, Elsom's categories provide a useful chart for modelling user's requirements, providing data for the system known as *user-centred design*.

	Cognitive	Conative	Affective
Background	What you know	Desires	How you feel
Foreground	Knowledge gained from system	Purpose of interacting with system	How you feel when using the system

Interface Culture

One of the unique phenomena of the Web-initiated "interface culture" is not so much about user-centred design, as about style, personality and expression by the author, or artist. Steven Johnson observes the lifestyle choice of the first Mac owners (p51):

... the first interface wars were basically cultural in nature, more about "lifestyle choices" than anything else. PC's, with their arcane codes and hideous green-on-black monitors, belonged to the suits, to organisation man. The Mac's playful interface spoke to a different demographic: jazzier, creative types, new thinkers and iconoclasts. Buying a Mac was an expression of individual identity, like Steve Jobs wearing T-shirts to board meetings – more of a fashion statement than a party affiliation. The computer you used revealed your personality type, not your politics.

Though Johnson is referring to specific computer platforms and operating systems, he goes on to make reference to the cross-media interface of current times.

The most profound change will lie with our *generic* expectations about the interface itself. We will come to think of interface design as a kind of art form – perhaps *the* art form of the next century. And with that broader shift will come hundreds of corollary effects, effects that trickle down into a broad cross section of everyday life, altering our storytelling appetites, our sense of physical space, our taste in music, the design of our cities. p213)

... the history of technoculture is the history of such interminglings, the unlikely secondary effects of new machines rippling out to transform the society that surrounds them.

Theory-driven production principles

There are various theories, principles and guidelines available for designing the computer interfaces.

Interface principles

Elsom-Cook suggests following a set of principles, oriented towards multi-media applications, similar to, and probably derived from Shneiderman's "Eight Golden Rules of Interface Design" (1998). These provide a practical application of cybernetic theory.

- Consistency – Try to maintain consistency. Ensure that the same thing is done in the same way in different locations
- Conceptual model – Try to provide a model of the system for the user which relates to their real-world experience
- Direct representation – Provide a visual interface which directly represents to the user what things are and what the state of the system is.
- Modelessness – Ensure that the same commands always do the same things. If they have to have distinct behaviours, make sure that these different modes are explicitly represented to the user.
- Closure – Tasks should have a clear end point indicated to the user.
- Reversal – Enable actions which the user carries out to be undone or easily removed with no loss of data.
- Feedback – Ensure that the user is constantly kept informed about what the computer is doing or has done.
- Selection – Try to enable users to do most things by selection rather than having to remember and type commands.

Semiotics

Icon design and interface metaphors draw on semiotic theory. There are some issues to consider here, especially when symbolic and indexical semiotics are used, since these rely on awareness of a user's cognitive background knowledge, or, an acceptance of a certain amount of conative learning "on the job". This is probably why many existing computer icons and metaphors are iconical, literal representations.

The literal nature of icons is sometime criticised as giving false impressions to the user. As discussed in the Nov. 1994 issue of *Software Development*, when an icon is very literal, such as a Paintbrush, the signifier, such as "line properties" is largely hidden. Users take the image literally, and expect some sort of brush type behaviour. In contrast, icons that are more symbolic, such as a short diagonal line, are more open for interpretation, because they do not directly suggest the signified. The item may contain settings for line properties, as well as brush properties, or any property that is related to creating a line.

Steven Johnson (p60) talks about the hysteria of "total simulation".

There's something perverse in this total deference to user-friendly simulation, like building a word processor that faithfully reproduces a mechanical typewriter, complete with stuck keys and worn-out ribbons. It's user friendly all right, but who wants that kind of friend?

The real magic of graphic computers derives from the fact that they're *not* tied to the old analog world of objects. (p61).

A successful example of a semiotic symbol is the computer desktop “folder”. Because the folder image is non-realistic, and symbolised, the user has no issues with this folder behaving very differently to the real-world version. The concept of a folder as a place to put things is successfully conveyed. A successful transfer of the concept, without the literal limitations.

Andersen (2000) takes a broader view of semiotics: (2000)

... semiotics may be helpful in creating interactive systems that better convey their intended messages. The reason is that semiotics is an abstraction of individual disciplines such as linguistics, art theory, drama theory and film theory. Therefore it can serve as a common language for transferring insights from one domain to another in a systematical way. This is useful in designing computer interfaces, since computers are inherently multimedia where codes from these diverse fields meet and amalgamate in practice.

Visual design style and aesthetics – graphic design

Many of the principles applied in general graphic design can also be applied to interface graphic design. A good comparison can be made with the design of forms. Both formats require the communication of essential information, the control of visual priorities and appropriate style, all within a defined space. Both formats also require skills in page layout, typography and readership control.

There is substantial theory behind how text and layout operate. Gestalt theory, for example, offers directly relevant theories of proximity, uniformity and grouping. Many practical guides are also available on proven formats and systems. Companies such as Apple and Microsoft use corporate style guides, with recommendations and advice on how to achieve a successful interface design that conforms to a house style.

However, as with graphic design for the print media, there are few instructions on how to move beyond the mundane towards excellence. It is perhaps no surprise then, that during the development of Human Computer Interface design (HCI), it was usual practice to consult the graphic designer at a late stage to add an aesthetic quality to the engineer’s work. It was widely believed that the “look and feel” could be touched up by a graphic designer late in the design process.

However, as design for user interfaces evolved throughout the 1990s, it became apparent that greater inclusion of visual designers produced far better results. This was clearly evidenced by the progress made by pioneers such as Atari, Amiga and Apple. In particular, Apple’s OS X shows a sophisticated merger of interface mechanics and cognitive workflow, all wrapped together in a smooth, friendly and approachable style that Apple named Aqua.

With visual designers now an integral part of the interface design process, it was natural that these designers would join the group of the new “interface visualisers” and begin to make visionary contributions to computer interface design. As Johnson states, (p215)

Every major technological age attracts a certain dominant artistic form ...

This digital age belongs to the graphic interface, and it is time for us to recognise the imaginative work that went into that creation, and prepare ourselves for the imaginative breakthroughs to come. Information-space is the great symbolic accomplishment of our era. We will spend the next few decades coming to terms with it.

Affective Design – research and application

Over recent years, aspects of affective psychology have been considered as significant contributors to the success of product design, including computer interfaces. This term has been adopted by researchers to refer to the emotion, feelings and moods experienced by users when dealing with a product. Affective design also includes the designing of machines that react to user's reactions, though this is not in the scope of this study.

Norman (2004), describes the new relationship between cognitive and affective research, and how affect has a direct correlation to functionality. Norman's initial summary is that aesthetics and the emotional experience of a product can directly improve usability.

These – and related – findings suggest the role of aesthetics in product design: attractive things make people feel good, which in turn makes them think more creatively. (p1)

Norman describes how a relaxed state of mind enables a user to solve problems more easily, thus contributing to greater usability of a system. As an example, we could look at a situation where the user encounters a problem with the interface; perhaps the stop button refuses to stop an operation. Our relaxed user, in an emotionally positive frame of mind, would typically pause and reflect. Perhaps they would ponder on what they were recently doing, and thus may realise that the computer is in the middle of saving their file, and so, has temporarily disabled the stop button. They would most likely then wait until the operation is finished, and normal function is resumed.

However, if the same problem is presented to an anxious user in an emotionally negative frame of mind, their first reaction would be to repeat the quit procedure several times, just in case the computer didn't "get it" the first time. After the repeated attempts fail, the user would then be more frustrated, and look for another way to quit the process. Perhaps they would try a forced quit, or even restart the computer, thinking that it has frozen. These actions, in turn, may cause the saving operation to become corrupted, with even more drastic outcomes for our already anxious user.

Norman comments on these two behaviours of responding to a problem:

This state of negative affect leads people to focus upon the details that are giving trouble, and if this fails to provide a solution, they get even more tense, more anxious, and increase their concentration upon those details. Contrast this behavior to that of people who are in a positive emotional state, but encountering the same problem. These people are apt to look around for alternative approaches, which is very likely to lead to the appropriate response...

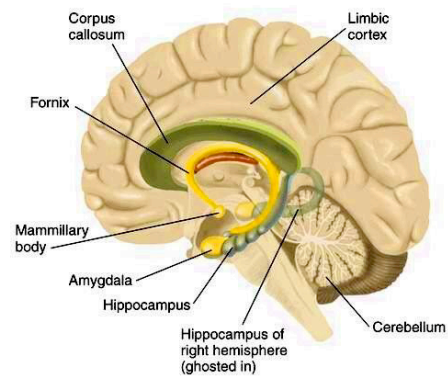
In other words, happy people are more effective in finding alternative solutions and, as a result, are tolerant of minor difficulties.(p2)

However, it appears that positive affect provides more than mere tolerance of interface difficulty. Research is showing that positive affect directly improves the ability to think.

There is a large amount of neuropsychological research investigating the relationship between emotion and behaviour, and particularly cognitive behaviour, the area that encompasses problem solving. Though debate continues in fields of psychology as to whether we are motivated chiefly by emotion or rational thought, it is accepted that emotion plays a significant part in decision making. Key research to this finding comes from Damasio (1994), who studied patients with frontal lobe disorders.

With these patients, the higher prefrontal cortex part of the brain was not communicating with the lower limbic section, which was already recognised as being responsible for generating emotions. The results for the patients was an inability to make decisions, even very inconsequential ones. As supported by Picard (1995), "Emotion does not merely play a tie-breaking role in making certain decisions; rather, it appears to be essential in learning the biases required to construct rational responses".

► Major Components of the Limbic System



http://www.driesen.com/brain_view - 7.htm

Picard, when discussing Damasio's findings, concludes that there is no part of the brain that is purely rational. The emotional activities of the brain play a vital part in all cognitive activities.

As Norman explains, the emotional contribution to the cognitive process allows the user to allocate "value" to the decision. Such value-based decision making is often expressed in the language used, such as "This was a *better* choice".

The result is that everything you do has both a cognitive and an affective component – cognitive to assign meaning, affective to assign value. You cannot escape affect: it is always there. More important, the affective state, whether positive or negative affect, changes how we think. (Norman, p6)

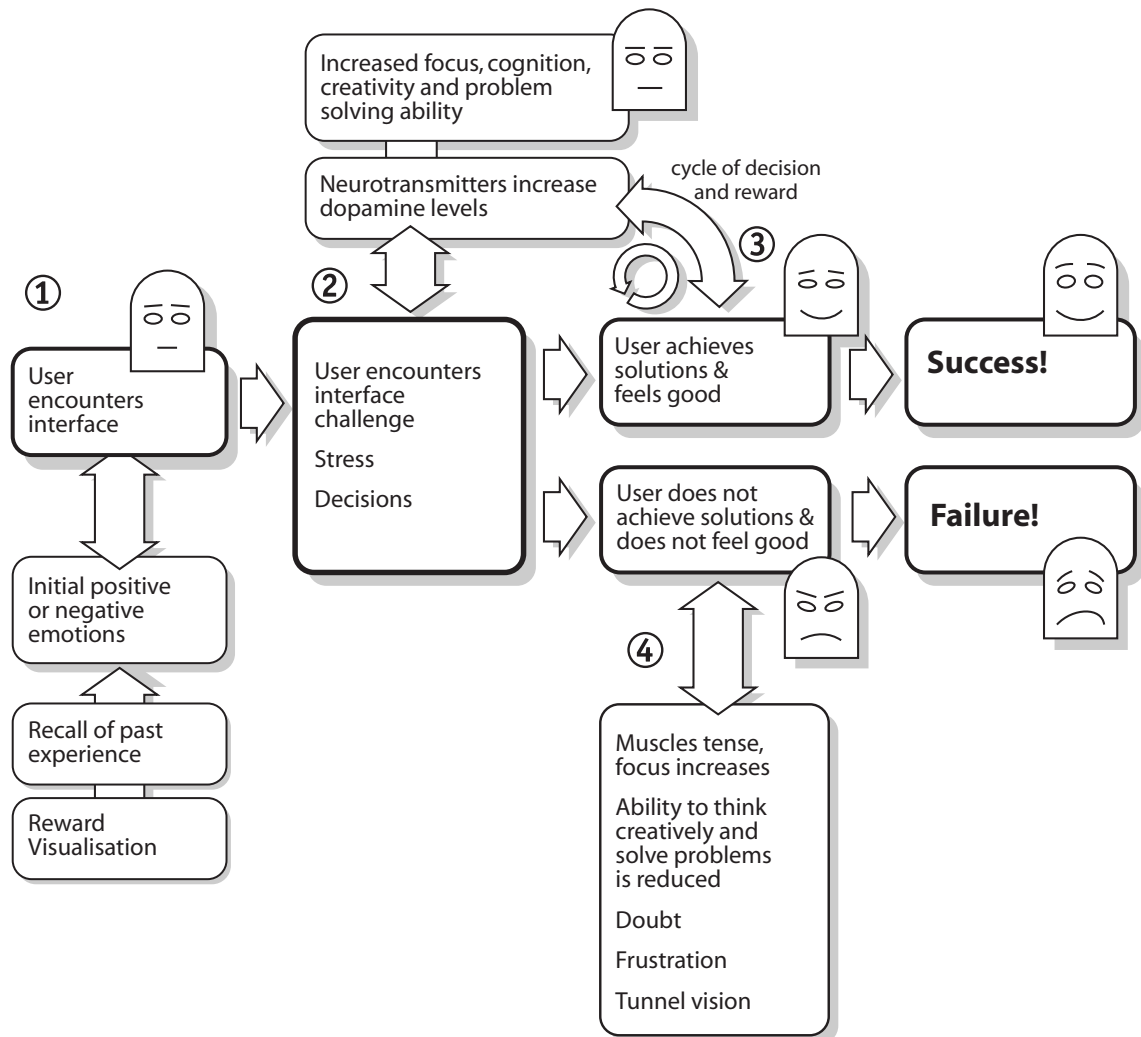
Ashby et al (1999) refer to research showing that positive emotion can systematically affect cognitive processing and improve creative problem solving, largely due to the effects of the neurotransmitter chemical dopamine in the anterior cingulate part of the brain, (p1). The anterior cingulate provides a mediation type of communication between the prefrontal cortex and the limbic, connecting, if you like, cognition with emotion. Amongst other roles, Dopamine "mediates the cognitive effects of pleasant feelings that may be denoted by self reports of pleasure, happiness, or satisfaction" (Ashby et al, 1999). Increased levels of dopamine would be interpreted by the body as "highly pleasurable". (Marr 2001).

The same chemical, dopamine, also improves cognitive flexibility (Ashby et al, 1999), as well as attention and focus, by protecting "goal related delay activity against interfering stimuli" (Marr, 2001, citing Durstewitz et al, 1990). This would mean that if our user is of positive affect, their problem solving abilities increase, they feel good about it, and their focus increases, to the benefit of solving the problem. A win-win cycle.

These behaviours, based around the neurochemical reactions form a very interesting sequence of learning events (see diagram below).

The Affective Flow

© 2007 Gray Hodgkinson



1. User encounters interface

Ashby et al observe how dopamine is released when the subject receives a reward, in particular, an unanticipated or surprise reward. Shultz in particular (Holleram and Shultz, 1998) has been involved with several studies that demonstrate how dopamine levels vary according to the prediction of the reward. If the reward is exactly as predicted, the levels do not change. However, if the reward is more than anticipated, the dopamine levels increase. Conversely, if the reward is less than anticipated, the levels decrease. As such, dopamine is a mechanism to facilitate reward-based learning. It is the body's way of marking the best outcome, and setting up a memory, or somatic marker (Damasio 1994). "This was good, let's do it again". As summarised by Marr, (2002) it is the new knowledge, or surprise reward that produces the most dopamine, produces the greatest pleasure and therefore most encourages learning.

We can relate this neurophysiological reaction to the computer interface. The user's first reaction may be to recall their own background knowledge, which could encompass several emotions, such as success, indifference, or failure. If the past experience was pleasurable in some way, the recalling of the reward will begin a physiological behaviour of reward anticipation.

2. User encounters interface challenge

This is the stage where the user is challenged, and a state of focus can occur. Analysis of information is required, and the user will need to make decisions. This could be largely a cognitive process, deciding which interface operation will best match the desired outcome. As the user examines the challenge, their focus on the problem increases. Neuropsychological research describes how the increased focus improves cognitive ability and increases the likelihood of achieving a successful outcome (Donahue 1993). This approach is tending to replace the familiar "flight or fight" theory. Flight or fight implies that the increased focus impedes lateral thought and reduces the likelihood of finding a solution, as the user, experiencing increasingly threatening emotions, narrows in on the problem. Norman refers to this increased focus as the "endangered" state, at which time the brain's neurotransmitters focus the brain processing, tense muscles, and reduce distraction so as to deal with the immediate problem.

This association Norman makes between increased focus and danger is not necessarily a given assumption. The increased focus state, including muscle tension, can also mean "readying the body for action". In this case, the action is a problem solving, decision making action. The user does not require a sense of danger to experience a visceral response. The recalled memory alone is enough to elicit a physical reaction. The state of increased focus therefore can be seen as a state of increased cognition, increased problem solving ability, all together with excited anticipation of success and reward.

Even if the user encounters a difficulty with the interface, this may not necessarily invoke a flight or fight response. It is quite probable that the user is focused, at the peak of their creative problem solving ability, and anticipating the reward of success.

3 User achieves solutions and feels good

If the user is successful, their interface decisions are confirmed, and the experience of these are reinforced, both emotionally and rationally. A cycle of decision and reward has been established, and the user anticipates this continuing (refer to diagram). All is good.

4 User does not achieve solutions and does not feel good

However, if the user is unsuccessful, the neurophysiological "high" is not experienced. All of the positive reinforcement has been for nought, and the user, in essence, has to start all over. Furthermore, the user now has emotional and rational negative reinforcement of the failed process. Though this is helpful as a learning tool, the reward anticipation has now been reduced, reducing the energy reserves required to solve the problem a second time round. The behaviour of a user, upon encountering repeated failure, would make intriguing further study by itself.

There are several inferences from this research which can be applied to an interface design. In particular, the importance of reward and reward-anticipation. Computer interfaces already have this mechanism partially in place, in the manner that information is only revealed following an action by the user. The simple act of opening a folder is a process of anticipation, action and reward. It may be appropriate to investigate whether a higher value reward, increases the pleasure of using the interface. The higher value reward could take several forms, some

suggestions would be the use of pleasing visual design, the use of audio, or perhaps by offering functionality beyond expectation.

There are many other neurological and behavioural theories that could be seen as influencing interface design. However, the one significant area of design that has applied affective design principles with some thoroughness is that of product design. One of the leading commentators of affective principles is Patrick Jordan.

Product design and Patrick Jordan

While the development of computer interface design has been driven by technical and mechanical solutions, product design has been dealing with the emotional interaction of customers for many years. It is well established that function alone will not guarantee sales of a product. If a product functions in a certain manner, then its look and feel, its emotional affect, must also reflect this. In this way, the nature of the product is communicated to the client, both on a rational, functional and emotional level.

Product design has also shown us that there is no distinct line between function and emotion. The two criteria can easily blur together, requiring sophisticated solutions from the designer. As a leading commentator in this field, Patrick Jordan's research assists us to see interface design from a different point of view.

In contrast to Norman, Jordan (2000) contends that usability is not the only prime goal, and is, in fact, a given expectation. As consumers become more knowledgeable about products, their expectations that the product will have good usability also increases. Consumers now expect usability, and are surprised and dissatisfied when a product does not perform well.

He talks of the need to understand people holistically: an understanding of the "wider role that the product plays in the user's lives"(p8), and that this is in fact a precondition of defining the product's specifications.

Four categories to define the user

In order to substantiate a holistic understanding of human characteristics, a framework is required. Akin to the concept of worldly knowledge discussed earlier, Jordan suggests four broad categories that users bring to the interaction – *Physio, Socio, Psycho and Ideo*. (p62-83)

Physio-Characteristics: External body characteristics, Body personalisation, Physical environment, Physical dependencies, Reaction to physical environment

Socio-Characteristics: Sociological characteristics, Status, Social self-image, Social relations, Social labels, Social personality traits, Social lifestyles

Pyscho-characteristics: Special talents and difficulties, Psychological arousal, Personality traits, Self-confidence, Learned skills and knowledge

Ideo-characteristics: Personal ideologies, Religious beliefs, (particularly Western/Eastern), Social ideology, Aesthetic values, Aspirations

Four pleasures to describe the experience

Associated with the four categories, the user experiences four categories of sensations, or "pleasures". (p12)

Physio-pleasure: the physical senses, including touch and smell.

Socio-pleasure: the way in which a product enhances the user’s environment, their relationships with others, their social position, status and image. This can include the practical performance of a product, as well as the user’s perceptions. For example the Internet gives socio-pleasure by offering an alternative social space, free from local physical distance limits.

Psycho-pleasure: cognitive and emotional reactions. The demands of the product, and the emotional experience of interacting with the product. For example the satisfaction felt when easily and successfully formatting a document.

Ideo-pleasure: the pleasure derived from “theoretical” concepts. For example a product that is made from biodegradable materials may satisfy the user’s sense of environmental concern. Or, an interface that clearly displays a complex structure satisfies the users sense of organisation. Ideo-pleasure also encompasses the art value of the product itself, the aesthetic pleasure in the mind of the user.

Experience

Jordan also uses the terms “formal” and “experiential” to describe how a product’s performance can be relative according to the expectation of the user.

“Formal product properties are those that can be objectively measured or that have a clear and fairly unambiguous definition within the context of design. Experiential properties, meanwhile, are those that are defined in the context in which the product exists, and of the views, attitudes and expectations of the people experiencing the product “(p87).

Jordan uses the example of a motorbike’s top speed, which when measured objectively, is 120mph. Experientially, this top speed could be either fast, or slow, depending on the person riding the bike, and the context that the bike is within. In open road use, the speed is experienced as fast, but on a race track, the speed may be experienced as slow. This experiential context has direct relevance to the behaviour of an interface. A recreational user may enjoy watching animated folders opening on the computer screen, whereas a professional user may be annoyed by the delay the animations cause.

Like other commentators, Jordan also provides a list of essential design properties for interface design. Jordan’s list bears a similarity to those proposed by others, such as Elsom-Cook, and Schneiderman’s “Eight Golden Rules of Interface Design” (1998), and no doubt shares similar origins. However, Jordan’s list has a deliberate bias towards satisfying the user. This serves to further illustrate Jordan’s shift from user-mechanical problem solving, to user-experience problem solving.

Summary of design properties of usable interfaces	
Interface property	Definition
Consistency	Similar tasks are done in similar ways
Compatibility	Method of operation is compatible with user’s expectations based on their knowledge of other types of products and of the outside world
Consideration of user resources	Method of operation takes into account the demands placed on the user’s resources during interaction
Feedback	Actions taken by the user are acknowledged and a meaningful indication is given about the results of these actions
Error prevention and recovery	The likelihood of user error is minimised and if errors do occur they can be recovered from quickly and easily

User control	The extend to which the user has control over the actions taken by the product and the state of the product is maximised
Visual clarity	Information displayed can be read quickly and easily without causing confusion
Prioritisation of functionality and information	The most important functionality and information is easily accessible to the users
Appropriate transfer of technology	Appropriate use of technology developed in other contexts to enhance the usability of a product
Explicitness	Cues are given as to a product's functionality and method of operation
Source: Jordan (1998)	

Jordan's emphasis and descriptions of user experience gives validity to the user experience-oriented design process. It is essential that the designer understands the user holistically, and also how the user may experience the product in their unique way. This should allow the designer to design more accurately for the target market, as well as catering for what the user may bring to the product interaction.

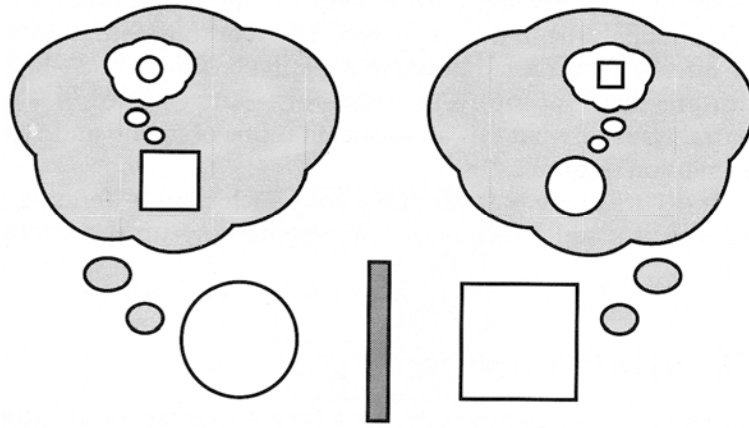
Engagement

With successful user experience comes "engagement". In this context, engagement refers to the immersive participation the user experiences when interacting with the product. Jordan quotes Aristotle's theory of poetics: "Aristotle claimed that a measure of quality by which a work of fiction could be judged was the extent to which the audience became engaged." (Jordan p46). This state of engagement has been recognised as an essential part of successful human-computer interaction. Several commentators have likened our relation to a computer as similar to an engaged interaction with another human being.

Laurel, in *Computers as Theatre*, (1993) talks of engagement as "direct engagement", comparing the similarity to "direct manipulation", first coined by Schneidermann (1987). Both approaches promote the importance of apparent instantaneous response from the computer to the user, in an immediate visually communicative manner, using such representative techniques as metaphor and semiotics.

Laurel speculates further on the concept of direct engagement, expressing dissatisfaction with the notion of the interface itself. Laurel speculatively makes the association between computers and theatre, where "There's nothing between the audience and the stage but some good illusion" (p12).

Laurel illustrates a fundamental problem with computer communication as "user-guessing". This is a potential endless cycle of the user trying to guess what the computer is expecting of the user. A variation of "I'm working out what you think I am thinking." This model of each trying to second guess the other implied "dizzying ramifications".



The "horrible recursion" version of the mental models view of the interface. More bubbles could be added ad infinitum. (Laurel, p13).

In *Computers as Theatre*, (1993) Laurel speculates on solutions that make the computer invisible, "as a medium through which representational worlds may be experienced". (p143).

Laurel further endorses a break from metaphor-driven design by suggestions on how the next level can be approached. She defines "action" as the primary component of human-computer activity – not environments, interfaces, nor objects. (p133). The solution, speculated by Laurel, relies on the "Agent" approach – where the computer takes initiative, makes some decisions on the user's behalf, assists in the problem solving process, and suggests results. Laurel is careful to explain that this does not necessarily mean a personification of the computer, or the use of on-screen characters. She discusses the concept of programmable agents or guides (p149), where a user may add characteristics to the guide's behavioural database – in effect programming the agent. Laurel travels further into computer response, including audio and kinaesthetic response, fully endorsing the computer as co-operative participant.

Clarke et al (1995), as reported by Jordan, conducted a test that explored Laurels ideas. (Jordan, p117). Agents were used to provide extra information to a database retrieval scenario, to investigate whether this made the system more engaging for users. As users retrieved information about a particular play, and read through the text, icons would appear leading to supplementary material – a "see also" scenario. Users were also provided with an on-screen notebook in which they could jot down notes – in effect an extended cut 'n paste clipboard. In a user evaluation, the System Usability Scale (SUS) scores showed no advantage over a standard, hyper-test based system. However, the users unanimously reported greater engagement and pleasure with the Clarke system.

Jordan takes three conclusions from this evaluation. Firstly, the strong link between level of engagement and the level of enjoyment, thus supporting Laurel's premise. Secondly, the use of agents appeared to have increased engagement. Thirdly, usability is only one of many factors, and to evaluate using a usability scale was an inadequate method, as it did not measure the engagement and enjoyment experienced.

Clearly, the manner in which agents are employed is critical. If they are too visible, the user may resent the feeling of losing, or even sharing control. If the agents are too quiet, they will not induce the sense of engagement. There are already examples of agents that work very successfully – such as spell checkers, Web search engines, online bookstores, and predictive text messaging phones. However, we also have examples of agents that provide great

annoyance, such as over-eager grammar checkers, auto listing functions, and templates that are never used. As user's skills develop, their requirements from the agents will develop, and agents must continue giving the user the feeling of engaged control.

Laurel's ideal scenario may be finding results in the development of "Affective Computing". As described by Picard (1998):

Affective computing is computing that relates to, arises from, or deliberately influences emotions. In practice, we are trying to build computers with the skills of emotional intelligence, such as the ability to recognize emotions, assist in communicating human emotion, and respond appropriately to emotion.

De Angeli et al (1999) also draws attention to this new "shift" for HCI, discussing how HCI can now shift towards "social cognition." Comparisons are made to how humans interact with each other, maintain relationships, co-operate and compete. "Cognitive activity occurs during interaction with tools, social cognition mediates our relationships with friends." (p1)

Though building an active affective computer is not the aim of this study, the validity of affective design as a design principle is substantial, and will be an integral part of this study.

An overview of interface development

The examination of relevant literature begins by outlining significant historical developments leading up to the development of the Windows, Icon, Metaphor, Pointer interface (WIMP). This is followed by examples of computer data representation, increasing in relevance to Web browser history. Thirdly, the case for 3D interface is examined. And finally, the chapter finishes with a few examples of interface development in related media.

Chapter sections:

- Formation of interface research groups - Human Computer Interaction
- Relevant history: Pioneers of interface design
- Development of the Windows, Icon, Metaphor, Pointer interface
- Information visualisation
- Mapping and representation of network data
- Interacting with networks
- Content visualisation
- Specific issues with Web browser history
- Examining appropriateness of 3D visualisation methods
- Inspirational concepts

Formation of interface research groups - Human Computer Interaction

HCI is a well established field supported by substantial research originally based in computer science.

Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.
(Hewett et al ACM SIGCHI Curricula 2002).

The Special Interest Group of Computer-Human Interaction (SIGCHI) was formed following a special topics session at the Association of Computing Machinery (ACM), Gaithersburg, Maryland, 1982. SIGCHI holds regular conferences, and continues to evolve in response to concerns regarding human-oriented aspects of computing.

Criticism of SIGCHI's technical orientation is described by P. Baeursfeld (P12, 1994), where she makes a comparison between SIGCHI's "Human-factors" focus and that of "User-oriented" design.

Involving the user is not simply making sure the user can adequately see, comprehend, or use something, although these important concerns certainly should be addressed by software developers. The added benefits of user-oriented design are in product usability and the creative designs that build on user concerns and needs.

In SIGHCI's Newsletter (p7 Nov 2000), reference is made to the relationship between science and social science:

Cognitive psychologists who strongly influenced CHI in the 1980s tended to be critical of work in the social sciences, and were not drawn to action research.

That has gradually changed. We realize that basic and applied research in the social sciences is critical to improving technologies that are increasingly used interactively in group/team, organizational, and community settings.

Finally, a broadening of vision and an awareness of the socialisation of the computer interface is indicated in the introduction and subjects posed for SIGCHI's 2003 conference.

CHI can bring hope to an increasingly push-button world that often seems frustrating and confusing to users. Although most CHI researchers and practitioners are motivated to make users' lives, communities and society better, there is a growing global research effort that is directly focused on, and concerned with, the social impact and implications of interactive systems.

The text goes on to introduce such topics as privacy, trust, empowerment, and emotional aspects of interaction. This expansion of interest beyond that of technical efficiency demonstrates the increasing awareness of the computer interface as a place of human experience, rather than just a place of data manipulation.

Relevant history: Pioneers of interface design – hyperlinks and WIMPS

Development of the hyperlink method of information management.

The concept for information connected and navigated by word links is credited to Vannevar Bush in his visionary paper about a text linked system called MEMEX in 1945. The term hypertext was later applied by Ted Nelson in 1965.

Other Hypertext systems appeared from this time. Of significance was Apple's readily accessible HyperCard product, which brought the concept to a wider audience. Apple also introduced the ability to incorporate graphics, making HyperCard a precursor of the non-linear multi-media authoring environment. This enabled non-programmers to create their own computer media presentations, though within a tightly controlled interface environment.

The hypertext-linked World Wide Web appeared in 1990, and it did not take long for images to be used for buttons and linkable objects. Even at this early stage, the Web's evolution into an interactive, multi-media environment was being increasingly pushed by the users.

Hyper linking as a concept continues to bring comment. The true significance and continued potential of hyperlinking is commented on by Steven Johnson (1997), who goes on to describe ways to utilise untapped potential. Donald Norman (1998, p212) predicts new models of information organisation, though also warns of the extra skill, time and effort required to author in the non-linear and hyper linked environment.

Development of the Windows-Icon-Metaphor-Pointer interface (WIMP)

The idea of symbolising information on a computer began with Douglas Engelbart. Howard Rheingold's words (1993) regarding Engelbart illustrate a problem still experienced today of how to manage increasingly complex amounts of information.

While driving to work one day in 1950, Douglas Engelbart started thinking about how complicated civilization had become. What were humans going to do about managing this complex new world that technology had helped us create? Engelbart asked himself what kinds of tools we use to help us think. "Symbols" was the answer that came to him, the answer he had been taught as an engineer. Could we use machines to help us deal with symbols? Why not computers? Could computers automate symbol-handling tasks, and thus help people think faster, better, about more complex problems? To the right person, the line of thought was inevitable, even in 1950; it never ceases to amaze Engelbart that other people didn't see it, too.

Engelbart and others at Stanford University went on to develop multiple tiled windows. In 1969, Alan Kay of Utah University proposed the idea of overlapping windows, and went on to introduce the desktop metaphor. These ideas together with the development of the mouse, culminated in work at the Xerox Palo Alto Research Centre (PARC). Their operating system Smalltalk incorporated the first desktop interface. Unfortunately, Smalltalk was bundled with the expensive and unsuccessful computer system Xerox Star.

Steve Jobs of Apple Computers, inspired by the work of PARC, was able to implement the desktop interface successfully with the launch of the Macintosh in 1984. The interface of the Macintosh was well refined and introduced to mainstream users most of the metaphors that were to determine interface design later. Of equal significance with the introduction of the Mac came the beginning of the creative computer-user culture.

To appreciate the immense value of using interface metaphors, it is helpful to first take a short overview of some issues facing computer data representation.

Information visualisation

Information visualisation is a well-established field predating computers in the form of maps, graphs and diagrams. Geisler (1998) comments on the nature of scientific information visualisation:

It is a way to visualize real objects that are otherwise difficult to see and manipulate, such as molecular structures, or to view simulations of scientific phenomena, such as the flow of air over wings. Because of this specific focus, scientific visualization has been the domain of a relatively small number of trained scientists.

By presenting information more graphically we make it possible for the human brain to use more of its perceptual system in initially processing information, rather than immediately relying entirely on the cognitive system.

Geisler surveys visualisation techniques and applications designed to enable a wide variety of computer users to more easily navigate information spaces, to better display retrieved information, and to improve their understanding of information.

Geisler uses Schneiderman's organisation by data type to identify seven types:

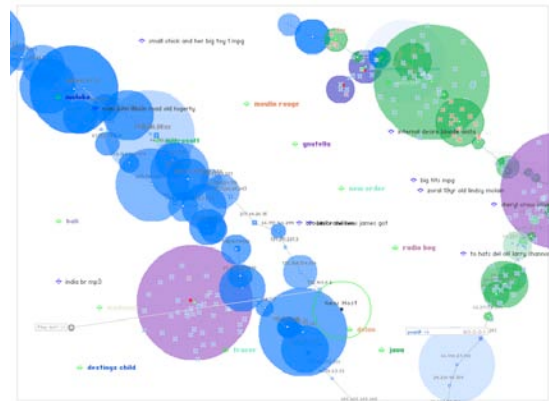
- One-dimensional
- Two-dimensional
- Three-dimensional
- Multi-dimensional
- Temporal
- Hierarchical
- Network

Although helpful when identifying different types of data, these categories do not by themselves suggest ideal ways to portray the information beyond the literal forms, such as using 2D bar graphs to represent 2D information. Furthermore, data is often a combination of these types, making the ideal representation more difficult to design. However, computer data offers an interesting place to begin examining visual representation. Of interest to this project is the mapping and representation of network data such as the Web.

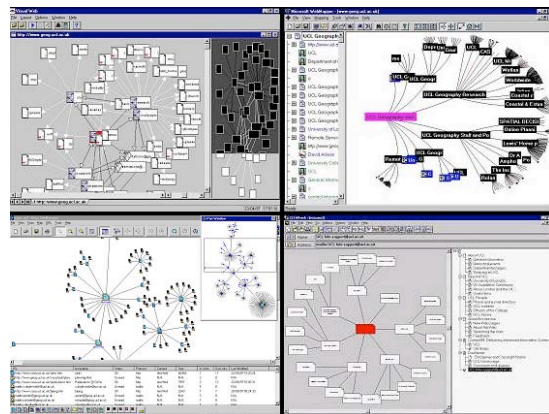
Mapping and representation of network data

Like many forms of data, Web data has no physical form. Any visual form perceived by the user is provided by the interface. With the proliferation of computer networks, network mapping is a common method used to represent the structure. Dodge's comprehensive "An Atlas of Cyberspace" categorises Web network representation largely by function. He uses 17 different categories, including Conceptual, Artistic, Traceroutes, Info Maps and Surf Maps. Many of the examples are maps created by software that tracks the data and constructs the representation in accordance with programmed algorithms. The shape of the map is usually not known until the program has finished compiling.

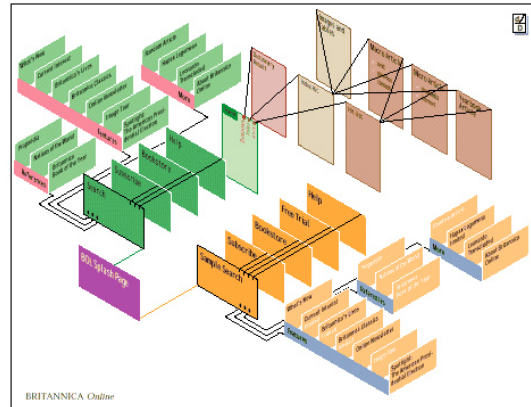
Minitasking is a graphical browser of the peer-to-peer Gnutella network by Schoenerwissen. This approach demonstrates mapping and real-time and representation. A user's search entry is shown "floating" in the view, and coloured bubbles represent site nodes. The display is updated in real-time.



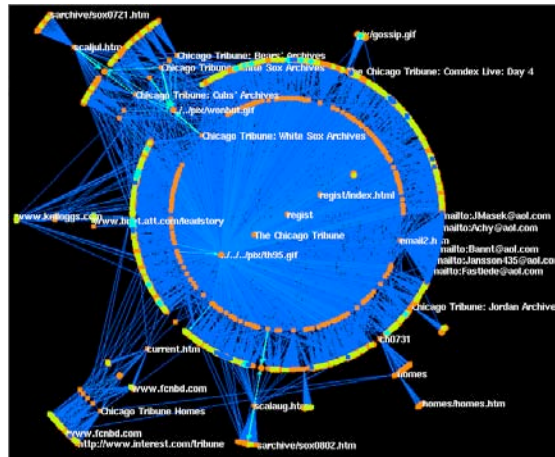
These Web site maps are created by site management tools, designed to help webmasters visualise and manage large, complex websites. Several different graphic styles of maps are available, including the horizontal tree and circular view.



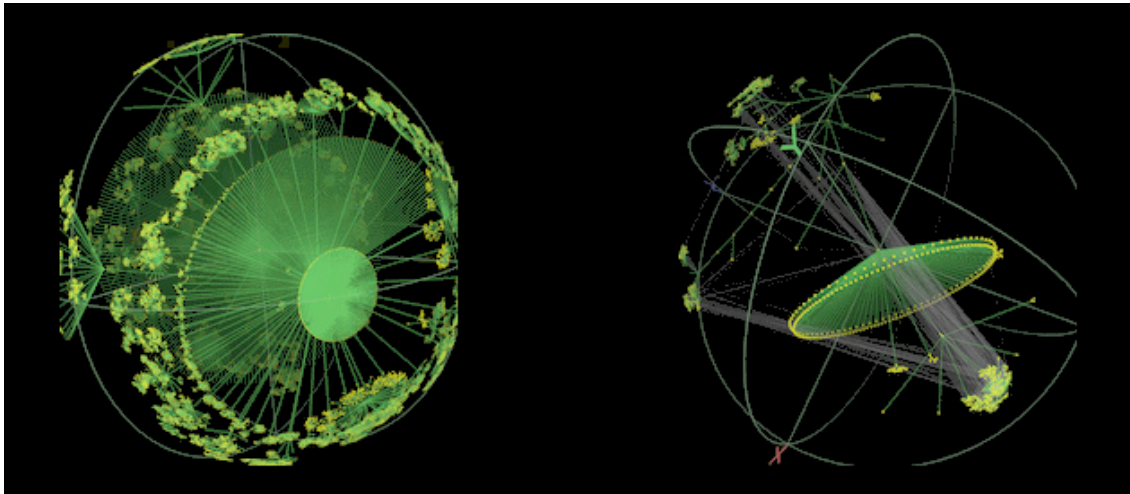
One of the graphic styles used by Dynamic Diagrams, is an example of a diagrammatic, isometric construction.



Nicheworks, developed by Graham Wills at Bell Labs, is an interactive tool for visualising large networks with hundreds of thousands of nodes.



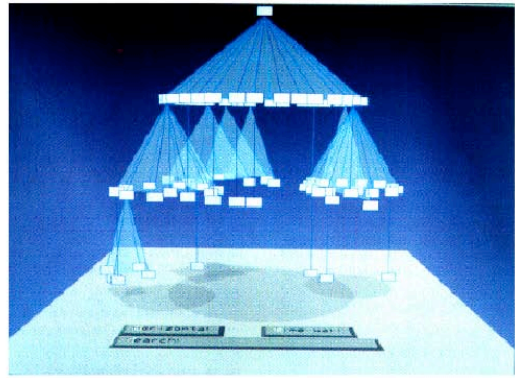
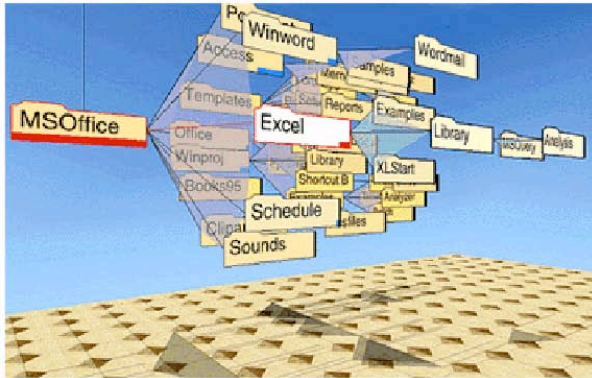
The Walrus visualisation tool creates 3D hyperbolic graphs of Internet topology. Developed by Young Hyun, Cooperative Association for Internet Data Analysis (CAIDA).



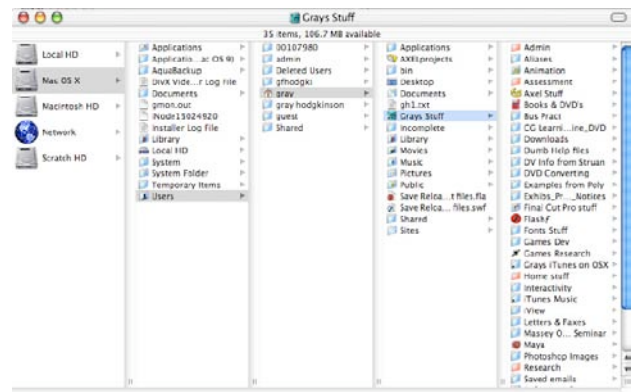
Data mapping techniques are capable of creating unpredictable, organic-like forms. Not only is the data represented in a mathematically accurate method, but the forms are often aesthetically inspiring, and would contribute to memorable visualisation. Since these programs focus on mapping, interaction with these forms is often limited. As interactivity increases, the mapping aspect is replaced by a priority for file management.

Interacting with networks

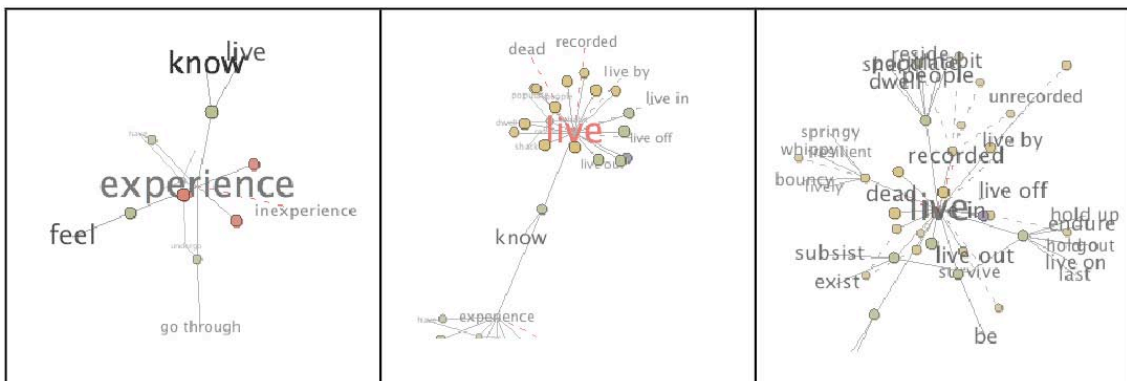
Cone and Cam Trees, developed by researchers at Xerox PARC, use hierarchies displayed in 3D, and are good examples of providing interaction while maintaining visual representation of the structure. The interfaces can rotate in response to the user, enabling better viewing of obscured nodes. Nodes can also be dragged into new positions. Due to the layering capability, much more information can be displayed than on a flat 2D metaphor, though, like all hierarchical systems, obscured visibility of other branches and nodes remains a limitation. (Robertson, Mackinlay, & Card, 1991).



With personal computer file management, such as the Apple column view, (right) the interface provides a hierarchical list method to manage a substantial number of files. This method suits the task in hand, and is easy for the user to manage. The main limitation is that only one hierarchy branch is visible at a time.

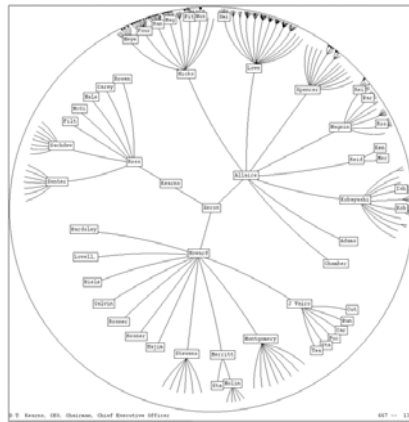


ThinkMap (below) provides interaction to data that is created in real time in response to the user's selections. The entire structure continually modifies its shape as the user clicks through their chosen path. ThinkMap uses a dynamic word association mapping concept "to create dynamic interfaces to information systems that reveal interrelationships often obscured by conventional methods of navigation and information display." (www.thinkmap.com).



A spherical, hyperbolic visualisation by Lamping *et al* (left) is inspired by a wood cut by Escher (below right). The user is able to drag towards the edges of the 2D/3D sphere, at which time

the image would “roll” to reveal more relationships. This method places the user at the central source node, with all other connections presented as hierarchies that extend outwards. A key concept of this method is that the source node is always in focus by being larger, or closer to the viewer than those on the perimeter.

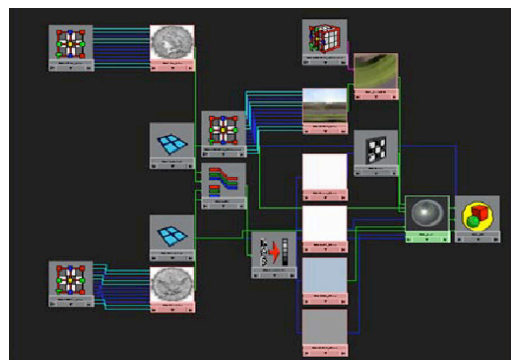


Of particular note with Lamping’s interface, is that initial inspiration came from a work of art, rather than from an interface design process. This “art-inspired” phenomenon is further investigated in chapter 6.

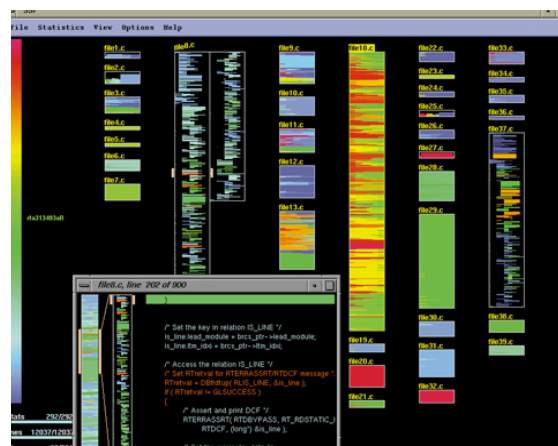
Content visualisation

As well as representing the structure of data, an interface can also be required to represent the nature of the content. As with structure representation, the methods the interface uses can dictate how the content is perceived, but with an ideal design, the interface “makes sense” for the user: the way the content is shown matches the nature of the content itself.

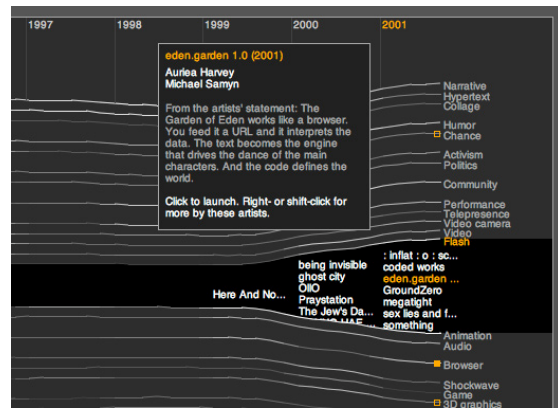
The 3D modelling and animation program Maya (right) depicts modular functions with icons, and the relationships between them with inter-connecting lines. The nodes can be moved and rearranged freely by the mouse, and the view can be zoomed in and out. Maya also provides automatic arrange and fit options. The user can also filter their view by choosing to view inputs or outputs of any one node, which can open up new relationship networks.



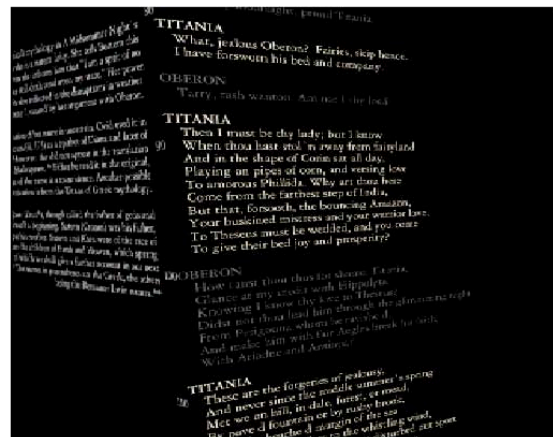
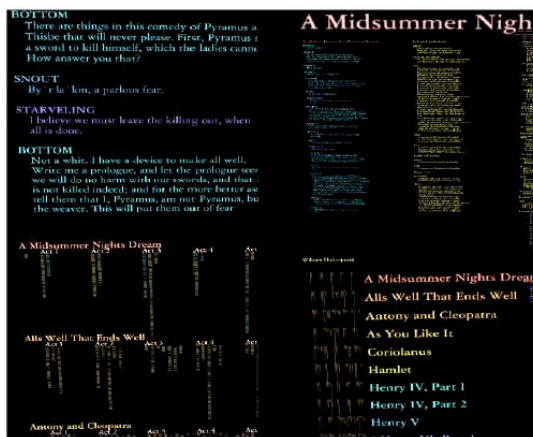
The Seesoft system uses miniaturisation to show the large amount of text used in computer programming code, with the editor being magnified in a pop-up window. Colour coding is also used to differentiate sections of code. This method allows the programmer to visualise the entire structure of the code, while also being able to work on specific sections.



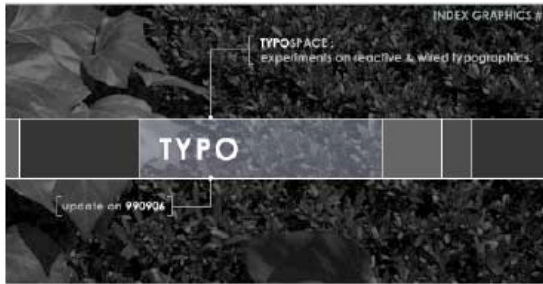
Martin Wattenberg with Idea Line, (right) displays a timeline of Web based creative works. (<http://artport.whitney.org/commissions/idealine.shtml>). Each thread corresponds to a particular kind of artwork or technology. Chronology is represented left to right. Upon rollover, the threads peel open to reveal details and links to the artist's site.



Small (1996) explores alternative ways to navigate large bodies of text. In the Virtual Shakespeare project, Small created a virtual environment in which all of Shakespeare's works are arranged in a single 2D-3D navigation space. Colours are used to distinguish actors, and notes are positioned orthogonally to the main text. The user is able to move around in the virtual space, zooming in and out, to access the content. Small uses the term "information landscape" to describe the virtual 3D quality of this environment, and though his study encounters many typographic rendering issues, it is interesting to see that he believed that this virtual environment is suited to this content.



In 1999 Yugo Nakamura introduced an interactive menu bar on his MonoCrafts Web site, (<http://yugop.com/ver2>). This menu bar would pan and zoom in response to movement of the mouse, providing focus and magnification to the highlighted item. Though experimental at the time, MonoCrafts was also a fine example of the interface design potential of Macromedia Flash. This rollover-magnify method was also used for Apple's OSX Dock, released in 2001.

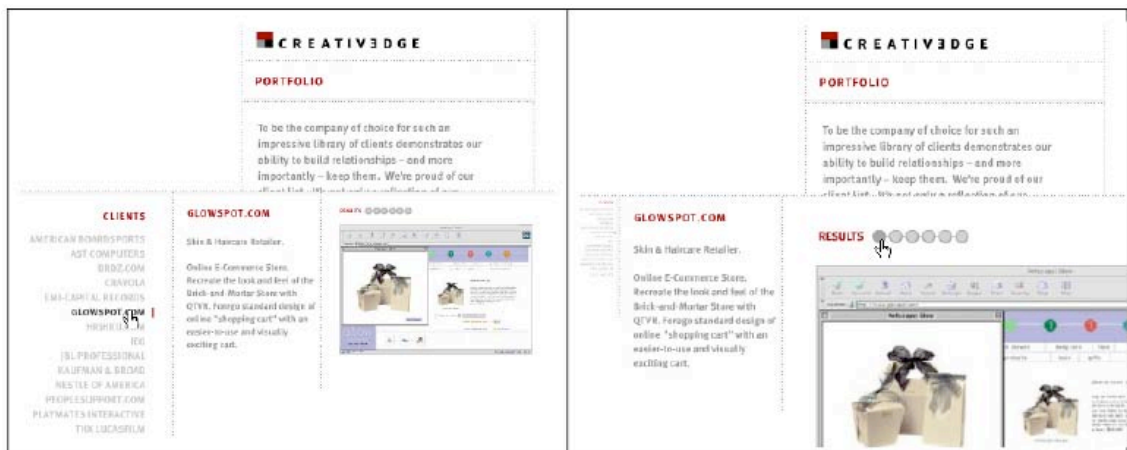


MonoCrafts 1999



Apple OS X 2001

CreativeEdge also use a 2D magnify concept to zoom into pages at their Web site, <http://www.8edge.com>. As the user moves over the interface panels, they grow in size while the adjacent areas shrink away.



Temporal data such as video requires a display method that shows its state over time. A typical video editing interface such as Apple's Final Cut Pro (right) uses a common timeline metaphor. This technique has its origins in the frame by frame images of cell animation and film, and the left to right time flow is readily accepted by users. Functionality is extended by including such options as frame size adjustment, thumbnails, sound wave display, zoom functions, and many drag-and-drop features.



Specific issues with Web browser history

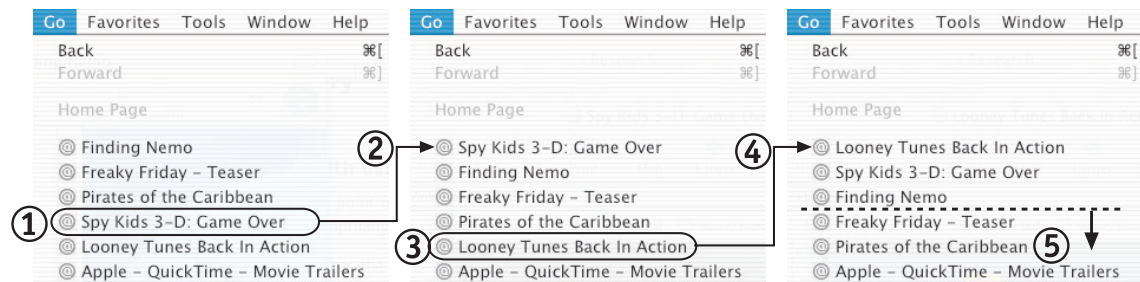
In order to build a prototype interface that embodies the principles discussed in this paper, it was necessary to select an existing interface or data group that would provide ideal material to work with. The specific task chosen to work with was Web browser history. As well as providing some unique issues to deal with, Web browser history is data that can be limited, creating a closed pre-defined group, ideal for construction and testing.

As a user browses the Web the computer records a list of visited websites. The most commonly used browsers such as Internet Explorer, Firefox, Netscape, and Safari (Web Stats) present this history to the user in a list format, either in a sidebar or as a drop-down menu item. The list approach, in general, has several inherent issues and causes significant problems for the user when they come to access and use the history data.

For example, the history list has the fundamental flaw that the list created by opening Web pages can be altered by subsequent retrievals. That is, regardless of when the Web page was first recorded, every retrieved viewing of the cached page resets the page's place in history. Herein lies the ambiguity. Which history is the preferred one? Does the user envisage the history as a record of when they first encountered the page, or a record of when they last looked at it? The current system commonly used makes no distinction between the two.

The diagram below illustrates how the use of a history list causes significant reshuffling of the original order. After two retrievals, the original order is significantly altered.

1. From the history list, the user recalls the page **Spy Kids 3**.
2. As a consequence, **Spy Kids 3** moves to the top of the history list.
3. The user then recalls page **Looney Tunes**, which also...
4. Moves to the top of the history list.
5. The user now has difficulty finding **Pirates of the Caribbean**, as it has now been pushed down the list from 3rd place, to 5th place.



The diagram shows how the user is required to keep two types of history in their memory:

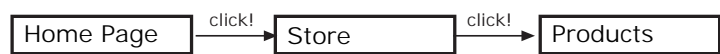
1. When the page was first browsed – eg, 3 pages ago, 4 pages ago, etc ...
2. The “reshuffled” order, as a result of re-viewing pages.

It is apparent that the user has little chance of retaining an accurate visualisation of their history list, once they start using it. This fundamentally undermines the function of the history-ordering approach. Users can work around this limitation by searching for page titles instead. This then, would be a simple name storage list, and need not be called a “history” list. It would be worthwhile to investigate how users perceive the history function, and to what degree they update their memory in accordance with the ever-changing history list.

Another fundamental usability problem lies within the back button, which is used as a means to step back through browsing history one page at a time. The back button uses a hierarchical stacking system to record a user's page sequence. If the user returns to an earlier page, and then follows a different link from that page, they will create a new hierarchical branch. The back button will now only return back up that particular branch. The earlier sequence of pages is no longer available.

The diagram below shows how the user loses back-button access to the Store and Products pages.

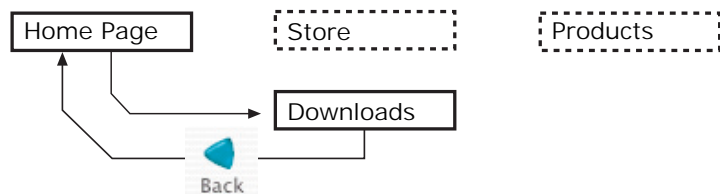
Starting at the Home Page, the user clicks through to the Store page, and from there to the Products page.



The user then uses the Back button, to return to the Home page. Store and Products remain available as "Back" options.



The user then selects a new link, Downloads, from the Home Page. The previous pages, Store and Products are no longer available via the Back button.



This hierarchical back button behaviour requires the user to be aware of when a new back button path is created, and when earlier sites are lost.

Users tend to assume that the back button simply records pages viewed, and generally do not understand why it sometimes does not work. Even if a user was aware of this limitation, it would be conceptually difficult to keep a track of when pages become unavailable. Most users simply click back and hope.

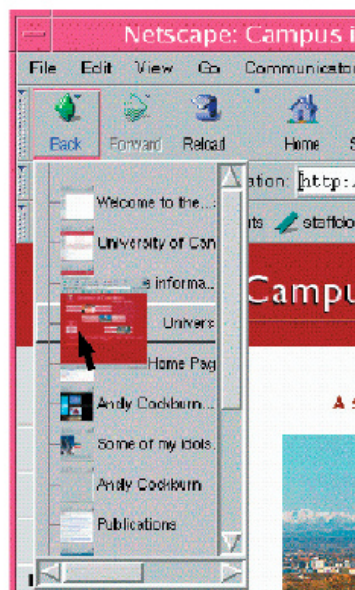
Cockburn and WebView

Empirical support for these observations are clearly described in the study by Cockburn et al, *Improving Web Page Revisitation* (2002). Cockburn et al present findings in five categories of revisitation research: characterisations of user behaviour; system models of navigation and their impact on the user's understanding; interface methods for increasing the efficiency of the Back button; alternative system models for navigation; and alternative methods for presenting Web navigation histories. Results and observations presented in the paper include the following: (p15)

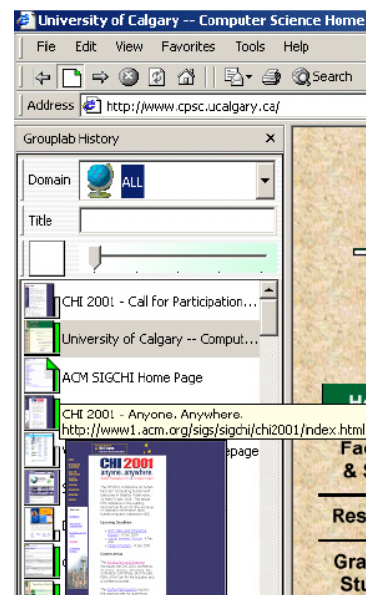
- Web page revisitation is a dominant activity in Web use, with more than 80% (on average) of Web page visits being to pages previously visited by the user.
- Most users have one or two pages that they visit much more frequently than all other pages.
- Some users make very heavy use of bookmarks, and incur problems with managing them.
- Many users misunderstand the stack-based behaviour of the Back button, even though they use it regularly.

Cockburn and colleagues went on to develop WebView, a group of interface applications implementing several improvements. WebView displays in a scrolling window accompanying the browser application, and represents visited sites with small thumbnail images. These thumbnails are automatically captured whenever a new page is displayed in the browser, and expand whenever the user moves the cursor over them. The thumbnails are listed in a non-destructive temporal list, that reorders any diverging paths into one usable list. The thumbnail images also include small “dog ear” graphics to indicate number of times visited, and whether the page is bookmarked.

The WebView prototype system demonstrates how temporal lists can be used to integrate the diverse Web revisitation tools in current browsers. It also demonstrates how the prevalent problems of page identification can be eased through simple visualisation techniques. (Cockburn, p15)



Webview



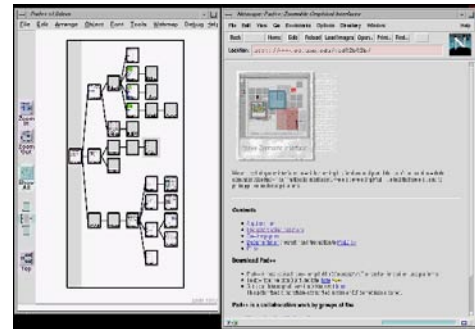
Kaasten

The addition of thumbnail images provides significant improvement to a history list’s success hit rate, and has been popular with history list research for several years. In the study by Kaasten, Greenberg & Edwards, “How People Recognize Previously Seen Web Pages from Titles, URLs and Thumbnails”, (2001), users using text-only lists had a 60% success hit rate of recognizing a page. Once thumbnail images were included, the success hit rate increased to 80%.

Kaasten et al (right) also set out to acquire formal knowledge of the recognisability of various thumbnail image sizes, quantifying the tradeoff between the size and recognisability, as well as other attributes that contributed to their success.

They concluded that users generally felt that thumbnails are good representations of pages, and that they can accurately recognise the page image at a variety of sizes. They also concluded that users rely heavily on a thumbnail’s colour and layout to identify its website, and so rely on consistent page layout design throughout a site to assist with identification. Users also used the thumbnail’s dominant text to identify individual pages, even though the legibility of the text was limited and related to the physical size of the thumbnail.

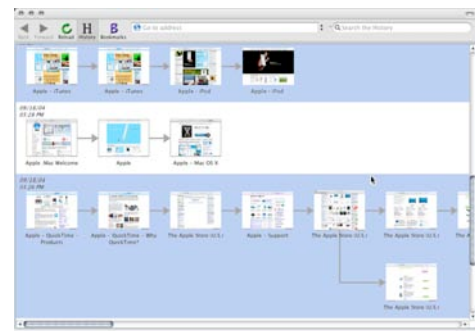
Hightower and Holland (1998) developed a browser companion called PadPrints that builds a graphic history-map of visited Web pages as the user browses. There were several innovations in PadPrints, including the recording of screenshots of visited pages to use as icons. Usability studies found that time and the number of pages visited were less than when using the conventional browser. Users also reported browsing with PadPrints more satisfying than conventional browsers.



There are several other studies of visual navigation within a browser. Gandhi, Kumar, Bederson and Shneiderman (2000) implemented a browser companion Domain Tree Browser (DTB) that also builds a history map while browsing. It also had the capability to construct more than one history tree.



Trailblazer by Benjamin et al (2004) assembles thumbnails into a horizontal layout, including multiple trees and branches. The arrangement of the pages reflects the original browsed order. This interface was designed to float over the top off the current page, but users reported “visual noise”: the confusion of imagery caused by the semi-transparent nature of the interface’s background.



Furthermore, Benjamin et al report that the linked path method does not serve users who create short paths, i.e., those who continually return to a search page. Their browsing behaviour creates many short sequences, which do not benefit from the horizontal arrangement of Trailblazer.

These hierarchical mapping methods are in some ways conceptually similar to the network mapping discussed earlier in this chapter in that they plot location and travel. However, history mapping methods are restricted to just that – a map of the history. Once a user begins to return to earlier pages, the mental image of the chronological sequence is interrupted, and the history function then becomes a hindrance. When the user uses a history list in this way, the list is behaving more like a bookmarks list. That is, a place to store, however temporarily, jump pages, from where the user will jump to new places. This suggests that a truly useful history list should also function as a bookmarks list, allowing reorganisation of the chronological order. This is a significant observation and will be investigated during this project’s design phase.

If the history list is to double as a bookmarks list as well, a second visual layout system will be required. A history sequence provides visual structure. What visual structure should bookmarks take? This is an ideal time to examine the role of spatial memory.

Spatial Memory – Data Mountain

The Data Mountain project by Robertson et al (1998) placed 2D thumbnail imagery onto a 3D perspective plane, in an attempt to generate extra functionality for storage and retrieval from a browser's bookmarks list.



Data Mountain

The project was intended to establish whether 3D spatial cognition worked the same way in a 3D virtual arrangement as it does in the real world. Commenting on results from an earlier study by Abrams (1998):

Left unanswered, though, was whether and to what extent spatial cognition was playing a role in users' navigational behaviors, and to what extent our browser designs could leverage what is known about spatial cognition and wayfinding. As users' personal Web information spaces grow larger, how can we effectively design the Favorites (bookmarks) user interface to afford efficient retrieval? (Robertson et al 1998)

Robertson et al created an interface called the Data Mountain, which allowed users to place documents at arbitrary positions on an inclined plane in a 3D desktop virtual environment using a simple 2D interaction technique.

Their results showed that the Data Mountain had "statistically reliable advantages" over the standard folder-list favourites mechanism used by mainstream Web browsers. In the report by Czerwinski et al, (1990) it was confirmed that thumbnail images, mouse-over text and spatial location memory each played a significant role.

Data Mountain also described several interesting observations from a user satisfaction point of view, that are directly related to the 3D plane metaphor.

The Data Mountain allows users to informally arrange their space in a very personal way. This informality appears to have great power, and is enabled by having the ability to view the whole space and the spatial relationships between the pages, as well as manually control those relationships in space.

The user study also suggests that spatial memory does in fact play a role in 3D virtual environments. We often heard subjects say things like “it’s right here”, or “I know it’s back there”, and move directly to the location of the page.

Storage times, retrieval times, and retrieval failures were all reduced because of this aspect of spatial memory’s influence.

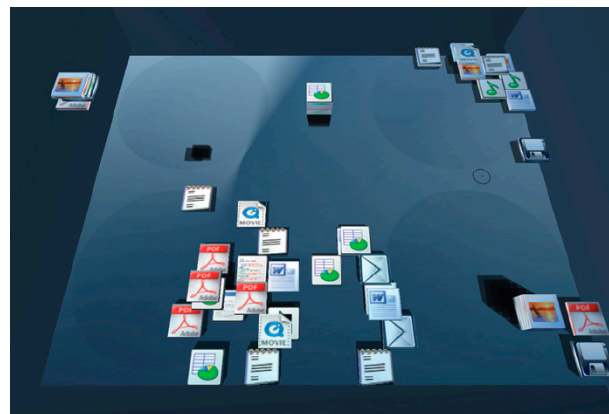
Cockburn et al (3D or not 3D, 2001), sought to isolate the perceived benefit of a Data Mountain-like 3D space as a place to organise documents. They concluded that the improvement to efficiency offered by 3D was not significant. However, users had a preference for the 3D form, and *perceived* it as more efficient.

Many users of the 3D interface also commented that the interface felt “natural” and “a good way to organise bookmarks”. Equivalent statements about the 2D interface were less common. (p6)

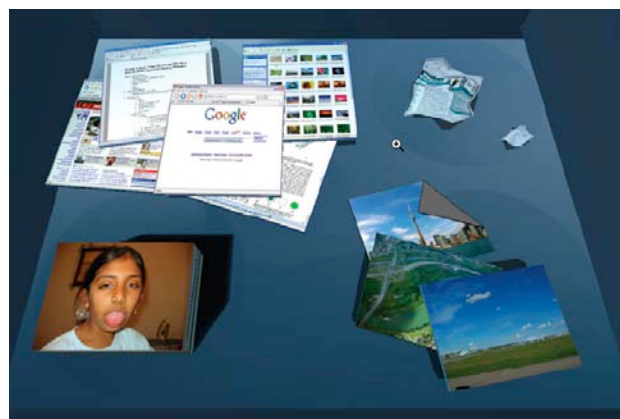
It should be noted that the Data Mountain approach places 2D thumbnails into a 3D space. As such, the 3D spatial arrangement is mostly used as an environment to stack, or layer the documents. This takes little advantage of the 3rd dimension and, in fact, the 3D aspect simply adds perspective to an already successful 2D form. This stacking method is often referred to as 2½D. Furthermore, while the 3D plane may add visual depth, it also has the potential to add complexity to an already successful metaphor.

BumpTop

BumpTop by Agarawala and Balakrishnan (2006) is also a 2½D desktop metaphor, though its most impressive feature is its document pile organisation methods. This approach is further enhanced by all objects having physical properties such as weight, mass, and collision behaviour.



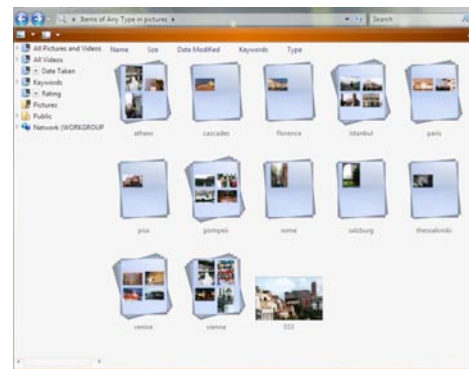
The authors identified the many strategies employed by real world office workers to organise documents. They point out that computer software by comparison offered a very limited range of organisation options. For example, workers often placed important piles closest, used specific files jutting out to form bookmarks within a stack, and often relied on the natural chronological ordering that takes place as items are stacked.



Based on these behaviours, the authors developed an extensive range of pile management techniques, some illustrated below.



Also making use of the stacking metaphor is Windows Vista (www.microsoft.com/windowsvista/), where it is used to show groupings of files with similar content. The stacks do not inherit as many real world properties as in BumpTop, but it is nonetheless interesting to see a mainstream developer increasing its visual organisation options for its users. This suggests a recognition of the value of visual organisation methods.



Examining appropriateness of 3D visualisation methods

With examples such as Data Mountain and BumpTop, it could appear that 3D offers more interface design potential than 2D. Constant throughout the studies of 2D and 3D navigation, are the favourable reactions towards the 3D space from users. There seems to be a desire, from researchers and users alike, to make 3D work. Is this in the belief that the 3rd dimension can add extra functionality, or is it simply a desire to make our computers more “cool”? And if a 3D interface is at first emotionally stimulating and rewarding, is this experience maintained as the interface is used?

As demonstrated by Data Mountain and other projects, 3D does not always improve an already functioning 2D system. However, 3D visualisation offers a strong sense of environment. This sense of place is generally quite different from folders and desktops, and it would be of value to investigate some of the principles behind 3D environment design, and to examine how the benefits can be applied to a non-3D interface. Vinson (1999) offers guidelines for navigating virtual environments, taking cues from the use of landmarks in real environments. Several key criteria that have a possible relevance to the virtual nature in interface design can be summarised as follows:

1. A user's view may become limited because of their location within the environment
2. Landmarks provide keys to orientation and navigation
3. Users will transfer mapping techniques from the real world
4. Users will compile their own cognitive maps to navigate the space
5. Awareness of movement and orientation is less in a virtual world than in the real world

Citing Lynch's (1960) descriptions for real environments, Vinson (1999) describes five general types of elements and their functions:

1. Paths – channel for navigator movement
2. Edges – indicate district limits
3. Districts – reference points
4. Nodes – focal points for travel
5. Landmarks – reference points into which one does not enter.

This highlights the most prevalent issue with using virtual 3D environments for an interface. Once virtual 3D is adopted, an extra layer of navigation is required, simply to move around within the environment. This is appropriate when the object of the interface is 3D, such as a building, a landscape or as in a 3D game. In these situations, the objects being investigated are 3D objects by their very nature, and to explore them in a 3D manner makes sense. However, Web pages are not naturally perceived as 3D. They are viewed on a flat screen, in a layered window environment, at best layered 2D, or 2½D. If these 2D pages are placed within a 3D virtual world, they risk appearing “artificially” three-dimensional.

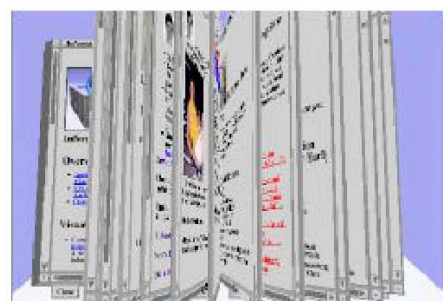
This forced “3D-ifying” of interface has been attempted many times, mostly with limited success. The 3D experience is initially interesting, but the novelty soon wears off, as the user attempts to operate the interface, and finds that the 3D features actually hinder use. As Nielsen states, (1998) the screen and mouse are 2D devices, designed for 2D manipulation. Adopting 3D navigation techniques for 2D Web pages simply adds another level of cognitive workload.

Fully 3D interactive interfaces – some examples

Web Forager

Web Forager, (Card 1996), provides an example of the 2D metaphor placed within a 3D environment, in an attempt to take advantage of the perceived extra spatial recognition offered by 3D. Web Forager employs graphic representations of books, complete with 3D flipping pages.

With Web Forager, the 3D work space functionality is much the same as that of a 2D layering design. Little is gained by using a 3D work place. The use of 3D flipping pages offers an easily recognised navigation technique, but inherits the limitations of the linear page by page presentation. Aside from the few benefits of using a book metaphor, it is questionable whether there is increased navigation functionality over a 2D design.

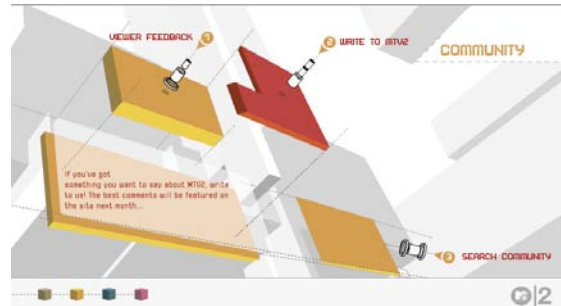


Web Forager is typical of many attempts at making interfaces 3D. Though often initially impressive, the usability of such environments is a problem, and usually requires extra effort for the same results as a 2D interface. However, some approaches stand out for specific reasons and have relevance to this project.

3D Interfaces from Macromedia Flash

Flash 3D interface designs were popular leading up to 2001, but the industry-wide emphasis on usability has seen many disappear. These sites were not true navigable 3D environments, rather, they used pre-set 3D objects and animations to provide a 3D experience, avoiding the issues of virtual environment.

Such was the case with MTV, a good example of Flash 3D. However, though the sense of 3D space was strong, it did not maintain continuity between pages, and did not represent a helpful metaphor. Its awkward navigation and slow download requirements contributed to its problems of usability.



The 3D design of MTV, and similar Flash 3D sites, emphasised aesthetic effect over usability. These interfaces did not always run well. However, the design invites the user to participate and provides rich interactive feedback with sound effects and animation. The MTV site is a good example of how aesthetics and 3D styling can enhance an experience, though also shows how forcing an interface into a 3D form, along with faulty navigation, can result in failure.

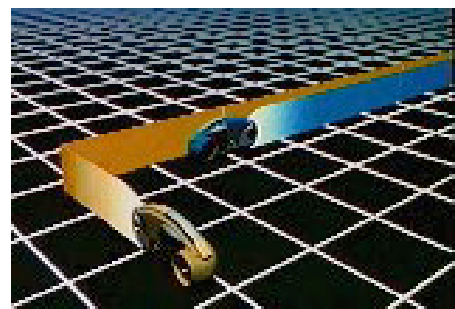
Inspirational concepts from the entertainment industry

Finally, in our review of relevant literature, it is worth casting a sideways glance to developments in the entertainment industry, in particular television, cinema and computer gaming. These media have a huge advantage over computer interface design in that the imaginative interfaces depicted do not actually have to work. They only need to *appear* to work and even then, only in the context of the story. There are also no users to report on the design's failings. This gives the writer the freedom to explore concepts without the constraints and necessities of usability. This concept-only approach is worth investigating briefly, as it provides a method to move the designer away from stereotyped solutions, and in this way is similar to the art-inspired starting point eventually used for this project.

Science fiction in television and cinema

When it comes to adoption of new technology, science fiction plays an important role on behalf of science by familiarising the general viewing public with new concepts. This increases the likelihood of user acceptance when the technology is finally introduced in real life. An informed user, even if informed via fiction, is also a more knowledgeable adopter and participant for user testing and evaluation. Of course, expectations can be unrealistically high (when do we get a holodeck!), but this over-confidence is preferred over fear and hesitation when it comes to user testing.

One of the earliest visions of digital reality came with the movie *Tron* (1982). The digital world was creatively portrayed as a computerised analogy of the real world, a method that was to become common in science fiction.



In 1995 Johnny Mnemonic gave vision to William Gibson's cyberspace – a darker more dangerous place than Tron's. Gibson's cyberspace was depicted as a metropolis, with towering architectural structures, navigated via virtual streets and tunnels, and floating interactive controls. This was a good representation of a "landmarked" virtual environment.



The Matrix (1999) gave us two versions of artificial reality. One is the illusionary world as experienced by humanity, the other is the underlying computer construction, depicted as an assemblage of green code.



The Minority Report (2002) reinvigorated popular interest in the holographic interface. Much of the fascination was due to its believability. Not only are similar features already available in today's software, but the more advanced aspects such as motion tracking are also common knowledge. The awareness by the audience that this interface could be possible increases the believability and excitement.



The extreme arm movements used in The Minority Report simply add to the drama, even if it would result in fatigued muscles very quickly.

Computer Games

Computer gaming is another area that can provide creative interface designs. And unlike television and cinema, computer game interfaces need to be work properly.

Jeff Dyck, University of Saskatchewan:

Computer games are one of the most successful application domains in the history of interactive systems. This success has come despite the fact that games were 'separated at birth' from most of the accepted paradigms for designing usable interactive software. It is now apparent that this separate and less-constrained environment has allowed for much design creativity and many innovations that make game interfaces highly usable.

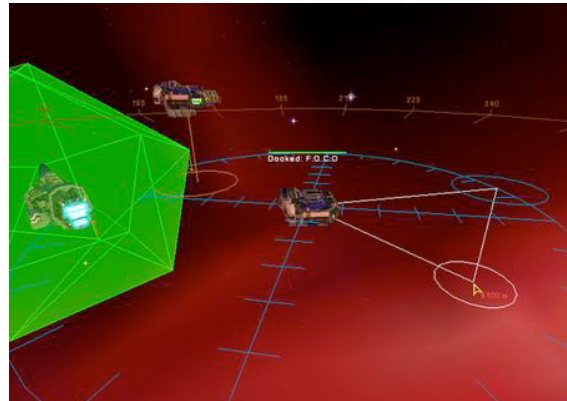
Dyck focuses on four principles that have arisen out of a focus on user performance and satisfaction: effortless community, learning by watching, deep customisability, and fluid system-human interaction.

Gamers have come to expect new, innovative features that they have never seen before, features that help them play in more efficient and more interesting ways. As a result, games have both become early adopters of new HCI technologies as well as innovators in the area of HCI interaction design.

Game interfaces have some advantages over more generic interfaces in that they are usually very specialised and can afford to make use of specific functions and aesthetics according to the game's genre. A user will not question the military nature of an interface used in a military game. As game genres have become established, so too have the interface operations. Most 'first person shooters' now operate in roughly the same way, as do role playing games, car driving games and other genres.

Two interfaces in particular are worth mentioning, in the way that they suggest the limits, or the high degree of speciality, that an interface can evolve to.

Homeworld (1999), a spaceship simulation by Relic, includes a complex but fluid 3D navigation system. The user is able to view from all angles, zoom in and out, and selectively filter the types of information shown. The controls require some dexterity and spatial awareness, though once learnt, are very effective.



Myst, from Cyan (1993), demonstrates an interface that is totally transparent – the user merely clicks on where they want to be, and the view changes to reflect this, carrying the person through the environment. Though very slow when compared to a desktop interface, Myst was the first popular game that attempted to increase user immersion by removing interface components as much as possible, replacing them with objects from the game's virtual environment.



Apart from rendering improvements, recent developments in games interface have concentrated on the game environment interaction, such as improved physics, artificial intelligence and controllers. These latest developments attend more to character control, than to the manipulation of information and files. As such, deeper investigation into games interface at this time seems unlikely to further inform the development of a Web visualisation interface.

The art and space of El Lissitzky

The “Proun” series of paintings by El Lissitzky have provided inspiration for many students of spatial form. The pure abstract forms of Suprematism and De Stijl were rebuilt on the canvas in accordance to personal visions that were forming the Constructivist theories of the time. Familiar shapes were recombined to form unfamiliar constructions. The paintings were two dimensional but invoked a strong sense of 3D composition and movement. When one looks at a Proun painting, it is not difficult to envisage the composition as some sort of modern-day, computer-rendered structure. It was this observation that initiated this study of Lissitzky’s Proun paintings.

El Lissitzky

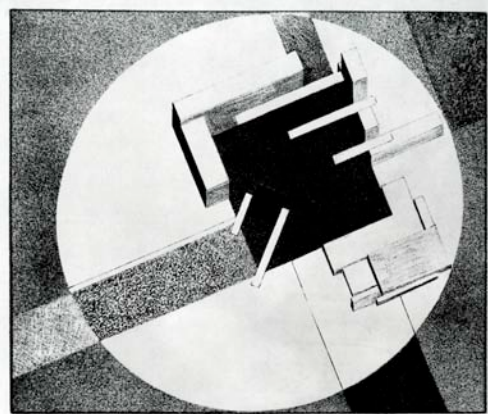
El Lissitzky was a pivotal Russian artist working in the 1920’s. With a series of paintings he called “Prouns”, he formed a bridge between the 2D art and theory of the Suprematists, to that of the Constructivists. His works and writings provide an opportunity to re-examine some of the principles of 3D space on a 2D surface.

Control of Space

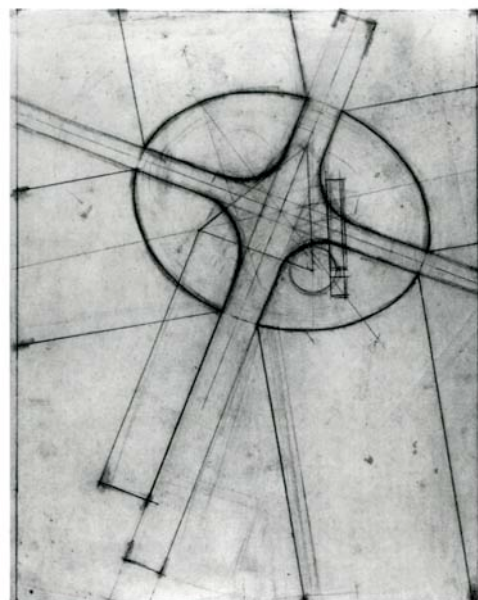
Lissitzky created the Proun as an “interchange station between painting and architecture”. He saw himself not so much as painting as constructing. “I have treated canvas and wooden board as a building site, which placed the fewest restrictions on my constructional ideas.” (Lissitzky-Küppers, p329).

Lissitzky’s Prouns and his associated theory makes a significant contribution to how we see space and form within a 2D canvas. Lissitzky created self-contained environments, that were both artistic and architectural, freely playing with perspective and projection, while still communicating form, scale, depth, and an impression of deliberate construction.

His awareness of 3D spatial interaction is evidenced by such comments as:

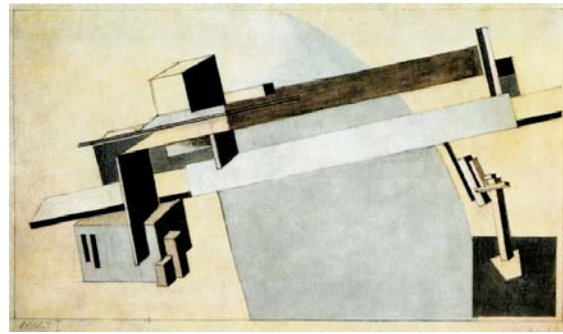


Proun 1E The Town 1921



Proun Study for G7

We saw that the surface of the Proun ceases to be a picture and turns into a structure round which we must circle, looking at it from all sides, peering down from above, investigating from below ... Circling round it, we screw ourselves into the space ... we stand between them and push them apart. (p347).



Proun1A_Bridge_1_1919

Lissitzky, professionally trained as an engineer, then an architect, consciously manipulates the architectural laws and concepts of environment:

Standing on this scaffolding in the space we must begin to mark it out. Emptiness, chaos, the unnatural, become space, that is: order, certainty, plastic form, when we introduce markers of a specific kind and in a specific relationship to each other. (p347)



Proun5A_1919

Lissitzky skillfully uses many compositional techniques to invoke the sense of structures in space: perspective and orthographic projections, overlapping shapes, angled planes, sweeping curves, directional lines, and the careful alignment, or non-alignment, of strategically placed shapes. Baljeu describing Proun elements states:

They free themselves, so to speak, from the surface on which they are painted, in two directions: forwards out of the picture and backwards into the picture" and "invalidates the idea that the picture must have a vertical axis. ... the impression that a Proun constellation is weightless.

Redefining what things are

Using the geometric tools from Suprematism, Lissitzky applied his architectural training and personal theories to give new meanings, and consequently, new functions to the shapes in his paintings. Once the painting space is explored, the functions are revealed; indicators of scale, areas of stability, visual anchors, and



Proun12E c1920

directional indicators are designed to draw the eye from one point to another.

Though his earlier Prouns revealed their real-world origins with such titles as “Town” and “Bridge”, his later works paid no such reference to the physical world. Instead, he saw the environment as being created within the picture frame, and existing within its own right, and within its own rules.

Proun is the creation of form (control of space) by means of the economic construction of material to which new value is assigned. (Lissitzky-Küpper, p347)



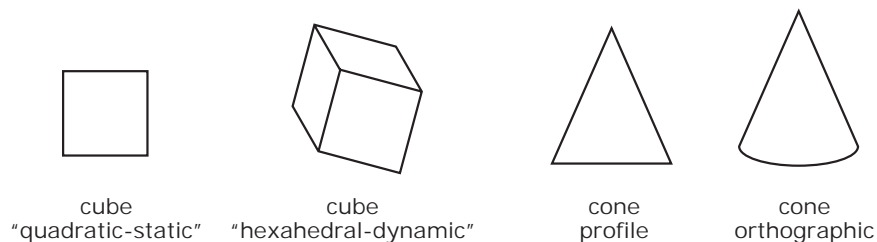
Proun93 Free floating Spiral, undated

Lissitzky saw the elements of his paintings as “signs”. “A sign is a form through which we express phenomena”. He describes two types of sign: the first uses meanings that are agreed upon by all, as in the symbols used in a map. “... with these signs we have expressed what was already there in the world, what had already been built.” The second form of sign, however, is more complex. “A sign is designed, much later it is given its name, and later still its meaning becomes clear.” As the viewer learns the visual language, so they will understand the work.

At the time this was an innovative concept. Lissitzky was asking the viewer to read spatial meaning into these otherwise abstract shapes.

Space until now has been projected on to a surface by a conditional system of planes [ie perspective]. We began to move on the surface of the plane towards an unconditional distance. We multiplied the axes of projection in this rotation, we moved between them and separated them. (Lissitzky: Towards the Defeat of art).

Lissitzky refers to the basic geometric building blocks, from which everything is constructed, as “plastic elements”. His descriptions for these shapes includes how the depiction of them alters their representation. A cube viewed face-on is a square, whereas when viewed from an angle, it is a six-sided cube, of 3 dimensions, hanging in space, and dynamic.



Lissitzky compared aspects of his spatial theory to aspects of science. In particular the process of reduction to basic elements and the reconstruction according to and within a system that evolves as the work evolves.

Computer data visualisation and Lissitzky

The Prouns of Lissitzky suggest alternative approaches and concepts that can be considered when visualising computer data. The interactions Lissitzky presents between environment and viewer perception have a parallel in computer interface and user behaviour.

The 3D nature of Lissitzky's Prouns invites the eye to travel into the works, and it is a natural step for the viewer to imagine moving around in this 3D space. Furthermore, the effect of using abstract shapes, as opposed to representational shapes, is to increase the viewer's involvement. As discussed earlier regarding the symbolism of icon design, abstraction requires the user to make an input. The user must use their imagination to discover the shapes' functions, or to apply their own. This process has the positive effect of increasing participation with the work.

For the digital designer, it is possible to visualise the Proun spaces as digital interactive spaces, whether this be as a immersive virtual environment or as operable interfaces. Taking into account Lissitzky's ideas, this transference to the digital environment is logical.

Lissitzky also suggests that the interface learning stage can be stimulating and rewarding, and does not necessarily need to follow expected paradigms. He shows the viewer alternative pathways through an environment; his roads are not always straight, they may be curved, spiralled or angled.

Lissitzky's redefinition of objects and meaning is echoed by remarks from Brenda Laurel in *Computers as Theatre* (1993). Laurel also promotes the recognition of the created environment as an immersive world in its own right, only this time, the world in question is the digital one. She is not reacting against norms in art, but against metaphor norms in computer interface design.

Designing human-computer experience isn't about building a better desktop. It's about creating imaginary worlds that have a special relationship to reality – worlds in which we can extend, amplify and enrich our own capacities to think, feel, and act. (p32).

Most art forms characteristically involve representations of real-world phenomena. As Aristotle observed, Art represents not what is, but a kind of thing that might be; environments, object, situations, characters, and actions are represented within a wide range of deviation from real life. (p125)

The process of bringing Lissitzky's forms and concepts into the design process begins in Chapter 7 – The Design Process.

Testing and Evaluation Methods

When to test – prototyping

Before we look at evaluation methods, it is necessary to define at what stage of development testing should take place. As Jordan describes, the earliest stage that prototyping could feasibly take place is with a defined product specification, either for benefits or properties. These written forms can provide sufficient product specification to warrant testing, whether concept or actual operation. Other generally accepted forms of early prototyping include visual prototypes, such as sketches on-screen and screen-based stills, and screen based simulations.

One form of early stage visual prototyping suited to interface design is known as paper prototyping. An interface design is hand drawn, or printed out on sheets of paper, and placed on a desk between a user and a person taking the role of the computer. Buttons, menus, and other interface items are added and removed, on separate pieces of paper, in response to the user's actions. It is a valuable technique when exploring navigation issues, particularly when multiple menu levels are involved. However, paper prototyping becomes more cumbersome when the actual nature of the interface is being explored, as properties such as aesthetics and animation cannot be sufficiently represented by pieces of paper.

Another form of prototyping is the "Wizard of Oz" prototype. The interface appears to the user to be fully operational, but is in fact being remotely controlled by a hidden operator. Because the interface behaves just like a finished product, the information gathered is very accurate. However, one potential serious drawback is the possible delay caused by the reaction time of the hidden operator. In certain circumstances, such as a button glow feedback, a delay is unacceptable, and would have a negative impact upon the user's experience. One partial solution is to allow the hidden operator to see the user, so as to anticipate their actions.

If realism of interface interaction is a goal, then the best prototyping method may be simulation. Often simulation is used as a second-best option for a product evaluation, when a fully working prototype form is not available. In the case of interface design, we are not only simulating a design, but since the same screen based-medium is used, we are in fact replicating the design in virtually all aspects. This makes this method a very valid form of evaluation. To the user, once in front of the interface, it would appear fully operational. An interface simulation would be built in an operating environment that simulates the final product, but uses different tools, and is perhaps limited to a particular computer or operating environment. This is a technique commonly used to simulate cell phone interfaces, using the Web animation software Adobe Flash. Though Flash would not be used in the final product, all functionality can be sufficiently replicated for testing and demonstration. This simulation method allows for concept development without, initially, being concerned with actual programming implementation. This approach best suits the design process and functionality of this project.

For this project the software environments of Adobe Flash, Alias Maya and AxelEdge 3D provide sufficient tools to construct a working simulation prototype. A fully working commercial version is not viable with these tools, and so is not sought at this time. It is also a possibility that some concepts proposed with the prototype are technically unrealistic. However, this situation is most likely to be a temporary limitation of technology or current programming

capability. Immediate feasibility aside, the main role of this prototype is to suggest alternative methods of interaction with the digital environment in ways that are stimulating and rewarding. As such, this study may make a contribution towards the continual development of interface design.

Methods of evaluation

It is generally agreed that for usability evaluation, deriving empirical information from observation rather than theory, produces the most relevant results. Jordan (p136) adapts several methods from usability evaluation for measuring experience with products from a holistic sense. A number of these have roots in psychology (questionnaires, experience diaries), marketing (focus groups, participative creation), and from the discipline of human factors (co-discovery). Non-empirical methods are also discussed by Jordan, though are generally presented as less effective.

One or more methods will be used to satisfy several design testing criteria identified for this project:

- User feedback is required at several stages throughout the design process
- Some expert feedback and one-to-one discussion is required
- A reasonable number of testers will be needed at the working prototype stage
- All participants will have to be of a sufficient skill level to provide worthwhile feedback
- Participants should have the opportunity to comment freely
- Appropriate amount of control of questions and direction of discussions

Evaluation methods are summarised as follows:

- Private camera conversation
- Co-discovery
- Focus groups
- Think-aloud protocols
- Experience diaries
- Reaction checklist
- Field observations
- Questionnaires: fixed response and open ended
- Interviews
- Immersion
- Laddering
- Controlled observation
- Checklist
- Expert appraisal

All of the methods that use interaction with the investigator, or where the user participates within a group, have the inherent possibility of behaviour influence. At the same time, when an interviewer is present, the direction of the conversation can be controlled. Without control, the discussion may go down paths that are not relevant to the study, or important subjects may be glossed over and not reported in sufficient depth. Some of the more independent methods, such as private camera conversation and experience diaries, remove control and discussion with the participant completely. Such independence is not necessary. It is preferred to retain some ability to converse with the subjects, whether this be via questionnaires or in person.

Other methods such as controlled observation and ‘think aloud’ protocols put the users into a very strong laboratory-test scenario. In such cases, the testing environment is foreign to the user’s normal browsing situation, and risks affecting the results. It was also likely, that due to scheduling and the availability of subjects, participant numbers would fall if the testing scenario was very formal.

Considering that the project is a Web interface, it seemed appropriate that an online evaluation format would place the users at greatest ease, inviting participation without pressure. This suggested that for the main working prototype stage, an online questionnaire would be the most appropriate form. If the link to the questionnaire was always visible on the interface, and/or appeared after a certain time or number of events, the users could give feedback immediately, with reactions fresh in their minds. With their permission, selected users would be followed up for clarification and discussion if required.

Nielsen (2000) advises that the iterative process, using no more than five users, is the best way to evaluate an interface design. He argues that after five users, little new information is gathered and feedback is simply repeated. It is therefore more productive to return to the design process, and implement a new iteration. Nielsen’s approach questions the importance of using large numbers of collected data, a scientific principle designed to overcome anomalies. Though this potential problem is accepted, Nielsen places a greater value on the iterative process. He points out that subsequent iteration testing can effectively act as extra user numbers, since they are experiencing a new design iteration. He does acknowledge that higher numbers are essential when more diverse groups of users are targeted.

The interface prototype in this project is likely to include several innovations or, at least, features that are unusual. Though Nielsen’s point is valid, a slightly larger group of around 20 to 30 knowledgeable users is likely to produce a wider range of feedback. This number would also give some empirical validity to the data, especially that of a more subjective nature. A very small group of expert users would be used for informal feedback and discussion in the earlier stages of the design.

Questionnaire details

Fixed response questions were largely used, with open ended comment boxes also available. Some questions were specifically emotive, and may be viewed as leading. For example, *“As you operated the isoBrowser interface, did the actions and methods of organising the Web page files appeal to you?”* This is deliberate, as the user is being asked to report on their emotive state at a specific time. The aim of this question is to prompt the user to consider specifically the degree of appeal they experienced.

The popular System Usability Scale format, using a Likert scale, was also considered and discarded for this type of question. This format measures agreement with fixed statements, and while the simpler data produced can seem an advantage, users are only responding to the single statement. Offering a range of responses to choose from provides a wider range of feedback for this project.

Production and evaluation process

The production and evaluation process falls into 3 stages:

Stage 1

Paper concepts, static screen-based mock-ups, on screen tests with some operable interface components. Selected experts will be consulted for an informal discussion. The purpose of this will be to introduce the project, and informally discuss concepts with expert testers.

Stage 2

Simulation prototype posted onto Website. The complete test includes a pre-determined sequence of pages to browse, so as to create the history sequence, the working interface and the questionnaire. Users invited to participate.

Stage 3

Incorporating feedback from stage 2, improvements are designed and implemented into a static design proposition. Further informal consultation with expert testers, and follow-up discussions with appropriate participants. If time is available, a second working prototype may be produced, though this is more likely to take place at a later date.



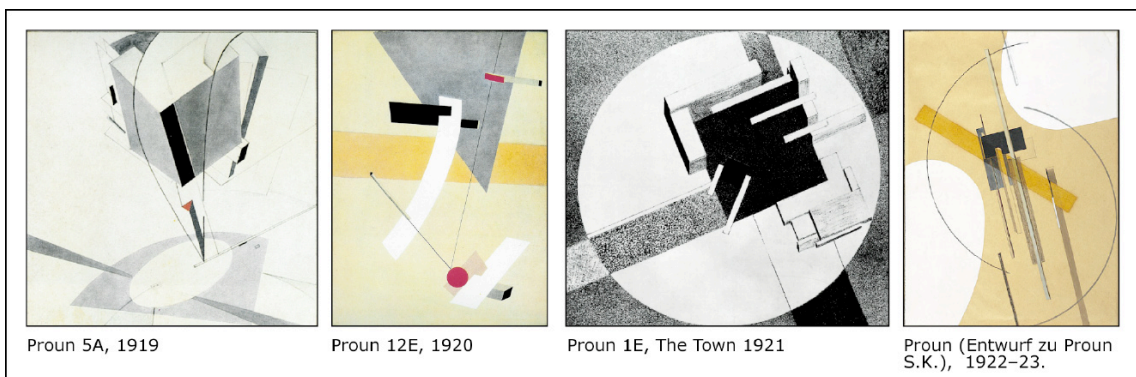
Part 2:

Design and testing

The Design Process

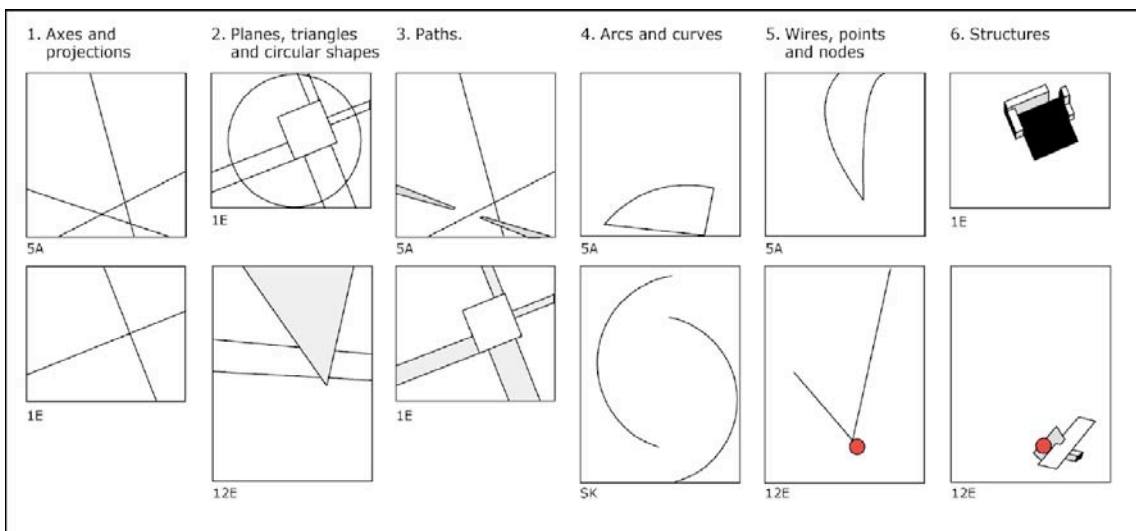
Lissitzky Deconstruction

The first step of the design process was to gain familiarity with the visual devices commonly used by Lissitzky. This was, in effect, a deconstruction process of several of the Proun paintings. It was hoped that this process would produce some insight into why the paintings evoked such spatial movement and intrigue. Perhaps these graphic devices used could also be employed in the virtual space of folders and icons.



Prouns. (Lissitzky-Küppers, 1980).

The elements within a selection of Proun paintings were isolated according to their roles, and given terms to describe their function.



1. **Axes and projections:** The prime axes and projections in a Proun provide the overall visual direction, and establish the central planes of interest for the work. Axes intersect at a variety of angles, further increasing the visual dynamism. Various parallel projection types are used. Different projection types are sometimes used within the same painting.

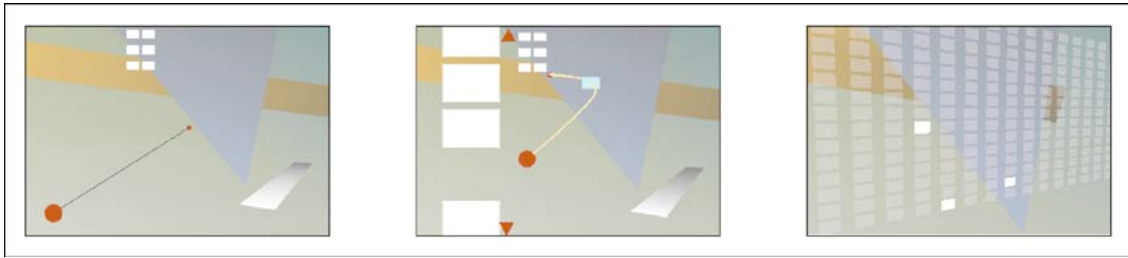
2. **Planes, triangles and large circular shapes:** These are used to define boundaries, either as floors, walls or as background forms. These devices also function to provide scale, or to give visual limits to the environment, similar to the role of a horizon.
3. **Paths:** Paths provide visual roadways, giving direction into and out of structures. They may be straight or curved, in some cases tapered, seemingly observing perspective. Their presence provides a certain amount of temporary stability, settling the eye in this or that direction.
4. **Arcs and curves:** Curves are a highly dynamic shape and add tension to static, planed surfaces. Though not as stable as a plane, or as dynamic as a wire, curved edges allow a plane to suggest movement, or at least to lead the eye from corner to corner.
5. **Wires, points and nodes:** The larger nodes provide static locators, from which wires frequently depart. These wires may move off the canvas, or they may end within another object, sometimes another node. These wires function as visual connectors between points. If a straight line is used, as in Proun 12E, the connection is relatively static. If a curved line is used, as in Proun 5A, the connection is dynamic, full of movement and tension. The curved line also has a stronger sensation of acceleration and depth. The colour red is often used for nodes, as if to draw attention to their function.
6. **Structures:** Structures are often found seemingly floating in space. Often a Proun painting is based around one of these structures, as in Proun 1E - The Town. In other cases, simplified structures are combined with other forms. They appear to provide an anchoring function, perhaps a static location, from which wires may connect, as in Proun 12E.

Lissitzky does not use conventional perspective projection. Instead he employs various axonometric parallel projection types. These drawing techniques are usually used in diagrammatic roles, to convey a shape's 3D qualities, while at the same time providing constant scale on all dimensions. This use of what is essentially a diagrammatic technique may suggest some solutions to representing the diagrammatic nature of interface.

Following the analysis stage, the first design experiments concentrated on building a Lissitzky-type environment, and giving form to some of the principles arising from the analysis. It was decided that Web pages would be represented by iconed screen captured views, accepting the value of iconed images as reported by such studies as Data Mountain. Four key criteria for function were identified:

- Representation of the chronological sequence of Web page encounters
- Re-sorting of pages, using as much direct manipulation as possible
- Storage of groups of pages
- Intuitive retrieval of stored pages

Early designs contained great visual appeal, as thumbnailed pages would speed off into the depths, along curved wires, towards distant shapes, where they would be organised into tidy stacks. This approach, however, contained significant flaws. Since the environment was built chiefly as a virtual space, the environment and the interface were not conceptually integrated. The space simply functioned like a virtual city, onto which iconed elements would move and hang, like so many lines of laundry. Though visually appealing, it was felt that this was at the expense of user interface principles.



Early designs

A significant issue was that this 3D-styled environment inherited all of the issues of 3D way finding. The first key problem was that of viewer placement. The third dimension presents the problem of what to move; the user's viewpoint, or the object, or both? Some initial solutions attempted to limit the effect. For example, instead of moving the camera in and out of Z-depth, the camera would remain fixed, and the pages themselves would fly up to the user, or away into the distance to be filed as needed.

Another key issue is that of user cognitive load. Depth navigation is another axis of navigation, and thus, another mouse control and another cognitive step for the user. This extra demand threatens to undermine a key interface principle, that of direct manipulation, where the user, as much as possible, is allowed to feel that they are directly manipulating the data. This principle, inherent in all WYSIWYG interfaces, is a fundamental principle of giving the user a sense of control.

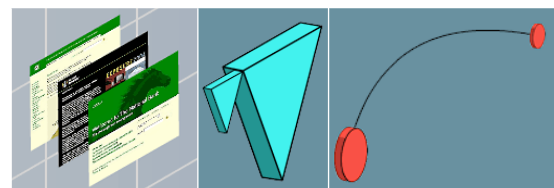
Furthermore, using 3D depth to enhance filing systems seemed unnecessary, as 2D stacking systems achieve a similar result, without requiring travel in the 3rd dimension.

It was therefore concluded that a 3D perspective-based environment raised too many issues, threatening to move the study too far into virtual 3D environments and away from the central brief of interface design.

The second design phase

The second design phase saw the adoption of a parallel perspective based environment, essentially 2D rather than 3D.

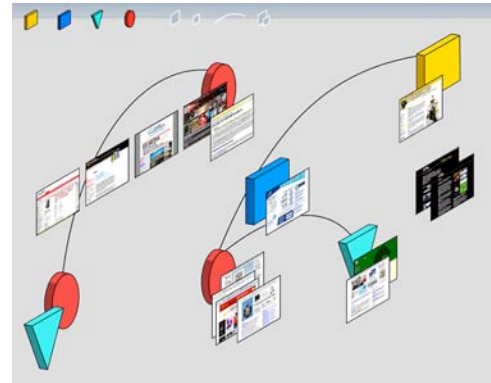
The principle design elements and functions transferred readily into a parallel perspective, or axonometric form. It was interesting to observe that the affinity with Lissitzky's work remained strong, possibly due to his works also being largely axonometric and diagrammatic in nature.



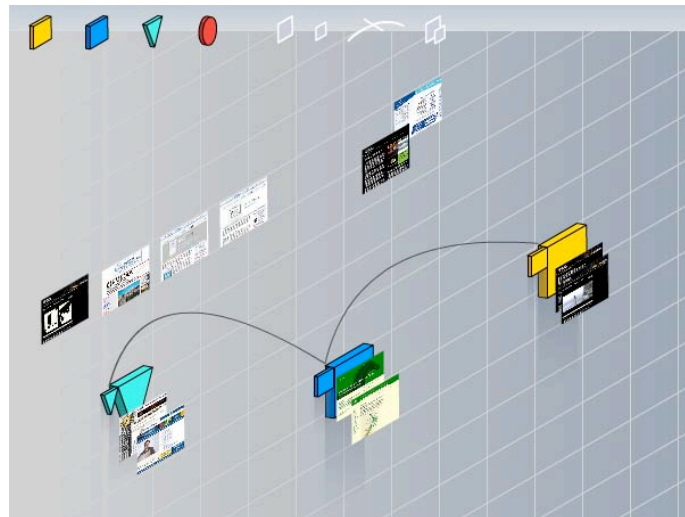
Immediately, several navigation and usability benefits emerged:

1. As there is no diminishing Z-depth, there is no need for a zooming mouse control, thus reducing navigation complexities and user cognitive load
2. Some illusion of three dimensions remains intact, potentially providing 3 axes of movement
3. It is an easier authoring environment, as all movements are in x or y axes only

A static model was built using a graphics programme to establish design layout, colours, size and relationships of the graphic items. Informal feedback from colleagues at this time suggested that the design contained a reasonable amount of visual suggestion as to its function. It was starting to *look* like a page thumbnail organiser.



A limited-function prototype was assembled using Adobe Flash. This was demonstrated to an audience of about 40 conference attendees. (Hodgkinson 2005). The presentation focused on interface design inspired by an art form, and this aspect was well received. The working model demonstrated the principle and working functions very effectively, and prompted further discussion.



Some concerns were raised about how complex the screen would become with a high number of connecting lines. Other comments suggested colour coding, more line width choices and more zooming options. Overall, the comments focused on details. The audience appeared to readily accept the overall operating concept, which was encouraging.

The conference presentation confirmed that the concept and general direction of the project had merit, and that it was viewed as a viable solution for history management and bookmarking. It also showed clearly that once an audience accepts a design concept, they very quickly move on to examining details. This made it quite apparent that the next iteration of the design would need to behave more like a completed product, with fewer restrictions. Furthermore, the page thumbnails needed to have greater significance to the tester, rather than simply appearing on the page. This implied that the next test should require the users to browse a series of pages, thus creating a meaningful set of thumbnails.

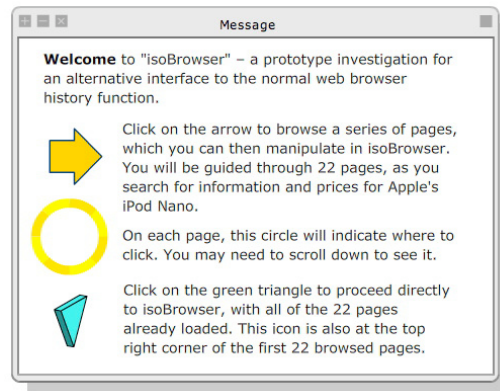
The use of geometric symbols functioning as “tag markers” also invited some comment. Though most audience members understood the role of these objects, some liked them and some simply didn’t. The main criticism was that these objects appeared as if they should do more. Since they resembled folders, viewers expected folder-like behaviour, such as the ability to be opened and to store thumbnails. This observation offered interesting possibilities, and it was decided to investigate this further in following tests.

isoBrowser – Implementation and Testing

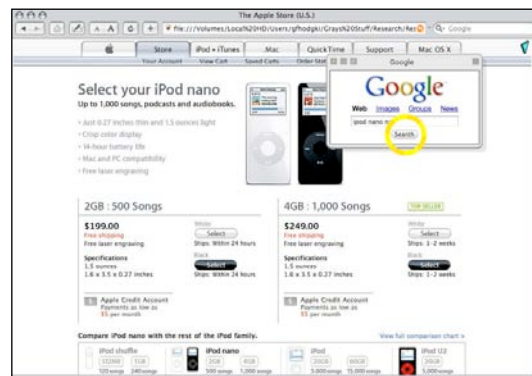
The third design prototype, now named “isoBrowser” was uploaded to the author’s website, www.designspace.co.nz/mdes.html. Staff and students from the Massey University Design school were invited to participate in the testing of the interface, and then to complete an online questionnaire. It is accepted that this group does not reflect a normal cross section of Web users. However, one advantage of using this group is that most respondents will have some awareness of the design issues involved, and the feedback is likely to provide informed suggestions and discussion.

The testing procedure consisted of three sections. Section one required the user to navigate through a series of 22 Web pages using a standard browser. The pre-determined sequence simulated a user’s behaviour as if they were searching for information about the Apple iPod Nano mp3 player. A bright yellow animated circle indicated where to click to proceed to the next page. These links were in fact the only operable links available. This created a navigation history which would match the history presented in the isoBrowser interface. This predetermined path was required, as isoBrowser is a self-contained prototype, and cannot actually read browsed pages from the Web.

As part of their navigation path, users were required to use the back button, a Google search box, select a page from the history list, and to frequently return to a Google search page. The purpose of these varying navigation methods was to highlight how a history list does not necessarily reflect the nature of the user’s browsing experience. The history list can become full of repeat items that do not necessarily reflect a user’s original order, nor the order they hold in their mind.

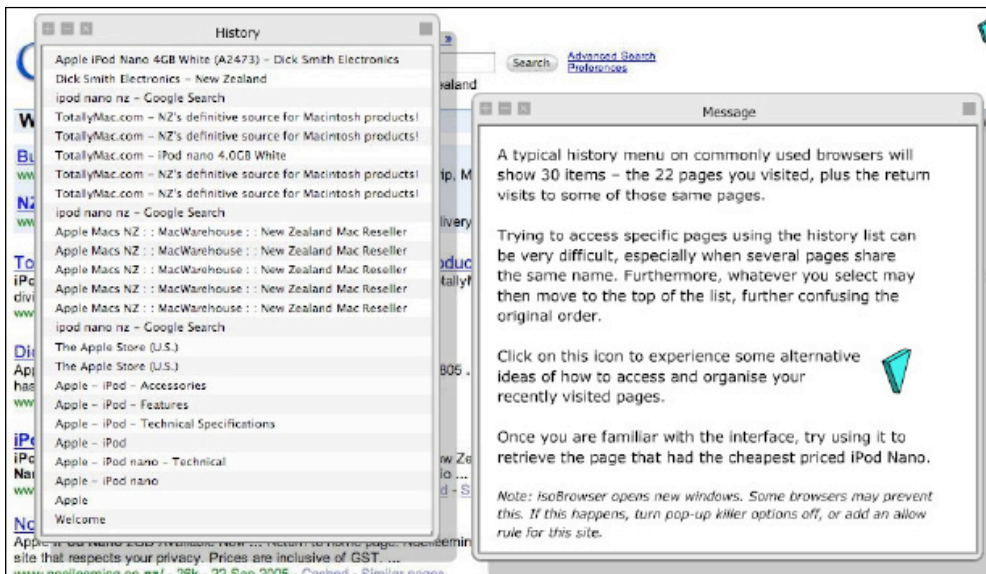


Testing procedure Welcome screen.



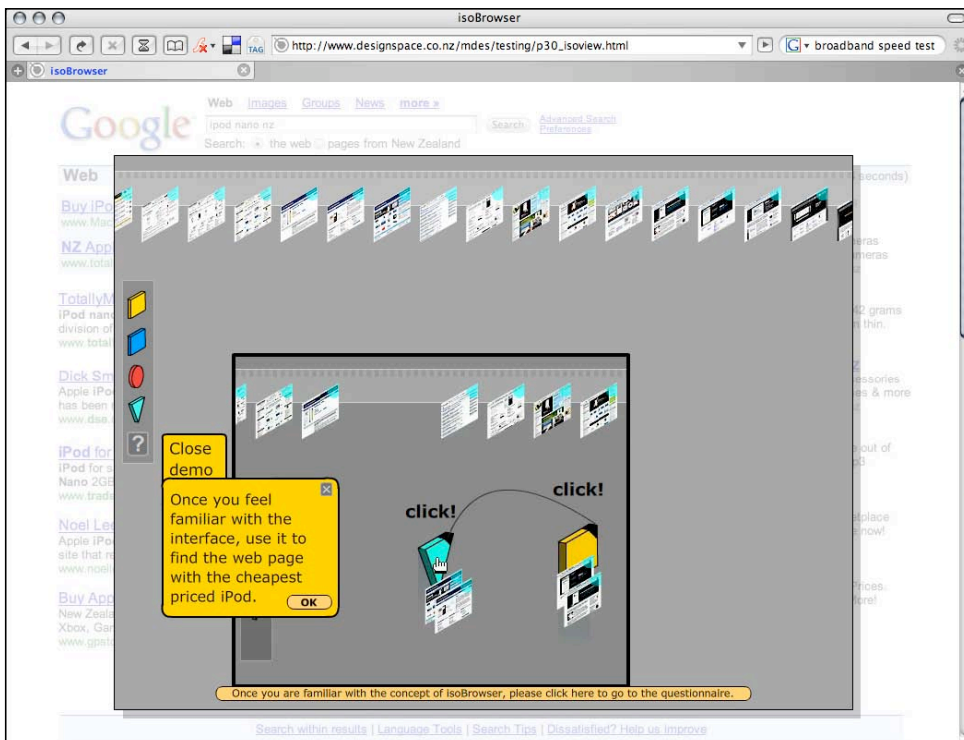
Example Web pages used for testing

After navigating the required number of pages, the users are shown the resulting history list. They are given a brief explanation of some of the issues, such as duplication of entries, and requested to follow the link to the isoBrowser.



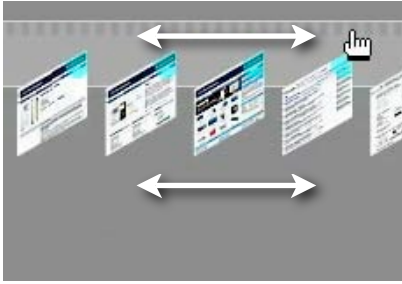
The isoBrowser interface

Once the user arrives at the isoBrowser interface, they are greeted with a recommendation to watch a brief instructional movie, demonstrating the operating methods. The user is then free to explore the interface at their own pace. After a few minutes, another pop-up window appears, asking the user to use the interface to find the Web page that contained the cheapest priced iPod Nano. The function of this request is to provide a standard task to test the interface and identify issues that may not be revealed with casual exploration.

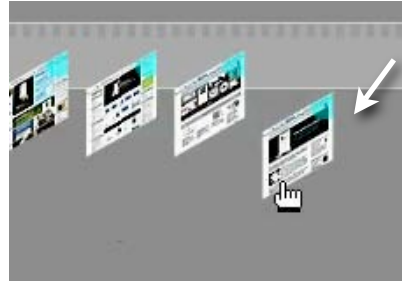


Screenshot of the isoBrowser interface floating over the Google search page. Included is the introductory movie, and the pop up window requesting the user to perform the task.

The instructional movie demonstrates the various functions of the interface.



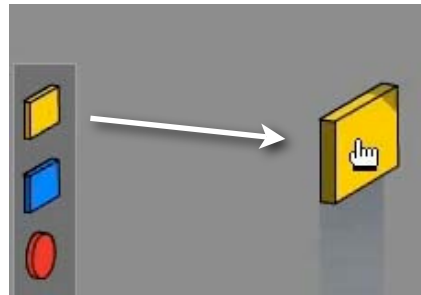
Drag Timeline. The top banner graphic is a scrollable timeline, on which thumbnails of the Web pages are attached, in chronological order from left to right, oldest to newest.



Drag off thumbnails. The thumbnail images can be dragged off the timeline onto the main working space.



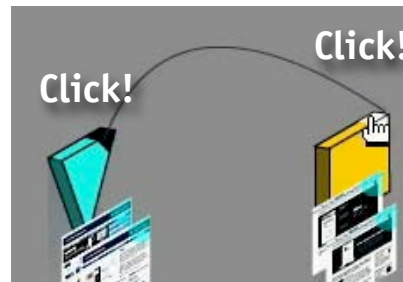
Large preview. Clicking on blue top right corner brings up a larger-sized preview image of the Web page. Return to thumbnail size by clicking a second time.



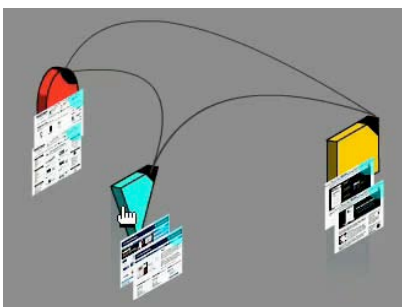
Drag off grouping icons. "Group Tag" objects can be dragged onto the working space.



Attached thumbnails. Thumbnail images will stay attached to the group tags, until dragged off. This allows for users to group pages together and move as a single unit.



Link lines can be created by clicking on the top right shaded corners of the group tag objects.



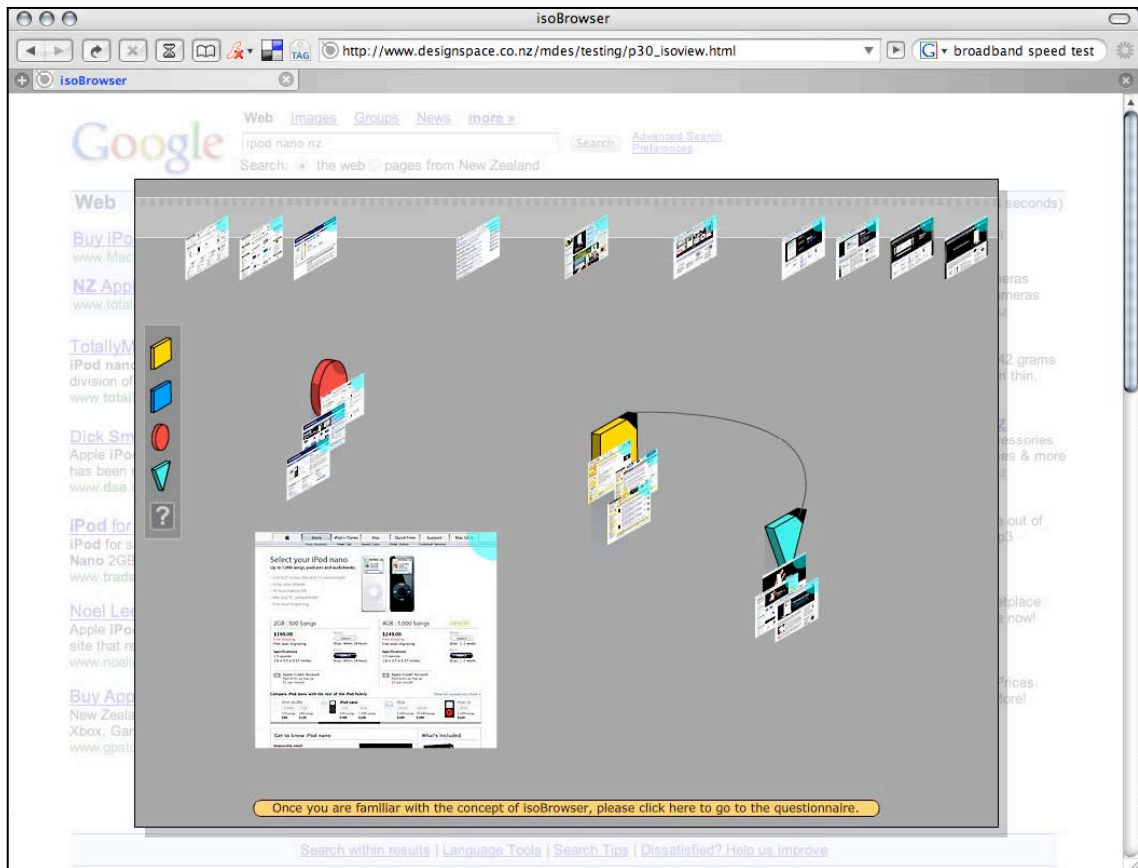
Multiple lines can be created between the various groups.



Navigate to the original Web page by double clicking the thumbnail or the larger preview image. The page will open in a new tab or new window, according to the individual browser's settings.

Anticipated use

It was anticipated that the users would grasp the overall interface concept fairly quickly, and would soon gain some familiarity with dragging thumbnail images off a timeline and then visually organising them into groups. When given the task of finding specific Web pages, it was anticipated that this would test the feasibility of this approach and highlight usability issues.

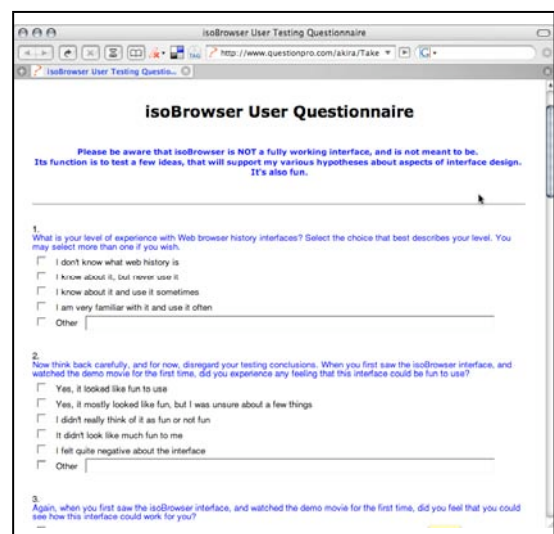


isoBrowser interface in action.

User participation

A link at the bottom of the interface took the users to an online questionnaire. This produced 25 respondents. All but one question included open ended "Other" or "Comments" fields, which produced a significant amount of information from the users.

The information retrieved from this questionnaire is reported and summarised in the following pages, and contributes significantly to the suggested design improvements.



Results and deductions from user feedback

Twenty-five users completed the questionnaire. Some questions allowed for more than one selection, giving the impression of a greater number of respondents. Four questions were skipped by one or more respondents.

Interpretation of the data produces interesting results:

1. What is your level of experience with Web browser history interfaces?

Out of 25 users, 23 were familiar with Web browser history, with only 2 stating that they never used it. This ascertained that most of the users had sufficient level of experience to comprehend an alternative approach to Web history display.

Frequency Analysis							
Answer	Count	Percent	20%	40%	60%	80%	100%
I dont know what web history is	0	0.00%					
I know about it, but never use it	2	8.00%					
I know about it and use it sometimes	14	56.00%					
I am very familiar with it and use it often	9	36.00%					
Total	25	100%					

2. Now think back carefully, and for now, disregard your testing conclusions. When you first saw the isoBrowser interface, and watched the demo movie for the first time, did you experience any feeling that this interface could be fun to use?

This question is an attempt to measure the emotional reaction of the user, as they first encounter the interface. The ideal response is a positive emotional reaction, which places the user in the best receptive state to explore the new interface and resolve its controls. 50% of users felt that either the interface looked like fun or mostly looked like fun. A neutral response was received by 42%, with 8% reporting that it “Didn’t look like much fun”. No one reported a negative reaction. This feedback supports the design as having a mostly positive affect.

Frequency Analysis							
Answer	Count	Percent	20%	40%	60%	80%	100%
Yes, it looked like fun to use	3	12.50%					
Yes, it mostly looked like fun, but I was unsure about a few things	9	37.50%					
I didnt really think of it as fun or not fun	10	41.67%					
It didnt look like much fun to me	2	8.33%					
I felt quite negative about the interface	0	0.00%					
Total	24	100%					

3. Again, when you first saw the isoBrowser interface, and watched the demo movie for the first time, did you feel that you could see how this interface could work for you?

84% users had either a reasonable or good idea of how the interface could work. Some hesitation was reported by 26%, and 5% reported some difficulty. It is reasonable to deduce that the demonstration movie served its purpose. However, only 19 users out of 25 answered this question. This could suggest that the extra 6 users did not watch the movie.

Frequency Analysis							
Answer	Count	Percent	20%	40%	60%	80%	100%
Yes, I had a good idea of how I could use it	2	10.53%					
I had a reasonable idea of how I could use it	11	57.89%					
I had an idea of how I could use some it, but not all of it	5	26.32%					
I had some difficulty seeing how I could use it	1	5.26%					
I could not see how I could use it	0	0.00%					
Total	19	100%					

4. As you operated the isoBrowser interface, did the actions and methods of organising the Web page files appeal to you?

This question seeks to find out whether the conceptual idea behind this design has appeal. The answers deliberately limit the user to considering the overall appeal, rather than individual functions and operations.

The largest majority of 64% reported that they felt neutral, some of the methods appealed, but some didn't. Twenty eight percent reported yes, that the methods appealed, as compared to 8% who replied negative. Even though the positives outnumber the negatives 3 to 1, the large neutral percentage is significant. Many of the reasons for this neutrality are revealed in the written comments section, and can be generalised as a reaction to interface concepts that did not fully meet expectation. This is supported by comments in the "features" question, question 8.

Frequency Analysis							
Answer	Count	Percent	20%	40%	60%	80%	100%
Yes, the actions and methods of organising appealed to me	7	28.00%					
Neutral. Some of the methods appealed, but some didnt	16	64.00%					
No. I did not like the actions and methods of organising used.	2	8.00%					
Total	25	100%					

5. What aspects appealed to you the most? (tick as many as you like)

This question seeks to evaluate the appeal of the main interface concepts. It was interesting to note that 25% enjoyed the scrollable timeline. At the same time, only 17% supported the option of being able to drag the pages off the timeline into the non-chronological working space. As reinforced by comments elsewhere, several users preferred to retain some sort of reference to the original browsed chronology of the Web pages. Thumbnail dragging and grouping received 21% appeal, with connecting lines, interface design and colours rated least important. Written responses indicate that users had differing opinions on the connecting lines concept, and that a greater degree of control should be included. Even though this question uses the emotive term “appeal”, it is clear that users are measuring appeal by how well a function operates – a mix of emotive and cognitive reaction. Though this response could be anticipated from a group of skilled and informed users as used in this test, it is also a desired behaviour to be expected from any competent interface user.

Frequency Analysis							
Answer	Count	Percent	20%	40%	60%	80%	100%
Being able to drag page thumbnails around	14	20.90%					
Being able to group related pages into groups	14	20.90%					
Being able to draw lines connecting one group to another	7	10.45%					
The idea of the horizontal timeline	17	25.37%					
Being able to drag my pages off the strictly date-ordered timeline	12	17.91%					
The design and colours of the interface	3	4.48%					
Total	67	100%					

6. When you used isoBrowser to retrieve the Web page that had the cheapest iPod nano price, what best describes your experience?

This question attempted to measure the interface’s ability to perform a practical task. However, the responses from users are inconclusive. 16% had not read the instructions, and so did not perform the task. 45% felt the interface was helpful or mostly helpful, whereas 55% found the interface didn’t help, or hindered the task to find a specific page. It may have been premature to expect the interface to perform such a specific task this early in the design process. Many functions need further fine-tuning, and these problems may have interfered with the task’s smooth performance. This test will be repeated with the interface’s next iteration.

Frequency Analysis							
Answer	Count	Percent	20%	40%	60%	80%	100%
The interface made it easy and natural for me to find the pages I was looking for	3	15.00%					
The interface mostly helped me to find the pages I was looking for, though not all the time	6	30.00%					
The interface didnt make much difference, I could have found the pages just as easily using the normal history list	6	30.00%					
The interface made it difficult for me to find the pages I wanted	5	25.00%					
Total	20	100%					

7. The isoBrowser interface lets you position page thumbnails and groups anywhere in the space. This is known as spatial positioning. The benefit of this is that it is easier to retrieve an item if you can easily recall its position. For example, "I left the Apple site pages near the right hand side ". Do you agree that spatial positioning helps you retrieve items?

The purpose of this question is essentially to confirm whether this group of users is already familiar with spatial positioning. With 88% of users either absolutely or partially in agreement with this statement, further questioning along these lines is unnecessary. Awareness of these principles also confirms the informed nature of this group of users.

Frequency Analysis							
Answer	Count	Percent	20%	40%	60%	80%	100%
I absolutely agree	<u>11</u>	44.00%					
I partially agree	<u>11</u>	44.00%					
I have no opinion on this	<u>1</u>	4.00%					
I partially disagree	<u>2</u>	8.00%					
I totally disagree	<u>0</u>	0.00%					
Total	25	100%					

8. What other features would you like to see added to this interface? (tick as many as you wish. Add your own ideas in "other")

Without a doubt, this question received the most enthusiastic response. Written comments are largely supportive of the broad concept, with many suggestions being offered. The highest rated feature was the ability to put pages back into their original chronological order, with nearly 20% response. Another 17% responded requesting pop-up labels of Web page names. Other desktop features received a fairly even response. Some user written comments suggest greater integration with the browser. This is discussed in the next section of this chapter.

Frequency Analysis							
Answer	Count	Percent	20%	40%	60%	80%	100%
Pop up web site name labels	<u>15</u>	15.31%					
Folders, and the ability to move pages into them	<u>12</u>	12.24%					
Snap to grid	<u>5</u>	5.10%					
More control over the connecting lines	<u>5</u>	5.10%					
Ability to change colours, and use colour coding	<u>12</u>	12.24%					
Ability to add custom icons to the page holders (the square, triangle and circle)	<u>10</u>	10.20%					
Ability to put the pages back into their original chronological order on the timeline	<u>17</u>	17.35%					
More zooming options	<u>12</u>	12.24%					
I have no ideas, it is already good enough	<u>0</u>	0.00%					
<u>Other</u>	<u>10</u>	10.20%					
Total	98	100%					

9. If isoBrowser was a real product, do you think that you would use it?

Not surprisingly, the strongest response of 63% was for “Sometimes, when I felt I needed that method of organising my browser history”. A further 12% indicated that they would use the interface once the extra features were implemented. The observation here, also supported by user written comments, is that this interface could be used as a supplementary method to organise files, not necessarily just for history or bookmarks. This is an interesting point for discussion, and suggests a merge between history browser, bookmark manager and desktop.

Frequency Analysis							
Answer	Count	Percent	20%	40%	60%	80%	100%
Yes absolutely	2	8.33%					
Yes, once those extra features were implented	3	12.50%					
Sometimes, when I felt I needed that method of organising my browser history	15	62.50%					
Maybe just the once, for interest sake	2	8.33%					
No	2	8.33%					
Total	24	100%					

10. What systems do you already use to organise your Web browser history?

As generally expected, 80% of users use the back button and history list. Over half of these users also made tabs of pages as they browsed. This suggests, in this group at least, that users adapt their surfing habits to make the most out of functions provided.

Frequency Analysis							
Answer	Count	Percent	20%	40%	60%	80%	100%
I dont use any systems	2	6.67%					
I just use the back button, thats all	4	13.33%					
I use the back button and the history list	9	30.00%					
I make tabs of any link I think I may need to return to. And if I forget to do this, I then use one of the above methods	15	50.00%					
Total	30	100%					

Miscellaneous comments – comments written by users in the “Other” fields.

The general comments section elicited generous feedback of varying value. Some users took the opportunity to explain the personal systems they have developed, and suggested building into isoBrowser. Some of these suggestions, such as shared Web tagging, fall outside the scope of this project, which concentrates more on visual organisation and navigation. Other users commented on specific items that caused problems, such as double-clicking being too responsive, and triangular icons looking like video ‘Play’ buttons. Overall, however, comments received in this section were very constructive and supportive, and can be grouped and summarised into three main categories.

Three categories of user requests and ideas for development

Several interface issues have been identified, which suggests several possible improvements.

1. Browser history-oriented

- *The timeline needs visual feedback to indicate first-browsed position in history.*

Several users commented on the need for this function. The presumption that users would discard the timeline position once the page was moved off and stored appears to have been incorrect. Perhaps once the user has finalised the location of the page, the original location can be deleted. But until the time that the user decides this, the original location still holds valuable clues for the user. If this visual feedback is to be provided, then some sort of discard or off switch will need to be supplied.

- *Thumbnails need pop-up text labels of original the Web page title, and other useful details such as search dates.*

The pop-up info tab is an accepted function of common GUIs now. The more an image loses its literal information, and becomes symbolic, then more useful pop-up info becomes, giving the user extra layers of information without cluttering the interface and without requiring clicking through to examine the contents.

- *On roll-over, a page’s connection lines to other pages and the timeline could appear.*

An interesting extension on the connecting lines visualisation. Rather than having the lines always visible, they would only show upon roll-over. Furthermore, the initial connections would be created automatically, and would only be altered by the user’s choice.

2. Desktop functions related

- *The interface needs some sort of search and find function?*

A search function becomes an essential tool in any file archival system. It is peculiar that many browsers do not allow searching of their bookmarks and history lists. With isoBrowser, a search would possibly work in a “bring-to-front” fashion, finding the appropriate folder, opening it, highlighting the file, and bringing all of this to the front layer of the interface. However, if this interface is to be integrated into the computer’s Web browser, then the browser’s own search function could be used. Some search options will be investigated in the final design.

- *The interface needs a folder-like mechanism to store files.*

As thumbnails are collected, it is clear that the working space will become very cluttered, and a second tier of organisation may be required. If the group-tag objects also act as folders, then files can be stored inside. However, this may not be the best option, as this approach will duplicate the folder-within-folder method of a standard desktop. This moves away from the visual organisational model into a hierarchy organisational model, and introduces new problems of navigation. Nevertheless, the request for folders is as a result of a need for greater organisation, and so some mechanisms will be considered.

- *Continuous zooming in and out would be better than a limited number of size changes.*
Since isoBrowser is fundamentally a visual organisation tool, it would make sense to have the flexibility of continuous zooming. This type of function is present in some design-oriented programs, though is not common at the desktop interface level. This function was considered during the early design process of this project, but at the time was technically very difficult to implement. It will be included in the final design proposal.

3. Integration with browser or desktop

- *The interface needs greater integration with browser, history and computer desktop.*
There was some discussion about where and how this interface would appear, with general consensus that a clearer integration was required. In the prototype, the interface appears in a floating panel above the current Web page. New pages would then load into either a new page, or as a new tab, obscuring the isoBrowser interface. To return to isoBrowser, the user would need to change windows or change tabs. Though this “go-and-return” behaviour is common with the desktop metaphor, it is not common with normal Web page browsing behaviour. A better option would be to integrate isoBrowser into the Web browser in such a way that it was ever-present. Two possible solutions have emerged as being most hopeful:

Integration with Web browser program

The isoBrowser interface could be expanded into a full Web browser program. It would not just be a history or bookmark navigator, but would become the main operation centre for all browsing. The interface would need to be expanded to include common functions such as an address entry panel and forward and back buttons. However, the fundamental issue of overlapping windows obscuring the main interface remains. If isoBrowser were to fill the entire working area, then any Web pages would have to either open in a tab, or a new pop-up window. This means that the act of opening a page removes the user from the interface, thus breaking interface operation and cognitive continuity.

Integration with browser as vertical sidebar

The second option is to place isoBrowser in a vertical panel to the left of the main browser window. Vertical sidebars have often been used in Web browsers for listed information, such as history or favourite links. The obvious limitation is the physical width of the panel. However, a corresponding strength is depth. The normal working size of a browser programme window provides a reasonable amount of depth to work within. But even with all that depth, to place isoBrowser into such a narrow space would require some significant repositioning of the interface elements. The timeline would possibly need to become vertical, and all icons and thumbnails would have to be reduced in size. However, it is possible that the overall concept will stay intact. This re-fitting would be an interesting exercise, and will be the first option investigated.

Merger with Desktop

At one stage during testing, it was suggested that some of isoBrowser’s features could be embedded into the computer’s main desktop and file explorer/finder interface. However, this larger role is beyond the scope of this project, and would involve the addition of many more functions. Nevertheless, this would make an interesting future design project.

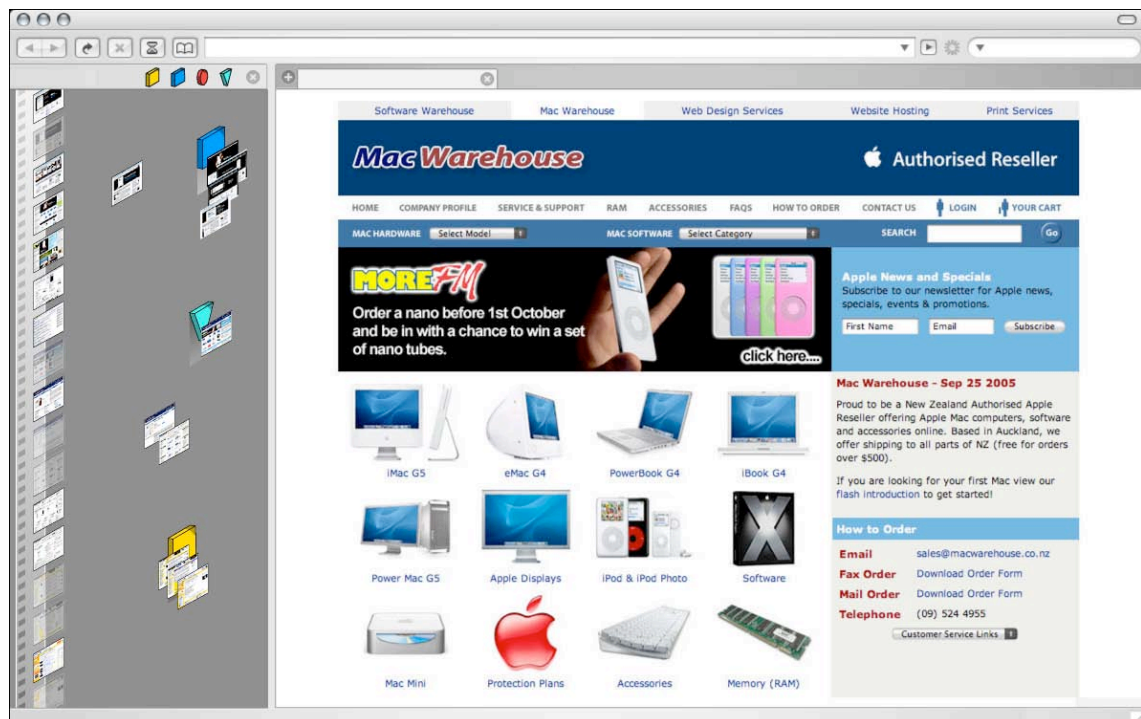
Design improvement possibilities

As a result of the first prototype's user test, feedback, and design reflection, several improvements could be pursued.

Integration

With some design adjustments, and a general 90 degree rotation of the layout, the interface fits sufficiently well into a vertical orientation. The graphical elements such as icons and thumbnails are reduced slightly in size, though not too small to make them hard to see and select. The vertical orientation of the timeline also continues to reflect the chronological order as successfully as the horizontal. Overall, it would appear that the operation of the interface would remain largely unaffected with the move to this new format.

However, the side panel approach does result in an overall reduction of work area, even with the reduced sized graphics taken into account. The first prototype used a central spacious working area, and very few users reported any anticipation of running out of space. The large space gave a natural impression that a typical collection of history items could fit into such an area. But with the side panel option, the initial impression is the opposite. It looks narrow. More spacial organisation options will need to be employed, such as stacking or the use of folders.



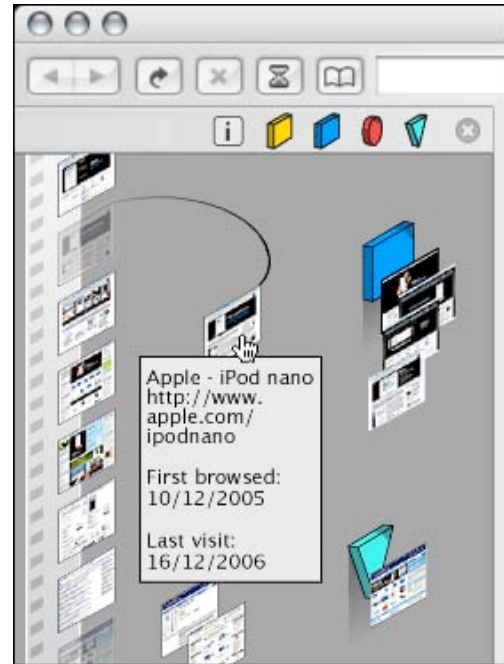
Suggested design solutions

Timeline

When pages are dragged off the timeline, ghost images will remain indicating the original browsed chronological placement. Users can snap the pages back onto the timeline if they wish. A clean-up button will be provided to remove all or selected ghost images.

Thumbnail behaviour

Upon rollover of the Web page thumbnail, a connecting line will appear, indicating the original position on the timeline. A pop-up panel will also appear, with information of Web page title, URL, first browsed date and last visited date. The user will be given a choice to include the pop-up panel, either by modifier key (control, shift, etc), or by selecting a button. Otherwise it is likely that the pop-up panel will at times interfere with thumbnail moving operations.

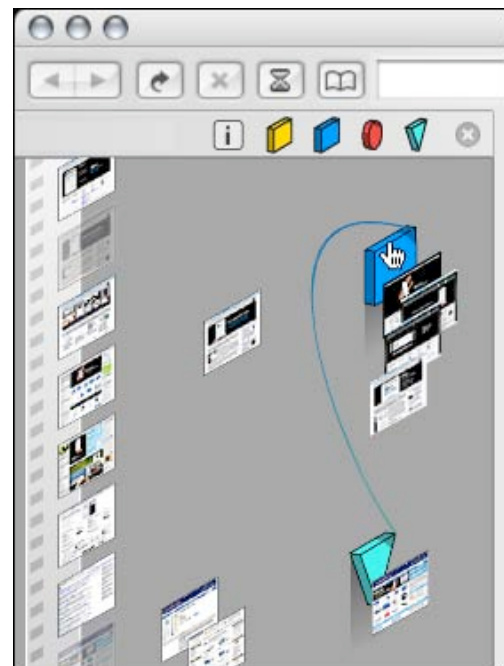


Rollover group tag

Rollover of a group tag object will reveal any connecting lines created by the user to other group tag objects. The lines will also adopt the colour of the connected object, further enforcing the linked relationship.

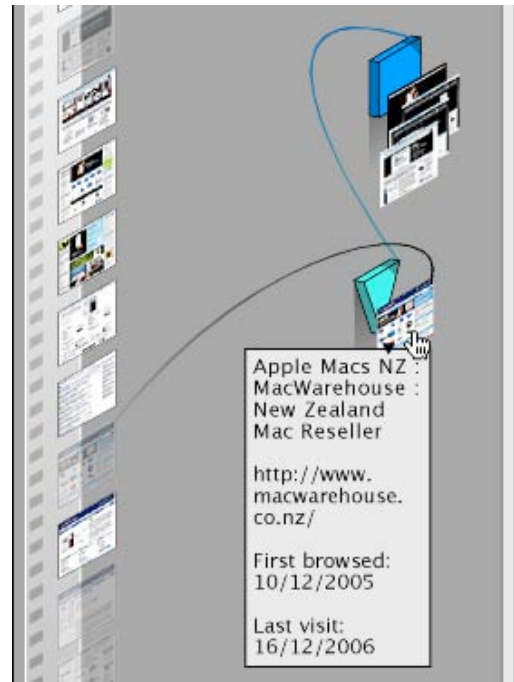
Users will be given several options on how the connecting lines display. Possibilities include:

- Show all lines
- Show lines only on rollover of the group tag object
- Show all lines within a set range, e.g., to the next 2 connected objects only.
- Adjust line thickness
- Adjust line transparency



Rollover on grouped thumbnail

When a page thumbnail is attached to a group tag, mouse rollover will reveal the pop-up information of the thumbnail and connecting lines from both types of objects. This may have a small 1/2 second delay to avoid unwanted pop-ups occurring as the mouse is moved around the screen.

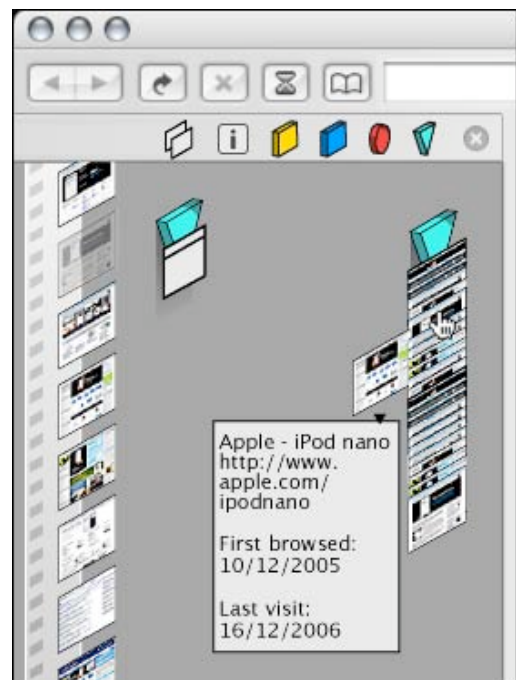


Stacking

The user will have the option of using a stacking function to organise thumbnails and save space. Upon clicking the stack button, page thumbnails will arrange themselves into a closely-packed vertical stack, and be filed away “inside” the stack symbol. Though at first this may seem similar to moving files into a folder, there is no intention at this time to allow the user to navigate to inside that folder. The intention is to remain at one interface layer, and avoid the possibility of floating folder windows.



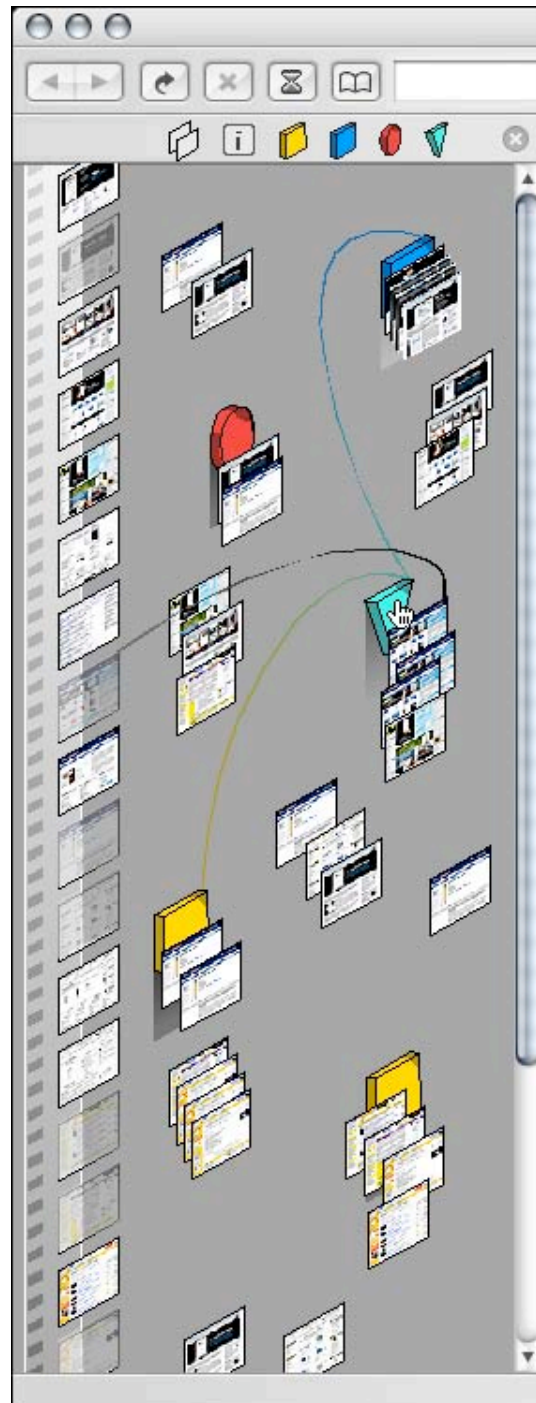
To open the stack, the user clicks on the stack symbol. The thumbnails will slide downwards, in a vertical, closely stacked arrangement. On mouse roll-over, the affected page and its information panel will pop out of the stack.



Capability and complexity

This view shows 35 Web page thumbnails and another 10 on the timeline. It is evident that at around 50 thumbnails, the interface space will become congested. The stacking function will assist, but may not suit all users. As congestion increases, more and more pages will have to be stacked, meaning that a greater number are being hidden from view.

One solution to congestion is to provide a scroll bar to the panel (as pictured). This would be a separate function to that of the timeline, and could have any user-defined limit. The user could scroll for a couple of panels, or for hundreds. The length of the scroll bar would indicate the portion of visible work space. The scroll function is built into most graphic user interfaces already.



The improvements outlined in this chapter attend to most of the issues raised by user testing, as well as discussions with knowledgeable individuals and selected experts. The move from a large central working space to a side panel working space is expected to generate new comments from users, and it will be interesting to build and test a second prototype.

Summary

Concept

This study analyses and brings together several divergent areas that are both familiar and unfamiliar to the visual designer's usual educational path. Though many sources have been called upon and channelled into this design process, the multiple threads merge naturally to a final conclusion. In this way, this study suggests a unique framework for approaching computer screen interface design.

The analysis began with a discussion about the democratisation of computer screen interface design. In particular the migration of graphic designers to the new medium of interface design. These visual designers often created interface masterpieces that were difficult to operate and alienated audiences and critics alike. This swiftly incurred a reaction from the computer science-based fraternity. However, those designers that survived the "usability wars", have emerged matured and are now valued as an essential ingredient of the interface design process.

To summarise, there are three essential components that have arisen out of this project:

- The inclusion of inspiration from an unrelated area to suggest concepts that would not otherwise be considered.
- The study of interface engineering and usability principles to provide sound foundations on which to anchor concepts.
- The inclusion of affective design principles to keep the design focused on user needs and aspirations.

The reactions received from presentations of this work so far have been encouraging. Designers based in the computer sciences are attracted by the use of inspiration, a wild card that is not normally part of their carefully planned work-flow. The visual designers are reassured that their empathy-based design approach has an essential role to play in an environment that is sometimes perceived as overly mechanical and logical.

The isoBrowser interface is incomplete in many ways: the look and feel needs refinement and it will need the work of a skilled software programmer to make fully operative. Furthermore, development of interface design is now so rapid that by the time this document is published, some of these features may already be in service.

But isoBrowser will remain successful as a demonstration of a design framework. It clearly describes the type of knowledge that needs to be absorbed before attempting interface design. It shows a framework that includes art, user theory, computer engineering, affective design, and a prototype testing scenario.

Features

The testing and evaluation stage produced valuable information. Though some of the feedback was predictable, other comments were unexpected, and were able to inform the design process. Also unexpected were the positive remarks regarding specific concepts, notably the timeline. This relatively simple function appeared to be a welcome surprise to users, who were also eager to contribute towards its development.

A selection of features stand out as being innovative and worthy of pursuing in on-going work:

- Representation of data as visual forms
The conversion of the history list information into a visually representative form demonstrates that listed data can be adapted to more useful interactive forms while maintaining integrity and without alienating the user.

- **Visual representation of interface function**
Users were impressed by the visual representation of the interface's functions and they anticipated successful operation prior to actual use. This demonstrated that users are more likely to react positively towards an interface if its operation method is clearly visible and appears easy to control.
- **Creating a positive frame of mind in the user**
Users generally approached isoBrowser in a positive frame of mind. As many testers were design students, it is accepted that this group had an inquisitive predisposition. However, they were also trained to be critical and would quickly see through superficial attempts to only please the eye. It is therefore reasonable to deduce that the interface was able to create a favourable first impression and maintain this throughout testing. The written component of this study explains why this positive attitude improves interface interaction.
- **Scrollable timeline**
The scrollable timeline is a simple but effective device for indicating the chronological sequence of browsed pages. Giving this list temporal, visual and interactive qualities gave the users a greater degree of control over how they wished to view and use their data.
- **Dragging and grouping objects**
The users in this study generally appreciated the freedom to place their page thumbnails anywhere in the working space. This supports other studies that also report a user appreciation for spatial positioning. The inclusion of link lines, grouping functions, stacking functions and pop-up information panels gives this spatial positioning method extra organisational strength.
- **Extension of history list function**
Throughout the design process it became apparent that this interface could deal with both history lists and bookmark lists. As users drag their pages off the timeline, they effectively create bookmarks or a "favourites" collection. Though a minority of commercial browsers allow for copying from the history list into the bookmarks list, this requires a conscious decision from the user. With isoBrowser this combination of lists happens naturally. This is a significant observation, and suggests that this interface could replace these two important functions of the current standard Web browser.

Conclusion

This study brings together several divergent areas of theory and practice to demonstrate a unique framework for approaching computer screen interface design.

The design process incorporates many principles from graphic design, interface design and affective design culminating in a unique prototype product that is the sum of all these parts. When designing for human-computer interaction the value of an under-pinning broad knowledge base should not be under-estimated.

The inspiration that comes from Lissitzky's experimental paintings also played a special role in this project. As a result of contemplation and analysis of these paintings, alternative concepts of representing and interacting with data were discovered and developed. In choosing to embrace Lissitzky's artworks and remain open to inspirational possibilities, several key features of isoBrowser have evolved which otherwise may not have eventuated.

Overall, the entire design process has benefited from a multi-disciplinary approach. In addition to this, a conscious "multi-attitude" approach has also played a crucial part. The attitude to this project was intentionally flexible and lateral, and can be seen as the essence of this study. It is hoped that this approach may stimulate other designers in successful projects.

The Questionnaire

(Appendix 1)

The questions are as follows:

isoBrowser User Questionnaire

Please be aware that isoBrowser is NOT a fully working interface, and is not meant to be.

Its function is to test a few ideas, that will support my various hypotheses about aspects of interface design.

It's also fun.

1. What is your level of experience with Web browser history interfaces? Select the choice that best describes your level. You may select more than one if you wish.

- I don't know what Web history is
- I know about it, but never use it
- I know about it and use it sometimes
- I am very familiar with it and use it often
- Other

2. Now think back carefully, and for now, disregard your testing conclusions. When you first saw the isoBrowser interface, and watched the demo movie for the first time, did you experience any feeling that this interface could be fun to use?

- Yes, it looked like fun to use
- Yes, it mostly looked like fun, but I was unsure about a few things
- I didn't really think of it as fun or not fun
- It didn't look like much fun to me
- I felt quite negative about the interface
- Other

3. Again, when you first saw the isoBrowser interface, and watched the demo movie for the first time, did you feel that you could see how this interface could work for you?

- Yes, I had a good idea of how I could use it
- I had a reasonable idea of how I could use it
- I had an idea of how I could use some it, but not all of it
- I had some difficulty seeing how I could use it
- I could not see how I could use it
- Other

4. As you operated the isoBrowser interface, did the actions and methods of organising the Web page files appeal to you?

- Yes, the actions and methods of organising appealed to me
- Neutral. Some of the methods appealed, but some didn't
- No. I did not like the actions and methods of organising used.
- Other

5. What aspects appealed to you the most? (tick as many as you like)

- Being able to drag page thumbnails around
- Being able to group related pages into groups
- Being able to draw lines connecting one group to another
- The idea of the horizontal timeline
- Being able to drag my pages off the strictly date-ordered timeline
- The design and colours of the interface
- Other

6. When you used isoBrowser to retrieve the Web page that had the cheapest iPod nano price, what best describes your experience?

- The interface made it easy and natural for me to find the pages I was looking for
- The interface mostly helped me to find the pages I was looking for, though not all the time
- The interface didn't make much difference, I could have found the pages just as easily using the normal history list
- The interface made it difficult for me to find the pages I wanted
- Other

7. The isoBrowser interface lets you position page thumbnails and groups anywhere in the space. This is known as spatial positioning. The benefit of this is that it is easier to retrieve an item if you can easily recall its position. Eg, "I left the Apple site pages near the right hand side". Do you agree that spatial positioning helps you retrieve items?

- I absolutely agree
- I partially agree
- I have no opinion on this
- I partially disagree
- I totally disagree

8. What other features would you like to see added to this interface? (tick as many as you wish. Add your own ideas in "other")

- Pop up website name labels
- Folders, and the ability to move pages into them
- Snap to grid
- More control over the connecting lines
- Ability to change colours, and use colour coding
- Ability to add custom icons to the "page holders" (the square, triangle and circle)
- Ability to put the pages back into their original chronological order on the timeline
- More zooming options
- I have no ideas, it is already good enough
- Other

9. If isoBrowser was a real product, do you think that you would use it?

- Yes absolutely
- Yes, once those extra features were implemented
- Sometimes, when I felt I needed that method of organising my browser history
- Maybe just the once, for interest sake
- No
- Other

10. What systems do you already use to organise your Web browser history?

- I don't use any systems
- I just use the back button, that's all
- I use the back button and the history list
- I make tabs of any link I think I may need to return to. And if I forget to do this, I then use one of the above methods
- Other

11. General comments: If you wish to, please add any extra comments here.

12. If you are happy to be contacted for further discussion about this project via email, please leave your email contact below. Unless you are already known to me, your address will ONLY be used for this purpose, and will be deleted following the discussion. Thanks.

13. Thank you for taking part in this questionnaire. If you have any questions, or wish to contact me directly, email me at g.f.hodgkinson@massey.ac.nz

Written comments from users

(Appendix 2)

By question:

1. What is your level of experience with Web browser history interfaces? Select the choice that best describes your level. You may select more than one if you wish.

- *Maybe look at the history as bookmarks*
- *If you mean pressing ctrl H and using the browser history, then yes. Use it sometimes.*

2. Now think back carefully, and for now, disregard your testing conclusions. When you first saw the isoBrowser interface, and watched the demo movie for the first time, did you experience any feeling that this interface could be fun to use?

- *Neutral, but also confused rather than "not positive"*
- *Would be nice to know that the ? ran the demo movie - had to go back and find it*
- *Mostly the use of the shapes - though I figure that is simply a way of grouping favourites? The timeline is a splendid idea.*

3. Again, when you first saw the isoBrowser interface, and watched the demo movie for the first time, did you feel that you could see how this interface could work for you?

- *It seemed a solid concept, but one can never be too sure.*
- *I could see it as a bookmarking interface rather than a history interface (a cross market between them)*
- *Not using history much - doubt i would find much use for it*

4. As you operated the isoBrowser interface, did the actions and methods of organising the Web page files appeal to you?

- *With the grouping it would be handy when the groups have been made for them to load into the browser*
- *I think it would take some getting used to, but I can see where it could be helpful. The obit effect of the tabs might be a little confusing, but the different colours and shapes sort that out.*

5. What aspects appealed to you the most? (tick as many as you like)

- *Being able to colour/shape-code my groupings*
- *For the limited task it was difficult to say, it was missing a key feature of removing pages from history, this would help unclutter the work area, instead I needed to move them to a red folder to say they were useless to me (like google pages...)*

6. When you used isoBrowser to retrieve the Web page that had the cheapest iPod nano price, what best describes your experience?

- *I don't remember doing this*
- *How did I know it had the cheapest price?*
- *Didn't know that this was requested - too much text to read*
- *The same coloured thumbnail corresponded to the same website so i could disregard the 'expensive' sites*

- *I didn't realize there were set instructions to do so. The browser didn't seem to specify any task that I could see*
- *Re-arrangeable tabs (with a Ctrl+Z option to reopen closed pages) would be better IMO. the shown concept of yours seemed to be an added task rather than seamlessly integrated. concepts like grouping, moving, side scrolling and linking are great. but the form it came in was difficult to use.*
- *Learning curve was too big. It took too long to find it so I moved to questionnaire*

7. (No comments field)

8. What other features would you like to see added to this interface? (tick as many as you wish. Add your own ideas in "other")

- *Snapping back into the time line would be great, and adding pages to bookmarks as well onto a separate time line*
- *When rolling over a thumbnail that has been dragged off the timeline show lines connecting back to the Web page before and after so I can see the original order.*
- *Put thumbnail into groups in the space as you leave Web page, ie create groups on the fly*
- *Search and sort function, both global and in the groups i made*
- *Why are the Web pages on an angle? It would work better if you could see them front on, like in power point. Maybe add an element of control of size too for poorly sighted people, e.g. the option of larger thumbnails. I wouldn't want to have to double click every time to actually see what the page was; that is exactly what we currently do with browser histories. This one needs to be more user friendly.*
- *Ability to label the coloured icons could be handy*
- *Page-wide search, or group search of text, that will order the pages within that group based on the occurrence of the result. Chronological ordering within the group. Within tabbed browsing- interconnected Web like layout showing page parents, and links between. (visually show history, i.e. the three pages you had originating from Google, would then come as three branches from the original Google page.) Close feature. I would love tabbed browsing with a bit of spatial rearranging (but not lots) perhaps horizontal, vertical, or multi-line tabbed header. but in my opinion the interface should never become the background of the task at hand. changing windows or minimising to get access to stuff is a real hassle.*
- *I would have liked to have been able to view the pages more clearly in the isobrowser instead of opening them up in another tab. It took longer for me to view them when I had to open and close each tab to remember what was on each page.*
- *Maybe some sort of filtering system? or tagging system while your looking at the pages can tag with 'price' then system can filter just those pages.*
- *Tag clouds on page holders (maybe hover and meta tags show up).*
- *Hover and page gets slightly bigger and straightens up would help with ease of finding info*

9. If isoBrowser was a real product, do you think that you would use it?

- *Depends on the price (\$0=yes!)*
- *It would have to be a free plug-in*
- *If it was for History only Nope, if it could be used to sort my hundreds of favs. Hell yes*
- *Depends if I were looking up lots of information for a project or not*
- *I'd probably use it for research rather than just browsing, like if i was looking for a tutorial, i could group other interesting one together*
- *Not using the history function much*

10. What systems do you already use to organise your Web browser history?

- *I use del.icio.us to store important junctures while browsing. A page that had lots of links or the one page that the cheapest price when comparing different browser tabs.*
- *Bookmarks. Both direct links and folders.*
- *Organise favourites into specific folders and categories.*
- *On my home computer i store pages in the favourites like i have, games, tutorials, schoolwork etc*
- *Google search history*
- *Tabs of ALL websites, then I progressively close tabs that I have dealt with, or don't want anymore. I wish I had Ctrl+Z to undo a close of a tab I wanted still. I also often bookmark into folders (or bookmark all tabs) and commonly open all bookmarks within a folder in new tabs.*

General comments: If you wish to, please add any extra comments here.

- *I find the difference between the timeline and the desktop area confusing. Are the items I drag off now bookmarks? I think you need to focus on one of the other. When given the task of finding the cheapest ipod I found the timeline useless without the names of the pages and other indicators like the length of time since I'd seen the page, how long I'd spent on the page. Maybe the problem with the demo is that I can't interact with it and the Web pages at the same time. I'd like a button in the browser where I could flag a page with a rating scale of "might be useful" through to "bookmark it". What about being able to tag pages with notes as you go. I think the desktop area is only useful for permanent bookmarks or as a temp holding area. But because I didn't get to drag pages there while I was browsing for the ipod I didn't have any use for it after the fact. I don't see how you're going to get any information out of your testing without being able to use the "real" Web and isoBrowser as you browse.*
- *How can I save multiple searches? What happens when I have lots of histories/searches?*
- *Not sure about how this thing works DURING a search - does it keep adding pages?*
- *Does this float on top of my browser or can I pull it outside the browser into its own app/ interface? Possibly seems like it take up a chunk of screen real-estate...*
- *Why would I want to connect chunks together with lines? How is this functional exactly?*
- *I like the timeline thing, but when in the middle of lots of pages, perhaps a tonal colour bar may help show how close I am to beginning or end of timeline.*
- *The shapes are confusing - I initially thought they were like stop/start buttons on a VCR - they need to embody something like a 'sticky' or a peg or a folder - something that symbolises quickly what they do - and that they function the same way (or do they not?)*
- *08/27/2006 1628594*
- *It wasn't clear to me that the time line was a history of my viewing in the video. Also why I would want to join the groups with lines. Also the video click to start disappeared when I hadn't clicked on it in a fairly short time*
- *I tend to have a very large list of favourites that I have stored over the last few years. Grouping them and organising them in this non linear way would be really helpful. I personally don't find history very useful since most of my un-favorite-ed Web browsing spawns from google (central hub).*
- *I can definitely see a use for this. Especially when doing intensive internet research (for whatever reason). The current browser history set ups are annoying.*
- *Great idea - Personally as wide screens are becoming more popular I would prefer a simple version that is vertical and is constantly displayed without interfering with my Web page.*

- *When you click too fast in succession but on different thumbnails, it still opened the Web page which was very agitating*
- *I think it's a good idea. Really helps organisation of search*
- *I didn't find it particularly to find the cheapest price. Maybe if you could mark thumbnails of interest as you create your history*
- *Couldn't find any instructions on the isoBrowser page. Though I understood the concept, it would have been nice to have a Wizard of sorts - the movie only explains so much* It was understandable though. *Unless there was sound and I didn't hear because my computer was on mute. Or there WERE instructions and I just didn't see them...*
- *I thought it was really cool, the idea of grouping parts together I think is where its at. One thing though, not sure if isoBrowsers the final name or what but originally I thought it had something to do with warez, www.isohunt.com for example [Torrent] site. nice work. Links you might like to visit: <http://honeybrown.ca/Pubs/BumpTop.html>*
- *I really liked being able to allocate pages to coloured icons. To allocate each page in the search for the cheapest iPod price I had to look at each page at a large size in order to see the text detail. It would have been quicker if I could have been allocating each page to a coloured icon as I went. e.g. attaching information pages to one icon, and pages with prices to another icon.*
- *Zooming interfaces are a good option, spatial awareness is a great thing, but zooming needs to be more fluid, imagine zooming in on the websites after rearranging them, highlighting info or flagging it within the page, and having that note carry forward to the zoomed out, icon state. a single large desktop that is infinitely (well not that big) zoom-able has its interests. Cheers gray, and good luck.*
- *I think this could be a viable product for browsing your history as it is more interactive than going through the normal history. Though I do not go into my history hardly ever. But maybe I would more if there was something like this to organise it and use it. I am struggling at the moment to find a reason why I would use it though.*
- *Interesting project, however not for me. Using tabs instead of history, or just google it.*
- *Overall Visual elements need some updating. However functionality is there and you're on the right track - keep going.*

Ed-Media Conference and Siggraph Taipei

(Appendix 3)

The art-influenced design process was presented at the 2005 Ed-Media World Conference on Educational Multimedia, Montreal, Canada. The enthusiastic response and discussion provided encouragement to continue in this direction. Pictured below are thumbnail copies of the main digital presentation images and quicktime videos.

As one of the keynote speakers at the Siggraph Taipei 2006 conference, I gave another presentation accompanied by a demonstration of the newly-completed interface in action.

Both conferences had a pedagogical theme and so the presentations focused on the art-influenced process and less on computer interface history, theory and user behaviour.

Ed-Media Presentation 2005

The following table summarizes the content of the 20 thumbnail images shown in the grid:

Thumbnail 1	Thumbnail 2	Thumbnail 3	Thumbnail 4
3D Interface Inspired by Constructivist Art Principles Gray Hodgson Massey University Wellington, New Zealand g.hodgson@massey.ac.nz	Art Informing Interface - why do this? • Design School environment - Visual, Digital • Function and usability alone do not generate originality • Need methods to inspire creativity and originality	This particular study demonstrates the "what if" method of designing. Or, idea generation by association. "What if a Lissitzky painting could be used as an interface?"	Lissitzky? Lazar Lissitzky, 1890. European architect and abstract painter, part of the Suprematism and the Constructivist art movements. Created a series of paintings called "Proun", a Russian acronym for "Project for the Affirmation of the New".
Lissitzky The paintings were two dimensional but invoked a strong sense of three dimensional composition and movement. His basic painting tools were geometrical objects: planes, circles, squares, lines, arcs dots....	Lissitzky Paintings use symbolic objects - Interface uses symbolic objects Lissitzky consciously creating 3D on a 2D canvas What would he do today if he had a 3D graphics programme ...?	Precedence Escher / Lamping Lamping et al (1993) took inspiration from a wood cut by Escher to design a typographic computer data visualizer.	Deconstructing a Proun • Axes and projections • Planes and arcs • Structures • Wires and points
Deconstructing a Proun • Axes and projections • Planes and arcs • Structures • Wires and points	Deconstructing a Proun • Axes and projections • Planes and arcs • Structures • Wires and points	Deconstructing a Proun • Axes and projections • Planes and arcs • Structures	Deconstructing a Proun • Axes and projections • Planes and arcs
Deconstructing a Proun • Axes and projections	First design phase A simple "folder wall" overlaying a background	First design phase Attempts to involve the 3D space	First design phase Visually appealing, but ... Moving towards virtual reality ... and it's problems: Navigating a 3rd dimension View placement User orientation Travel time Computer processing overhead Time to re-evaluate, and isolate some key principles
Second design phase Isolating key elements that can contribute towards an interface design Isometric - Illusion of 3D, while maintaining 2D interaction Abstract objects - use as navigation markers & identifiers Curved lines - to create connections	Mock up prototype	Working prototype	Summary The lateral-thinking design process of what-of association can be a useful tool for developing design possibilities. The investigation of an art form can provide useful direction and inspiration for the development of a contemporary piece of functional, usable interface design.

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- The Eight golden Rules of Interface Design are: (p74)
1. Strive for Consistency
 2. Enable frequent users to use shortcuts
 3. Offer informative feedback
 4. Design dialogues to yield closure
 5. Offer error prevention and simple error handling
 6. Permit easy reversal of actions
 7. Support internal locus of control
 8. Reduce short-term memory load.
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Web Stats. (2006) The methods used to record browser types used are not exact. For example, many of the less used browsers identify themselves as Internet Explorer. However, the dominance of Internet Explorer is unquestioned, and is generally accepted to be in the range of 40% - 60%.

Summarised results

Internet Explorer	45.68%
Firefox	27.35%
Netscape	4.22%
Safari	2.11%
Opera	1.5%

Retrieved Dec 06 from: www.webreference.com/stats/browser.html, & <http://www.ews.uiuc.edu/bstats/latest.html>, University of Illinois.

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