Intuitive interaction –

Steps towards an integral understanding of the user experience in interaction design

By

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I hereby declare that this thesis is entirely my work

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Abstract

A critical review of traditional practices and methodologies demonstrates an underplaying of firstly the role of emotions and secondly aspects of exploration in interaction behaviour in favour of a goal orientated focus in the user experience (UX). Consequently, the UX is a commodity that can be designed, measured, and predicted.

An *integral* understanding of the UX attempts to overcome the rationalistic and instrumental mindset of traditional Human-Computer Interaction (HCI) on several levels. Firstly, the thesis seeks to complement a functional view of interaction with a qualitative one that considers the complexity of emotions. Emotions are at the heart of engagement and connect action irreversibly to the moment it occurs; they are intertwined with cognition, and decision making. Furthermore, they introduce the vague and ambiguous aspects of experience and open it up to potentiality of creation. Secondly, the thesis examines the relationship between purposive and non-purposive user behaviour such as exploration, play and discovery. The integral position proposed here stresses the procedurally relational nature and complexity of interaction experience. This requires revisiting and augmenting key themes of HCI practice such as interactivity and intuitive design. Intuition is investigated as an early and unconscious form of learning, and unstructured browsing discussed as random interaction mechanisms as forms of implicit learning. Interactivity here is the space for user's actions, contributions and creativity, not only in the design process but also during interaction as co-authors of their experiences. Finally, I envisage integral forms of usability methods to embrace the vague and the ambiguous, in order to enrich HCI's vocabulary and design potential. Key readings that inform this position cut across contemporary philosophy, media and interaction studies and professional HCI literature. On a practical level, a series of experimental interaction designs for web-browsing aim to augment the user's experience, and create space for user's intuition.

Keywords:

Interaction, intuition, non-instrumental needs, exploratory interaction, emotional usability, HCI.

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Glossary of Acronyms:

AI: Artificial intelligence

CHI: Computer –human interaction (American version of HCI)

CPU: Central processing unit

DT: Desktop

DTP: Desktop publishing

HCI: Human-Computer Interaction, sometimes Human Computer Interface (older interpretation, mainly by programmers (Preece et al. 1994, p. 714))

HFE: Human Factor Ergonomics

GUI: Graphical User Interface

IA: Information Architecture

IS: Information systems

IT: information technology

IR: Information retrieval

KLM: Keystroke logging model

MMI: Man-machine interaction / interface

MIT: Massachusetts Institute of Technology

PC: Personal computer

UCD: User-Centred Design

UI: User Interface

UX: User experience

WIMP: Window – icon – menu - pointer

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Introduction

I am an IT professional specialising in Web usability, who has become increasingly interested in the "inter" in Human-Computer Interaction (HCI). The concept of an Integral user experience is my attempt to re-think the current definition of intuitive interaction. My extended concept of Intuitive interaction, indicated by the capital I in Intuitive, focuses on unstructured interaction such as browsing and exploration, and emphasises the emotional aspects of interaction as a complement to structured interaction methods. An integral user experience then unites Intuitive and goal-orientated aspects of interaction. This means re-visiting the meaning of terms such as the current use of intuitive design and interactivity, which in its current implementation is reminiscent of Zizek's "interpassivity"; or "ease of use" which confuses simplicity with simplification. Furthermore, this conception will attempt to critically review HCI methods, especially as usability goals like "empowering the user" often turn out to cause the reverse: by excluding the user from unpredictable or unexpected interactions and from a deeper understanding of the system, or even preventing them from doing things the way they want to do them. On a practical level an Integral user-experience considers not only how users are affected by an Internet solution, but also how users can affect their interaction experiences as co-authors.

The context of this work is Internet interaction; in this work 'browsing' is used as an umbrella term for active and passive implicit or unstructured interaction behaviour. The Internet started out as an informational medium. Now Internet products are not only transactional, dynamic, and up-to-date 24/7, they also co-exist with all kinds of "tainments" such as entertainment, edutainment and infotainment; hence users change modes and moods and combine a variety of cultural backgrounds. Such backgrounds are composed not only of various nationalities but also sub-cultures, including the fast and fickle consumer culture of an audience that is bombarded will media and advertising. With HCI turning towards the Internet and intangible informational products, related practice and methodologies need to move towards the intangible too. This means that it is no longer enough for HCI practice to research the efficiency of the interfaces in question by simply taking them at face value, i.e. the buttons to click in sequence, in close proximity, or grouped sensibly, albeit this is still important. More important however, is to gain an understanding of the Internet as a medium, and the relations between this relatively new medium and its users. Ideally, this results in interaction design that releases users from their passive role as consumers given fixed multiple choices, and accepts them as equal partners in the creation of user experiences in Internet interaction.

I call such user experiences 'integral experiences', in that they unite structured and intuitive interaction. In everyday language, intuition refers to a hunch, or a gut-feeling, it can also appear "'like a bolt from the blue' or emerge into consciousness much more slowly" (Claxton 1998). Intuitive use is a popular term in HCI used to refer to a positive user-experience, yet there is no clear definition as to what it means. Sometimes used synonymously for usability criteria such as "ease of use" or "ease of learning" (Preece 1994, p.14), it can also mean that "people can utilise [software] with a minimum of training" (linfo.org /usability). Jeff Raskin (1994) suggests replacing *intuitive* with *familiar*. If intuitive indeed stands for "readily transferred, existing skills" (ibid) it basically stands for viewing the new through the old. Contrary to this, inspired by my reading of Bergson (1913), I view intuition through its potential as an active driver of creation. This enables me to revisit and challenge traditional HCI assumptions. In user interaction, intuition offers an alternative motive to that of goal-orientation, opening up interaction to the multiplicity of emotions at play in the process: such as curiosity, exploration, and experimentation or play. Creativity in this context can mean active innovation or users' situated creation of their own experiences during interactions that they can co-author and thus take in unpredicted directions. Embracing emotions in interaction assists in engaging user experiences; indeed, strong levels of engagement can overcome the challenges of unconventional or novel solutions. Intuitive interaction also complements explicit theories of learning with implicit ones, such as non-conscious or unstructured forms of learning, and results in possibly un-articulable or unconscious, knowledge. Most importantly, Intuitive interaction suggests fluid transitions between varying degrees of implicit and explicit modes of interaction. Such an augmented notion of interaction that includes a more fluid interaction process, embraces the complexities of the new and unknown, therefore the form of intuition proposed here is opposed to the current understanding of intuition in HCI that reduces interaction solutions to the familiar or tried and tested.

My starting point is an observation by Marcia Bates about professional researchers' search behaviour in IR environments. Bates claims that researchers' shift between focused and unfocused search behaviour results in an evolving search behaviour, she terms *Berrypicking.* She stresses that in Berrypicking the query is constantly evolving, and thus actively produces paths through information. As my approach is user-centric I would argue that users evolve, change directions and integrate somewhat random deviations from linear paths. This observation goes against assumptions of search behaviour that iteratively optimises queries and purely goal-oriented interaction in general.

My research questions investigate whether this observation holds up for Internet interaction too, a medium that started out purely informational and has now developed into a heterogeneous multifaceted and dynamic environment of informational (web-access) software, along with immersive and user generated content. Furthermore, if users display a behaviour like Berrypicking on the Internet too, other questions then arise: why do these deviations happen, what happens during them and how can this observation that departs from traditional models of goal-oriented interaction be integrated in existing models? My investigation is twofold: I refer to related, yet interdisciplinary studies as well as employing practical design experiments which are evaluated by participants.

Similar to Bates, in my investigation I focus on the moments of unstructured interaction, of random dips and detours, experimentation and exploration. At the same time these excursions stay in more or less close proximity to the original query or line of investigation. This behaviour is discussed in experimental studies of learning, in particular early and non-conscious learning, which also called implicit learning. This means random excursions from structured behaviour are a form of learning, and are a naturally occurring behaviour. Indeed animal experiments with species of higher organisation show that, in absence of pressure, the desire to explore or learn through experimental action is a naturally occurring emotion. Therefore my investigation includes the role of emotions in exploratory interaction behaviour. In fact, it turns out they play a pivotal role.

Emotions are more of a source of debate in Human-Computer Interaction then they used to be and are seen as crucial for engaging user-experiences. Some approaches focus on the role of emotions in fun and enjoyment; others on their role as subjective value judgements. In the form of enjoyment they have found a path into usability models since higher levels of engagement are thought to provide higher quality user experiences. My investigation of the emotional layers in this work exceeds these aspects of subjective value judgements or fun and enjoyment; indeed, throughout my work the role (and the energy) of emotions is viewed as alternative motivation to goal-orientation in action, as well as being crucial to implicit learning and thus in voluntary or even creative action.

Therefore I believe my contribution unfolds as follows: based on my research I would argue that exploratory or intuitive interaction is intertwined with goal-orientated interaction, and can even - for certain amounts of time - dominate in certain content areas such as entertainment or news. This challenges purely functional and goal-orientated assumptions of user behaviour, and overcomes a simple stimulus-response view of interaction.

On the interface level this means provision for exploratory interaction needs to be augmented, as the sole use of highly structured navigation support can even hinder exploration. In addition, exploratory emotions play a crucial role in initially unstructured implicit or non-conscious learning. Creating the connection between emotions and human learning in my research extends the role of emotions from their importance in engaging user-experiences to touch on another usability dimension: learnability, which from the aspect of designing truly innovative interaction scenarios in the fast evolving space of the Internet, is a crucial dimension to focus on. Finally, the energy of emotions plays a crucial role in user actions, as do exploratory emotions in creativity. This energy can act as an alternative motivation which challenges an assumption of purely goal-orientated motivation in traditional HCI. Allowing for users' exploratory, or even creative energy, to be integrated in future design solutions means not only interaction solutions but also HCI processes and practices need to accommodate these active users, including the active shaping of interfaces they are working with. In return to usability dimensions, an enriched approach to user-centred design affects a third dimension: If effectiveness stands for the 'the accuracy with which a user can achieve their goals' (Quesenberry 2003, p83), then future HCI solutions need to provide effective support for user situated creations.

This work therefore critiques the currently limited acknowledgement of the role of emotions in the traditional HCI domain; and notes that their importance also escapes standard testing methods. Emotions or affect in HCI (Norman 2004) or relevant computer science research (Picard 1997) are integrated in existing cognitive models of information-processing, which re-iterates the disembodied view of the human. In order to escape traditional HCI's rationalistic tendency to flatten the complexities in interaction processes in interface design, I turn to media and interface theory. Besides gaining an understanding of the interface as a medium in itself, this also illustrates the multitude of layers between users, software, their interfaces and the Internet. I also turn to philosophy to explore the tensions between involved antagonists in the interaction process, notably to Foucault, Deleuze, and Bergson. This move is supported by critical approaches to science as an institution such as those in science studies, which encourage cross-disciplinary work (Sardar 2001, p 30); and is also inspired by the work of computer scientists and cross-disciplinary working researchers, who have critiqued HCI practice through philosophy or critical theory, e.g. Weizenbaum, Winograd & Flores, and Coyne.

The thesis also touches on many aspects of progressive HCI research. For example, drawing on knowledge from a wide range of disciplines and including users as co-authors of

their interaction experiences touches on key aspects of Participatory Design (Muller 2003). A focus on emotions in the context of interaction relates to the thought behind embodied interaction (McCarthy & Wright 2004, Dourish 2001).The suggestion of complementing goal-orientated navigation tools with provision for browsing touches on the idea of designing calm technology to engage "*both the center and the periphery of our attention and in fact move back and forth between the two*" (italics in original, Weiser & Brown 1995). Displacing an absolute concept of control with a relative one of more or less control which is shared by the users, results in them shaping their own - likely unpredictable - experiences. This also shifts interaction design from that of a fixed commodity generated by experts to a shared space of co-ownership and co-design. Finally, gathering the emotional aspects of interaction in a conversational and open-ended qualitative evaluation in the context of an unhurried timeframe - which allows for the processes and developments of sense-making - includes aspects of ethnographic approaches to data collection. Overall, this work joins a stream of progressive HCI work and theories, sometimes referred to as the "3rd paradigm of HCI" (Harrison, Sengers & Tartar 2007), that opposes to the mainstream HCI thought and practices referred to as the 1st and 2nd waves. These earlier waves, which view HCI through the lens of engineering and cognitive science, I usually refer to as 'traditional HCI'. The progressive stream is united in their attempt to overcome rationalist assumptions in HCI practice, and their inherent mind-body separation. Instead, 3rd paradigm related research highlights the intrinsic complexities in interaction processes and their temporary interplay with tangible and intangible contextual issues.

The emergence of 3rd wave HCI research therefore counteracts prevailing rationalistic tendencies which are still present and being nurtured by the two following sources. Firstly, HCI education is usually positioned in computer science (CS) departments; consequently, teaching literature emphasises software engineering thought as well as on cognitive science. In my critique I focus on the current Greater London teaching guide (CIS315), published in 1998 and still current as of writing this research. It refers in part to HCI research of the early 80's, thus producing a software-producing workforce which reinforce old paradigms in contemporary IT and Internet production practice. Arguably, another effect of HCI's proximity to CS in academic institutions might be the reason there is still a considerable amount of contemporary research undertaken which conforms to the early waves of HCI. Secondly, the bestselling authors of professional HCI literature such as Jacob Nielsen, Don Norman and Ben Shneiderman, established themselves as part of the GUI based computer revolution in the mid-80's, and have hardly departed from those early paradigms.

Yet, their publications form the source of HCI knowledge for many self-taught or migrated Internet professionals, which are a sizeable part of shaping this relatively young and still emerging medium. It is precisely my intention to reach interested computer science students as well as practice based or self-taught internet professionals, which is why I tried to keep this work approachable and relevant to contemporary internet production and practice.

Admittedly by choosing to focus on those sources of HCI knowledge, I omitted other practices which could usefully be employed to critique traditional HCI paradigms. For example the practice of software hacking and pirating as alternative modes of conceptualising innovation be traced back to the beginnings of computing about 50 years ago (Levy 1994). This is still relevant today, as Matt Mason correctly points out. Illegal pirates, business and users are now "all in the same space, working out how to share control information in new ways" (2008, p.4). Also, since computing technology is now highly intertwined with our daily lives, studying human culture such as interactive or digital art could act as a catalyst for change and innovation in HCI (Blythe et al. 2007). Another practice based approach, and thus appealing to the practice based HCI discipline, lies in what Coyne calls 'liberal pragmatism' which introduces terms like "freedom, community and engagement" into related discourses (1995, p.x). Firefox's developer community which produces plug-in widgets and extensions for users to download and install can act as an example for this approach in Internet interaction. Finally I have merely touched on some approaches, such as the political background leading to participatory design, or the progressive 3rd wave approaches I briefly listed above, which could serve to critique 1st and 2nd wave paradigms.

This work therefore develops as follows: the first chapter lays out the basis for my argument and traces the roots of traditional HCI's engineering mentality and affinity to cognitive science through its immediate history back to WWII, and includes angles of information theory and cybernetics. The extended history goes back almost 200 years to the start of the industrial revolution and will also cover Taylor's time and motion studies of early last century. The rationalistic stance, of course, reaches all the way back to Descartes in the 17th century. The last 40 years in particular highlight HCI's focus on the interface in interaction design, a tendency that prevails in Internet interaction. An excursion into traditional design and testing methodologies not only confirms their rationalistic orientation, but also gives an insight into the fragmentation of - and the struggles amongst - HCI disciplines.

Chapter two demonstrates how media and interface studies, and contemporary philosophy can be used as tools to investigate the complexities and agendas of interfaces, and the role

of the entangled user during interaction. This demonstration helps to shift HCI's focus on the user-application interaction to user journeys and experiences as an emergent property in Internet interaction. Moreover, this positions user interaction as a subset of interactions in the interplay of technologies, (HCI) practices, cultures, and social relations which form the larger context and network of Internet interaction.

Chapter three revisits intuition in the context of theories of learning, neuro-science and philosophy. This creates the groundwork for a revised notion of intuition in interaction, and extends this investigation of complexities in interaction into users' conscious and non-conscious emotional levels. It also introduces a mode of interaction as being unfocused and implicit exploration, which turns out to be vital in early and unconscious forms of learning. Hence, it offers a different route to usability's requirement of 'ease of learning': the route of active monitoring, exploration or experimentation in the process of sense-making. One necessary precursor for exploration is the absence of bodily needs or pressing tasks, another is an appreciation of time as being unhurried or 'slow' time. Intuitive interaction makes space for more or less active modes of exploration which deviate from focused interaction, and repositions emotions from the position of being reactions to interaction to being an alternative motivation to goal driven interaction. Exploratory deviations are therefore a form of co-authoring the user experience. The repercussions on the HCI discipline of such a perspective on interaction are explored in view of the concepts developed in chapters two and three.

The last chapter introduces my practical design experiments and findings of their evaluation by users. The experiments not only explore users' interaction and emotional engagement on an intuitive level such as browsing, but also explore interaction scenarios where users actively create their own links and environments. The experiments which involved random browsing interaction establish exploration as a fluid space, which depends on the proximity to the original query or subject. At a glance the experiment that allowed users to actively shape their own environments seemed to contrast browsing scenarios, yet the experiments join up in investigating how users could benefit from displacing an absolute view of control (provided by the interface) with a more fluid notion of more or less control in interaction. Though sample sizes are small I believe there is sufficient support to take an integral perspective on interaction. An integral user-experience unites goal-orientated and Intuitive interaction, and thus re-confirms interaction as active user participation in terms of their journeys and experiences in Internet interaction.

Chapter 1. A short history of Human Computer Interaction (HCI) and Usability

Essentially HCI and usability derive from two streams: one is tool and machine interaction and their efficient use; another one stems from ergonomics, dealing with the human factors in the work place and also military research. In this chapter, I will present some definitions of HCI and one of its key concepts in usability. I will trace its heredity through Industrialisation, Taylorism and Fordism as well as ergonomics and military history including a view of their repercussion on users ways of working. Then I will investigate currently used methodologies of HCI and usability testing and critically view their significance for interaction design. This will demonstrate the importance of a holistic approach to the design of computer interaction and pave the way for the anticipated move from usability engineering to an integral understanding of the user experience.

The term HCI was developed in the mid 80's to describe a new field of study in the increasingly computer aided work place, particularly as operators mostly consisted of "novice users" i.e. users that had no computing specific background. According to Preece et al. HCI was supposed to overcome the 70's focus on the (man-machine) interface and incorporate broader issues of interaction, as well as the bias of the former term Man-Machine Interface (MMI) (1994, p.7). The goals of HCI are: "to produce usable and safe systems [and] to develop, or improve the safety, utility, effectiveness, efficiency, and usability of systems that include computers." (p.14) Usability is a "key concept in HCI" (ibid) and is defined by ISO 9241-11 as "the extent to which a product can be used by a specified user to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (usability.gov 2008). However is has been recognised that this standard forms a narrow view of usability and currently ISO 13407, a standard to achieve a "human-centred design process for interactive systems" is in the process of being adjusted to incorporate an enlarged notion of the user experience including hedonic[1] user goals such as enjoyment and fun (Bevan 2008). The adjusted standard will be called ISO9241-210 to become part of the ISO9241- set. The current usability factors list as "Ease of learning, Efficiency of use, Memorability, Error Frequency and (subjective) Satisfaction" (usability.gov 2008; Nielsen 1996;). Sutcliffe adds "consistency, adaptability, guidance and structure" (1984, p.45).The latter list almost reads like a description of desirable interpersonal skills for teachers and instructors, as it adds emotional values to the supposedly empirically measurable facts of usability. Therefore, usability stands for considering the user in the interacting process and as a pre-cursor for user centred design. In

[1] Bevan refers here to Hassenzahl's hedonic user goals, i.e. stimulation, identification and evocation (2003) and adds pleasurable emotional reactions to these goals.

its extended form, it will not only measure the usability of a product or (software) solution, but also the user's experience.

The enlarged concept of usability not only stands for a richer user experience but also for the interdisciplinary nature of HCI practice. Most HCI experts now accept, or even welcome the fact, that HCI is not only an interdisciplinary field of the initially involved disciplines as in "computer science, cognitive psychology, ergonomics and organisational psychology" (Preece *et al.* 1994, p.39), but also incorporates "soft sciences [like] philosophy, sociology and anthropology" (p.41). While a lot of interesting work is currently being researched or produced that has incorporated the contributions of the extended circle of disciplines, the reductive ways of thinking seem to prevail well into the 21st century. Charlotte Wiberg (2001) identifies three different kind of reductive tendencies when it comes to include hedonic[2] usability principles:

> (1) *Usability reductionism*, where enjoyment is simply seen as a results of ease of use. (2) *Design reductionism*, where enjoyment and fun are features to be added on by graphical and industrial designers. Finally (3) *market reductionism*, where the concept of fun is only seen as an advertising tool. [Emphasis in original]

Similarly Harrison, Tatar & Sengers (2007) argue it is time for a 'third paradigm of HCI' to emerge, as an enlarged notion of the user experience and contributions from disciplines other than traditional engineering and cognitive science struggle to have an impact on the user experience. HCI veterans seem key-players in this struggle to adopt a more progressive stance. Being well known names in HCI circles their publications are highly influential to students as well as a wide range of commercial practitioners. Alan Dix's work forms the basis for the current academic teaching curriculum or (as of writing 2008); Jacob Nielsen, Don Norman, and Ben Shneiderman, are amongst the top selling usability and user experience authors in the commercial market. Before I illustrate the continued fragmentation of HCI as a discipline, I would first like to trace the roots for HCI's traditional focus on the interface, engineering & cognitive science through history as I believe the strength of engineering values and scientific methods derive from its broader history: while the term "HCI" has only been established two decades ago, HCI's history reaches at least as far back as two centuries ago, to the "second industrial revolution, the one from tool to machine" (Flusser 1999, p. 45)

[2] Charlotte Wiberg too uses Hassenzahl as a source in this paper.

HCI roots: from tool use to machine use and Taylorism

This section will discuss the tool as a historical precursor of the machine, and subsequent machine development, with a view of the repercussions in the involved production and design processes, and the changing role of the user in these processes.

The Oxford Dictionary defines a tool at its most basic level as a "hand held instrument" (Hornby 1995). According to Weizenbaum, "a tool is also a model for its own reproduction and a script for the re-enactment of the skill it symbolises. That is the sense in which it is a pedagogic instrument, a vehicle for instructing man in other times and places in culturally acquired modes of thought and action" (1976, p. 18). This means a tool is not only an external instrument, but also the embodiment of human creativity and skill. "It is a constituent of man's symbolic recreation of this world. It must therefore inevitably enter into the imaginative calculus that constantly constructs his world. [...] In this sense it is an agent for change" (ibid). McLuhan noted regarding the man-instrument interaction that "we shape our tools and thereafter our tools shape us" (1994, p.xi), while Flusser comments on the mutual repercussions it in less abstract terms: "A shoemaker not only makes leather into shoes; he also makes a shoemaker out of himself" (1999, p.44). For Flusser the beginning of the use of tools is co-occurant with the beginning of culture and the alienation of primitive man from his natural environment, which is now "both protected and imprisoned by culture" (p.45). Flusser then moves on to explain the effects of the second industrial revolution, the one from tool to machine. "Machines are tools that are designed and produced in accordance with scientific theory, and therefore more efficient [...] Thus the relationship between human and tool is reversed and human existence changes" (ibid). The machine becomes the centre of activity; the human develops as an appendage to the machine. Flusser dates the second industrial revolution about 200 years ago. At this time, manufacture was still at a very early stage. The direct antecedent to the factory was the "table system", mainly used for packing or bottling plants. Even though the tasks were already fragmented (weighing goods and filling it in jars, supply lids, seal jar, stick on label) and a regular flow of production was achieved with synchronising and serialising movements, the movements were coordinated between humans and the speed was set by the worker. The foreman, that supervised the work would compare the speed amongst tables, not to a clock or any external pace maker. Yet, an external physical object, the table, "recombined tasks that had been broken down by the division of labour; the table itself merely conveyed dead traces of living labour and was external to the activity of labour itself" (Doray 1988, p.41).

About at the same time the division of labour was embodied for the first time in a machine. In 1804 the weaver Joseph-Maria Jacquard invented a machine that would make the jobs of overworked weavers tolerable: The Jacquard Loom. This is significant as "it is considered the earliest use of binary automation, the same system of mathematics employed by computers today" (Long 1994, p.34) "The actions of the human weaver were codified and converted into marks on the wooden card which then were read by the machine in order to repeat them" (Gere 2002, p.22). Dubois and Mercier sold their first self-acting machine in 1818: "a carding engine, combined with a Bely (a machine for roving the wool) and a spinning Jenny" [a multi-spool spinning wheel] (Doray 1988, p.50). Their business flourished and in 1865 the Mercier factory specialised in producing machine-tools (ibid). This now establishes that machines act as man-made systems[3], which constitutes industrial labour as human-system interaction. Three criteria need to be fulfilled to design efficient machine tools: "increased precision, greater speed and the reduction of the workers free will" (Doray 1988, p.61). In other words not only was the compression of time added to the fragmentation of labour, "by the breakdown of jobs into task, and of tasks into simple movements to be performed at a set speed" (p.2), workers also were divorced from their bodies by synchronising them to machine pace in terms of motion and time. In turn, while machines initially mimicked human production processes, now they demanded the redesign of those processes according to principles of mechanisation. In continuation of Flusser's shoemaker example earlier: "Soles were cut and moulded with a steam press rather then with a shoemakers trimming knife [...] and so on" (1999, p.50). Machine production also sets new standards in terms of quality, or rather lowers it to mediocrity, as noted by the shoemakers delegation, 1867: in the case of shoemaking, we have noted the significant fact that the division of labour results in uniformly mediocre work, and we no longer see the masterpieces which could be held up as models for young workers to emulate (Doray 1988, p.47). The transfer of skills to machines made the "automaton the workers double, [...] machines began to compete with the skills of workers, which were becoming obsolete". "The site of mystery has been displaced from the human element to the mechanical element; machines seemed to be an alien power in the world of work" (p.46).

Mass-producing machines had not only developed into the better worker, they also provided social control over their subjects and progressively increased his subordination.

[3] Andy Smith, author of Human-Computer Factors; quotes as most appropriate definition: system: a complex whole, a set of connected things or parts; an organised body of material and immaterial things according to a set of rules. He distinguishes between natural and man-made systems, and brakes down the latter into Engineered / physical systems; Social systems and Human activity systems., p 15, users and information systems.

While initially developed to relieve the human body from the motorics and mechanical part of work in order to release human skill, they transformed the worker initially into an extension of the machine and then as stopgaps between machines. In order to increase the efficiency of industrialised mass production Taylorism introduces the idea of "scientific management", where "every element of the work of every worker becomes the object of accurate, detailed and scientific investigations, and knowledge replaces opinions" (Doray 1988, p83). Taylor states that engineers and managers are best suited to counteract the evil of inefficiency in the work place and lead the way to efficiency with scientific management (Taylor 1911, p5). Work should be re-organised according the following principles:

- A division of labour between management and workers on the one hand which means managers would control work processes rather then foremen or skilled workers (pp.5ff)
- A division of individual tasks involved in the work process on the other, to improve efficiency and "develop a science for each element of a mans work" (p.15)
- Scientific time motion studies to control costs and the efficiency of movements during work processes (p.9)

As a result of managers controlling work processes, management was separated form ownership and became a skill while reducing and fragmenting tasks to the simplest possible actions reduced the skills required by workers and deskilled the manual labourers. Many see Taylorism as the enslavement of the worker to the machine, with his body being instrumentalised and separated from his personality. "It is quite true that the Taylorist model of man excludes speech, desire, identity, sexuality and [...] other dimensions of human personality" (Doray 1988, p.82). Stripping the human of its human qualities allowed Taylor to view the body through machine properties and to investigate it like an instrument or an engine. "Work could now be seen as the conversion of energy within a system" (p.76). The principles of such studies can be traced back as far as 1786, when Lazare Carnot wrote: an animal is like an assemblage of corpuscles separated by springs which are compressed [...] and therefore contain a certain quantity of living force" (ibid) and effectively to Descartes' *De homine,* an early "articulation of the mind/body interactions [between] the rational soul [...] and the animal spirit" (Wozniak, 1995). The animal-machine and animated motors are equated through their mechanics, their technology can be applied to the human body. Organisms and machines obey the same laws and organs are vital to make up machines, be it animal-machine or industrial engine. The human body is interchangeably considered as an organ or instrument in view of his machine environment. Investigations following this line evolve around bio-energetic studies like

the transfer of energy, optimal utilisation of muscle force and possible a general law of fatigue and the analysis of movement.

Conveniently this line of thought covered two practical aspects of work organisation too: "optimal utilisation of the 'goodness' of the animal motor would allow a foreman to know in advance how much a workman suited to his task could produce in a day" and through 'optimal utilisation' of muscular force, according to Chauvou[4], work could be sped up. In other words, production became predictable as well as cheaper to produce simply by raising the speed. By the way, many of the studies of physiology of labour took place not in factories but "military or penitentiary environments, where labour displayed a simplicity and malleability unknown to the industry", in workhouses, prisons, and in construction sites. More interestingly even, although "questions are no longer posed in such crude terms, they are still relevant and of major importance to the future of ergonomics" (Doray 1988, p.74). As the time periods in the studies were short, the results turned out not to scale very well to full time work. Increased machine speeds combined with the numbed attention of workers due to fragmented repetitive tasks caused rising accident rates and negatively affected "the economic optimum" as Chauvou coined his approach.

From machine to interface interaction

40 years later the problem of men being to fitted to machines stills persists, as the following case study illustrates: Ergonomics applied to crane cab seats (Taylor & Francis 1977). In 1950 a survey was undertaken to support new crane specifications. Initially the specifications were improved from the electrical point of view, but during the survey Dr. Bramley - the head of the electricity board - became concerned with the poor control facilities and consequently the work condition of the operators. It seemed nobody had given the arrangement of machine controls any consideration beyond machine support. Figures about loss of work time due to injuries reflected the problem: 1.392 in 1954, 19 of them being fatal. Moreover "although the emphasis is on crane cabs, the research is also applicable for many rolling mill and other control cabins" (Sell 1977, p.2). The problems list controls being either out of sight or an uncomfortable reach of the operator, the operator had to lean out the cabin to reach them; other controls were out of reach while the operator was leaning out. Visibility was limited and the position of viewing slots made it impossible to sit down. Controllers were bulky and therefore wide spaced out to prevent interferences from handles; some controls had multiple uses, yet had to be operated in dark

[4] Chauvou established that if a given task is to be carried out, it costs less to double the speed then to double the load". (Amar, 1914, p.25, in Doray 1988, p. 77)

or inaccessible situations. Drivers were almost unprotected in a varying cold and hot, noisy and dusty environment, and exposed to fumes.

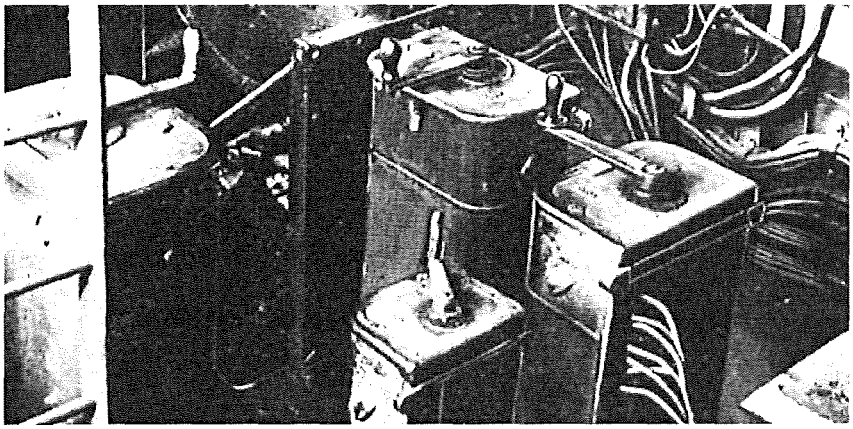

Figure 1.0, Typical older design of crane cab. (Sell 1977, p. 2)

The solution after an iterative design process resulted in the following prototype: The operator could sit down, while all controls were in easy reach of his feet or arms, levers, latches, rollers, etc; and were designed according to anthropometrical and ergonomic specifications. Controllers lost the direct machine connection and became representative: For instance instead of rotating several times to lift a machine part, the controller was designed to adjust the height according to the feel of resistance with a maximum of one rotation. Hydraulics took over from the "animal motor" to create the actual lifting force. In other words, the solution was to remove the controls from their direct machine connection and arrange them around the body of operator.

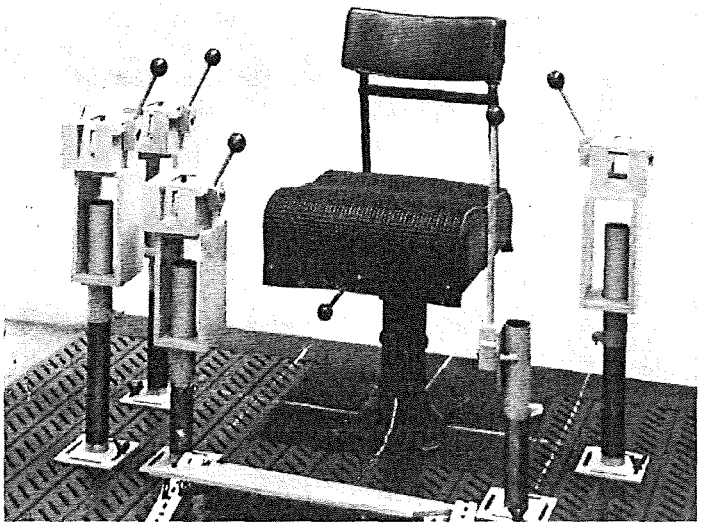

Figure 1.1. Adjustable mock up of rolling mill control point (Sell 1977, p. 28) [Crane cab prototype]

Even though the operator is still in the midst of the action, directly connected to the work environment through his vision and integral in bridging the fragmented workflow of ma-

chinery, these alterations mark the beginning of the machine adapting to the human body. After 150 years of machine domination the man-machine relationship started to go back into balance. Or so it seemed. While the separation of machines and their control points continued to develop into technology and interface, the other part the relationship did not get quite the same attention: the human body.

In 1995 David Oborne still opposes the argument that "people are more adaptable than their machines and their environments, that they can learn to interact with their situation more easily - and cheaply - and so its easier to make people 'fit' with their surroundings than the reverse" (p.2). Likewise, David Meister confirms "One of the significant aspects of Taylor's work is that he employed formalised methods of data collection and statistical analysis that are not far removed from those HFE [Human Factors Engineering] professionals use today" (Meister 1999, p.148). Moroney (1995) also "suggested that Taylor's principles of work design and time and motion studies became the bases for today's task analysis methods" (in Meister 1999, p.148). While Oborne and Meister identify Taylorism as fore-runner for of an instrumental mind set in Ergonomics with a tendency to treat the human as the machine appendix, Gere sees Taylorism as the social forerunner to the next technological development that revolutionises the work environment: the computer. Taylorism is a key component of Fordism, a term coined by Gramsci. Fordism combines scientific management with an extreme mechanisation of the mass production process (Gramsci 1971, p.308 ff). When the first assembly lines were introduced in Ford factories in 1913 tasks were partly broken down to the level of single movements. In the process the Fordist worker was so highly specialised, in few motions or movements, that he was effectively de-skilled. While the pre-Fordist factory worker could regain some social status by building up specialised machine operator skills, the Fordist worker has not even a machine to specialise in. The assembly line is not a machine; it does not collect, turn or modify anything, it only continually moves. The assembly line therefore symbolises the concept of a machine as in continuous motion, its extreme time compression expels thinking from the work process as it would effect the physical performance i.e. waste time; the worker is completely automated and in terms of man machine interaction reduced to an entirely physical and reactive level. The speed set in advance, the worker has no choice but to internalise it. Like a processor, the assembly line clocks an army of workers into almost circuit like movements enclosing the worker in an infinite deja-vu experience of the same minute serialised task. Some theorists see those metaphors materialised in early mechanical-electric computing where paper tapes physically resemble the

assembly line, releasing codified instructions, causing minute binary-like movements in the process; and conceptualised in the thought model of computers as "Turing's imaginary device not only invokes the typewriter, one of the paradigmatic information technologies of nineteenth century capitalism, but also in the tape and writing head the model of the assembly line. The algorithmic method, which this machine intended to automate, is itself a model of division of labour" (Gere 2002, p.21).

HCI roots: Ergonomics and military history

Taylorism was not only key concept in Fordism but "a milestone in the pre-world war I antecedents of HFE" (Meister 1999, p.148). Until then in machine dominated times "the only test of the fit of the human to the machine was of trial and error, in which the human either functioned with the machine (and was accepted) or could not (and was rejected)" (p.147). An anecdotal example claims that "in World War II the Russians selected their tank operators by applying the size criteria: Anyone who was small enough to fit the cramped quarters of the T-34 automatically became a tank operator" (Meister 1999, p.148).

The actual term "Ergonomics" was coined just after the Second World War in 1949 with the establishment of the "National Ergonomics Research Group" in England, "followed in 1961 by the creation of the International Ergonomics Association (IEA). The HFE [Human Factors Engineering] movements started out in the UK as interdisciplinary area involving the departments of physiology and psychology, but the study of industrial psychology soon declined, possibly due to (economic) depression. Dul and Weerdmeester's (1993) account of the continental history of the Ergonomics approach lists Physiologists, psychologist, anthropologist, medical doctors, work scientists and engineers as involved disciplines. Research issues evolved around military matters, like aircraft simulators, aviation psychology, intelligence tests and the operation of complex military equipment. Even though the USA saw the first industrial research labs being founded in 1925, with the first staff for human factors added in 1946, almost all human-factors research during and immediately after WWII was military funded. For example, the laboratory that was founded during the war by the University of California War Research became the US navy electronics laboratory. What is now called the "human research laboratory" was founded in 1953 by the army as Human engineering Laboratory. Other so-called *think tanks*, like "the RAND Corporation, which split off from it, were established and funded by the military". (Meister 1999, pp.153/4,). After 1945 research laboratories carried on to develop human performance research and "some of the major psychologists in WWII continued their work" (Meister 1999, p.154), but moving in the 'military-industrial' com-

plex also saw the application of their work to physical systems, such as "studies on air traffic control". Almost all important researchers in that area were engineers and only the event of World War II turned HFE into a behavioural discipline. While the connection between psychology and engineering during the war was a rather vague one, in the mid-50ies it firmed up and matured into a new discipline, however not without problems: Meister's perceived "acrimony between researchers and appliers because of the notion developed, that research should be useful to application"(p.155). Two conclusions follow from this: Meister's observation suggests that the struggle between involved disciplines in HCI might be historical, which might be the reason these struggles subsequently extend into the additional disciplines in our days. Also in the forming, HFE adopted methodologies of behavioural science and engineering practice by ergonomics and consequently for HCI, including the friction between the respective methods.

Considering that every single introduction to HCI teaching materials still reminds software engineers to produce "less off-putting solutions" to end users (see Dix et al., Preece et al., Sutcliffe), with Booth literally urging "software engineers need to overcome hostility towards users" (1995, p.xii). I don't entirely share Meister's interpretation of the roots of this acrimony. My interpretation is that the understanding of communication is, to some degree, still the hostile one of the post-WWII battlefield: Information is the linear connection between sender and receiver and successful communication is the lethal strike on the enemy. This assumption is supported by the use of language, such as calling potential users until today the 'target group' as well as trying to predict the 'zigzagging' ways of users through Wiener's AA- predictor, "a remarkably ambitious calculating device that he called the "antiaircraft (AA) predictor" (Galison 1994, p.235), designed to characterize an enemy pilot's zigzagging flight, anticipate his future position, and launch an antiaircraft shell to down this plane " which became "the prototype for an new understanding of the human-machine relation" in a new science called "cybernetics" (ibid). Similar to HFE or ergonomics, Cybernetics was closely intertwined with war and post-war technology such as weaponry and telecommunication, as well as computer development. It incorporated information theory as formulated in *a Mathematical Theory of Communication* by Shannon-Weaver in 1949, which defines one of the most significant milestones in communication technology and theory.

On a technical level, it represents the separation of message transmission from its semantic content; or to speak with McLuhan, the demarcation of the separation of medium and

message. Rephrased in terms of cultural theory it stands for the disembodiment of the message, which Kathryn Hayles (1999) discussed critically in *HowWe BecamePost-Human.* Shannon was merely interested in the technical problems of transmitting a message, not what those messages mean (p.54) and was therefore reluctant to use the word information in his publications.

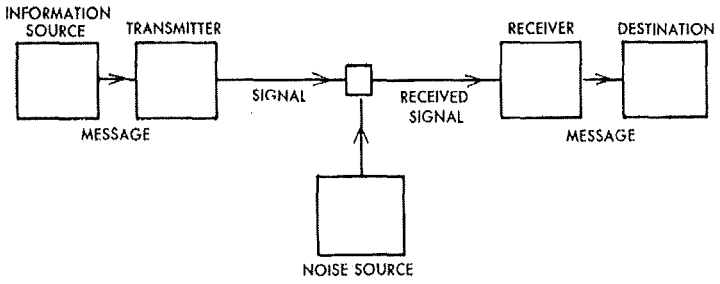

Figure 1.2. The mathematical model of information by Shannon and Weaver 1948

Wiener, probably the best-known figure in developing first order cybernetics, drew considerably from the ideas of information theory for the development of cybernetics, as well as other disciplines and consequently saw cybernetics as an interdisciplinary theory about communication. First order cybernetics was concerned with the mechanism of self-regulation and feedback, but it was also a filtering, detection and prediction theory (Wiener 1965, pp.5/6). Cybernetics was of great interest to the American military in looking at ways of automating warfare (Gere, p.61) and became the "model for military command in the cold war" (Edwards 1996, p.40) as it gave military planners the option to simulate scenarios, as naturally there was no possibility to actually test them. The pivotal contribution of cybernetics to military control was probably embodied in the development of the "Whirlwind Computer" at the MIT in the late 40's "and its offspring, the SAGE computerised air defence system" (Edwards 1996, p.75). A radar defence system, that offered "real-time" simulation of data and "immediately display[ed] it in a form that humans could readily understand" (NCSA & EVL 1995).

Another simulation technique the military - industrial complex invested heavily in was technology to simulate flying airplanes. Then as now, it was more cost effective as well as safer, to train pilots on the ground before exposing them to the risks of flight. The early flight simulators consisted of mock cockpits built on motion platforms that pitched and rolled. A limitation, however, was they lacked visual feedback. This changed when video displays were coupled with model cockpits. Ivan Sutherland, the inventor of the first ever-interactive graphics program "Sketchpad" demonstrated that it was possible to use the computer as a visual medium. It allowed the user to draw straight on the screen by

using a "light pen" and manipulate what had been drawn. In his commercial work with David Evans "ESIG" (Evans & Sutherland Image Generator) in the 1960s and 1970s developed the CT-5 and CT-6 flight simulators as well as systems for sea, and land simulation (Carlson 2003). By the 1970s, computer-generated graphics had replaced videos and models. These flight simulations were operating in real time, though the graphics were primitive. In 1979, the military experimented with head-mounted displays. These innovations were driven by the greater dangers associated with training on and flying the jet fighters that were being built in the 1970s (ibid).

Naturally the entertainment industry was interested in these developments, which are now classed as the pre-cursor of virtual reality (Bellis 2004). The first computer game, called Spacewar, was written in 1961, and 1972 saw the release of the first video game console for the home market, Magnavox Odyssey" (ibid). By now the global sale of computer and console games exceeds $10 billion dollars annually, inducing further integration of the entertainment, computer and military industries (Poole 2000) and naturally the American Army runs its own commercial war game section not only as PR tool, but also as a means to recruiting (Petermayer 2004).

While I think game interaction could be highly inspiring to HCI in terms of interaction design, the reality is that the line of thought that found its continuation into HCI interaction design is the one of first generation cybernetics: "largely based on engineering paradigms" obliged to the "traditional scientific view of the observer standing outside of the system being observed." (Gere 2002, p.63) Military training introduced remote spatial aspects by layering the notion of secrecy, like "off-site-training" and exploring emotional responses to critical situations, on top of the basic engineering anticipation of man-machine interaction. This required the artificial recreation of real world situations in an enclosed laboratory to prevent any leaking of possible classified information. It consisted of simulation of equipment as well as reality, leading to "remote interaction"; communication became telecommunication, and control became spatially detached towards telecontrol, for instance for operating weapons of mass destruction. To facilitate this separation in practice meant the development and deployment of new infrastructures. The initial intent of promoting remote access soon progressed into a strategic problem of preventing the vulnerability of such tactically important control nodes. The answer was a communication system without any centre as described in Paul Baran's paper *On distributed Communications* published in 1962 as part of his work for the defence think tank RAND Corporation. The idea is that if the information is distributed equally amongst various nodes,

so even if a single nodes as destructed the system is still intact as an entity. "Post nuclear America would needed a command-and-control network, linked from city to city, state-to-state, base-to-base" (Sterling 1993). Even though for single nodes, their switches and wiring could not be protected against a possible nuclear attack, which would disastrous effect on any network. "As a result ARPANET was born, intended to promote the sharing of super-computers amongst researchers in the United States" (ibid). APRANET can be seen as the direct predecessor of the Internet. It consisted initially of four nodes, connecting the research departments (i.e. the computers) of UCLA, Stanford (University of California) Santa Barbara and the University of Utah. (Gere 2002, pp.66-69).The structural decentralisation required in turn the re-design of the involved control "nodes" in terms of equipment and access needed by the operator or user, i.e. it required the redesign of the notion of involved interfaces.

First generation computer interfaces were, similar to industrial machines, knobs, dials and bulbs of different colours (Walker 1990, p.439). The interface was inseparably attached to the machine to represent computer processes. Mechanical-electrical equipment required the operator to move between machine parts in order to flip switches or reconnect cables. In order to use the operator's skills and the computers processing power more efficiently, John McCarthy developed the concept of time-sharing. "This involved the computer dealing with the work of many users at once by cycling though sections of each user's processes very rapidly" (1990 p.64). This was taken further in 1962 by J.C.R. Licklider in his paper 'man-computer-symbioses' which offers a model of human operator's integration beyond automation, taking into consideration the state of the AI, the earlier mentioned concept of time sharing, plus interactive computing and networking (ibid). Physically this re-centred the equipment efficiently around the operator, providing individual "PT's" (personal terminal); but it also reduced physical interaction to "hand – eyes" actions only, and confined him to total stillness in front of a control screen.

As for input devices, as the computer industry developed new data manipulation and entry techniques, new hardware solutions had to reflect this innovation. Douglas Engelbart founded the Augmentation Research Centre (ARC) at the Stanford Research Institute in 1963/64. It was also Engelbart who developed, with the help of ARPA[5] funding, in the 12 years of existence of the ARC the concepts of computing as we know them today: "word processing, cutting and pasting, separate windows, hypertext, multimedia, outline processing, computer conferencing, and even the mouse"(Walker 1990, p.66). While the

[5] Advanced Research Project Agency

screen and the keyboard adhered to the established metaphors of the light-emitting display of television and the typewriter, the mouse constituted a truly new concept and hardware device. Sutherland's light pen transformed into a stylus-pen that acts an input device for graphics tablet, used by many computer users such as designers and architects. The 'experimental pointing device' another one of Sutherland's input innovation disappeared, but the mouse became pivotal in today's computer interaction enabling GUI's and WIMP operating systems.

The arrival of the new technologies in the mid-60's created a new situation for HFE. The initial focus on computer systems and their hardware interfaces (like keyboards) soon progressed into the software area, when in the eighties the general public started to use PC's. HFE saw a new speciality field emerge as the published articles focusing on the MMI (Man-Machine interface) increased between 1965 and 1985 from 1% to 30% (Meister 1999, p.157). From the mid-80'ies the term MMI was replaced with Human-Computer Interaction (HCI). This demarcated the birth of this new field of study, corrected the gender bias, and also "acknowledged that the focus of interest was broader than just the design of the interface and was concerned with all aspects that relate to the interaction between users and computers" (Preece 1994, p.7). The shift from HFI to HCI supposedly signifies a shift from human-machine interaction to Human-interface interaction. Hence, the next section looks more closely at interface generations and their repercussions on the involved users.

Before I move on to talk about HCI specifically I need to specify my use of some acronyms. Another indicator for the empirical mindset of the discipline is that "HCI" is synonymously used for "Human-computer-interaction" well as "Human-Computer-Interface". Some engineers and computer scientists still use the term in its older definition today. More recently HCI stands for Human-Computer Interaction and I use it exclusively in that sense. That makes HCI "the processes, dialogues and actions that a user employs to interact with a computer in a given environment". The terms "UI", for the user interface, and "CI", the computer interface, describe more narrowly the interface between the systems and the user, i.e. dialogues on screen" (Preece 1994, p.714). Usability is sometimes short for usability design; Usability as such is part of the evaluation phase of a product development cycle and delineates a set of testing methods to explore the efficiency, effectiveness and satisfaction of a solution, findings which in turn inform usability design as a functional design discipline.

From system interaction to interface interaction

In the 60's computer access as we know it now was largely in place due to the many ground breaking innovations of the last 15 years: John McCarthy's concept of timesharing in order to 'squeeze more performance' out of the very expensive computer systems lead to the physical separation of access point and actual machine (Walker 1990, p. 441). Licklider's idea of the 'man-computer symbiosis'

> was realised in a time sharing system, [...] which incorporated a General Purpose Display System (GPDS) that included a primitive graphical interface – the first of its kind. With graphical symbols for input and output functions, the GPDS foreshadowed modern icon-based graphical user interfaces such as the Windows or Apple operating system. (Van Atta, Reed & Deitchman in Edwards, 1997, p 269,)

Walker considers this as 'third generation' interface with the first generation being the already mentioned knobs, dials and switches of the 50's and the second generation introducing punch card based 'batch processing', where users consisted of expert users, as in computer scientists, and programming was done in machine language. With the arrival of third generation interfaces the interaction changed considerably. 'Real-time feedback' combined with timesharing offering users the chance to "compose their jobs interactively and monitor the progress online". The computer now presented" interactive, conversational interaction (...) to a new class of users" (Walker 1990, p. 441). Programming languages moved from "Assembler" to "High-level" languages, like Fortran and Pascal (Nielsen 1993). Conversational systems broadened the accessibility of computers, and shifted the user group from computer to operator experts; the nature of the relationship shifted towards a 'one-to-one' engagement and operators started to consider their terminals as 'their personal' machines. Technically it means the separation of mainframe computer and access points in terms of input (terminal) and feedback (screen). Fourth generation systems saw faster terminals emerge, which allowed for the return of larger amounts of information on screens, which consequently enabled the presentation of text menu choices, e.g. selections could be made simply by pressing one or two keys, or using an arrow key.

'Menu command selection' coupled with data entry modelled on filling in a form, rapidly became the standard for application systems intended to be used by non-computer specialists" (Walker 1990, p.442) such as specialized groups without computer knowledge (e.g. bank tellers) (Nielsen 1996).

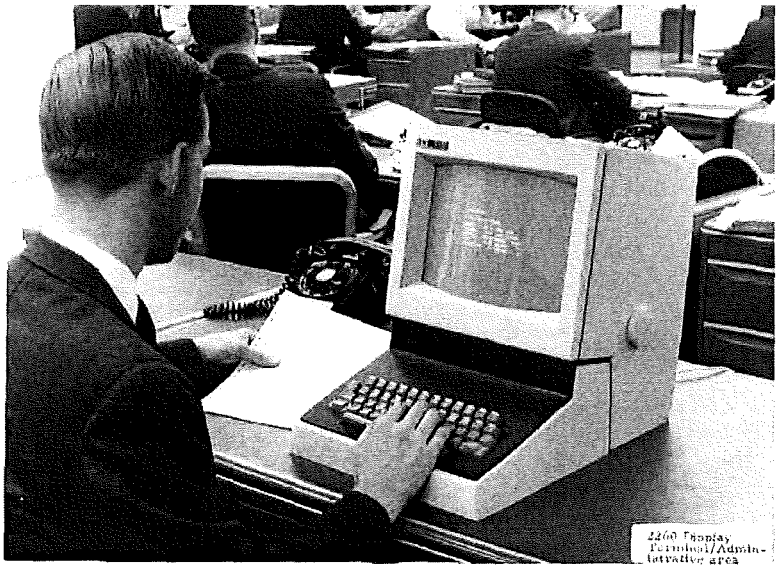

Figure 1.3.IBM 2260 Display Station (da Cruz 2001)

The simplest case were binary keyboard operated, on-screen menus offering simple yes / no and true / false choices, more extended ones would be operated by numerical keys (choose 1, 2 or 3).

They looked similar to something like this:

DO YOU WANT INSTRUCTIONS (Y, N)

Extended versions of those menus could look like this:

YOUR CHOICES ARE

1 -- GET 12 LINES OF BRIEF INSTRUCTIONS

2 -- GET 89 LINES OF COMPLETE INSTRUCTIONS

3 — GO ON PLAYING THE GAME

TYPE 1, 2, OR 3, AND PRESS 'RETURN'[6]

The significant change of fourth generation systems and interfaces consisted of the change in user groups: from expert operator users to "non-computer specialists". With this change a problematic started to emerge that is still subject to the majority of usability discussions now: "people who have studied how users actually learn and use systems find (...) that users see them in a very different way than the designers intended – frequently moving from menu to menu by rote learning of keystroke sequences, leaving the carefully crafted menus unread" (Walker 1990, p.442). To be precise, there are actually three problems: Firstly: users interact in unexpected ways: they explore what's at hand or rather on screen when they need it on a trial and error bases. Secondly: Users learn in un-

[6] Examples recreated from Ben Shneiderman 1992, p. 102.

expected ways: they prefer learning by doing to learning by reading, and in that doing they are unstructured and non-methodical; they form their own conclusions and consequently their own reality about their computer relationship. In other words: users prefer to act then to re-act, and the way they would want to act is quite unpredictable. Thirdly: People who study how users interact with systems are neither the designer of the systems nor the authors of the manuals. (p.442)

With the arrival of computers in non-specialist but computable work environments like banks and accounting offices, the work place is restructured to, what Nielson casually calls "white collar labour mechanisation" (1996): Similar to the reorganisation of work processes during industrialisation to suit machines, now work processes became organised to suit computer system functionality. This re-organisation combined with user support in the form of help instructions and manuals constitute the systems-centric approach to human computer interaction that work environments are still suffering now. Complexities increased with what Walker calls the arrival of fifth generation systems in the mid-70s: Graphics or more specifically the GUI, the graphical user interface. Developed by the learning research group at Xerox Palo Alto Research centre by Alan Kay, it enabled a completely new way if interaction: Direct Manipulation. The iconic symbols resembled a physical desktop, using "virtual interface metaphors" for files, folders, documents, and for tools like applications or peripherals such as printers.

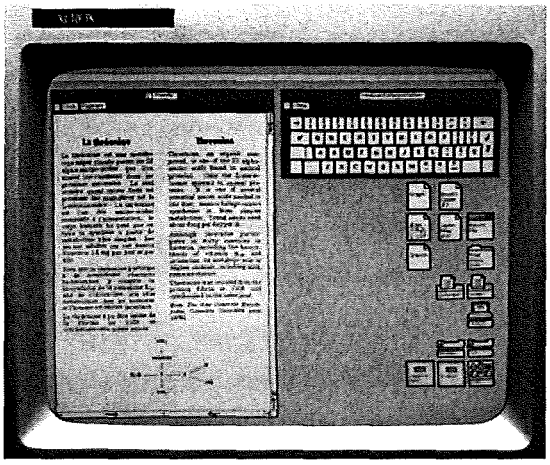

Figure 1.4.1981: The Xerox Star 8010 (Digitbarn computer museum 1998- 2008)

As not all interactions map directly on a visual representation it was necessary to extend into "composite metaphors", the combination of virtual and other metaphors e.g., scroll bars, menus, windows or conceptual interaction, namely copy and paste. Interaction consisted now of dragging, dropping, re-sizing windows and clicking icons or buttons, instead of solely keyboard use and command entry. This means the space for interpretation,

for the process of meaning making, by users increased dramatically along with the unpredictability of a users path through an application, as now many more objects are on offer for exploration. Walker welcomes this development as a well overdue return to long lost direct computer access: "It is ironic that five generations of user interaction have brought us back to the starting point. Users of the first computers had dedicated access to the computer and direct control over its operation" (Walker 1990, p.443). Now interaction has become object orientated: instead of typing or choosing a command first and then the file or document that should be effected, now the object is chosen first, and then the action executed. Only the access is *not* direct - though it might be more direct then via hardware interfaces - it is representational, and it is mediated. Not only by programmers who actually decide about the "behaviour" i.e. the coding of the object, but also by the designer who decides about the nature and quality of the representation and its functionality. Direct manipulation was already present in Sutherland's 'sketchpad', mentioned earlier, but only few applications actually utilised it at the time, such as the Xerox Star 8010 and the Apple Lisa. Ben Shneiderman's enthusiastic paper 'Direct Manipulation. A Step Beyond Programming Languages' (1983) envisioned this interaction mechanism for a wide range of applications, from spreadsheets to flight reservations (p.497, in Wardrip-Fruin & Montfort, 2003). Some of these applications have now been long used in direct manipulation, such as spreadsheets and word processors; on the internet they are only emerging now as informational software solutions and dynamic screen-scripting amalgamates. For example Bret Victor's 'Bart widget' is a travel planning tool that dynamically combines travel maps and schedules. It instantly re-arranges journey information according to user's manipulation of departure and arrival on-screen markers (2006).

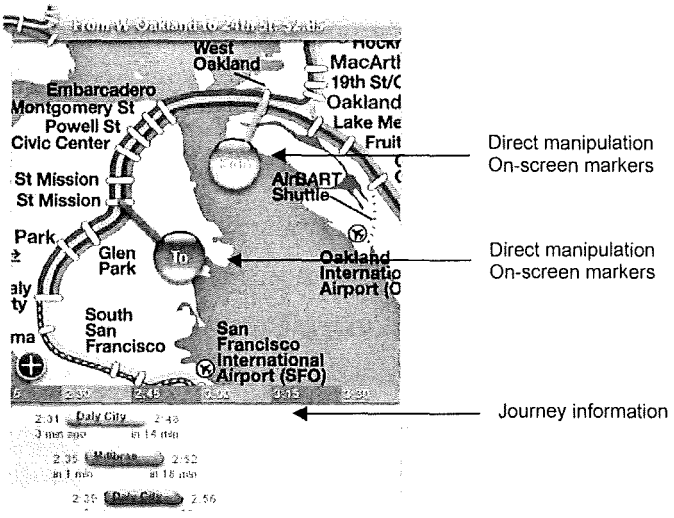

Figure 1.5. The Bart widget (Victor 2006)

Direct manipulation refers strictly to the human-object interaction, as actions such as dragging, resizing or pulling a menu item, fed back visually and instantaneously by the computers programming. Only dragging a file across the screen does not reflect a file being dragged somewhere inside the computer between different locations, which is what direct access in the times of knobs and dials did. It means the file description in the directory changes, and the relevant underlying code changes, unnoticed to the user. Empowering the user through direct manipulation means the user has became part of the virtual office environment in the shape of the cursor or pointer, which resembles the representation of the user to the computer. For the computer to know about user actions, the mouse movement are tracked and mapped to spaces and objects on the screen. Hence the interaction concept of direct manipulation signifies not only entering the realm of representation but a basic form of surveillance, the surveillance of the displaced user moves in the virtual office world of their DT computer. In turn the increased mobility of the interface immobilises the user, renders them once more subject to a machine attachment and part of a (networked) computer system. Furthermore the virtual moves of the user are confined to choices the programmer assigned to the objects; the user is always on the system producer's turf: interaction is only possible on the terms of the programmers and the user's experience formed on the terms of the designers. Alas the idea of user empowerment due to Direct Manipulation is deceptive and on closer examination turns out to reduce the user's action merely to reaction in a multiple-choice scenario.

Kittler agrees, the power shift towards the user is deceptive.

> "the so-called philosophy of the computer community tends to systematically obscure hardware by software, electronic signifiers by interfaces between formal and everyday languages. (Kittler, 1997, p150).

The effects are two-fold:

> "Firstly, on an intentionally superficial level, perfect graphic user interfaces, since they dispense with writing itself, hide a whole machine from its users. Secondly, on the microscopic level of hardware itself, so-called protection software has been implemented in order to prevent "untrusted programs" or "untrusted users" from any access to the operating system's kernel and input/output channels". (Kittler, 1997, p.151)

This means users are kept on a controlled level of interaction and the power of producing knowledge has now been taken over by corporations, not only for the reason of gaining that power, but to exploit this power in a commercial sense. I will expand on this view more in a later chapter and return to the chronology of events for now.

Since the 5th generation not much changed visually in terms of interface design: mouse, keyboard and screen are the standard input tools on the hardware side and almost all software packages feature Graphical User Interfaces. Nevertheless, the next step in computer development still instigated another groundbreaking shift in use and usage: The introduction of microprocessors in the early 80's. It transformed the workstation (the networked computer with separated input and output peripherals) into separate independent minicomputers. It didn't look much different, but demarcated the beginning of the personal computer such as the IBM PC in 1981. "Workstations were still more suitable for applications needing data visualization or complex graphics, but PCs were adequate for word processing, databases, and communications" (computer_history_museum).

Figure 1.6. 1981: Commodore VIC 20 [home computer] (Howe)

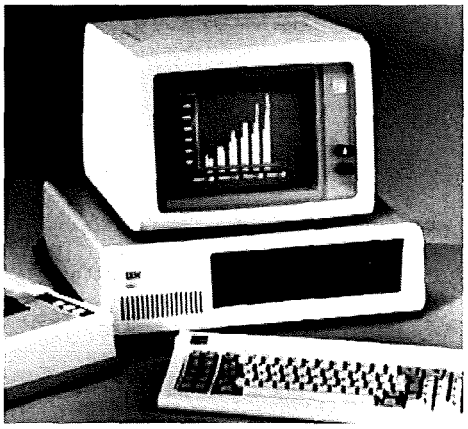

Figure 1.7. IBM PC 1981 [personal computer] (IBM)

The computer might have disconnected from the visible network in the office, but only to start an invisible one: Connecting the offices with private homes and the different age groups. PC's were suitable for simple games as well as running basic software. While the Xerox Star failed to become a commercial success, mainly for cost reasons, computer systems that re-used 'existing infrastructure', e.g. the television set as display and cassette tapes as memory storage (such as the Commodore VIC 20), were much more cost effective and consequently more successful. Until the Apple Macintosh came along.

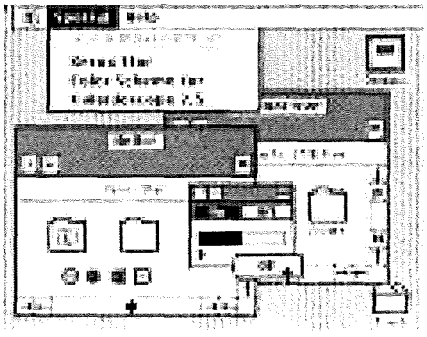

Figure 1.8.Screen shoots Apple Macintosh 1984 (Digibarn.com)

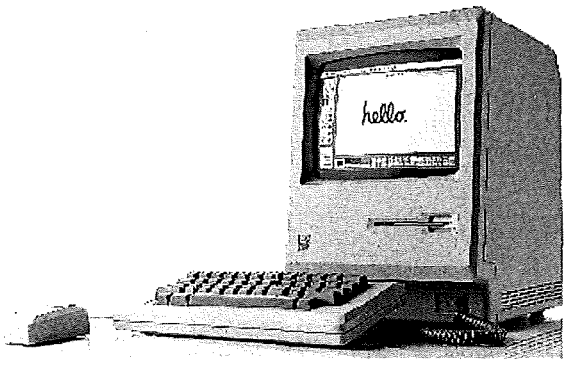

Figure 1.9.Apple Macintosh 1984 (Rubin 2004)

Steve Jobs, chairman of Apple computer, had seen the Xerox Alto and was determined to produce a computer that incorporated all the innovation of the Star 8010, but at a reasonable cost. "The result was the legendary Macintosh, a machine that had enormous influence on our computing technology, design and culture" (Cooper 1995, p.68)

That makes 1984 probably the point in time 'when Pandora's box opened'. The computer moved from the domain of experts to being an industrial strength consumer culture. Indeed, the Macintosh was the first "designer" computer. The case was developed by 'frog design', a product design company that transformed the usual rectangular computing squares into the stylish, off-white cube. It was modelled to a certain degree after the Star 8010, but with some significant differences in terms of display: As for the hardware, the Xerox DT "virtual paper" screen had given way to the to the TV screen, i.e. a screen with landscape orientation; on the software side it featured not only a GUI with multiple windows but also multi-tasking between applications. This combination started to blur the last boundaries of usage and user groups.

> "The Mac single-handedly brought an awareness of design and aesthetics into the industry. It not only raised the standards of userfriendliness, but also enfranchised a whole population of skilled individuals from disparate fields who were previously locked out of computing because of the industry's self-absorption in techno-trivia" (Cooper 1995, p. 69)

Not only did this move the computer into the consumer mass-market, but also into the realm of visual culture. As a product design object it set new standards for the visual appearance of technical equipment in the home and most likely outdid all existing "gadgets" like the phone or television set at the time. It marked the birth of the notion of user-friendliness in its first generation as the consumer-user literally needed to "buy into the concept of computing": with the buying power scoring the first point in terms of power on the user side. It became a visible statement of the progressive mindset of the owner, inviting them at the same time to engage with computing in much more entertaining way: The Mac started up with a cheerful "bing" sound, and later a striking chord, and an image of a happy smiley face as hello. It came as standard with a little "Mac Suite" of programmes like "Mac Paint" and "MacWrite" plus impressive sound capacities, which also made it the choice for many musicians wanting to work digital. In other words the Mac transformed computing into a multi-media experience, combing text, sound and imagery. This concepts extends into the interface: The MAC GUI presents application access in iconic form, feedback pop-ups were accompanied by a feedback sound effect and the trash can played a little tune (Scrooth) when emptied. (This caused numerous calls by

desperate toddler parents at help desks, as their offspring deleted entire contents of hard disks to play that tune again and again.) The development of a program called "Kid-Pix" an entirely icon / mouse operated drawing application, proved indeed that the user group had extended into age groups below primary school. Finally, a program called "Page-Maker" sold the Apple Macintosh through its intuitive interface to the industry, initially the publishing industry. "PageMaker's metaphor was the pasteboard" (Levy 1994, p.215) and soon publishing professionals detected that "spreadsheets and word processors would work with the same intuitive charm as PageMaker" (p.222).Direct manipulation and the MAC GUI's metaphoric and iconic style extended into its applications and set the standard for intuitive HCI.

The Macintosh operating system featured not only windowed applications, but also multi-tasking between them, i.e. one could run more than one application. This proved to be so successful that "Bill Gates named his hastily cobbled together response to the Macintosh's success 'Windows'". (Cooper 1995, p.71) Yet it took Bill Gates 10 years (Windows 95) to catch up properly with the windows functionality as the MAC pioneered it. His early window versions displayed applications in a window and offered multiple views or tools in several windows, by using a technique called "tiling"." Tiling meant that applications would divide up the available pixels in a uniform, rectilinear tessellation" (ibid), evenly distributing out the available space to the application, 'but at a horrendous loss of pixels', i.e. screen estate. The Mac version on the other hand using overlapping windows extended the screen space and allowed the user to freely shuffle through overlapping windows of various applications, as they followed the metaphor of papers on their desktop. The unconstrained approach to windows in the MAC interface "(...) benefits from an invention introduced by the cinema: the mobility of the frame". (Manovich, 2001, p88).

This phenomenal success of the MAC GUI marks a turning point in interface history; it became THE 'modern GUI, dominating and omnipresent' (Cooper 1995, p.70). It also marks the point of separation of software and hardware interface, as no matter what the underlying technical architecture (IBM compatible, or Mac) or the computerised task was, it was all united in the race to get a share in what seemed the vital success concept of computer interaction. Despite initial intentions, when HCI was formed, to overcome the focus of the early 70's on the [man-machine] interface (Preece et al. 1994, p.7) the arrival and success of the GUI re-established the focus of HCI firmly on the interface.

Publications such as "Human-Computer-Interface Design" (Sutcliffe 1988, p3) as teaching material aimed at computer science students, or "Designing the user interface" aimed

at students and interested industry individuals alike. Ergonomics has taken a back seat, authors "draw on some material from ergonomics" but in general "many ergonomically oriented interface issues (such as workplace design and hardware ergonomics) cannot be covered" (Sutcliffe, 1988, p2). Instead, definitions, methods and explanations of effects of interface design are offered. Some are quite pragmatic like "Interface design became important because pleasant, attractive, easy-to-use software sells well." (Interestingly enough until today many HCI practitioners consider UI design is as user-friendly once the "aesthetics" have been addressed). Some acknowledge the change in user groups and attitudes:" A plausible explanation for this [importance of the interface] is that for the first time computers and their software became mass circulation commodities for ordinary people" (Sutcliffe, 1988, p2). Indeed, as the usage areas of computers extends well beyond the work place and user groups are by now largely "novice users", i.e. users lacking understanding of the technical structural issues of computing, HCI is faced with a multitude of users attitudes, all much different from the functional stance expected by computer literate experts in the past.

In fact, the user journey for this new user group often resembles an emotional roller-coaster: The personal and individual connections users create with their computer via an exiting multi-media experience are often closely followed by frustration when the user hits the limitations of the GUI. Users feel deceived when computing turns out not to be as easy as it disguises itself to be to begin with, afraid when the computer reacts unexpectedly, out of control when automated functions take over to "simplify matters", patronised when GUI designers confuse simplicity with instructions for let's say the "less able", or plain frustrated when they can't go about a task as they would like too. This is no news to practitioners and many introductions to relevant publications start with something like: "Frustration and anxiety are part of daily life for many users of computerized information systems." (Shneiderman, 1992, p.III) or "People have realised and complained for a long time that computer systems are difficult to use, obtuse and jargon ridden"' (Sutcliffe, 1988, p3) and years later in 1994 Jenny Preece still states "HCI is a rich challenge" (p.8).

Due to the enormous success of the GUI, HCI design stepped up in terms of complexity. In fact, I would argue it not only overturned the initial aim of overcoming the focus on the interface, but also re-established the leading role of engineering and scientific method:

> "Interfaces have to be specified so that their behaviour can be predicted and described in an exact manner. To do so requires precise methods of specification, many of which have been borrowed from software engineering. As the human-computer-interface will comprise a significant amount of the overall software in a system, it is natural that the computer scientist should wish to apply rigorous standards to it" (Sutcliffe 1988, p5).

This was written in 1988, and Sutcliffe is still used in contemporary UK teaching guides (see p.43, Cooper & Murrey 1998). This might be the reason the why this outlook made it into the 21 century, but also it is applied to the latest information technology: the Internet.

Interfaces and interaction on the Internet

Similar to computer software, the interfaces of Internet sites and applications started out text based, offering limited functionality such as three line email messages and the exchange of research articles. Dissimilar to software, interaction on the internet fulfilled informational needs: sending messages or exchanging articles rather than achieving specific tasks (like writing a letter or running calculations). Another difference consists in the non-linear character of the underlying structure or the platform of interaction. After all, the Internet was deliberately designed as a network, so in case of military emergencies, like an attack on one information node (i.e. computer), crucial information could travel via a different route through the network between multiple alternative information nodes. This significantly affects interaction and the UI of Internet access software, also called 'browsers': text evolved into "hypertext", a term coined by Ted Nelson in 1963 (Nelson in Wardrip-Fruin & Montfort, 2003, p.144).

Nelson's vision of Hypertext was fundamentally more complex then its first implementation in browser software, he envisioned it as part of a "file structure for the complex, that changing and the indeterminate" (p.134ff). Users were supposed to enter, edit, list and connect links freely to suit the multifaceted needs of writers and scientist alike (ibid). Nevertheless Hypertext in the implementation of Tim Berners-Lee's first web browser stood for a major innovaton compared to analogue and linear versions of text, as information could now be experienced and presented in a non-linear way with the use of "hyper links" (underlined "active" text lines link to related information). The interface of "WorldWideWeb", the first browser mimicked the non-linear structure and offered users the chance to create their very own "view" of the Internet with options like "mark link", "save link" etc, and to restructure it ("link to new", "unlink"), and finally participate ("create new link") (Berners-Lee 1993).

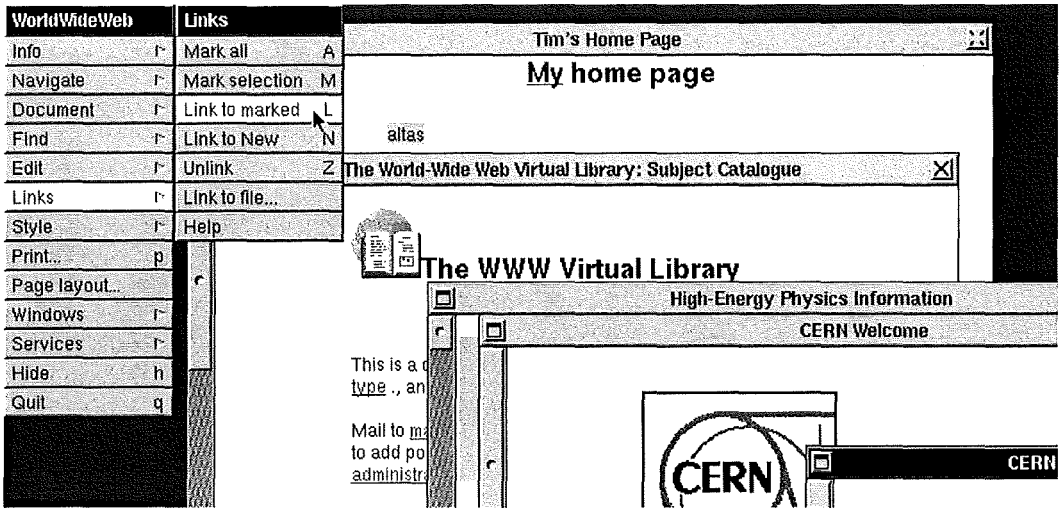

Figure 1.10. World-wide-web, by Tim Berners-Lee (w3.org)

In other words the first Internet access software was an interactive editor, not a read-only browser. Starting from 1991 the Internet was opened up to commercial use in several stages. This not only marked a turning point in terms of the development of the internet, but also of its use: the internet changed from an academic text based communication tool into a platform for commercial representation. While the publishing industry conquered the new medium, it not only experienced a facelift to shape up as the top multi media medium it is now; such as image integration, animation, extensions via plug-ins like Flash, QuickTime and so forth, it also firmly positioned involved interfaces in the realm of consumer culture and visual consumption. The reason being, the media producing industry at the time could only perceive the new channel through - what McLuhan calls the "rear-mirror-view" – the metaphor of print: a clear separation between author and audience, reducing the initially mutually interactive internet-experience including hypertext creation to the reactive one of passive spectators. Web browsing became 'read-only', reducing interactivity to mere 'inter-reactivity'[7] and the user experience to Cubitt's 'passive read'. Nowadays this shift of the Internet from an interactive communication channel to a medium of visual consumption could be referred to as "Web 1.0" (O'Reilly 2005). "'Netscape', the browser developed to suit this purpose "framed 'the web as platform' in terms of the old software paradigm" from desktop to web-top so to say (ibid). Netscape was supposed to control web-content and applications by standardisation, and consequently via scheduled releases and licensing agreements. As for interaction, Netscape had lost the option for users to participate in shaping the content of Internet, but offered improved graphics integration and basic animation to facilitate the already mentioned facelift.

[7] inter-reactivity is a term I coined and I use to refer to interactivity in circumstances where action has been displaced by reaction.

Bolter and Grusin investigate these internet developments in their work *Remediation.* Internet interfaces flip between "transparent interfaces of immediacy such as realistic reproductions of the scenery or objects and "opaque interfaces" represented by hypermediacy: the re-working of earlier media forms, and layering of multiple media interfaces with metaphors of other media. The interplay between immediacy and hypermedia leads to the erasure of the appropriated media and to their own brand of immediacy. (Bolter & Grusin1999, p.9) The space for remediation coincides with Manovich's 'cultural content', the context of its presentation in the shape of a browser on the other hand divides "the computer screen into a set of controls" (2001, p.95). Now internet interfaces become a battlefield for a number of incompatible definitions: "Depth and surface, opaqueness and transparency, image as illusionary space and image as an instrument for action" (p.96). As a result

> cultural interfaces walk an un-easy path between the richness of control provided in the general purpose HCI and an 'immersive' experience of traditional cultural objects such as kiosks and movies (p.95)

Both, Bolter and Grusin and Manovich, thus point towards interaction between media in a way that involved struggles and clashes. The former with a focus on the tension between appropriated media and of the new medium producing its own interface immediacy, the latter pointing out the struggles between the different qualities of image interfaces.

The perceived quality of the internet as web-top publishing tool identified "three key aspects of web site design: information architecture, technical design and graphic design" (Rosenfeld & Morville 1998, p.7). HCI did not pay much attention to the internet until about 1998 and the arrival of IE 4.0 or Netscape 4.0. Until then, due to the static nature of internet information, a discipline called information architecture was in charge to create "organisational and navigational schemes that allow users through site content efficiently and effectively (Garrett 2003, p.94). This means the originally intended non-linear reading and writing practice Ted Nelson had in mind was harnessed further by another layer of control. IA acknowledges that hypertext can bypass hierarchies; consequently, it is displayed as a potentially confusing and therefore ineffective way to go about information retrieval (Rosenfeld & Morville 1998, p.53). Backgrounds in information science and librarianship are best suited to information architecture (IA) design (Rosenfeld & Morville 1998, p.17), hence the new discipline took easily to the scientific character of usability, and usability engineering, and joined the larger umbrella of HCI practice. Information architecture thinks of itself as a design discipline, which considers the user, but focuses on informational content. Usability was redefined as 'findability' (p.8), the goals

of internet uses are browsing and searching; usability testing was up to usability engineers and the aesthetics to the graphic designers. So, only a few years into the commercial use of the internet the division of labour was re-established in the design and production process of the latest technology at the time.

While their backgrounds differed, IA and usability engineering methods and outlook aligned easily when browser 4.0 versions came along incorporating basic dynamic features such as database queries and web access software. Such Internet interfaced applications comprised e-commerce and online booking systems, and service products like insurance and mortgages. With the new orientation towards software in the shape of web-ware, usability and usability engineering moved in the sphere of web-site and web-ware design. In the context of the internet software had become informational and shared the space with cultural content as well as being surrounded by browser controls. Naturally, this new context for HCI had repercussions on the user interaction. Nevertheless in 2000 Jacob Nielsen, one of the best selling HCI practitioners proclaims in the introduction to his book *designing web usability*:

> **Art versus Engineering**
> There are essentially two basic approaches to design: the artistic ideal of expressing yourself and the engineering ideal of solving a problem [...]. This book is firmly on the side of engineering [...]. I believe the main goal of most web projects should be to make it easy to perform useful tasks. [...] You will find many rules, principles, guidelines and methods in this book. (p.11) Many of these results have withstood the test of time. When methodologies and results from the mid-80s continue to be useful in the late 1990s, there is every reason to believe they will continue to hold into the 21st century. (2000, p.12, emphasis in original)

Despite Nielsen's optimism about the universal character and utility of usability testing and engineering methods, the unfolding events over the next few years proved him to be mistaken. The combined approach IA and usability engineering to the added complexities of the new dynamic functionality transformed the processes of transactional or web-access software into a serialised, predicted and fixed order of steps. In the name of efficiency, linear and preset paths organised internet interaction in information hierarchies and informational software. The unreflected upon transfer of offline interaction and interface design concepts and methods ignored another crucial aspect of online interaction: The architecture of internet information enables instant real-time tracking of user journeys by way of server logs, page hits and server load measuring; i.e. for the first time in HCI history user journeys can be followed WHILE the user is undertaking a task IN REAL –TIME, as opposed to observing them in lab conditions. This seems to take the possibilities of user surveillances to new levels, but with an unexpected twist. Uncom-

pleted online-purchases or configuration processes and data fragments are logged in the same way as successful completed ones, creating a record of resistance and attempts to go about tasks in unexpected ways. User tracking thus in turn challenges HCI's claim to be able to predict user reactions using "scientific methods" and to guarantee success to employing businesses. The power mechanism had flipped with HCI on the receiving end and under pressure to re-act. The electronic user has escaped the radar of HCI by leaving predicted paths and reacting differently then anticipated – the lack of expected inter-reaction almost grinds the Internet as a business channel to a halt. In reaction to the dot-com tumble in 2001 Tim O'Reilly postulates the emergence of the web 2.0 movement:

> "Shakeouts typically mark the point at which an ascendant technology is ready to take its place at centre stage. The pretenders are given the bum's rush, the real success stories show their strength, and there begins to be an understanding of what separates one from the other" (O'Reilly 2005).

O'Reilly states that the 'web 2.0' movement contrasts 'web 1.0' applications like 'Britannia online' with 'Wikipedia', 'mp3.com' with 'Napster', and describes 'Netscape' as the standard bearer for Web 1.0, while 'Google' is the standard bearer for Web 2.0 (ibid). In short the concept of web-top publishing is receding in favour of user participation. O'Reilly illustrates that the development of "architecture of participation" such as Napster (or more recently last.fm) and Ebay form the future requirements for interaction design and shift ownership of data back to the user. In terms of the user experience and internet interaction design several aspects seem noteworthy: "Web 2.0 is an attitude, not a technology", it asks the wider web production community to "trust your users" and aims for "rich user experiences" and increased user participation. (O'Reilly 2005). As for web solutions, loosely joined [web] components should replace simplified entities such as websites or web-ware. These solutions represent "perpetual betas", incomplete at launch and to be completed through an 'open source politic', thus combining the needs of future online applications: space for user participation during development *and* use, combined with an understanding of temporaryness of product life cycles and their iterations.

While it is still debated if Web 2.0 really reforms the internet to become a grass-root phenomenon again, or if O'Reilly merely runs a brand exercise to cash in on a long-overdue technical update of dynamic web technologies (Goriunova 2007), it is clear that the concept of the user experience has become an integral part of online interaction discussions which is highly intertwined with design approaches and methods. The concept is so significant to businesses, that a small publication by J.J. Garrett (2003) entitled *elements of the user experience* has become an unexpected and considerable success (Garrett 2000)

with 5 star rating from readers and experts alike (Fischer 2002; Miller 2002; Amazon UK). Garrett seems to address the need for methodologies to support the new design goals and the lack of new methodologies, yet essentially it boils down to pointing out the duality of the Internet as an information medium and platform for software applications, and addressing a set of methodologies to each purpose.

> The Web was originally conceived as a hypertextual information space; but the development of increasingly sophisticated [...] technologies has fostered its use as a remote software interface. This dual nature has led to much confusion, as user experience practitioners have attempted to adapt their terminology to cases beyond the scope of its original application.
> The goal of this document is to define some of these terms within their appropriate contexts, and to clarify the underlying relationships among these various elements (Garrett 2000)

The solution, to point out the several layers of the planning process and to re-address existing methods accordingly, feeds suspicion that Web 2.0 might be just a technology update and the shift to user experience a name change that goes with this shift.

Web as software interface Web as hypertext system

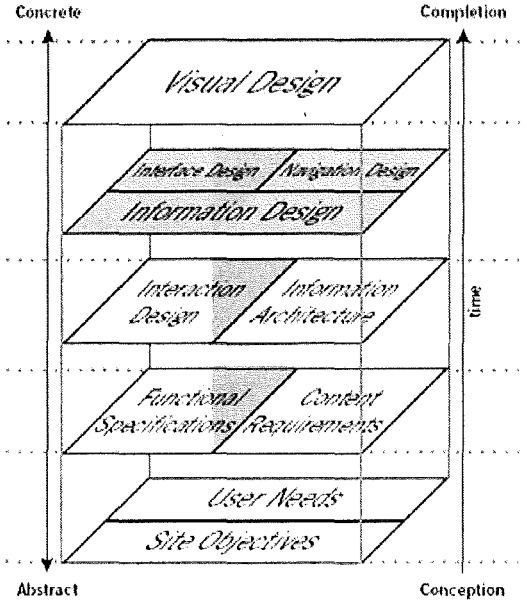

Figure 1.11.The elements of user experience (Garrett 2003, p. 33)

Indeed Garrett's view still conforms with techno-reductionism; fictitious users (Garrett 2003, p.55) and that the user experience is a predictable commodity: user centred design is the design approach that will create engaging and efficient user experiences (p.19) and the way to measure the effectiveness of a user experience is its conversion rate[8] (p.15).

[8] for example if 3 of 32 detected visitors end up taking out a subscription, the conversion rate is 3%.

The next section looks further into this clash between the traditional approach of HCI disciplines' and the complexities of new media and internet interaction. Not only are the methods as such at stake or their adaptation. User behaviour on the internet is radically different from desktop software interaction as the internet as a platform on the one hand constrains web-access software (Ajax technology added direct manipulation only recently to web UIs, e.g. in iGoogle), on the other hand the informational character of the internet infiltrated software and software interaction. The boundaries between entertainment, browsing, and goal orientated task achievement increasingly blur into insignificance.

HCI, a fragmented discipline

Traditionally established HCI concepts, methods and processes subscribe to 'techno-rationality'[9] which collide with the supposedly experimental/observational or empirical aspects of this practice. This tension becomes most obvious when it comes to 'user-centred design' (UCD). Several dominating concepts of the discipline become apparent: firstly an 'expert culture' that displaces empirically gathered knowledge with expert (de-sign) knowledge. Secondly 'predictability', in reference to scientific methods, and thirdly a functional view of the user through system parameters. UCD is supposed to remedy the situation, and enable user experiences that are more engaging. No agreement about those methods has yet been reached. As a result, HCI literature (including the literature used in teaching) presents a fragmented view when it comes to user experience design.

A small caveat before I start: The literature I critique in this section consists mainly of reference material recommended by the current Greater London University teaching guide CIS315. To my dismay, I found that this guide was published a decade ago (1998), and has not since been updated except to the extent of referring the reader to more recent editions of the main reference book which is Dix *et al.* 2004. Therefore in my own teaching, I used a more up-to-date version from the B-list of the teaching guide, i.e. *Interaction Design, beyond human-computer interaction* by Jenny Preece *et al.* (2002). This situation might not be specific to London though, as McCarthy and Wright observe that reductive thought and rationalism still prevail in academic and pedagogical practices around technology and computers (2004, p.25). So while much work has now been done in this area, it is still important to point out that reductive tendencies are deeply embedded in HCI research, design, evaluation and testing methods and methodologies.

[9] a conglomeration of technological and instrumental views, coined by Coyne

Theoretically, HCI is a multidisciplinary practice and it should, therefore, be possible to draw from a large pool of methodologies. Even though it is often reiterated in HCI, Booth is probably the most realistic when he states that ergonomics and cognitive psychology are "equally well established", yet HCI and software engineering are not as integrated as one might expect. "While software engineering may not be totally neglected within HCI, and although software engineering might continue to thrive independently of *human-computer-interaction*, the two areas are certainly not as integrated as many researchers believe it would be most profitable" (Booth, 1995, p.16). He continues in his assessment of the interdisciplinary nature of HCI: "Social psychology and sociology have been classed as the *neglected disciplines* as they are not given the representation and coverage they deserve within the literature, given the importance of the problems they might address. This may be because most studies of HCI have tended to concentrate upon one user and one system" (ibid). McCarthy and Wright (2004) confirm that the ethnographic turn, a set of research methods that derive from anthropology which favours field work over the laboratory, greatly challenges traditional HCI thought of the 70s and 80s (p.7). The ethnographic stance rejects the idea of the neutral observer in support of an engaged, situated, relational and plural interpretation of cultural practices (pp.36/7). This is precisely the crux though, as Button (2000) argues that the ethnographic account is always secondary and mediated by the (professional) researcher, and can never be from within (in McCarthy and Wright, p.39); a discussion reminiscent of 1st and 2nd wave cybernetics, a correspondence I explore in more detail later.

Traditional HCI methods are still reminiscent of 1st wave cybernetic thought in terms of tracking and prediction, and its alignment with an objective scientific stance in the form of quantifiable statements. Usability engineering was defined by Tyldesley (1988) as 'a process whereby the usability of a product is specified quantitatively, and in advance' (Preece 1994). The term was promoted by Jacob Nielsen, probably one of the best-known usability gurus in America.[10] Usability testing then demonstrates, as the product is being built, that it does or does not reach the required levels of usability (in Preece 1994). Usability engineering has been well received by a number of companies because its semi-scientific and engineering nature provide a systematic procedure for testing the usability of a product during development (Preece 1994, p.650). This has repercussions for design and production processes as well as the attitude towards the user. Usability processes are

[10] Incidentally, in America HCI is actually called CHI (computer human interaction), which, in my opinion, reflects its emphasis more accurately. Nielsen positions himself in CHI and remarks that the use of the acronym HCI "is preferred by some who like 'putting the human first' even if only done symbolically" (Nielsen 1996, p.23).

analytic; they assume that the behaviour of users is predictable to the degree that users can be replaced by usability or HCI experts in every phase of the product cycle, as we will see.

The research phase of HCI projects usually breaks down into a number of analytic steps such as target group analysis, requirements analysis, as well as user tasks, needs and environment analysis. If actual users are involved, they would state their requirements, describe their tasks and needs, and give an account of their environment as they see it, and so forth. A quantitatively oriented stance is assumed for the researcher: "Requirements gathering [...] must focus explicitly on the usability of systems" and "should be captured such that they can readily be translated into meaningful quantitative statements" (Kuljis 1999, p.23). The expert driven process follows the same steps, however HCI experts replace users, develop a requirements list, and so forth, based on best practice guidelines while *considering* users. The design phase then refers to modelling the results: There is tasks modelling, about which Smiths comments that Tayloristic task analysis is still an essential part of the design process, which is "the process of breaking down a user task into elemental actions" (1997, p.336). Journey design comprises use case modelling. "Writing use cases is a means of capturing the behavioural requirements of software systems and business processes" (Cockburn 2000). This practice derives from the object-oriented programming community in the late 80s and "describes the system's behaviour under various conditions as the system responds to a request from a stake holder, called the primary actor" (ibid). *The primary actor* is the user as the analyst imagines him to be, with goals defined, again, by the functional analyst considering the task analysis. Finally, prototype design and simulations demonstrate aspects of interface and systems functionality. Rapid prototyping again, is actually an expert evaluation technique where experts review early prototypes (Preece 1994, p.540), which supposedly speeds up the early phases of design

The replacement of users is convenient as it saves time and money. For example, Nielsen admits that he has no universal blueprint when it comes to the collection of target group characteristics. Collecting these facts means recruiting a steering group which is a time consuming task and information gathered by marketing or sales departments is well guarded by organisations. Consequently, "it is amazing how much time is wasted [...] by arguing over what the user might like or might want to do" (Nielsen, 1996, p.47) so that researchers often resort to making assumptions due to lack of concrete user involvement. System documentation, however, is easily available, and therefore for practical reasons (ibid) their [expert] analysis yields a large part of the knowledge used in the design proc-

ess. Coyne identifies this lack of interest in user participation as yet another manifestation of the rationalistic stance as "'[affirming] a non-participative, hierarchical view of knowledge [...] (1995, p.28) and considers this design approach to be "rationalistic insofar as it assumes the objective status of problem statements and to the extent that it assumes that understandings can be readily articulated as formulas, process diagrams, charts tables and lists – that there is a privileged relationship between these 'representations of knowledge' and thought" (Craft in Coyne 1995, p.22). He adds the "rationalistic tradition is evident in certain empirical approaches to the evaluation and design of computer systems" (ibid), which is precisely the next step in the HCI process. Usability testing involves iterative evaluations of early and late prototypes, as well as evaluation during production and implementation via usability and user acceptance testing. The systemic nature of the design process extends into the evaluation phase: the focus of usability testing is still firmly centred on setting users tasks and measuring their efficiency, predictability, and goal achievement. These methodologies are recycled "mainly from cognitive sciences" with a quantitative focus, such as "performance measures, observation, structured questionnaires, experiments, structured interviews, ranking grids, logging use," and to a lesser degree from qualitative methods such as "focus groups and user feedback" (Nielsen, 1993, p.224).

The two predominant testing methods are interpretative and predictive evaluation. Similar to the design process, interpretive evaluation comprises analytic observation, experimentation methods, and using actual or potential users to test applications. Interpretative evaluation can be done in the workplace, but more commonly takes place in laboratories, where "subjects generally undertake tasks in a controlled environment" and "recordings can be made of the subjects behaviour using video and keystroke logging equipment" (Preece 1994, p.610). Preece states "as well designed laboratory experiments are not easy" and "controlling all the variables in complex human interaction behaviour can be difficult [...] HCI has developed an engineering approach to testing: [...]. The experimental set-up and procedure roughly follows the scientific paradigm [...] in semi-scientific conditions". Human supervisors monitor tests as well as software applications; the latter are particularly suited to quantitative tests, such as structured interviews and questionnaires, while system use is logged in the background, unnoticed by the user. "Logging the users actual use of the systems is particularly useful because it shows how users perform their actual work and because it is easy to automatically collect data from large number of users working under different circumstances" (Nielsen, 1996, p.217). The debates be-

tween human and software observation, and between direct and indirect observation, point towards a preference for indirect observation, as "for various physiological and psychological reasons the eye produces a poor visual image, which the brain has to interpret" (Gregory, 1966, in Preece, 1994, p.616), also "direct observation can be obtrusive because users may be constantly aware of their performance and [of] being monitored, which can alter behaviour and performance", also know as the Hawthorne effect[11]. "Empirical studies as described here and a dependence on them are rationalistic insofar as the studies assume the validity of reducing complex human behaviours to measurement [...] and the detachment of the experimenter's values from the experimental situation" (Coyne, 1995, p.23). Just as the role of the observer is more complex in the equation, so is the role of the observed 'subject'.

Predictive evaluation, also called expert evaluation, is based on educated guesses about anticipated user behaviour. This evaluation is sometimes called 'structured expert viewing' and was developed by Molic and Nielsen in 1990 to accommodate the need for cost-effective techniques for usability testing, where expensive test laboratories were not an option. Two methods are available: heuristic evaluation and cognitive walkthroughs. "Heuristic evaluation involves having a small set of evaluators examine the interface and judge its compliance with recognized usability principles (the 'heuristics')" (Nielsen, 1996, p.155). The number of guidelines varies. Those Nielsen suggests offer between 162 (Marshall at al., 1987) and 944 (Smith and Moiser, 1986) options (in Nielsen, 1996, p.93). The methodology of the cognitive walkthrough derives from software engineering.

> "As in software engineering, the goal of a walkthrough in HCI Design is to detect problems very early on so that they may be removed. [...] [Experts] then walk through the task, reviewing the actions that are necessary to achieve the task, and attempt to predict how the user population would most likely (**WORDS MISSING**) the problems that they would encounter." (Preece, 1994, p679)

The expert position of the usability engineer is emphasised by the usability-testing methods Nielsen (1996) included paragraphs in his book, 'Usability Engineering', entitled "The user is not always right" and "Users are not designers" (1996, pp.11-13). In these sections the views of users are trivialised with reference to preferences about the visual execution ("users may not always make the most appropriate design decisions" and "Us-

[11] Individual users may be directly observed doing specially devised tasks or doing their work, with the observer making notes about interesting behaviour or recording their performance in some way, such as by timing sequences of actions. Direct observation is often an obtrusive method because users may be constantly aware of their performance being monitored, which can alter their behaviour and performance levels. This phenomenon is known as the **Hawthorne effect**, after a 1939 study of workers in the Hawthorne, Illinois, plant of the Western company. (Preece, 1994, p617)

ers often do not know what is good for them") or predictions of the unknown ("users had a very hard time predicting how they will interact with potential future systems with which they have no experience"). Nielsen is making an important point here about the value of predictions in its current use in the usability-engineering process, which will be discussed later in my chapter on a revisited notion of 'intuitive design'. Unfortunately he draws the wrong conclusions, at least in my opinion. In short, HCI experts have a tendency to interpret user reactions along best practice guidelines or they undertake the whole testing process without user involvement and impersonate the user, based on their expertise, something which identifies both evaluation streams as focused on experts.

Finally, there is the Newtonian view of time in the interaction process. User performance is measured and predicted not only in terms of task performance, but also in terms of time. The keystroke logging model (KLM) claims that "quantitative prediction[s] can be made as to how long tasks will take using different systems and methods" (i.e. the time between reading the instructions and reacting by pressing the correct key on the keyboard or the menu on screen). "[KLM] aims to predict user performance for unit tasks within interactions, typically tasks taking 20 seconds or less using [the] keyboard and mouse" (Cooper and Murray, 1998, p.28). As a rule of thumb, the average time taken for user actions ranges from 20-40 seconds, depending on the application. On the Internet, the thought behind the keystroke logging model translates into 'session time outs', particularly for secure applications such as Internet banking. If there is no key activity for a set time, the application terminates and denies further access. In other words, the comprehension of time lies somewhere between Taylorist and Newtonian parameters; time as a commodity is measured in discrete increments; unit allowances are predicted and addressed to tasks and task elements. This view is debated by now, as illustrated later in this section, as users multi-task and act unpredictably. I will expand on the latter point later in this thesis. The action of users is not only unpredictable, but frequently intertwined with exploratory moves and detours. Time pressure stifles these moves, which far from 'wasting time', as actually form early and unconscious forms of learning. An unhurried mode of time on the other hand supports these forms of learning, and therefore, in effect, supports the usability of a solution.

From Usability engineering to user centred design (UCD) and the user experience

The role of usability engineering was to answer the call for a user-centred design model: the application of usability testing results to the interaction design process. A prevailing reductive attitude derived from engineering and cognitive science seems either to view

the user through the systemic lens or to dispense with the user altogether. UCD now seems to expand the concept of usability into the user experience, yet the degree to which this occurs and the methods used vary.

Smith offers the following definition of what UCD means:

> A fully user-centred information systems approach is one where all potential users of the proposed information system have the opportunity to be actively involved [...] in the whole analysis, design and implementation process. Instead of acting as passive [...] providers of requirements [...] users are able to contribute to the development of systems which demonstrate high levels of usability [...]" (Smith, 1997, p81).

Another definition that immediately pulls the focus back to traditional HCI goals reads

> [UCD is] a development approach in which all types of users needs (functional, physical and aspirational) are addressed so that usability (effectiveness, efficiency and satisfaction) is maximised in the end product" (Smith, 1997, p367).

So how can these varying definitions of UCD co-exist? Smith resolves the situation by illustrating the different levels of UCD:

Three levels of user centeredness

Level	Design option	Contributions experts	Contributions users
1	Technical centred	Analyse, design, deliver	Are informed, consulted, trained
2	Joint user-expert	Analyse, design, deliver; co-design	Are present, informed decision makers
3	User centred	Provide technical advice to users	All contribute to design

Figure 1.12.Source: Smith, 1997, p 83

This chart explains how usability can claim to be user centred while at the same time remaining firmly in traditional techno-rational HCI territory: UCD level 1 *considers users*, while viewing them through the systemic lens. As mentioned earlier, this is less a problem of methods and practice as such than a matter of culture. It is increasingly acknowledged that HCI cultivates a certain mindset and it is time to expand on the engineering and scientific culture (Harrison, Tatar & Sengers, 2007). Booth notes, when discussing the change of user groups, that there is a possibility that software designers assume that "a person using a computer system [is] likely to have been immersed in the same conventions and culture as the individual that designed it" (1995, p.3). Shneiderman adds that "computing technology is at a crossroads", 'Renaissance 2.0' should bridge the 'two cultures', Art and Science. "This modern Renaissance would unify thinking about technol-

ogy by promoting multidisciplinary education and sympathy for diversity" (2002, p.2). Cooper dedicates a whole chapter to programming culture – subtitled "An Obsolete Culture" – and the isolation that is part of it: "One strong cultural determinant of software engineering is that it is done alone" (Cooper 1995, p.116). He concludes with a statement, with which I very much agree, that "it is not technology that dehumanises us, [...] it's the technologists, or rather the processes they use, that create dehumanising products" (p.120).

Karin Knorr-Cetina (1999) claims the machine-science equation is not only true for certain scientific disciplines, but for all science. She terms it "epistemic culture": "amalgams of arrangements and mechanisms - bonded through affinity, necessity and historical coincidence - which in a given field, make up how we know what we know. Epistemic cultures are cultures that create and warrant knowledge, and the premier knowledge institution throughout the world is, still, science" (1999, p.2). Her examination exemplifies cultural diversity within sciences as disunited and identifies the problem as present within the entire western knowledge society. She questions the belief in "one kind of knowledge, one science and one scientific method" (1999, p3). Also, further extension of the system in its current form needs to be avoided, as it would emphasise the process rather than create more knowledge; the solution lies in permeating boundaries to enable a complex system of multiple knowledge cultures.

Participatory Design (PD) seems to be the solution that allows these boundaries to be permeated and produce complex knowledge structures: a set of theories, practices and studies and a highly diverse field that brings together UCD, graphic design, software engineering, psychology, anthropology and political science to name a few (Muller 2003). Some refer to PD as the *Scandinavian approach* due to its origin (Bodker, in McCarthy & Wright 2004, p37). There is a connotation to the Scandinavian approach though, as it pays particular attention to the political aspects involved in an organisational context and opposes management-centred traditional (HCI) design (McCarthy & Wright 2004, p.37).

> [PD's] position is intentionally reflexive, explicitly acknowledging observers' engagement in their observations, interpreters' engagement in their interpretations, and theorists' engagement in their theories. (McCarthy & Wright 2004, pp.37/8).

Organisational politics don't usually enter HCI discourse. McCarthy & Wright keep their analysis short and neutral, Christopher Loch is another exception who recommends acknowledging that these politics support innovative and potentially controversial designs in organisations (Loch in Laurel 2003, p.215). Muller (2002) positions PD as the *Third*

Space in HCI, the fertile in-between space: between software producers and users, organisations and their workers, and participants in general.

PD has found its way into the recommended teaching literature. Preece et al. (2002, pp.306-312) cover the topic in a small section including its origin and *one* of the 10+ techniques mentioned in Muller's paper. Dix's et al. (2004) account is similar, yet it omits PD' political background and comments that is has not been widely practised outside Scandinavia (p.467). Both accounts use workshop scenarios to illustrate PD, however the descriptions read in a similar way to UCD level 3 prototype iterations. Particularly in quoting Mumford, Dix et al. set the three levels of UCD as synonymous to levels of participation (p.469). Both accounts fail to expand PD's space beyond the usual user-designer relation in the HCI process into the complex multi-disciplinary field Muller described. Likewise both fail to acknowledge PD's potential to bring out un-articulable knowledge in users by means of actively creating their own prototypes or descriptive artefacts, and do not even mention the playful aspects of games and the dramatisation of interaction scenarios which are conductive to creative improvements by both designers and users (Muller 2002).

Evidence for HCI's fragmentation in (teaching) literature is plentiful, Dix et al.(2004) in particular is a rich source for collecting evidence. For space reasons I will restrict myself to listing a few examples: In the introduction to the third edition they acknowledge the interdisciplinary nature of HCI only to re-iterate in the same sentence that "computer science and system designs [are] a central concern (p.4) of HCI. On the one hand they discuss Williams James[12] theories in a short section on emotions (but end up settling for Don Norman's notion of affect as a intensifier of emotions (p.51), which re-iterates the idea that the mind can be viewed as an information processor (Boehner *et al* 2005)). At the same time, *unbelievably*, the waterfall model is still featured as an appropriate software development methodology (although in its iterative version (Dix et al. 2004, p.228)). Even the current teaching guide (1998) challenges this model due to its linear nature, which usually places usability testing at the end of development in the form of user-acceptance testing. They favour Boehm's spiral model, which is open to participatory design and iterative prototyping, and is therefore UCD orientated (Cooper & Murray 1998, pp.44/5). Similarly in Dix *at al.* reductive, quantitative cognitive models like GOMS and

[12] William James controversially argues that emotions are responses to physical reactions rather preceding physical responses. This argument is puts the body before the mind in interaction, a thought that is particularly challenging to the traditional HCI stance.

KLM are still said to produce "remarkabl[y] accurate predictions" with some cautions that these models might be more suitable to expert users (2004, p.441) while Preece *et al.* clearly state that the scope for these models is very limited, as users multi-task, don't work sequentially and users behaviour is thought to be unpredictable (2002, p.455). This schizophrenic attitude seems common in HCI veterans. Ben Shneiderman[13], argues that *new computing* "is about what users can do [and] successful technologies ... must support relationships and activities that enrich users' experiences (2002, p2). As to how new computing facilitates this he proclaims:

> I'd rather see tools that empower people by making them a thousand times as effective as an un-aided human. A bulldozer makes the driver stronger than the strongest human, a gun makes the hunter 100 times more deadly, and a camera makes the photographer *more precise and more rapid than the best artist"* (2002, p.63, my emphasis).

Similarly Jacob Nielsen made a case for participative design as early as 1994 as "[u]sers often raise questions that the development team has not even dreamed of asking (1996, p.88), elsewhere he states the "First rule of usability [is:] Don't listen to Users (Nielsen 2001), although he continues: "pay attention to what they do" (ibid). As mentioned earlier, Nielsen raises an important point about unarticulable knowledge and the role of prediction in user behaviour; yet to generalise a rule from this against qualitative feedback in favour of expert observation regresses into 1st wave cybernetic thought about tracking and prediction. Traditional HCI's schizophrenia flips between ill-reflected upon progressive interaction concepts such as intuitive user experiences (so reducing them to buzzwords) and the traditional reductive and instrumental attitude instead of opening them up to the dialogues which the new complexities invite. This might have been the reason why Preece et al. abandoned HCI as central interaction design discipline. Instead, they opt to move interaction design to the centre of the stage and increase the scope of contributing disciplines and fields, which forms the first step towards these important dialogues. According to the authors "interaction design [...] is concerned with a broader scope of issues, topics and paradigms than has traditionally been the scope of human-computer interaction (HCI)" (Preece 2002, p.v). This move enables Preece at al. to expand the traditional usability model into an enlarged user experience mode that escapes the various HCI reductionisms (Wiberg 2001).

[13] Ben Shneiderman has been mentioned earlier with regards to his paper on direct manipulation in 1983

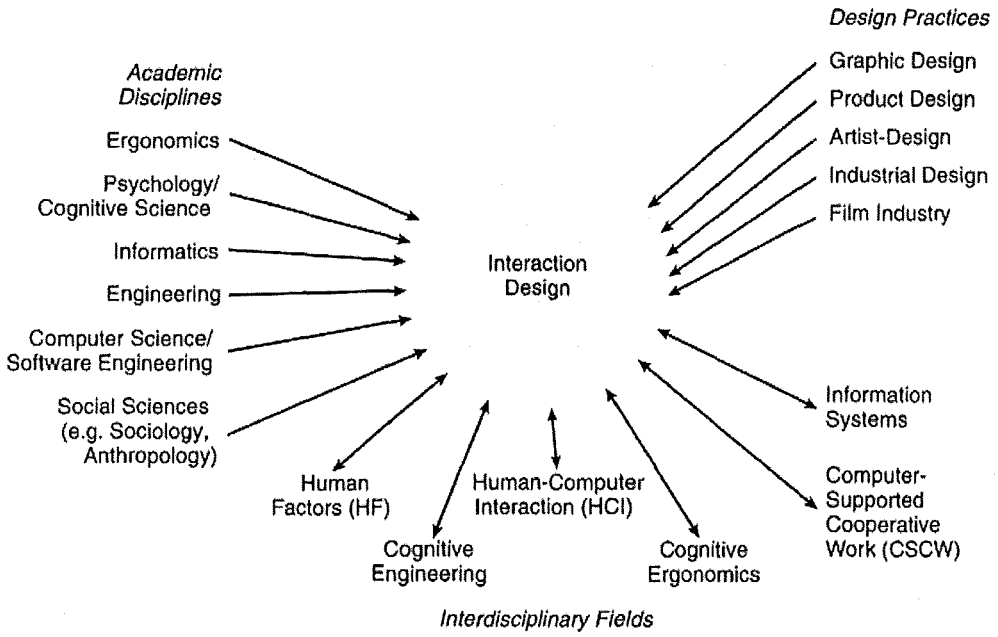

Figure 1.13. Relationship amongst contributing academic disciplines, design practices and interdisciplinary fields concerned with interaction design (Preece et al. 2002, p. 8)

They make a deliberate move not only to include subjective accounts of the intangible aspect of users' experiences, but also hope to leverage knowledge from the entertainment and games industry for an enriched notion of the user experience including exploration and play. This in turn widens the field of interaction design and involves broader audiences or user groups.

The question that remains unanswered is – and I am undecided myself - is it possible to achieve enriched user experiences within an (enlarged) context of HCI or will it be necessary to leave this discipline to its own devices, and move outside its domain to think about future interaction?

Summary:

The history of HCI lies in machine interaction and machine tool evaluation. More recently, machines have become computers or computer systems, controls have become interfaces and operators have become users. The rise of the information age saw the disembodiment and implosion of physical systems and the explosion of their virtual and visual representation in the form of software and interfaces, which shifted man-machine interaction effectively to human-interface interaction.

With the introduction of the Internet, the fragmentation between systems and their interfaces has extended into virtual realms. Information and applications have merged and have become informational digital services. Yet traditional HCI continues to ignore the multiplicity of visible and invisible layers, and their interferences and overlaps, in interface development. Instead, they accept interfaces at 'face value'. The purely functional view of their visual representation focuses on the efficiency of directly mapped or 'true' depiction of controls and tools. 'Empowering the user' is seen as synonymous with supplying the user with controls and buttons. 'Ease of use' derives from physical controls and assumes an intuitive knowledge about their use, as "buttons are for pushing and dials are for turning", 'ease of learning' boils down to step by step instructions, usually presented in a set order. In other words, HCI's understanding of interfaces and their functionality remains instrumental. Now it is interfaces instead of systems that are subject to scientific research and design methodologies; they are tested in terms of efficiency and effectiveness the same way that physical objects and controls used to be tested. The effect is twofold: the focus on the interface as a means of control leaves no space for meaning-making as a process, nor does it allow exploring the space between the UI elements, their connections, or the relationship between them and the users in interaction.

Traditional HCI methodologies derive from scientific methods of cognitive psychology and established functional practices in software engineering. Both sets suffer from a reluctance to adopt qualitative methods and to develop a systemic view of the human involved in the process. Despite alternative methods that have been developed for more then a decade now, such as situated and embodied approaches to interaction or participatory design, traditional ways of thinking still prevail. One reason might be that current a-list teaching literature still presents the traditional models and methods, while alternative literature (b-list) with a more comprehensive approach, at best represents the fragmentation of HCI practice. This fragmentation is apparent between the first and second wave of HCI, i.e. engineering and cognitive science, and even more so between the second and third wave, which are the alternative approaches mentioned earlier. HCI's interdisciplinary disposition (and struggles) remains a challenge for this practice and future interaction design.

Chapter 2: Multi-disciplinary reflections on the interface

This chapter opens up issues relating the space between interfaces and the underlying media, and gives a richer account of their interplay and of the strategies of the in-between layers. It benefits from the thought of cross-disciplinary positions, considers media and interface theory as well as seeking inspiration though contemporary philosophy to give a range of different viewpoints. The section *Tool vs. Medium* reveals how HCI's functional/rational design perspective shapes discursive interfaces as tools to control interaction. At the same time it illustrates a longstanding critique of this rationalistic stance through pragmatist thought. The section *Medium and interactivity* adds more layers to the discussion, in the form of the medium. Famously foregrounded by McLuhan in the formulation *the medium is the message* this looks at how media shape content, but also reveals a systematic displacement of the medium through simulation and/or digitisation. This development is not simply a historical issue of the new replacing the old, but of strategies at play. *Strategies of the Interface* focuses on investigating the recognising strategies in question, in particular Bolter and Grusin's immediacy and hypermediacy. *HCI and internet interaction* looks at how interfaces that simply represent underlying systems create an objective space of interaction on the internet, in contrast to subjective ones. Though supposedly suppressing users' movements, the objective space can track and therefore visualise those movements, thus combining objective and subjective spaces to HCI and by doing so undermine power relations. Viewing these relations through Foucault's work as well as through Deleuze's reading of Foucault on the subject on power relations reveals them as not solely oppressive mechanism, but also as productive.

The interface beyond HCI

The space between systems and their representations in interfaces is brimming with layers of technology, mediation and organisational structures, yet HCI's reductive stance results in a literal translation of control into control tools and flattens this space into the surface level. Software interfaces and their design are viewed as a process of creating tools for system control. Critical voices against this view have been raised for the last 40 years by media theorists and computer scientists alike. Computer scientist who have attempted to view their practice critically through philosophy include Weizenbaum, Winograd and Flores, and Coyne (1995); and, in terms of media theory, McLuhan (1994), Kittler (1997), Manovich (2001), Bolter and Grusin (1999). Of these, Weizenbaum , Winograd and Flores share a background in artificial intelligence (AI) research, Coyne's context is IT design. Besides revealing and critiquing the rationalism underlying the use of

HCI methods, they point towards hidden power structures in the scientific design process. To employ philosophy to review IT critically, is an understandable move according to Kittler's (1997), as the notion of technical materialism has long displaced philosophy anyway. Weizenbaum, writing in the early 70s, was inspired by Dewey's pragmatism, as was McLuhan (1994). Coyne cites both of their theories, in addition to critical theory, as postulated by the Frankfurt school. Media theory opens up additional layers of interaction besides HCI: McLuhan (1994) investigates interactivity between media and its effects on user participation; Bolter and Grusin (1999) take this investigation into the realm of digital media and the Internet, and Manovich (2001) a media practitioner, artist and a theorist, views new media interfaces through a cinematographic lens.

Tool vs. medium

As described earlier, the HCI discipline draws research methodologies from cognitive science, and design methods from software design and suffers from what might be called a 'rationalistic double whammy'. System design assumes that the interface falls naturally in line once the system has been designed, and HCI applies this assumption to interface design, which is why HCI sometimes synonymously denotes *Human-Computer Interaction* and *Human-Computer Interface*. Consequently, interaction is seen as a process that is "instantiated at the interface [...] which will translate both directions of inputs and outputs" (Cooper & Murray, 1998. p.32). Effectiveness is achieved if the interlocking is successful, that is, if an action triggers the reaction predicted. Communication is the successful sequential exchange of instructions in various forms, such as "issuing instructions [...] or action-based communications such as Direct object manipulation [of] virtual objects" (Cooper & Murray 1998, p.33). The interface, in this context, acts as an exchange facilitator, and ideally constituting a *direct mapping* of the underlying system. Don Norman, part of the Norman Nielsen usability group, explains

> mapping, [as the] meaning of the relationship between two things, in this case between the controls and their movements and the results in the world. [...] Natural mapping, by which I mean taking advantage of physical analogies and cultural standards, leads to immediate understanding. (1998, p.23)

Norman also appropriated and popularised Gibson's concept of affordances in the context of HCI. As a design principle it is entwined with the usability criteria 'visibility' as

> affordance provide strong clues to the operation of things. Knobs are for turning; slots are for inserting things into. [...] When affordances are taken advantage of, the user knows what to do just by looking. (1998 p.9)

Hence the two major principles of design for understanding and usability are: "1) provide a good mental model and 2) make things visible" (Norman, 1998, p.13). As a conse-

quence, "a good system interface [that] must be usable" (Cooper and Murray 1998, p.39) rather then the machine/system itself. Sutcliffe notes that "Interfaces have to be specified so that their behaviour can be predicted and described in an exact manner; to do so requires precise methods of specification" (1988, p.5). This underlying belief that scientific methods will produce the best solutions has made its way into the interface. It is seen as an objective representation of underlying systems, a means of giving users control in a way that is similar to levers and knobs in physical systems.

Joseph Weizenbaum provided a more reflective discussion about tools and their extension to computer technology as early as 1976 in his book 'Computer Power and Human Reason' (republished 1984). Questioning the idea of a neutral tool as a facilitator, he notes that the tool's physical presence stands for a new approach, and also points out the repercussions of tool use on the user as well as on the environment: "A tool is also a model for its own reproduction and a script for the re-enactment of the skill it symbolises" (Weizenbaum 1984, p.xx). The effect is twofold. Firstly, the tool acts as the embodiment of a technique or process which preserves it in time, rendering it as a means for reproduction and instruction. This view develops the idea that the tool is not a simple utensil but is the manifestation of an externalised thought and technique. If technique is the 'method of doing something expertly' (Oxford dictionary 1995), then the tool is a representation of best practice and gains a value beyond its mechanical value. "

> The tool as symbol [...] thus transcends its role as a practical means toward certain ends: it is a constituent of man's symbolic recreation of this world. In turn, the tool as physical object begins to act as a symbol – with repercussions for the social status of the tool owner or user as an expert or craftsman. In that sense, the tool is more then a mere device: it is an agent for change" (p.18).

Once a tool has gained a physical presence, it has effects and repercussions: It affects the user's perception as well as their relationship to their surroundings.

> It is readily understandable that hand-held tools and especially hand-held weapons have direct effects on the imaginations of individuals that use them. [...] Their experience of their world changed and so must have their idea of their place in it. (Weizenbaum 1984, p.19).

Twenty years on, Coyne's (1995) critique of the rationalism in technical production indicates that Weizenbaum's points are still valid at the level of Information technology design. He confirms Weizenbaum's observation that in the design of modern tools, in the form of IT technologies, rationalistic orientation still "affirms that means (such as technologies) are subservient to ends (such as human needs). [...] As the rational orientation suggests that technologies (means) arise and are developed in order to address needs

(ends)" (1995, p.29). Weizenbaum's remark that the "rejection of direct experience was to become one of the principal characteristics of modern science" (1984, p.25) is echoed in Coyne's deconstruction of rationalist assumptions, such as the superiority of theory over practice. He concludes that certainty is fragile in the world of theory as "practice does not follow from theory, or even technologies develop from science." (1995, p.30) Both authors critique the decontextualised treatment of interaction in technology on that grounds that "rationalism promotes the independence of reason from the material world of bodies and machines. [...] Reasoning can be considered to exist in the abstract, independently of a medium", which results in communication being "largely a matter of passing information from one subject to another through the medium of the external world, assuming the immutability of subject and object", (1995, pp.18-19) a view in line with the mathematical definition of communication, as postulated by Shannon in the late 40's. Weizenbaum notes the implications for the practitioners by this definition, as

> "it must be acknowledged that it urges man to strive to become a disembodied intelligence, to himself become an instrument, a machine. So far has man's initially so innocent liaison with prostheses and pointer readings brought him" (1984, p26).

It is apparent to Weizenbaum that this internalisation has a ripple effect: "The mechanisation of reason and of language has consequences far beyond any envisaged by problem solvers we have cited" (1984, p.252). As an AI researcher, he investigates formal and natural languages 'as games', that is, as rule-based systems, through the view of mathematical game theory, and the resulting 'conversations' with humans. Manovich, who also has experience with game production, delineates this space as one of "open interactivity" (2001, p.59), where "both the elements and the structure of the whole object are either modified or generated on the fly in response to user's interaction with a program" (p.50). Weizenbaum is not satisfied with the mechanical multiple-choice option that is considered as interactivity. The interplay between language rules and 'tool design' still results in "computer systems that permit the asking of certain questions, that accepts only certain [input] 'data'" (1984, p.36). He has a clear idea that power mechanisms are at work and control is exercised to produce the 'sayable and the non-sayable', to use a Foucaultian phrase, and concludes: "In order to understand how the computer attained so very much power, both as an actor and a force on the human imagination we must first discuss where the power of the computer comes from [...]" (Weizenbaum 1984, p252).

His investigation hints at McLuhan as a source of inspiration, particularly when he moves on from the effects of the 'grammar of print' in individual human-computer conversation

to the effects on society in terms of infrastructure. McLuhan explains what happens to the tool - or tools - once they are absorbed by the machine: "As contrasted with the mere tool, the machine is an extension or outer ring of a process. [...] Printing, [...] the mechanization of handicraft, breaks up the movement of the hand into a series of discrete steps that are repeatable" (McLuhan, 1994, p152). Weizenbaum views the augmented machine tool as an 'embodiment of law' and notes: "It seems odd, even paradoxical that the enhancement of a technique may expose its weakness and limitations, but should not surprise us" (1984, p21). The law-abiding machine tool, combined with enormous processing power absorbs the potential of possible change and acts as an instrument of reproduction. "The computer then was used to conserve America's social and political institutions" (Weizenbaum 1984, p31) at a time when they were on the verge of collapse, preventing necessary radical procedural change, in order to deal with emerging new societal patterns. His final chapter culminates in a passionate argument for an all-encompassing understanding of reason so "that rationality may not be separated from intuition and feeling" to "combat the imperialism of instrumental reason" as "power is nothing if it is not the power to choose"(p.259).

Weizenbaum's (1984) inclusive definition of reason is reminiscent of Bergson's integral argument regarding the use of intuition in obtaining absolute knowledge instead of the relative one of pure reason. McLuhan's mentions Bergsons's "Creative Evolution" in his analysis of the movies as an extension of man; the way Weizenbaum paraphrases the term 'Global Village' shows that he was certainly familiar with McLuhan's work. Coyne, too, views the print metaphor as the starting point for the mechanisation of thought. He uses McLuhan to position rationalism as "McLuhan affirms the primacy of practice" (1995, p.47) and quotes him directly: "Rational," of course, has for the West long meant "uniform and continuous and sequential. In other words, we have confused reason with literacy, and rationalism with a single technology" (McLuhan 1994, p15) Coyne's focus then is not on the embodiment of instrumental reason in the machine tool, but on the disembodiment of the content and the human in the technical communication process: The message as a disembodied packet or 'container' is stripped of its context: "Rationalisms affirms that the physical presence of a technology is subservient to what it contains or accomplished" (Coyne 1995, p.28), in other words, once the efficiency of technology as a transfer mechanism is dealt with, the focus jumps to the properties of the message to be transferred, which are ideally identical throughout the journey. This aspect of rationality not only ignores the interaction between medium and message, but also effectively dis-

misses it as interference. The idea of identical message transfer between sender and receiver assumes that the properties of the incoming message can be measured at the point of reception. This leads to Coyne's second point, that the human as disembodied 'receiver' is reduced to a means of perception and the range of possible sense 'data' reduced to the optical one: "Rationalism's indifference to the senses can be seen as favouring the visual sense" (1995, p.28).

McLuhan discusses similar points in "Understanding Media" (1994) and offers a highly inspirational outside space for reflection from computer science for both Weizenbaum and Coyne. Just as McLuhan sees rationalism not only as a problem of certain disciplines but as problem of literate Western man, Coyne identifies rationalism as a problem beyond computer science or science, as such, but as "a discursive practice, we are all caught up in" (1995, p.18). The problems of separating the message from the medium is echoed in McLuhan's observation that "indeed, it is only too typical that the 'content' of any medium blinds us to the character of the medium" (1994, p.9). His discussion of extensions covers tools, machines and various media in chronological successions, e.g. pre-mechanical or tribal extensions, mechanical extensions and those of the electric age. In terms of types, there are extensions of the body and the senses. The tool "extends the fist, the nail, the teeth, the arm" (McLuhan 1994, p.152), while extensions of our senses point towards a phenomenological view as "we have already extended our senses and our nerves by the various media" (1994, p.3). Exploring extensions in their own right and not according to established categories derives from a need to re-read older extensions "anew, accepting very little of the conventional wisdom concerning them" (ibid). The understanding of those principles should help us to see why 'old' extensions had to come to an end, and how to deal with the emerging new media, which are not actually new, but more precisely hybrids, faster conglomerates and a different combination of tools, rather than serialised or pattern imposing media.

Medium and interactivity

McLuhan (1994), therefore, not only offers a space for contemplation, but also inspiration for a theory of interaction, as he aims at an approach that escapes rationalistic limitations. He emphasises the notion of power embedded in defining those limitations as the result of a culture "long accustomed to splitting and dividing all things as a means of control" (McLuhan, 1994, p7) and its effects on society. His chapter on 'Media Hot and Cold' could serve as a means to understanding user participation through the notion of antagonists, rather then opposites, and through the notion of intensities. The 'reversal of the

overheated medium' could act as stimulation for interaction design 'in the electric age'. In my investigation I will loosely follow this structure and employ theorists like Manovich (2001), Bolter and Grusin (1999), Kittler (1997) and Hayles (1999) as references.

McLuhan's most famous aphorism "the medium is the message", far from following a Cartesian dualism, is not a way of ignoring content, but of drawing attention to the separated treatment of the two intertwined elements and to a culture "long accustomed to splitting and dividing all things as a means of control" (1994, p.7). The message is synonymous with content and the medium with the means of communication. As content has become ubiquitous, the choice of medium has become the message. Take public mobile music listening for example: the once celebrated concept of mobile music listening pioneered by the Sony Walkman in the shape of a cassette player is by now almost considered 'the homeless persons' version of public music consumption. mp3 players are a step up, the Sony-walkman phone is even 'classier' and in the lead might be the tiny, shiny, highly designed iPod players, that for safety reasons are almost invisble[14]. At the time of writing several versions of the iPod are connected to the various listening modes. Superficially this unites the mobile music community in one large iFamily. But family members know: bulky is old, slim is new; within slim there is 'stick-slim' for the pocket money range, the 'narrow-slim' nano falls in the gadget range, and the slimmest 'iPod nano' ever with a curved high res' colour quarter screen is currently cutting edge (September 2008). In the digital world it is fair to say that the compression mode has come to be the message. Mp4 is cooler then mp3, iTunes are more stylish then other formats. (They display with album images, etc, while mp3's are show as text only). Apple's own compression mode of the iPod in particular comes with a retro twist a la the 1950's: it is as proprietary as a record turn table. iTunes, using a crippled Mpeg 4 format (protected AAC), that only works on iPod products and few designated computers for license reasons. iTunes are only available at the iTune store and attempts to transfer iTunes to non-licensed Mac or a PC causes them to become 'unknown files: they store but they don't play. This illustrates the ambiguous role of the 'medium'. The medium internally acts as storage, but at the same time inscribes itself into the content as a compression format. Externally in turn it shapes the hardware into lifestyle items, thus it completes the message; and as content – software – hardware conglomerate then acts as a social symbol as well as access control. Furthermore, the notion of the 'medium' stretches between dichotomies: On the one hand it stands for containing and preserving, on the other as an in-

[14] London Transport has launched a campaign 'Travel wise' that urges gadget owners to hide them, in particular iPods.

between, as mediator, as an agent of change. It stands for conservation versus change, and protection versus intervention. At the same time, while oscillation between these poles, it can be everything from a physical use-tool to a fluid concept of possibilities. The mutually shaping interaction between medium and content is easily to understand based on the example of digital product design objects. It also shows that the digital medium consists at least of two tiers: Software (Mpeg player application) and hardware (physical device). Does this designate software as a medium in digital-media-interaction?

Manovich thinks so: in 'the language of new media' he follows a methodology of 'digital materialism', he follows a 'bottom up' trajectory from code to content (2001, p.35), or software to interface. This interdisciplinary work discusses both concepts of computer science and media studies, and investigates how a computational logic infiltrates digital media. At the same time, their respective micro-cultures sneak in, viewing users as audience or operators, not participants. The content layer corresponds to the 'cultural layer', which amalgamates three sources: print, cinema and computer applications; code corresponds to the 'computer layer' (p.63). The properties of the computer layer are listed as: numerical representation, modularity, automation, variability and cultural transcoding (p.44). As he considers the last three to be sub-modes of the first two I will briefly talk about those only. 'Numerical representation' means the medium consists of digital code, of a programme. It follows that content can now be described mathematically and is subject to algorithmic manipulation. 'Modularity' means content now consists of discrete samples, which can be combined without losing their individual identities. One could argue that this breaks the dominance of the fragmented, continuous and lineal nature of print medium as criticized by McLuhan. Except that code can be just as lineal and continuous as literary writing. The programming language 'C' is performed as a sequential line-by-line description of instructions, as was early html code. Another indication for the similarity to natural language is that code can be written in even the most basic text editor like "Note Pad". Manovich mentions 'Lingo' and took a course at university on 'Algol' programming, both of which support the concept of 'modularity' in their organisation, but this still does not mean programmers *write* in numerical code. Both, Lingo and Algol are classed as 'high level languages', which almost resemble natural language. For example: "if 'key down' = "a" then 'go next'" is a lingo instruction to the computer to react once the user presses the 'a' key.

In other words, an Algol or Lingo programmer would be using high-level language as an interface to a low-level language or assembly. Furthermore once the executable has been

rendered (the binary or in MS environment an '.exe' file) it is also impossible for the programmer to modify the code. The point I am making here is one of access. In the process of interaction with an executable or a programme there is no way to change the course of action, or of manipulating its algorithm. If changes are necessary, one needs to go back to the author software environment, change the high-level code, and compile another .exe file. Likewise, if a lay user wanted to edit for instance a digital image, the only options are 'menu based interactivity' through editing software. Manovich mentions Photoshop, an expert production tool which costs about £450; without such an editor no change to the digital image is possible. So, even though the nature of the medium has radically changed, in Manovich's account the interaction experience through interfaces is largely reduced to the passive read and the users' role is still the "dissociated role of the literate westerner". The digital medium is thus delineated as means of reproduction, it conserved the 'fragmented and specialist approach' (McLuhan 1994, p.64). Manovich is quite clear about this too: "Not surprisingly, modern media follows the factory logic, not only in terms of division of labour as witnessed in Hollywood film studios, animation studios or television production, but also on the level of its material organization" (2001, p.296).

The treatment of the 'cultural layer' follows suit. Manovich states

> we are no longer interfacing to a computer but to culture encoded in digital form. I will use the term 'cultural interfaces' to describe the digital representation of cultural data: texts, photographs, films, music, virtual environments. (2001, p.80)

Manovich's views "new media [to] simulate old media" (p.116). Yet it is the space between the old and new that Bolter and Grusin see the processes of *remediation* at work; not as a simple refashioning of older media, but for the mutually transforming "constant interplay between immediacy and hypermediacy" (1999, p.257). Immediacy aims to erase traces of representation while hypermediacy "acknowledges multiple acts of representation and makes them visible" (pp.33/4), for example through interface elements like multiple windows. As the discussion of remediation unfolds, these processes not only affect media like TV, photography, film or painting, but also bodies, and economic and social practices, which are turned into 'new media', such as virtual reality environments or MUD's. Thus, re-*mediation* extends mediation or a linearity of media successions McLuhans critiques in the *rear-mirror-view*; it also extends into reflections on the users experience. The historical connections between inter-affecting media have been displaced by rivalling strategies; hence the form of their account of this process is a 'genealogy' (p.IX) of social relations as well as the tensions of power mechanisms. At a glance their inves-

tigation seems purely to focus on the interface or representation, but a closer look reveals a critical view *through* the interface at these strategies at play. Bolter and Grusin's starting point is virtual reality, which they view not as replacement for reality, but as an alternative digital reality; the synthetic 'four eye machine', the intense eye-to-eye contact between machine and human. In this context, immediacy presents the following challenge: "If the purpose of media is indeed to transfer sense experience from one person to another, the wire [of virtual reality] threatens to make all media obsolete" (p.3). Hypermediacy's counter strategy to this challenge reveals the emergent properties of remediation. Remediation can produce new experiences and new media. Virtual realities head-sets, wires and gloves neither erase the interface in the virtual experience, nor interface directly to sense experiences. In fact

> The user of virtual reality is constantly aware of the discrepancies between the virtual scene and the real world, and that awareness is an important part of her experience. [...] the visitor is participating in the remediation [and] begins to explore the limits of the embodiment that the environment affords (p.253)

Likewise the possibility to project images directly onto the retina does not erase older media. They resort to counter strategies to escape extinction (i.e. hypermediacy) and re-establish themselves in new media, however they are being transformed in the process: "a medium is that which remediates" (p.65). In other words, *remediation* produces media as the processes involved de-and re-contextualises media well beyond their formal and technical descriptions.

> (...) cultural recognition [of new media] comes not only from the way in which each of the technologies function in itself, but also from the way in which each relates to other media. Each participates in a network of technical, social and economic contexts; this network constitutes the medium as a technology. (Bolter & Grusin 1999, p.65)

This agrees with McLuhan views that we need to look beyond the visual manifestation and at the larger context:

> An abstract painting represents direct manifestation of creative thought processes as they might appear in computer designs. What we are considering here, however, are the psychic and social consequences of the designs or patterns as they amplify or accelerate existing processes. (1994, p.8)

McLuhan and Bolter and Grusin therefore are agreed in not only acknowledging how media inter-affect each other, but each of them point out the relevance of mediation and remediation that takes place beyond the immediate representation in the interface. McLuhan's examples for the social effects of mediation include of course the much-quoted print process as mediation of the written word into the abstract repeatable symbols of typography.

Bolter and Grusin stay in the digital realm to illustrate the social effects of remediation. They trace remediation back to the early 50's when computers started to digitally represented accounting and billing applications. A "Computer can be a symbol manipulator and could therefore remediate earlier technologies of arbitrary symbol manipulation, such as handwriting and printing" (Bolter & Grusin 1999, p.66). However the biggest impact before remediation of visual media must have been the emulation of the typewriter in the 80's, when computers entered the market in a large scale. "The computer could then become a medium because it could enter into the social and economic fabric of business culture and remediated the typewriter almost out of existence" (ibid). Which causes Kittler to claim: "we do not write anymore" (1997, p.147) meaning that applications like MS Word blur the boundaries between software consumption and content production. Writing a letter by means of a text processing application means triggering many low level algorithms that encode tracked keystrokes into binaries. In the process we consume the editors visual interface, which obscures entirely the actual computing processes. So "[w]e simply do not know what our writing does" (Kittler 1997, p.148). Manovich explains: "Word processing, page layout, presentation and Web creation programs come with "agents" which can automatically create the layout of a document, spell check, format, etc. (...) Writing software helps the user to create literary narratives" (2001, p.53). The interaction of writing has entirely shifted to interface 're-enaction' with the convenient addition of copy-paste-options; remediation has successfully erased the medium.

Kittler notes that: "[...] on an intentionally superficial level, perfect graphic user interfaces, since they dispense with writing itself, hide a whole machine from its users" (1997, p.151). The reason for this is not to make the interaction with the computer more pleasant, attractive or easier to use, but to protect the code for commercial reasons from 'untrustworthy programs" or "untrustworthy users" (ibid). Moreover this is not just true for hardware, but also software and every 'license, dongle and trademark prove the functionality of one-way functions', which are functions 'that hide an algorithm from its very result.' Kittler views software as an interface to hardware, and as these interfaces can only exist in combination with hardware, they are in themselves non-existent and only form the "environment of everyday languages" around hardware. This might be a bit easier to understand if we remember that in the early days of computing, programmes were hard-coded into one chip. By now, only the programme that starts up every PC, BIOS, still has its own chip, dedicated to BIOS services. Kittler comments: The 'BIOS services' are currently defined as "hid[ing] the details of controlling the underlying hardware from your

program." (p.149) Also, invisible to us, all our moves on a computer are inscribed in the files we produce, e.g. even a simple word file that is produced in an environment reserved for academic use, will carry this information in the code, courtesy of an instruction set of the save function; if the files are then detected in a commercial environment, the producers are liable for fraud and legal actions. Similarly we could receive computer viruses, hidden in the code of graphics we have received, because we can't tell by the file size if that file is badly compressed, high definition, or malicious. We would need to be able to look directly at – and understand – the code. In that sense software, as content of hardware, still acts as what McLuhan calls the "juicy piece of meat carried by the burglar to distract the watchdog of the mind" (1994, p.18). Whether we like it or not, interacting in interface world, "we are blind towards the medium" (p.9).

Manovich (2001) on the other hand argues that new media interfaces reveal previously concealed layers: "Interactive interfaces foreground the paradigmatic dimension" (p.204). In other words, the "[d]atabase (the paradigm) is given material existence, while narrative (the syntagm) is de-materialised (p.203). This makes no difference to the users' experience though as such interfaces are "still organized along the syntagmatic dimension. Although the user is making choices at each new screen, the end result is a linear sequence of screens which she follows" (p.204). Manovich also offers an explanation as to why this interactive medium follows linear sequences: new media "follows the dominant semiological order of the twentieth century — that of cinema" (ibid). Manovich's cinematic view of cultural new media interfaces, where interaction is synonymous with watching a movie, might be seen to reduce user interaction to the passive absorption of older media (filling in, making sense, completing; p.71/2); paradigmatic interface interaction on the other hand effectively "asks us to identify with somebody else's mental structure" (p.204). Combined with the fact that new media "takes 'interaction' literally, equating it with a strictly physical interaction between a user and a computer" (p.204) it is no surprise that Manovich concludes interactivity is a myth (p.70ff). Manovich's important observation about new media's reversal of visualising database structures in the interface is discussed in the section on objective and subjective spaces of interaction. Nevertheless, his discussions rarely touch on the social or experiential multifaceted networks in which these cultural and computational layers unfold. Yet, according to Katherine Hayles, it is precisely this space that produces materiality. "Materiality thus emerges from interactions between the physical properties and a work's artistic strategies. For this reason, materiality cannot be specified in advance (...)" (2002, p.33). She refers to electronic media in

this observation, though she speculates how this experience will affect our perception of traditional media. Nevertheless, what Hayles presents here is what '3rd wave' HCI circles would refer to as an interaction theory of situated and emergent action, as she continues "materiality emerges from the dynamic interplay of a physical robust world and the human intelligence as it crafts this physicality to create meaning" (2002, p.33).

McLuhan also developed an approach to media that could apply to Human-Computer Interaction. He distinguishes media according to their potential for user participation along the lines of energy values and intensities. 'Hot' delineates high intensity or high definition of the medium and offers little space for participation; 'cold' corresponds to low definition and a higher potential for interactivity, in short: 'hot excludes, cold includes". In addition the connection is considered: if the extension is of a single sense, as of the eye or the ear, media are 'hot'; if there is multiple sense involvement, they are 'cold'. Another way to put this, of course, is to contrast the embodied with the disembodied experience. Degrees between these poles are possible and some media are hotter or cooler then others. For example: "A photograph is visually and 'high definition.' [It is a] hot medium [...] that extends one single sense in 'high definition'. High definition is the state of being well filled with data" (1994, p.23) Therefore the move towards lower levels of definition enables interactivity "as a lecture makes for less participation than a seminar, and a book for less than a dialogue" (p.24). A photograph's potential for user participation is low, digital or not; it engages the eye in an intense relation while bombarding it with high definition data. On the other hand if the screen shows a text box for user input with not much other information, the user has the potential to physically and cognitively fill the empty space, while engaging the body to a certain degree too. Thus the interaction with a web search interface is cooler than the one with a digital photograph, but not as cool as for example, it would be if walking through a multimedia installation in a 3D space that was combined with sound, visuals, wind effects, etc, and reacted reacts to the bodies' movement in space. The relative positions between 'hot' and 'cold' vary not only between those poles but also over time and in relation to other media or participants. Which means something or somebody in the interaction network can be 'hot' and 'cold' at the same time since it always depends on the position of the counterpart it is contrasted with. For instance in comparison with tribal culture we are hot, yet as part of a hot society we can choose to use the phone, a cool 'participational' medium, or listen to the radio, a 'non-participational' hot medium. In the context of web design this means websites can

be relatively 'hot' or 'cold', depending on their context and content components, or even contain both 'hot' and 'cold' elements in the same interface.

McLuhan's move to use the notion of intensities in order to describe user or audience participation, concluding 'in the electric age the principle of the divisibility of every process has been reversed' (1994, p.36) is a major leap beyond Shannon's restrictive mathematical version. It inspires an approach to interaction which is not solely technical but which allows for the investigation of less tangible aspects of connections, relations and mechanism; finally it moves away from viewing the human as a receptive, disembodied eye-brain, to one which recognises "wholeness, empathy and depth of awareness is a natural adjunct of electric technology" (p.6). The absolute positions of binaries are abandoned in favour of a fluid network of interdependent and relative positions, as the energy produced by the speeding-up processes through mechanical extensions backfires on them until they break down due to overheating. The moment of break down however is at the same time the moment of the breakthrough of the old tribal structures: the eruption of the overheated centres with boundaries forms new decentralised autonomous multiple centres without boundaries (McLuhan 1994, p.71), while the reversal of energy flows through implosion empowers the 'rhizomic' new centres to use a Deleuzean term: "Electric power, equally available in the farmhouse and the Executive Suite, permits any place to be a center, and does not require large aggregations" (p.36). Released from the linearity of mechanical movements, media zig-zag through the electric network, the interaction between them now taking the form of "crossings or hybridizations" which "release great new force and energy as by fission or fusion." (p.71) Likewise "instant synchronisation of numerous operations" (p.349) 'ended the assembly line' and gave way to multiplicity. The reversal of energy flows enables us now to think in a different way and not only detect the struggle between media and message, the strategies of deception "with one acting as the "content" of the other, obscuring the operation of both," (p.52) but also recognise the strategies embedded in media that affect us though interaction with them: "it is electric speed that has revealed the lines of force operating from Western technology" (p.16).

In short, electric speed plus the reversal of flows via the implosion of the electric age has the potential to reverse the 'rational, visual patterns European patterns of experience' and their literal translation as "uniform and continuous and sequential" into rich, diverse and holistic experiences in the interaction with networked new media. However, for this to happen it is crucial to develop an awareness of the intangible issues and mechanisms involved as "the products of electric fusion are immensely complex." Likewise it takes

"standing aside from any structure or medium, [so] that its principles and lines of force can be discerned. For any medium has the power of imposing its own assumption on the unwary" (McLuhan 1994, p.15). The past section opened up the larger context of interaction such as media strategies at play and that social practices and relations impact media processes as well as embody interaction; it also served to establish the necessity to look closely at the connections involved between elements, layers, hybrids and their interplay in conceptualising the interface.

Strategies of the Interface

So far the notion of the interface in Human-Computer Interaction oscillates between the extremes of a collapse into a single layer and the multiplicity of several layers between computer and user. While Manovich argues that content and interface now are synonymous and declares software to be medium, Kittler not only re-states that hardware is the medium, thus adding a third conceptual layer, but views the multiple layers of programming languages that make up software as a "postmodern tower of Babel" of language interfaces (1997, p.149). The following discussion will show that the interface occupies a similar space to the medium and that the connections involved are fluid as opposed to hierarchical. Similar discussions are overlapping, if not covering the same aspects in supposedly different categories. The focus however is on the variety of strategies between layers of the interface, which illustrates the stark contrast to the assumption in HCI practice of a direct and unmediated connection to represented systems. Kittler's observation about the multiple layering of programming languages on the computer side are echoed by Flusser in terms of the interface:

> "The technical image is an image produced by apparatuses. (...)
> [T]echnical images are abstractions of the third order: They abstract from texts which abstract from traditional images which themselves abstract from the concrete world." (p.14)

Every layer of abstraction inserts itself 'between the work and human being' thus obscuring the previous layer, until we eventually lose track of the layers and with that lose the ability to 'decode' the technical image. Flusser (1999) views the relationship between text and image as one of struggle, which started with Christian history, and is continued "in modern times, [as] a struggle on the part of textual science against image-bound ideologies. (...) In this struggle against ideologies, it absorbed ideas and became ideological" (p11). Once we confuse the "non-symbolic, objective character of the [technical] image" with "ways of looking at the world" and confuse their symbols with reality, we become ignorant in the ways in which we critically engage with those images. In turn those im-

ages become magical, or rather second order magical: "conjuring tricks with abstraction: prehistoric magic is a ritualisation of models knows as 'myths'; current magic is a ritualisation of models knows as 'programs'" (p17).

Strategies of immediacy and hypermediacy

The early computer interaction experience carried the notion of the obscure and mythical too, hence HCI's strategy consists in striving for transparency of the interface to counteract user apprehension and create user-friendly designs. Several computer artists have played with the notion of myth in the experience with computer and technical power, such as Laurie Anderson in her installation 'Nerve bible' in which she treats computer interaction as the 'new religion': it seems powerful, but we are reduced to an understanding through iconic depictions; we don't understand it, so we worship the new technology. HCI practitioners too know of the magic of computer powers in the discussion of the interface. "New technologies provide extraordinary - almost supernatural - powers to those who master them" (Shneiderman 1992, p.2) Good interface design should harness these powers and help to "reduce anxiety and fear of computer usage" (p.32), and users might even get excited "when the interface is constructed by (...) the *principle of virtuality* – a representation of reality that can be manipulated." Shneiderman also quotes Rutkowski who "conveys a similar concept in his *principle of transparency*: (...) the tool seems to disappear" (Emphasis by the author; p.202).

This notion of reality through transparency is precisely one of the strategies identified by Grusin and Bolter earlier, which are employed by the interface to erase the medium: the logic of immediacy: as it strives for transparency, immediacy attempts to erase all traces of the media so the user is left "in the presence of the thing represented" (p.8), examples are 'realistically' rendered 3D graphics with lightening, perspective and shading effects which have the goal of doing "as well, or better, than the painter or the photographer" (p.11). Immediacy is also the drive in developing 'virtual reality', an alternative digital reality directly projected into our eyes. This attempt to be as real as possible also means "removing the programmer / creator from the image" (Bolter & Grusin, 1999, p.28). Yet the design strategy, which is supposed to de-mystify through digital 'hyper-clarity', turns out to far from neutral: the erasure of all traces of production as well as of its materiality decontextualises the interface. This follows a dream of freeing the informational patterns from the mortal body because, once information is not "tied to a particular instantiation", it is "free to travel across time and space" and "once we become the information we have constructed, we can achieve immortality" (Hayles 1999, p13). Hayles talks about disem-

bodiment in the context of cybernetics, while Bolter and Grusin use feminist sources to disclose the role of desire in the striving for immediacy, and of "the male gaze" in art and media theory: "we call the desire for immediacy, which then becomes a male desire to posses, or perhaps to destroy, the female." Early examples of how the clinical male gaze wants to analyse and control are dated by when Haraway to a 1538 illustration by Dürer which shows a craftsman studying his female model through the grid of a linear perspective frame. More contemporary examples are given by feminist critical film studies. In Hitchcock's Vertigo (1958), for example, "we share the detective's gaze through Hitchcock's transparent style", and "perhaps his desire for both cognitive and sexual immediacy, which is the real subject of the film" (in Bolter & Grusin 1999, pp.78-80). While Bolter and Grusin list some examples merely for reference, "even though they might be somewhat exaggerated", they maintain that: "The logic of immediacy has perhaps been dominant in Western representation, at least from the Renaissance until the coming of modernism" (p.34).

The second strategy used by the interface to erase the medium is *Hypermediacy*; as the counterpart of immediacy, which erases the medium through the notion of opacity. "In digital media today the practise of hypermediacy is most evident in the heterogeneous "windowed style" of world-wide-web pages" (Bolter & Grusin 1999, p.31). Through a concept of recycling, repurposing and re-using metaphors of older and newer media alike, it "privileges fragmentation, indeterminancy, and heterogenity" over presenting a finished works of art or design (ibid). Attempting to achieve a sense of "liveness" for instance by featuring a web cam, running digital clocks somewhere in the corner, animated 'live tickers', etc, "hypermediacy strives for its own brand of immediacy" (p.9). According to Bolter and Grusin, hypermediacy works with the pleasure principle; it is an invitation to enjoy the collage and juxtaposition of various media elements at the digital level, an invitation to intense visual stimulation. "Sometimes hypermediacy has adopted a playful or subversive attitude, both acknowledging and undercutting the desire for immediacy" (p.34). In that sense, hypermediacy almost works as the 'female counterpart' to the desire of the transparent male gaze, it works through seduction, and a desire for visual indulgence. The ongoing dance between the two dichotomies at surface level displaces the dynamics between interface and medium and establishes new media interaction as interface interaction, which successfully disguises the medium

HCI and Internet interaction

So far I have argued that the traditional focus of HCI on the interface prevents it from paying attention to the relations between instantiations of the user-interface. On the internet, some of these relations fold back on HCI in the form of web-statistics: tracking makes users movements visible, at the same time they tell of HCI failures in terms of predicting user experiences. Several observations follow from this: Tracking is facilitated by objectifying the internet and subjective spaces like interaction with a search engine escape tracking. Tracking can be seen as a form of user surveillance, yet to designers it complements the objective space of internet navigation with the subjective space of user's moves. Finally, visualising mutual power mechanisms between interaction design and users touches on the larger power fields in the commercial internet.

On the Internet, interaction design disciplines that adhere to scientific methods such as IA and traditional HCI continue to superficially empower users by providing them with interface controls, while actually constraining them within linearly established paths in online processes. In other words, provision of navigational elements made by HCI (and IA) reproduces discursive practices as well as exercising control over users in a way reminiscent of cybernetic feedback loops, as in 'tracking, feedback and prediction'. The instrumental view of interaction ignores the internet's multi-faceted character. Starting from the mid-90s, internet browsers, which were initially text-based, soon offered graphics and animation integration and eventually dynamic database access. The internet moved in rapid succession from being a purely informational medium to become an advertising channel, a mass medium, and a channel for online transactions. Online businesses employed HCI to implement software systems for Internet users such as account databases and product catalogues. Yet, this web-access software is still surrounded, and increasingly infiltrated, by information, entertainment and immersive content. This development is not a chronology; it is a story of addition and fragmentation, of shifting and displacement, constituting a space of struggle. Divisions between the various kinds of content are not as clear as traditional HCI makes them out to be. As discussed in chapter one, Jesse Garrett's attempt to deal with these multiple co-existing streams of internet functions separates the areas of information and software in terms of methods and application. Yet, this ignores their various hybrids as well the immersive and entertaining areas of the internet. For example, the online purchase of a mobile phone is a life-style statement as well as a business transaction, i.e. it combines immersive and goal-orientated elements. Manovich points out that the co-existing control and content interface elements constitute

> an un-easy path between the richness of control provided in the general purpose HCI and an 'immersive' experience of cultural objects: [...] the older Western tradition of pictorial illusionism in which a screen functions as a window into a virtual space, something for the viewer to look into [...] and the more recent convention of graphical human-computer interfaces which, by dividing the computer screen into a set of controls with clearly delineated functions, essentially treats it as a virtual instrument panel (2001, p.96).

This fragmentation of internet interfaces has repercussion for the user-experience: According the Manovich, it separates the internet into: "a subjective space, [where] its architecture [is] responding to the subject's movement and emotion" (p.231) and an objective space where "we are asked to follow pre-programmed, objectively existing associations" (p.75). Manovich mentions news groups and mailing lists as examples of subjective space and I would add search engine interaction as another example. Search engine interaction revolves around user keywords; the return page results in a list of links and short descriptions of the engines' finds, usually ranked by relevance and spread over several pages. The interplay between users' action and returns received is constantly shifting: users may refine search terms or, based on the new information they receive, choose to explore other options. Either way, such shifts affect the resulting pages, thus creating a "space [that] can literally change, becoming a mirror of the users' subjectivity" (Manovich 2001, p.231). Search engines therefore form "a subjective space, its architecture responding to the subject's movement and emotion" (ibid). However, the objective space of fixed link structures, visualised database categories and informational hierarchies however, enables a mechanism which in turn threatens HCI by means of its own values: Tracking and measurability in the form of web statistics. While search engine interaction escapes tracking (search terms can be recorded when they are entered, but not the subsequent journeys), track coding can be attached to every fixed link. Tracking software then matches the page requests against the sitemap and results in a clear picture about the moves users make on the site and their journeys between site sections. Successful user journeys are reported in the same way as the failure of users to 'inter-react' correctly. High drop-out rates in check-out processes, deserted shopping trolleys, and incomplete informational products float around on the information highway as traces of HCI failures. Inaccurately predicted user journeys ricochet, shooting holes through the way HCI's has constructed the ideal electronic user by methods of scientific truth. One could say that users' resistance has a voice; their journeys have become visible to businesses, thus complementing the objective space of fixed navigation with the subjective moves of exploration and deviation made by users. Yet this is not the only tension in this process, so my investigation of HCI practice on the Internet looks into various aspects of this struggle.

Rhizome vs. library

One of the tensions derives from the origin of web browsing in a 'rhizomic' or subjective space, and its objectivation by various HCI practices. Initially World-Wide-Web (WWW) browsing experience employed the metaphor of the sea; users "surfed" the web, moving along the surface, carried by the direction of the waves they encounter during their ride. The "narrative [was] driven by the character's movements in exploration (Manovich 2001, p.233). The initial routing system of the informational network consisted of hypertext links, a concept invented in 1965 by Ted Nelson (1974, p.1). "Hypertext is a new and highly non-linear way of structuring information" (Rosenfeld & Morville 1998, p.40), which means that exploring the internet was a free-floating, relatively unstructured experience, " [...] a nomadic reading, neither negating place nor universalising it, but wandering, and taking the hereness and nowness of place with it as unstill reference point" (Cubitt 1998, p.6). Internet Surfers - or users - manoeuvred freely from topic to topic, from site to site, as the mainly academic community often provided links to other sites of a similar subject to create an open, comprehensive landscape of knowledge. "[T]he Internet [...] and its features and patterns of use have grown 'bottom-up'. The internet is regarded largely as a grass roots phenomenon" (Coyne 1995, p.148). With the introduction of commercial large-scale websites in the early 90s, the force of the 'state apparatus' moved in: online-organisations and businesses divided "the smooth landscape of knowledge" amongst them, thus changing it into a "striated space; a space which is counted in order to be occupied" (Deleuze & Guattari 1988, p.385). With it came a need for control, in order to keep 'surfers', and consequently interaction mechanisms such as hyperlinks, contained within a confined space: the corporate website.

> "One of the fundamental tasks of the state is to striate the space over which it reigns, or to utilise smooth migrations and more generally, to establish a zone of rights over an entire exterior, over all flows traversing the ecumenon. [...] There is still a need for fixed paths in well defined directions, which restrict speed, regulate circulation, relativise movement, and measure in detail the relative movements of subjects and objects" (ibid).

'Information architecture' (IA) as term coined by Richard Wurman about 1975, then related to information design; later it was appropriated for the design of informationally complex sites (Information Architecture -Wikipedia).

> Information architects "organise the patterns inherent to data, (...), create the structure or map of information which allows others to find their personal paths to knowledge; and constitute the emerging 21st century profession addressing the needs of the age to focus upon clarity, human understanding and the science of the organisation of information (R.S. Saulman in Rosenfeld & Morville, 1998, p.10)

The initial purely informational nature of the WWW seemed to offer the opportunity for an existing profession to re-invent itself in the new medium: Librarians. When librarians made their first move towards the Internet, they called themselves "cybrarians," an amalgamation of "librarians in cyber space" (Rosenfeld & Morville 1998, p.17). The process of re-invention however reproduced an existing offline-framework online, and formed a discipline deriving from information science and librarianship dealing with the challenges presented by an innovative approach to reading such as hypertext, and browsing as 'nomadic' and unstructured reading mode. Indeed, IA assumed that Hypertext "can get confusing pretty quickly" and related user journeys "look like an architecture designed by M.C.Escher" (Rosenfeld & Morville 1998, p.121). Therefore, for IA Hypertext is secondary to the "primary organisation structure[s]", and as "ad hoc navigation [...] between content items [that] do not neatly fit into the categories of hierarchical, global and local navigation" (p.57). The primary control elements - or "navigational elements" – provided by IA consist of menu bars, buttons, sitemaps, and indexes that enclose content and allow users to interact within *one* website. A good structure is viewed best as "the hierarchy, a top down approach; the foundation of almost all good information architectures is a well designed hierarchy" (Rosenfeld & Morville 2007, p.37), which is in direct contrast to the internet as grass root phenomenon. Similarly the sitemap is defined as "structural representation of the architecture of a website" (p.67). This approach effectively re-writes the rhizomic structure of the Internet according to McLuhan's 'grammar of print'. So, while metadata's workings in the background can form a subjective space for interaction as in the case of search engines, rendering metadata visible in the shape of navigational categories and control elements fixes them into single instantiations of controlled vocabulary and transforms the affected areas of the internet into objective spaces.

Interaction in the objective space

Producing and interacting in this objectified space results in a force-on-force relationship between HCI practice and users. Users are presented with pre-programmed pathways in their search for information. There is no choice but to glance through the menu items or buttons, no choice but to click on a button or link, no space for action only for reaction. I tend to call this reductive interaction mode "interpassivity", an appropriation of Slavoj Zizek terms which represents substituted pre-rendered response for the users, and "emulate[s] the ideal customers reaction in advance" (1997, p.112). Interpassivity might formally resemble communication, but it prevents the user-subject from changing the topic without abandoning the whole conversation, i.e. leave the site. These pre-rendered an-

swers not only close communication in 1st wave cybernetic manner, they also subject users to a relationship of force as "Force is an action upon an action, on existing actions, or on those, which may arise in the present or future" (Foucault, in Dreyfus 1983, p.220) which exceeds the violence and the discipline exercised over bodies (Deleuze 1988, p.70). Particularly in online transactions these lines of force gain materiality, or objectify users, whichever way one wants to look at it. Examples for transactional products include online-shopping and insurances, mortgages, or holidays bookings. In the process of receiving and giving information, users interact interchangeably with data management systems such as databases (DB) and content management systems; in doing so they populate their allocated space within those systems, and become data representation themselves. The interaction in online-purchases is strictly sequential and highly structured; the sequence is dictated by financial cost per query to businesses. Internal DB queries are cheaper then external ones, external DB queries prior to user purchases incur costs to online-sellers with the possibility of losing that money. Hence, user details are first matched against the internal account DB for validation, including possibly an internal rating system about the users ranking as a desired customer. Next the home address details are collected and verified against a post code DB. Susan Leigh Star notes the importance of the physical home in the world of Netizens (Net Citizens) "Being homed means that I can pass through the innumerable interactions that complex state bureaucracy requires, giving my name, address and social security number, without being ashamed" (Star 1995, p.25). The social security number has been replaced with the credit card number these days; hence a credit rating check forms the next step. This is not only the most expensive external DB check in the series; it also has direct repercussion on the users' credit rating, as every request leaves 'a print' on the record. Too many requests are detrimental and unsuccessful checks cause it to plummet[15]. Credit checks classify users by their own criteria. 'Green' indicates a high score and gives the go-ahead; 'amber' returns a reference number to user, accompanied with the request to proceed on the phone; 'red' stops that transaction entirely; in this case the user is also black listed on internal account lists, to protect the on-line seller from further unsuccessful - and expensive - external checks. If the user tries to purchase online again, they won't pass the first hurdle of internal validation. This process of diving in and out of personal, financial and individual details means that a form of power over the user is established which Foucault calls 'the new form of

[15] This includes multiple submits caused by users hitting the 'back button' during transactions to remind themselves about previous data entries. I have no references for the description of this check-out process as this is based on projects I have personally worked on. Whenever I sign a contract, I also sign an NDA which prevents me from disclosing particular details of any project I am working as well as make any of my work my employer's intellectual property.

pastoral power'. It is an 'individualising power' that is different from 'royal power'. It works by knowing the individual's most personal details and 'innermost secrets', "as a very sophisticated structure, in which individuals can be integrated, under one condition: that this individuality would be shaped in a new form, and submitted to a very specific pattern" (Foucault, in Dreyfus 1983, p.214). Successful data/money transaction objectify and dissolve users into data streams, otherwise their data is tagged with a warning flag. At this stage, businesses probably know more about the financial situation of an online customer than they do themselves, unless they have purchased their own credit rating report. At the same time, the interrupted, deserted and uncompleted journeys of much desired online-customers equate to lost income for online-business which puts pressure not only on the immediate relationship between HCI employers and HCI disciplines, but extends also into wider relations, for example with the online-arms of offline businesses. User surveillance therefore not only gives visibility to the subjective moves of users, but it also taps into the immediate and wider network of power mechanisms. This is not to say that users have an equal role in power struggles, but they have a potential to affect the lines of force, as Deleuze calls them, in these power networks: "each force has the power to affect and to be affected" (1988, p.71). Nevertheless, Foucault's work on power is important here in that it helps to go beyond a simple view of power relations as an immediate oppression – resistance mechanism. Though Foucault's investigation of the network character of power starts from resistance, it "consists of analysing power relations through the antagonism of strategies" (Foucault, in Dreyfus 1983, p.211/2). In other words, one can view the unstable interplay of power relations and strategies as an 'economy' (p.210), or apparatus [*dipositif*] consisting of discursive and non-discursive elements (Foucault 1980, p.194). I would argue that relations between internet users, interaction designing disciplines such as IA and HCI, businesses, technology, computers, networks and evolving techno-culture form such an apparatus. This explains why

> Power is everywhere; not because it embraces everything but because it comes from everywhere [...] Power comes from below, that is there is no binary or all-encompassing opposition between ruler and ruled at the root of power relations; ... (Foucault 1990, p.93/4).

Or simply put "every group and every individual exercises power and is subjected to it" (Sheridan 1980, p.218). This move reveals the productive energy of power mechanisms.

> We must cease once and for all to describe the effects of power in negative terms: it 'excludes', it 'represses', it 'censors', it 'abstracts', it 'masks', it 'conceals'. In fact power produces, it produces reality; (Foucault 1977, p.194)

Deleuze develops the productive element in these relations in his investigation of the "lines of subjectification" which he sees as twofold: as lines of escape as well as lines of

variation and creativity. The line of escape, by "bypassing the line of forces grows, meanders and turns back on itself and goes underground, [...] or works on itself or affects itself" (Deleuze 1992, p.161). Indeed, once a user discontinues a particular journey, the seriation of re-actions is interrupted; they disappear from the radar of tracking. However, the users might not discontinue internet interaction altogether; they might choose to start a different journey, to "reinsert themselves in another [apparatus]" (p.162), and through "continually aborting, but then restarting, in a modified way" (p.164) produce their individual paths of creation. So, in this process users escape the lines of forces as well as transforming themselves into the creator of a journey that consists of multiple ruptured or linear journeys. Businesses, however, cannot ignore users falling of the radar, but have a choice about how to react. One way is to continue to try to enclose and control user journeys by means of tracking, feedback and prediction, which views the future through the history "of what we are and what we cease to be" (Deleuze, ibid). This will continue to trigger the lines of escape. Another way to read this is as an indicator for change, and 'to be attentive to the unknown which knocks on the door" (1992, p.165), which points towards lines of the new, or variable creativity.

The lines of variation and creativity return us to the subjective space, the space that mirrors users' subjectivity. Deleuze argues that these lines point towards the new, which is not the same as the fashionable (1992, p.163). User-generated content (UGC) combines both the fashionable and the new. Fashionable, as UGC is the latest hype in terms of the participatory internet, though "that was what the Web was supposed to be all along" (Berners-Lee in Gorinova 2007). New, as the latest generation of UCG allows users to add meta-information, or tags, which create a 'bottom-up' mechanism of indexing, also called 'Folksonomy' (an amalgamate of *folk* and *taxonomy*). Connecting content by tags "result[s] often [in] an immediate and rewarding gain in the user's capacity to find related content (Folksonomy-Wikipedia). At the same time, as these connections don't necessarily follow structured categorical relations, returned content might be re-contextualised in unusual groupings and thus open the space for serendipitous discoveries that is discussed in more details in the next chapter. Admittedly, tags are not the most consistent way of finding information. However, while mainstream IA exhausts itself in criticising this fact and "[i]f forced to choose between the old and the new, [...] will take the ancient tree of knowledge over the transient leaves of popularity" (Morville 2005, p.139), a privately run social bookmarking site developed a version in 2004 that works with both their reader groups, machines *and* users: the triple tag (Machine tag - Wikipedia). Machine or triple

tags follow a special syntax, which can easily be learned and therefore used by users. For example *flickr:user=Brigitte tells an engine that I am a flickr user with the name of Brigitte, or *medium:paint=oil specifies the properties of a depicted oil painting. This way search engines return more specific results of such tagged items, e.g. instead of a variety of oil related items (from salad oil to engine oil) it would return solely images of oil paintings (straup 2007). This kind of tag therefore combines machine readable and natural language, i.e. objective and subjective elements to shape the landscape of the internet; it therefore acts as an example of how these two spaces can complement each other in creating lines of variability and creativity. I will return to this idea dissolving seemingly opposed dichotomies (such as objective and subjective, structured and exploratory) into a fruitful complementary relation of antagonists, later in my discussion.

Summary:

Looking at HCI methodologies, as in research and application of this research to design via questionnaires, observation, testing and so forth, one would think that HCI is an empirical practice. Closer investigation reveals a - by now invariably criticised - rational stance of the way research and design methodologies are used. This stance results in a reductive view of the interface as a means of control and ignores repercussions on interaction stemming from this belief. One repercussion is the assumption that if interface design is based on the concepts of visibility and direct mapping, they form *intuitive* instructions which are clear and un-ambiguous.

In critiquing this stance I have employed several disciplines: computer science, media studies and interdisciplinary theorists. Coyne critiques that rationalism assumes the immutability of subject and object, and that communication is largely "a matter of passing information from one subject to another through the medium of the 'external world'". He lists the criteria of rationality as a lack of concern with the practical, and as a view of physicality of technology being subservient to its accomplishments, as a means to an end. The abstract is favoured over the rich aspects of interaction with technologies, and a negligence of the body as rationalism elevates the mind over the body. McLuhan turns this reasoning on its head to counteract the strategies of abstraction and disembodiment and argues that in the age of ubiquitous content one needs to look at the medium to get the full picture. In doing so he can then identify the various strategies of how media inscribe themselves into content; his idea of 'hot' and cold' media then investigates the effects of participating audiences or users. Bolter and Grusin argue that these strategies of new media interfaces oscillate between transparency and opacity in quick succession, and in their

working they appear to be opposite dynamics only united in the aim to erase the underlying medium. This means that, unnoticed by HCI practitioners, the transparent interface they are striving for has been displaced by its simulation; and, as HCI practise is oblivious to the involved strategies, they prevail: Thus HCI discipline has become ideological through its belief in the interface as an authentic system representation.

Manovich describes such interfaces as objective space in contrast to those that form a subjective space; the latter mirror users' subjectivity in such things as blogs, message boards or forums, others invite exploration. Objective spaces visualise the paradigmatic, static aspect of underlying database or content-management systems. Only it is precisely this objective space that enables communication with traditional HCI disciplines about users' subjective moves, explorations, detours, discontinuous journeys in a language they understand: Every link in the objective space can act as a node in tracking users' journeys, i.e. make them visible. The resulting tension between antagonistic concepts like subjective and objective spaces, directed interaction and exploration, completed and abandoned (e-commerce) journeys is not necessarily negative. In fact, viewing these power relations through a Foucaultvian lens reveals these tensions, relations and networks also as productive. Deleuze's understanding of Foucault's work takes this idea further and identifies 'lines of variability and creativity' leading to constant re-invention and the newness in the criss-crossings, folding, and mingling lines of these social apparatuses of relations and tensions. It follows that the interaction between supposed dichotomies is productive and that they work in tandem. This idea is further investigated in the next chapter with a focus on it potential for creativity and interaction as a process of becoming.

Chapter 3: Intuitive interaction - an integral notion of the user experience

HCI has a tendency to retro-fit innovation and divergent research to existing models (Harrison, Tatar & Sengers, 2007; p.3) with the effect that the larger outlook of the discipline in regards to interaction remains unchanged. This practice of retro-fitting, or reducing innovative research to match established engineering paradigms and practice specific scientific methods (Nielsen 2005), positions HCI practice as a closed discourse. This becomes clear in particular when discussing the user-experience in the context of HCI. The shift towards the user-experience is supposed to transcend the traditional goals of usability, as in efficiency, effectiveness and satisfaction. Yet HCI struggles to integrate concepts that elude direct measurement such as the social, or emotions and feelings.

The following chapter therefore attempts to re-read examples of these HCI struggles and open them up, inspired through my reading of Bergson's *Introduction to Metaphysics (1913)*. Through this reading, I critique a purely functional view of interaction in HCI, in particular displaced action by reaction. Admittedly, action and re-action can look deceptively similar in (web-access) software interaction, as in a simple click. This is why Manovich calls interactivity in software and new media interaction a myth and a tautology, as it takes "interaction literally, equating it with a strictly physical interaction between a user and a computer, at the sake of psychological interaction" (2001, p. 204). It is precisely to avoid this trap that we need to look closely at the space or difference between re-action and action; in fact I believe the power of emotions, feelings and creation is precisely situated in this space, and the role of emotions is to open this space up to difference and creativity. How does this relate to HCI? "It is this gap between a model of function and its actuation that in some cases describes a degree of freedom, and that in others puts into place a paralysing incapacity to act" (Fuller 2003, p.107)

This chapter investigates this gap between reaction and action from different viewpoints, such as the workings of emotions, theories of learning, and interaction in search behaviour. The communality amongst those approaches is that they all point at the potential of voluntary action, towards difference, change or even creation, in this gap. It concludes that integrating emotions, or qualitative aspects of experience, complement s existing models of HCI practice. Yet doing so does not aim for 'optimising' those models, but to evolve them so they support integral user experiences, i.e. affirm users as active co-authors of their journeys and interaction environments, and allow for their unpredictable and creative actions.

Intuitive use vs. intuition

The term "Intuitive" or "intuitive use" is widely used in HCI, despite lacking a proper definition. Sometimes it is used in the sense of "innate or instinctive" (Blackler et al, 2002) but mostly it stands for "readily transferred existing skills" or familiarity (Raskin 1994, p 17). The successful execution of learned and internalized reaction is an immediate response to a prompt, design or software interface. Response rates are then measured against (Newtonian) time to evaluate the user-system performance.

> A technical system is intuitively usable if the users' unconscious application of prior knowledge leads to effective interaction. (Mohs et al, 2006a; in Blackler & Hurtienne 2007)

This assumes 'intuitive' supports usability aims such as effectiveness and efficiency, and the more intuitive an interface is, the faster the user can reach their goals, and the better a website performs in terms of user traffic throughput. Despite drawing on unconscious processes, 'intuitive' becomes both quantifiable and a commodity that can be tested.

Before I explain my own view of intuition, which critiques the reductive understanding of HCI I would like first to introduce Bergson's idea of intuition, which inspired my understanding of intuition or intuitive use. I am in no position to discuss metaphysics on its own grounds. This excursion into philosophy serves as a tool as well as an inspiration to gain a different angle on the subject. Bergson's idea of intuition and time is diametrically opposed to traditional HCI thought. For him, intuition is a mode of contemplation (2002, p.88) that postpones bodily action; it requires reversing the customary direction of thought towards utility (1913, p.52). In turn, it opens a space for creating change or difference. Ideas that emerge from this contemplation are ambiguous, and take time and effort to develop. This is why we need to resist the temptation that the intellect has to rush into "finding only the old in the new" (2002, p.35) and to reduce it immediately to the familiar for ease of understanding. Intuition is a kind of experience: perception is an external, material experience, and intuition a virtual, inner experience. Bergson considers that is is an immediate pre-reflective experience and only possible in duration. Duration is an understanding of time that prolongs "the past into a present which is already blending into the future" (2002, p.32); it is a concept of lived time, a time that is forever passing and in transition, and is very different from Newtonian time. Through this connection with the past in duration, we can reach into the unconscious, and thus enlarge consciousness. It is a philosophical method to arrive at new concepts, but "the faculty of intuition exists in each of us, but covered over by functions more useful to life" (2002, p.47) In other words intuition is always the starting point for thinking differently. It is not a feel-

ing or an instinct, but it is necessary to know about the qualitative multiplicity of feelings to understand the process of engagement in intuition. To start with it requires a kind of "intellectual sympathy" (1913, p.23) through which we are able to connect intimately with an object, to know it from the inside out. Once we have engaged with an object in this way, we feel "a certain determinate tension" (1913, p. 47) or impulse, and start an intense inner journey of exploration that oscillates between our inner experience and our reflection on it, between the immediate experience and its abstraction. We need to make an effort and look closely; then, in the flux of duration, we may detect fluid concepts and shades, interpenetrating and continuous, yet continuously changing at the same time (1913, pp.48-51). How can we describe this experience? For that, we need to return to the external world of space and language. "Between intuition and intelligence thus intensified, language had, however, to remain" (intelligence in Bergson is customary human thought, which is oriented towards utility and the needs of the body). Nevertheless, it stands at the beginning of the creative process, as "from intuition one can pass to analysis, but not from analysis to intuition" (1913, p.42). How long does an intuition last? As long or as short as it takes, this is the nature of duration, of experiential time. In fact, the very reason that it is easily overlooked is that "the act that creates the method lasts but a moment" (1913, p.53). So, one way in which we can understand intuition is that it is like an impulse that makes us change direction, yet if we turn around to grasp it, "it is gone, for it was not a thing, but the direction of a movement" (1913, p.61). It can also be understood through the interval it creates between reaction and action. Though intuition is an inner experience, it is only possible because of the body's action prior to the intuition, i.e. the processes by which our senses gather perceptions. Once infolded into the mind, they form the virtual material that is reorganized and rediscovered during an intuition (1913, p.61). At the same time through this delay, or zone of indetermination, intuition is constitutive of voluntary action as it produces an interval between stimulus and response or automatic action (1988, p.32). It is human[16] habit to react, but "it is more then human to grasp the interval" (1913, p.55). Knowledge gained in this intense coupling of external perceptions and internal organizational process is of a different quality than if it was gained through synthesis only; the latter produces relative knowledge, through the integration of intuition we gain absolute knowledge (1913, p.20). Intuition thus stands for the intense interplay between the qualitative and quantitative multiplicities of the inner experience and external matter; it stands for an "integral experience" (1913, p.62).

[16] Bergson equates human action with a reactive dealing with everyday needs and practicalities. To think (difference) and delay reaction transcends general human behaviour into the metaphysical dimension.

A few questions stem from using Bergson's concept of intuition as inspiration in this context. What are the repercussions on experience? Intuition is thinking in duration, and

> (1) Duration is a heterogeneous flux or becoming. (2) It is irreversible, straining always towards the future. (3) It is continually creating newness or novelty, and hence is intrinsically unpredictable. (4) It is the inexhaustible source of freedom. (Goudge in Bergson 1913, p.13)

What do we gain by viewing the user experience through Bergson's metaphysics and his method of intuition? Bergson says it best himself: An intuitive approach would unite science and metaphysics and would lead science "to become conscious of their true scope, often far greater than they imagine. It would put more science into metaphysics and more metaphysics into science" (1913, p.54). So this is not a question of whether one is better or worse, it is more about a complementary, mutually beneficial co-existence, about the shifts and possibilities it opens up. Just to be clear, these complementary qualitative aspects are not thought to 'optimise' existing models in a more holistic way in order to make them more efficient or effective. The intention is to evolve existing models of thought in new and unpredictable directions, i.e. to bring change about and think differently.

Inspired by Bergson's reading, my own concept of intuition follows his approach to contrast abstract metric thought – in his case of science, in mine of HCI- not with a simplistic binary opposite, but the unfolding, oscillating and overlapping of the qualitative complexities or multiplicities of virtual, or intangible, inner life. Intuitive interaction tries to overcome a simplistic utilitarian concept of the user-experience by complementing it with the complexities of conscious and non-conscious emotions; I refer to this enriched view of the user experience as *integral* user experience. Emotions are not only the subjective or individual value judgements of encounters, but an alternative drive or motivation to goal-orientation. They can act as an impulse to change direction and/or interrupt habitual or customary thought to playfully re-arrange it or turn to explore the unknown. Emotions embody interaction. Integral Intuition is positioned in the delay between reaction and action, Bergson's *zone of indetermination,* which overcomes the simple stimulus-response mechanisms of a purely functional view of interaction. The larger context of intuitive interaction is, again, a qualitative view of time, akin to Bergson's duration; I call it experience time. Themes to be investigated closely are related to the steps in Bergson's method of intuition. These themes are those of engagement, exploration (including the quality of the feelings involved in this processes) and the interplay of consciousness and unconsciousness. Themes indirectly relating to the discussion will be the shift from response to experience time, from the precision of the singular instance to the vagueness of multiplic-

ities, passage and transition, and the difference between automatic (re)action and voluntary action. To start with, I outline the traditional HCI usability model and some conflicts surrounding it, I also introduce some more progressive approaches.

From measuring user satisfaction to engagement

The following section looks into two recent publications that I consider relevant to my work on an integral notion of the user experience. Both works are progressive in the sense that they make space for emotions and consider emotions and engagement vital for the quality of experience. Both works are an important stepping stone for my work, as they feature a more inclusive view of the user, and McCarthy and Wright in particular push the boundaries of traditional HCI practice. At the same time, a closer look at the moment of interaction reveals traditional undercurrents to prevail. Though addressing users' emotions overcomes rationalistic assumptions in interaction, users are still reduced to responses in interaction.

User satisfaction, as a measurement of usability, renders an emotional user response into binaries like satisfaction / frustration. Yet recognition that there is an emotional connection between the user and the computer that goes beyond mere measurability in terms of satisfaction of use seems to have been stated by computer scientists more then 30 years ago: MIT Computer scientist Joseph Weizenbaum had already observed in the 70's:

> The fact that individuals bind themselves with strong emotional ties to machines ought not in itself to be surprising. The instruments man uses become, after all, extensions of his body. Most importantly, man must, in order to operate his instruments skilfully, internalize aspects of them.[...] In that sense at least, his instruments become literally part of him and modify him, and thus alter the basis of this affective relationship to himself. (1984, p 9)

More then 20 years later a 1999 usability publication featured a usability study that compared about 50 web pages in terms of information retrieval within a set time, such as opening times and ticket prices of Disneyland. The Disney site achieved the lowest rank with a score of 10 out of 100, while the best site scored 55. So in terms of usability the Disney site failed. However, when asked which site to pick as their favourite, a substantial number of the testers picked the Disney site as they "liked Disney, it seemed more interesting" even "if they had gotten completely lost and failed to complete any of the tasks" (Spool 1999, p.14). In other words, instead of hunting for concrete information the users lost themselves in the experience and found that enjoyable in itself. So while testing usability factors provided feedback on how successful users were in achieving set tasks, it failed to reflect the users' impression of the experience. By the way, the highest ranked

site was "Edmunds", a highly task orientated site featuring resources for vehicle buyers, such as car and truck prices, specifications and reviews. The Disney site in contrast featured immersive and entertaining content such as games and videos along with theme park information and reservations.

Institutional sources (like the U.S. Department of Health & Human Services) still refer to the ISO standard 9241 – 11 to define usability and measure the quality of the user's experience based on the following criteria: effectiveness of learning, efficiency of use, memorability, error frequency and user satisfaction (Usability.gov). However, some recent publications in the field of HCI present a more inclusive understanding of a user's experience. Whitney Quesenbery has published her model of the "5 E's" and John McCarthy and Peter Wright released a book entitled "Technology as Experience". Whitney Quesenbery is a Canadian usability expert who runs her own consultancy; she is a frequent speaker at conferences such as ACM, IA summit, SIGCHI, etc (Whitney interactive design 2004). McCarthy and Wright are both senior lecturers in their respective universities in computer science in the UK and Ireland. Quesenbery used the dimension "satisfaction" as a stepping stone for establishing a more qualitative approach by displacing it with "engagement". Her model features a "multifaceted view of usability" (2003, p.81). This shifts static models which require equal fulfilment of each criteria to more dynamic version, where possibly low levels of one criteria, for example efficiency, can be balanced out by high levels of engagement. This means that the criteria of usability are expanded into interdependent dimensions and create a model that "raise[s] the emotional level and create[s] a sense of a dynamic interaction (Quesenbery, 2003, p.83).

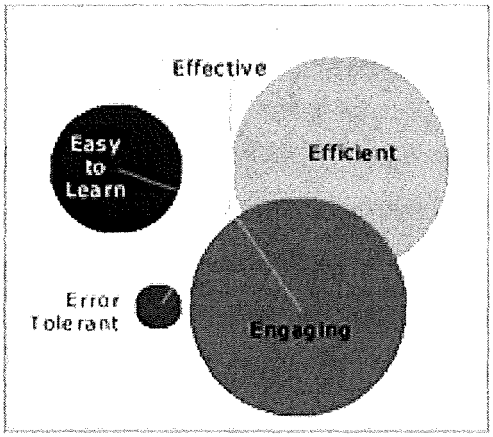

Figure 3.0.Whitney Quesenbery's model of the 5 E's (Quesenbery, 2003, p. 93)

This shifts a static list of usability criteria towards a fluid interplay of their dimensions, so that the usability model can now accommodate for a variety of user experiences, includ-

ing design solutions which are less geared towards efficiency, but may enhance experiences by being entertaining, engaging or immersive, like the Disney site. The shift from satisfaction to engagement also introduces new goals for interaction such as notions of discovery and exploration, which interpenetrate with purely task orientated goals. Quesenbery also does away with the often quoted "ease of use", which draws on familiarity and internalised behaviour, and uses them, in my opinion, as the basis for a repetitive design practice of 'tried and tested', and can even lead to 'dumbing down' in the worst case scenario. To change the emphasis from "ease of use" to "ease of learning" shifts the aim of usability testing from the user's performance regarding recognising the correct way to approach interaction encounters to exploring the user's developing interaction processes. Despite being slightly more progressive and making space for hedonic emotions, replacing satisfaction with engagement essentially leaves the original usability model intact as measurement of the user-experience.

This is possibly why John McCarthy and Peter Wright attempt to make a more radical move when it comes to integrating the role of emotions and engagement with the user experience. In fact in their work on "Technology as Experience" they aim

> to make lived experience with technology the primary reality in practice and comment on relations between people and technology, especially in HCI and Computer-Supported Cooperative Work. (2004, p.183)

In their view emotions are not only a greater or lesser part of an (interaction) experience, but the "emotional and sensual quality of experience ... should be central to our understanding of experience of living with technology. [...] We must understand the emotional response and the sensual quality of the Interaction" (p.13). Because this book is geared towards HCI practitioners a lot of attention has been given to addressing HCI's known predicaments such as the tendency to be "more comfortable with the laboratory than the outside world" and to acknowledge that "HCI and related disciplines are not used to dealing with experience" (p.6). It is a clear departure from the "hegemonic discursive practices of rationalism" (p.24) and cautions against treating the user-experience as a commodity:

> Employing the phrase "user-experience design" as a reminder or motivator to designers to pay attention to people's experience of technology is one thing. Employing the phrase to indicate that a particular user experience can be designed is another thing altogether. The latter suggests a return to the simplicity of a technologically determinist position on what experience is. (pp 9-10)

Many points in McCarthy's and Wright's thorough exploration of the experience by means of their reading of Dewey and Bakhtin correspond with my understanding of the integral user experience. They stress the procedural and relational nature of this experi-

ence as well as the role that emotions and engagement play. Also, they consider action and creativity embedded in a playful approach of experimentation and exploration (pp.68/9). Their work appropriates Dewey's notion of the aesthetic and prosaic experience. It is important to understand that the aesthetic experience in this context does not refer to art, art objects or "a museum conception of art" (p.58). Instead, they consider it as the potential of every experience to be enriched, meaningful, and whole. Every experience can oscillate between our ordinary everyday experiences and the potential it has to be fulfilling, surprising and creative. Therefore the aesthetic experience is continuous with the prosaic experience (p.57), it integrates "meaning and movement, involving all our sensory and intellectual faculties [and] is emotionally satisfying and fulfilling" (p.58). At the same time it positions "experience [as] a process of sense making" (p.17). Their argument – akin to Bergsonian thought – is that this perspective has further repercussions: considering the role of emotions makes experience contextual (p.8), participative (p.17), and irreversible as it is always situated and connected through the engaged self at the moment of encounter and action. In fact, the relationship between emotions and situated action and creativity is one of their key concerns. They note that the role of emotions is "currently underplayed in situated accounts of action" (p.9) and stress that intense experiences require "holistic engagement" (p.82), i.e. intertwined bodily and intellectual engagement. Though reluctant to state definitions or anything that sounds as if they are developing a theory of experience, they offer approximations, ideas, and "pragmatic tool[s] for thinking about' experience" (p.103). Hence we find that ideas about engagement, emotions and feelings are intertwined in and inseparable from the various angles they use to illustrate aspects of the enriched or aesthetic experience: it forms its rhythm through intensity, the rhythm of "the tension or release of engagement" (p.62). It is also the intense relation we form with the other through "answerable engagement" which is the "rich engaged responsitivity to the other" (p.67) including technology. Full engagement is only possible if the whole person engages: "The body, the senses, and the physicality of the technology are intrinsic to interaction" (p.82). Thus experience is embodied (p.82), temporary (p.85) and interpenetrates events beyond the immediate encounter (p.105). It is a world of becoming (pp.70/1) and constitutive of the primacy of action (p.21). In view of my own work on the integral user experience I welcome their initiative and agree that these concepts are key issues, and that it is important to make them part of the vocabulary that allows to discusses the user experience. Likewise, the shift from performance evaluations based on response times, be it interfaces or users, to the relations involved in interaction is similar to my understanding of an integral user experience. In-

tense engagement is a crucial aspect of the aesthetic and the integral experience because emotions and feeling are not simply conscious reflective responses to encountered situations but are also constitutive of action. Unfortunately, this is the point where they fall short of their aspiration to overcome reductive HCI thought. They position action and creativity not as the point of change, but as the space for reflexivity and adaption. The next section will look into this common misconception of traditional HCI: a purely functional view of interaction mistakes the mechanics of reaction and voluntary action in HCI to be identical: a click is a click is a click.

(Inter)Action: From reflexivity to creativity

Despite McCarthy's and Wright's emphasis on the emotional aspect in situated action and creativity, I would argue that the way they position emotions and the felt experience in practice reconfirms a technologically determinist position: emotions are solely viewed as responses, which downplays their energy and potential for an active impact of the user experience. This refers to a point I made earlier about interaction and action looking deceptively similar in HCI, resulting in a confusion between the mechanics of reaction and the voluntary nature of action in interaction. I will investigate several of the authors' examples to make this point clearer, as it is a common misconception in HCI practice.

McCarthy and Wright claim that the key to understanding the emotional aspects of the felt experience is that action is situated and creative (2004, p.17). However, in my opinion in their work action and creativity are positioned not as the point of change or difference, but the space for reflexivity. According to the authors, we are involved in an continuing dialogue with our subjective and partial perceptions of objects, people or representations which we complete "in relational activity, consummation of the experience is treated as a shaping or finishing-off" (p.73). Through this ongoing relational process we not only make sense of our encounters and the world around us, but also of ourselves. Moreover, we not only create our actions or responses but we construct ourselves: "In this moment the self is authored" (p.75). Through reflexive feedback loops we are creating the self by adaptation; i.e. we are reduced to the power to be affected. Despite emotions' capacity to act as indicators of needs and point at change (p. 22), when it comes to change, we seem to be reduced only to being able to change ourselves, instead of actively shaping or changing our experiences. This becomes clearer when we look more closely at McCarthy's and Wright's examples for the enriched or fulfilling experiences. Listening (and tapping along) to jazz, watching movies and or visiting art galleries can be highly absorbing or emotionally engaging experiences, but they are "passively absorbed through

our senses" (Pine & Gilmore 1999, p.31)[17]. So, despite McCarthy and Wright's focus on developing experiences with interactive technology, many of their examples for aesthetic or fulfilling experiences are based on passive participation. Observing and listening might be intellectually absorbing, but users don't create their experience during participation by overt action, such as executing an action that has not been pre-set. The view of activity as absorption in processes then extends into examples of experience with technology, which are mainly viewed through software interaction[18] such as Excel, a spreadsheet application, or web-access software as in chat rooms and an internet shopping experience of one of the authors. The authors state that some users might view the experience with Excel through a purely task oriented lens, while "for others it is a very enjoyable way of making sense of situations and events through creating and viewing patterns" (McCarthy & Wright 2004, p.69). Fulfilment here is a matter of individual interpretation; we choose to enjoy something or engage with something, or not. Pine and Gilmore refer to active processes of absorption as *Educational experience* (1999, p.32). One case study follows the authors experience spending over three days and a total of five hours of buying wine online from a badly functioning site, to illustrate the intensity of engaged pleasure and pain such as the pleasure of trying something new, relating to a wine buying community through their comments, the pain of waiting through long delays and anticipating crashes, and the frustration once the site actually does crash and all efforts so far are lost. This example views the role of emotions as responses and ignores their role in overt or voluntary action. Though grounding interaction irreversibly in the moment in which it occurs, interaction here is still as reactive as in traditional HCI. By equating passive experiences such as gallery visits, cinema experiences or jazz performances, with interactive technologies and software interaction they ignore the materiality of counterparts in interaction. In my opinion both examples easily afford playful or emotionally unifying action, or what Pine and Gilmore would call an *Escapist experience,* actively involved participation (1999, p.33): during the online shopping experience ways to act include emailing the webmaster about possible site performance problems, trying to find online reviews about this site and its performance, or information about the wines it features; finding another site that

[17] In employing B. Joseph Pine II and James H. Gilmore, authors of "The Experience Economy" I follow Jenny Preece's advice that, when it comes to users-experience design, the HCI discipline should seek inspiration and help from businesses with established knowledge when it comes to entertainment and immersive experiences than HCI.

[18] With the exception of POGO, a technologically enhanced learning environment for children. It is difficult to position POGO in this context. POGO acts as an interactive embedded editing suite to enable children to produce narratives, e.g. little internet videos. While creative processes are inherent in production and I don't doubt children will have created their own experiences with technology, the accounts of the project do not make it clear if that was the case. Due to the institutional framework there was an emphasis on the educational aspect, e.g. the teachers set structured activities, including timing, content and dynamic (McCarthy & Wright 2004, p. 99) and the creators of POGO stressed not to jeopardize successful pedagogic activities currently used in the schools, but enhance it. (Rizzo et al., p.189, in Funology, 2004). McCarthy and Wright focus on the sensual and spatio-temporal 'threads of experience' (e.g. bodily involvement and level of absorption) in their analysis of POGO, but admit themselves that this is a limited way to approach experience (p. 101)

sells wine online, or simply to abandon the site and buy wine from the local off-licence on the way home. Likewise, in Excel it is perfectly possible to create Mondrian-like images by typing rubbish data into the spread sheet columns and using a combination of graph functions. Finally we have to consider the examples from internet-interaction which are missing here, considering their work was published in 2004: blogs, ratings, and peer-to- peer communities, i.e. examples that view the user as active participants in creating internet content, an act I would argue, that can be fulfilling and classes as an "aesthetic experience [as] it is created in prosaic moments of answerable engagement" (p.67). In short, McCarthy's and Wright's investigation of emotions, engagement and experience remains inconclusive: Despite their excellent work on the importance of emotions in embodying interaction, this adds little to the realm of experience relevant to interactive technology: active user participation. The felt experience in technological interaction is limited to emotionally charged re-actions and responses to representations, which is still in line with traditional HCI thought. Likewise, in their account creativity only serves adaptation, serving to shift our perceptions of utility or enjoyment. Through some of the emotional accounts in their case studies the violence involved in interaction with technologically determined designs or representations is perfectly obvious (p.155). In my view interactive technology provides an area where the interplay between user (guest, participant) and technology can provide substantially different experiences compared to traditional media, because (user) activity is favoured over passivity. In this area users' creativity can have an impact, and they can act as co-authors of the experience. However, my point is not simple argument for the freedom of a liberal subject in software interaction, or a quest for more user-friendly solutions, as including users' activity or creativity will neither free users from the limitations and interferences in technical communication, nor make it any 'friendlier'. Rather it aims to give the user a more active role in this complex communication process in design *and* interaction.

Another point of critique on McCarthy's and Wright's work is addressed in the next section: In their work on emotions, they don't differentiate between conscious and non-conscious emotions, or note the ambiguity involved in relating to them through language or in the interaction between them. In the next section the work of Damasio helps to open up the complexities of emotions and feelings; in a similar way to Bergson he views the space between them as *zone of indetermination* or voluntary action.

The complexities of emotions

The following section briefly touches on how traditional HCI and surrounding fields subject the role of emotions to existing and established thought models, such as goals orientation, user adaptation, and computer optimization despite more progressive views in recent HCI research. Damasio's work has acted as source material in this regard, so I return to his work to look at emotions, feelings and affect more closely. The framework for this discussion turns out to run in parallel with Bergson's belief that bringing together schools of different thought benefits and complements them: Damasio's work shifts from solely focusing on the mind to the intertwined co-existence of body and mind, as for Damasio emotions are body and bodily actions. Feelings are the brain's way of knowing about composites of unconscious emotions, and so dealing with emotions opens a path to the unconscious. Damasio develops a hierarchy of emotions, yet at the same time illustrates the shifting layers within these hierarchies, and also notes the interaction between emotions and involved complexities.

Emotions have found various ways into the fragmented field of HCI. Even so, reductive, quantitatively orientated models still prevail in spite of more progressive models which have made a case for the complexity of emotions at play. Emotional Usability is an approach that tries to take into account how users feel and suggests methods like the Differential Emotions Scale or Semantic Differential for quantifying emotions and their intensity in order to integrate them successfully in business models (Mueller 2003). This approach assumes that we can accurately position emotions and that their intensity can be represented by a scale. Marje Geldorf makes a case for emotional computer-interaction: computers need to have affective abilities added as they need them for the practical goal of functioning with intelligence and sensitivity towards humans (2001, p.16). This approach views affective capacities as a means to optimize system functionality. Rosalind Picard who works in the field of AI, draws on the work of Damasio in her book "Affective Computing" (2000) to explain the role of emotions in perception and decision making and their necessity for rational thought (p.12). Similarly, Don Norman "addresses emotion as an additional internal component of the traditional information-processing model of cognition" (Boehner *et al* 2005, p.3). These approaches integrate emotions as supportive of or as possibilities to optimize traditional HCI goals or outlooks, but don't investigate emotions on their own merits. Visibility is still a key issue for Don Norman: "we now have evidence that aesthetically pleasing objects enable you to work better" (2004, p.10), and like Picard he refers to Damasio's work on emotions' role in decision

making. This reductive view of the role of emotions in relatively recent publications comes as a surprise considering the fact that Aaron Sloman and Monica Croucher positioned emotions with respect to motives in a much more powerful role in the context of computer science more then 25 years ago. Sloman & Croucher replace the simple belief "that all decisions are based on the goal of optimising something measurable called `utility'" (1981, p 12) with the complexity of multiple motives, which are in constant flux through their interaction with secondary motives, like desire and preferences. This flux is facilitated by emotions; emotions act as interrupters which change or modify behaviour when change is needed. Though partial and incomplete as knowledge and despite the presence of multiple motives they enable intelligent systems to cope with an uncontrollable and unpredictable environment. As early as 1962, prior to Sloman and Croucher the work of Silvan Tomkins in the area of psychology positions emotions not as a response to, but as the cause of, something happening. Izard postulates, referring to Tomkins in related work, "that the affect system is the primary motivational system" (Tomkins & Izard, 1964, p.19) For Izard the motivational properties of affect constitute a fluid layer in the subsystem of human personality with self-generating motivational properties; its complexity goes well beyond the simplicity of a stimulus-response mechanism (ibid).

Damasio's work too gives us a glimpse of the complexities of emotions at work. His systematic approach through evolution can help us to disentangle some of the confusion between emotions and feelings. Similar to Bergson in *Matter and Memory* in introducing of the zone of indeterminacy, Damasio develops an evolutional history that illustrates the biological role of emotions to instigate bodily action. Emotions are automatic reactions or non-conscious actions of the body serving to maintain its well being, ranging from very basic levels in simple organisms (e.g. metabolism, reflexes) to high levels in complex organisms (emotions proper e.g. joy, fear, shame, etc). Yet not only do the layers of the highest level interact with each other (i.e. background, primary and social emotions), all levels are constantly influencing and affecting each other. Eventually evolution introduced a layer exclusive to humans: the of the level of feelings, the level where emotions make themselves known to consciousness (Damasio 2003, pp 28-50). Yet this layer is quite elusive to science (pp. 3-4), meaning that there is no directly corresponding brain or bodily response that can be measured. Two conclusion follow from this: Firstly, unless there is relevant equipment at hand (and expert scientists such as Damasio), our emotions can't be accessed directly; we need to rely on the interpretations through our feelings. Feelings escape equipment and scientific access, they come to us as fluctuating compos-

ites of a multitude of body states such as energy, fatigue or malaise (p.88) through "ever changing picture[s] of life on the fly" (p.7). In addition our interface to feelings through language mirrors this temporality and ambiguity. Terms that attempt to categorize feelings are approximations and much argued over (Goleman 1996, p.289/90). Secondly, as feelings operate in consciousness we do have access to them, so "feelings open the door for some measure of wilful control of the automated emotions." The development from simple to complex organisms seems to have installed "emotions [...] to respond effectively, but not creatively" to the encounters of daily life. Feelings introduce a way to control emotions and by interacting with "past memories, imagination and reasoning" they lead to the "possibility of creating novel, non-stereotypical responses" (p.80). Like Bergson, Damasio views the space between emotions and feelings, between automatic and voluntary action as the space for human creativity.

Let us look closer at the non-conscious level of emotions such as the immediacy of some non-conscious emotions, non-conscious perception and the role of emotionally competent objects. Damasio looks at high-level emotions to explain emotions that regulate social behaviour; behaviour that regulates how we interact with each other. Social behaviour is not confined to humans and social emotions regulate behaviour in the absence of language or consciousness. So, worms as well as bees display social behaviour. The difference between simple and complex creatures is that complex ones can add acquired emotions to the innate emotions (pp.46-48). These conditioned emotions have the potential for immediate action, to bypass conscious thought, which enables us on the one hand to deal with repetitive situations efficiently, like changing gears while driving a car, on the other to react very fast when we don't have time to think, for example when we need to remove our body from danger. This is where HCI at the moment puts intuition. The flipside of unconscious action presents a challenge for traditional HCI thought: We not only react unconsciously, we can also perceive unconsciously. Certain brain regions, such as the amyglada, "become active when they 'detect' [...] emotionally competent objects" (Damasio 2003, p.57/8). Emotions are constantly monitoring and evaluating objects around us, sometimes unconsciously, sometimes in tandem with the consciously thinking mind (p.54). "We process not only the presence of an object but its relation to others and its connection to the past" (ibid). Simple everyday examples are hearing our name at a party while actually being involved in a different conversation, or immediately focusing on slowing down a car when a ball rolls into the street (Claxton 1997, pp.100ff). So, the unconscious detection leads to a complex internal process that can "reverberate and am-

plify itself" to "become an emotion", or "shrivel away and close down" (Damasio 2003, p.58). By the time we are adults, most objects around us have become more or less emotional competent objects (ECO) to us. The advantage of this mechanism is, no matter "whether one is paying attention... subsequently, attention and proper thought *can be diverted to those stimuli"* (p.61, emphasis in original). This challenges the traditional HCI assumption that perception is solely a cognitive and conscious process, and puts the body before the mind in the chain of events during the interaction process. So, emotional attention is dependent on the presence of an emotionally competent object (ECO) or stimulus, like a key-lock mechanism. "Note that they [ECO's] select a preexisting lock, rather then to instruct the brain on how to create one" (pp.58-60). I would like to present this fact as a challenge to HCI design, although not in the literal sense that designed objects are presented to wired-up bodies and the results measured; besides, all of the processes involved are more complex than my short summary makes them out to be. Nevertheless, I can imagine ECO design as an emerging design aspiration in progressive HCI, as an additional layer to UCD so to speak. Despite the slight irony about HCI's love for acronyms in this suggestion, there is a serious point too. Designing emotionally competent objects does not only relate to interaction objects or interfaces, and is definitely *not* an argument for visually richer interface design. As we see later in my interaction experiments, design for Intuitive interaction extends into the functional layers of web-applications. More importantly, ECO design is put towards HCI practitioners as a challenge to transform themselves from detached observers into emotionally competent collaborators in the design process, which will in turn become evident as a quality in interaction process. In other words, this is an invitation to practitioners to view their practice as a creative rather then a functional discipline, aiming at guarding safety and quality control. Also, emotions are highly intertwined with cognitive processes, and can be triggered by thoughts and memories i.e. they play a role in learning, which is another reason why I view emotional competence to be a recommendable HCI consideration.

> "As things stand now, the amyglada has a greater influence on the cortex, then the cortex on the amyglada, allowing emotional arousal to dominate and control thinking" (LeDeux 1999, p.303).

Through Damasio's work we are in a position to deal with affects conceptually in a more sophisticated way, as well as getting closer to Bergsonian thought. The terms that are currently used synonymously actually point at different aspects of intangible issues in interaction. Damasio uses affects as an umbrella term to cover both emotions and feelings (p.150), feelings are the conscious partners of emotions (p.80) or their shadows (p.6/ 29), they create a potential space for novelty, change or creation. Feelings are our interface to

emotions, yet not a necessarily precise one. Emotions are the unconscious and automatic "actions and movements [...] in specific behaviours" inside our bodies (Damasio 2003, p.28). Both have their own complexities: emotions are in constant drift and flux interfering with each other in more or less complex processes to regulate internal and external body reactions. Feelings are part of a complex machinery that is "itself a contributor to the processes of consciousness, namely to the creation of the self" and involved processes are "multi-tiered and branched" (Damasio 2003, p.110). To complicate matters further, conscious and unconscious complexities both interact and mutually change each other constantly during the unfolding of a feeling (p.132). Damasio's work on emotions and feelings is a good starting point for us to think in a Bersonian and integral way about the issues at hand: Damasio puts body and mind, consciousness and unconscious, emotion and feelings side-by-side; yet they are not opposing dualities but highly intertwined complexities. These complexities resonate with Bergson's multiplicities; emotions and feelings are virtual multiplicities, they are heterogeneous interpenetrating intensities that differ in quality, not in degree. He also views the interval between emotions and feelings as the interval where wilful or voluntary action takes place. The integration of this interval between emotions and feelings in turn makes space for a qualitative notion of time, which I often refer to as 'experience time'.

Integral intuition, the third concept: time

The following section will continue to resonate with the themes discussed in the last section, but will also add some raise others, such as confusion, exploration, vagueness and creativity. Most importantly, it will shift the surrounding framework of the discussion from the quantitative efficiency of the stop watch to the qualitative richness and productiveness of experience time.

The continuation of this investigation of intuition changes between fields that can act as source material to HCI, and moves from neuroscience to experimental psychology. Guy Claxton, professor at the learning science department in Bristol, UK, writes in particular on implicit and unconscious learning and creativity. As discussed earlier, "learnability" or effectiveness of learning" is one of the original usability requirements (usability.gov; Nielsen 1996; Shackel 1990 in Preece 1994; Shneiderman 1992), so his work is relevant for two reasons: Firstly, HCI's interest in learning processes benefits from Claxton's ideas regarding unconscious learning, and secondly because of his works affinity to a 'Bergsonian' qualitative view about time as unhurried duration. His first step is to introduce the space for intuition to occur in a "third speed of time" as in slow time. Claxton is

not the only one to popularise studies on intuition (see Gladwell 2006, Myers 2004), but he has taken a different mode of time into consideration in this context. This sets the scene for discussing various intensities of unconscious learning, as in implicit and unstructured learning, its relation to playful exploration, contemplation and rumination, for the conditions of creativity and how intuition interacts with other modes of thought.

Claxton's book entitled *Hare Brain Tortoise Mind* starts by introducing a third speed to accompany the fast speed of immediate intuition, of the *hare brain* or automatic reaction, and the speed of deliberate thought, which he calls 'D-mode': the slow speed of gestation in the 'tortoise' or 'undermind' (1997, p.7). This is the unconscious counterpart to intuition as HCI understands it at the moment: sometimes erupting, out of the blue or suddenly without even thinking about it. Immediate intuition can also arise from physical practice: "Neither a concert pianist nor an Olympic fencer has time to figure out what to do next" (1997, p.2). Bergson calls this kind of memory a "motor habit" of the body, a memory that is repeated automatically (1988 pp.82-84). True intuition on the other hand, emerges in an alternative timeframe, in slow or experience time: unconscious knowledge develops at its own pace, provided it is undisturbed, unhurried and surrounded by relaxation and patience (Claxton 1997, pp.2-8). Claxton emphasises that slow time stands for a certain quality or mode of time rather then being a measurement for slow passing time: it is a kind of gestation time that comes with connotations of protection and nurturing. However, it can also act as a kind of impulse, that shifts our time mode: "paradoxically, thinking slowly does not have to take a long time" (p.214). D-mode, on the other hand, channels the brain into familiarity of repetitions by applying time pressure (p.214). Claxton argues that by its power of intuition, the slow undermind can tackle problems that defy the purposefulness of pragmatic thought, and that the value and productivity of slow developing and intuitive knowledge has been neglected due to a focus on deliberate and conscious thought (1997, p.13). A united view of the conscious mind including the 'undermind' helps to understand of the subtle interplay between clarity and confusion (1998, p 219), and the conditions of creativity. In developing this argument he summarise numerous case studies and research papers on the subject.

In a similar way to Damasio and Bergson, Claxton positions various levels of implicit or unconscious learning as steps in the evolutionary history of complex organisms. Fish can detect, register and make use of patterns like rock formations to avoid the dangers they might face at low tide. The next step up is moving from passive pattern reception to active exploration through curiosity: rats as well as monkeys are pro-active when it comes

to interaction with their environment "Being receptive, attentive and experimental" are evolutionary functions built into the brain, and unless there are more pressing issues at hand, no further encouragement is needed (pp.18/9). Humans have the same ability to form unconscious knowledge as the following experiments show. Diane Berry and Donald Broadbent[i] took problems like managing traffic control, school budgets, and factory production problems to the test by simulating them in computer games. Trainees were able to make the necessary adjustments in this complex task relatively quickly, but "the ability to articulate that knowledge emerge[d], if at all, much more slowly" (pp.22/3). So, "[g]iven a complex practical task to perform, expertise develops well in advance of the ability to explain or consciously detect patterns of information." (Claxton 1998, p.217) Several more studies that support theories of implicit learning are provided in the work of Pawel Lewicki, who researched emerging unconscious with pattern recognition through visual stimuli on computer screens[ii], and Reber's essay 'Implicit Learning and Tacit Knowledge'[iii], gives a summary on other work in this area. A frequently quoted study that focuses specifically on unconscious knowledge escaping cognition and conscious articulation, has been provided by Nisbett and Wilson (1977) called 'Telling More Than We Can Know': Verbal Reports on Mental Processes" (Claxton 1997, Gladwell 2006, Myers 2004). Gladwell expands on one of the studies they cite, namely the swinging ropes experiment by Norman R. F. Maier[iv]. In this experiment, Maier showed that when participants were asked to comment on how they arrived at an implicit solution, to put it simply, they made it up (2006 pp.69/70, see also p.155). This means access to implicit processes, even to our own, proves to be difficult. The problem of extracting tacit expert knowledge in a structured way so that it could be put to use in computer system has also been discussed by Winograd and Flores in the context of AI. They too don't see it as a problem of communication though; rather they "see that experts do not need to have formalized [or explicit] representation in order to act" (1990, pp.98/9). This is also why participatory design resorts to prototypes, card sorting and other game like activities to extract knowledge which escapes oral articulation.

Implicit learning (passive & unstructured learning) seems to be superior to explicit learning (structured and rational learning) when it comes to managing situations that involve complex patterns of contingency (Lewicki, Hill & Czyzewska in Claxton 1998) and counter intuitive complexities (Berry & Broadbent 1984, in Claxton 1998) because temporary states of confusion are tolerated better if we don't try to prove "a conscious hypothesis" (Masters 1992, in Claxton 1998). An informal example for this would be the

interaction that occurs when children and adults deal with a 3D puzzle,or a Rubik cube. Children with their playful (unstructured) approach generally master the task much better then adults who not only fail to master the task with a rational - explicit (active structured) approach, but get very frustrated in the process (Karmiloff-Smith 1992, in Claxton 1998; Claxton 1997, pp.28-30). At the same time, the power of implicit learning is directly dependent on its position in (unhurried) experience time or gestation time. Once the condition changes its power diminishes. In another experiment, Schooler and associates[v] required the participants to think aloud while solving mind puzzles. One group was dealing with analytic puzzles, the other ones with insight problems.[19] The group that dealt with analytical problems had no problem commenting on their reasoning; members of the group that dealt with insight problems however frequently paused, and the pauses grew longer and sometimes there seemed to be nothing going on in the participants' mind. (pp.88-91). Schooler commented in his paper

> 'Verbalisation may cause such a ruckus in the "front" of one's mind that one is unable to attend to the new approaches that may be emerging in the "back" of one's' mind.' (Schooler *et al.* in Claxton 1997, p.90)

There might be an insight here regarding a qualitative testing method in HCI, called the "Think aloud protocol"[20]: it seems that verbalisation during interaction can not so much *share* the inner experience, but *interfere* with the sense-making process. I will talk about possible repercussions of considering intuition on HCI practice later on. For now, it seems that a change of the context of intuition in regards to time, from slow speed to the urgency of D-mode, affects unconscious knowledge forming. Deprived of its pace it resorts to interrupting explicit and cognitive processes, in turn the dips and delays during the verbalisation make space for the workings of unconscious processes or they cease to work.

There is another reason why we should respect this space of unconscious processes along with its particular requirement in regards to time: it is precisely the space for potential creativity. Though creativity's energy is more active than the passivity of implicit processes - it takes a different direction, and it does interact with consciousness through insights - they are intimately connected to each other, with both relying on a timeframe of slow speed, patience and an unhurried, relaxed ambience. Claxton uses a case study to illustrate the process of creation which unfolds in a way reminiscent of Bergson's method

[19] Insight problems are those where all information is available, but the solution requires a little 'twist' like crossing the boundaries of the rectangle that frames the puzzle.

[20] The Think-aloud protocol is a method used to gather data in usability testing in product design and development, in psychology and a range of social sciences. These protocols involve participants thinking aloud as the are performing a set of specified tasks. Users are asked to say whatever they are looking at, thinking, doing and feeling as they go about their task. This method was developed by Clayton Lewis (C. Lewis and J. Rieman, Task-centred user interface design, an introduction", and further refined by Erickson & Simon (1980, 1987, 1993) (Think-aloud – Wikipedia 2008)

of intuition. The case study interprets an autobiographic description by Herbert Spencer, a nineteenth-century English philosopher[vi] and his approach to developing insights. First Spencer describes how he would resist the temptation to try to find a solution by determined effort, because "an effort to arrive forthwith at some answer to a problem acts as a distorting factor in consciousness and causes error". Rather he would enter a mode of "quiet contemplation ... [to] allow those proclivities of thought [...] to guide the mind in the right direction". By allowing the mind to take this excursion, the mind would eventually find the right conclusions (Spencer 1952, in Claxton 1997, p.49). If we remember, Bergson speaks of the violence the mind has to do to itself to reverse the direction of customary thought (1913, p.51). Following the continuity of durations (p. 49) is a matter of allowing the 'proclivities of thought' and eventually new concepts emerge as "from intuition one can pass to analysis" (p.42). Claxton points out that this process of creation is an inward movement; it is the reprocessing of existing information, and reveals the minds ability to "discover over time new patterns and meanings within the information it already possesses" (Claxton 1997, p.49). This inner exploration is also an active, ruminative movement, as opposed to the passive pattern recognition of our environment which Claxton sometimes calls "learning by osmosis". This means that in intuition - as the mode of creation - implicit knowledge, or regressive memory as Bergson calls it, which usually escapes conscious thought, has a chance to come forward and reach consciousness. Again, working in slow mode does not necessarily require a long time. Creation has a fast acting, spontaneous relative: serendipity, the sudden novel connection of familiar information, producing unexpected, surprising insights. Intuitive or implicit knowledge forming, therefore, acts a precursor to the potential creativity and serendipity. In intuition, this unconscious knowledge can be actuated, always provided it is sheltered by gestation time that comes with connotations of protection and nurturing.

While Claxton clearly contests the "widely held assumption that D-mode is the most powerful mode of thinking" (p.49), his work on intuition stands for overcoming an either/or position and moves it on to an intertwined co-existence. He claims that we need "a more accurate understanding of the nature and status of intuition: one that neither under nor overvalues it" (p.50). He is not alone: David Myers (2004) weighs up the pros and cons of intuition. Besides intuitions relevance to non-conscious learning, expert learning, and tacit understanding he mentions *creativity* as spontaneous appearance of novel and valuable ideas are a possible outcome of this subconscious learning. *Social intuitions* are our effortless spontaneous trait inferences, moral intuitions our contagious moods, and

because of our capacity to divide our attention we can process large amounts of information that return as intuitions, as we don't remember learning them in the first place. Myers also lists the 'perils' or misreadings of our intuitions: often enough we don't know why we do what we do, and misprediction of our feelings and behaviours: we badly mispredict the intensity and duration of our own emotions and consequently mispredict how we might behave in certain situation (2004, p.127/8).

Jerome Bruner uses intuition to propose a more inclusive teaching model in the form of a spiral curriculum as an alternative to a model that adheres to a reductive "computational view" (1996, p.119), and Malcolm Gladwell, similar to Claxton, focuses on the power of intuition to counteract a view that decision making is a rational process and uses scientific research to prove it. Yet he clearly points out how fallible snap decisions can be if not grounded in expertise or long standing experience. Therefore, I can only read the following attack on this work by Peter Morville, one of the top selling authors on Information Architecture (IA) on the internet, as Morville having fallen victim to his own fears:

> In "Blink" Malcom Gladwell [2005] puts a positive spin on what he calls "thin slicing" or "the ability of our unconscious to find patterns in situations and behaviour based on very narrow slices of experience" (p.23) He contends that "if we are to improve the quality of the decisions we make, we need to accept the mysterious nature of our snap judgements" (p.52). I disagree, thin slicing is not infallible. It can have disastrous, regrettable results" (Morville 2005, p.157).

In this example, "thin slicing" refers to a form of social intuition, or a rapid unconscious understanding of social relations through bodily or facial micro-emotions. Yet, Gladwell's aim is not for us to accept snap decisions as the preferable form of decision making. On the contrary, he states that the expert on this, Dr John Gottman, can "thin slice" behavioural patterns between couples within minutes, only *after years and years of practice!* Likewise in the preceding chapter "the statue that didn't look right" in the same publication, the *world's foremost experts* were able to spot a fake statue in seconds. So, even though a rapid judgment, which preceded analytic thought, was formed and uttered in seconds by simply looking at a statue or a video, it was the result of conscious and unconscious learning over a prolonged period of time. Snap decisions can act as an interface to intuition, but are not reducible to it. To collapse into and judge the whole process by the brief moment of its instantiation is precisely why Claxton (and Bergson) reject a sole view of time as metric and spatialised time, and went to some length to introduce a different mode of time slow time, gestation time, experience time and duration. I do agree on one thing with Morville: It seems he has made up his mind about Gladwell's work and

the value of intuitions shortly after the first chapter, while chapter three starts on case studies that produce fallible intuitive decisions; a snap decision with a regrettable result indeed: His 2005 publication re-inforces an image of enlightened man, that overcomes the passionate grip of the amyglada. He finds no consolation in the fact that intuitive ways might be biological or social: "The wisdom of crowds does not negate the value of bright individuals and informed decisions" (Morville, p.158). Personally I see the work on intuition as useful in raising awareness about how people make decisions and how this is part of social interaction, so that researchers, like HCI practitioners, understand that they can not assume a purely rational decision making process. Claxton adds, that even if snap decisions are wrong, they deserve "serious, but not uncritical attention" (1997, p.50) Gladwell illustrates how "wrong" snap decisions can point towards practices of culture, in this case towards gender and race (2006, pp.92-96).

Exploring the various elements in intuition helps us to enlarge our vocabulary and to deal with the space that has been opened by an integral understanding of the user's experience. Intuitions come in various shades in relation to HCI: there is passive browsing, more active exploration, and in its most active form it is creation. Positioned in the dips, delays and intervals between actions, they redefine those intervals or spaces between actions: they are not voids that suspend us (Bergson 1913, p. 48), or failures to react to, understand or perform. On the contrary, these are spaces where we might contemplate our latest or next moves, consider a different approach or simply take a break from goal or utility orientated linearity to allow for the workings of the unconscious. They bear the potential of creativity and resulting action, but also the potential for the actions that happen in the same time frame: unconscious perception, passive absorption, playful exploration and active sense making. The next step is to find out how we can relate this knowledge to interaction, and the experience with technology.

Berrypicking, an integrated approach of explicit and implicit interaction

Marcia Bates' work features an inclusive (or integral) view of the way humans gather information in IR. Her model works through an evolutionary approach that includes not only the social or ambiguitiy, but also intuition in the shape of random dips.

Marcia Bates coined the term "Berry picking" to describe search behaviour in information retrieval (IR) environments. It challenges the traditional IR model in four areas: (1) Nature of the query, (2) Nature of the overall search process, (3) Range of search techniques used, (4) Information 'Domain' or territory of conducted search. Queries are not static; according to Bates research, in the process of searching users constantly shift be-

tween focused search behaviour and less focused browsing behaviour. The search direction doesn't follow a linear path, instead, every time users come across a new piece of information they get new ideas and follow a new direction, which means that

> at each stage they are not just modifying the search terms used in order to get a better match for the query. Rather the query itself (as well as the search terms used) is constantly shifting, in part or whole (Bates 1989)

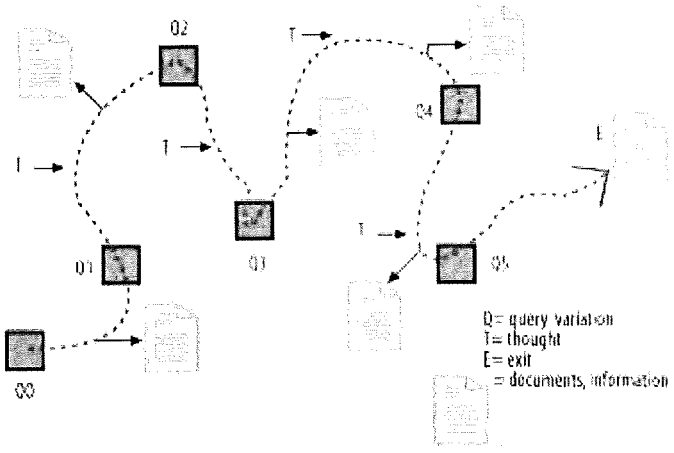

Figure 3.1. Marcia Bates' Berrypicking, evolving search (Morville 2005, p.60), also in Bates 1989

Berrypicking is therefore the concept of an evolving search, which unites the directed goal oriented search with unfocused and more relaxed mode of browsing. At the same time users pick up useful information at every single stage, which means that the findings are also not a single search result, but a multiplicity of "selections at each stage of the ever-modifying search. A-bit-at-a-time retrieval of this sort is here called *berrypicking*" (Bates 1989, emphasis in original). The inclusion of browsing as part of the method opens search methods to a whole host of new possibilities, allowing the users to 'jump around' in information and stray from the original query, yet users usually stay in the vicinity of the original topic. Bates recognises "there is still a lingering tendency in information science to see browsing in *contrast* to directed searching" (1989, emphasis in original), therefore a large part of her paper deals with suggestions on how to provide for browsing behaviour and potential online solutions in information retrieval (IR) environments. Her list of key advantages of browsing is quite controversial and challenges conventional IA assumptions about interaction with information: users should be able to "jump the rails" of classification, something which avoids an early focus, and an easy overview in terms of general subject matter similar to snapshots; "area scanning" (inspired by physical visual scanning of library shelves) which allows for random dips and moves between chronological, topical, or a-z author systems and the subsequent accidental connections sometimes produce serendipitous discoveries; "flipping through books" to

get a gestalt sense of the "feel" or character of the author and his or her approach. Finally, a "citation browse" which applies a citation to potentially unrelated subject areas quite often inspires creativity though serendipitous connections, as the line of thought might create an unconventional grouping and footnote scanning allows backtracking the roots of an information source. Berrypicking therefore introduces the concept of semi-directed searches, an integral view of search behaviour that consists of less purposeful yet topic related browsing. Bates stresses that Berrypicking is not browsing, but in order to support Berrypicking better provision for browsing is needed. Berrypicking is notably different from Salton's[vii] idea of iterative feedback to improve the query, as this idea "is still well within the original classic model [of IR] as the presumption is that the information need leading to the query is the same , unchanged throughout, no matter what the user might learn" (Bates 1989).

Document > Document representation > | Match | < Query < Information need

Figure 3.2.: recreated from "The Classic information Retrieval Model" (Bates 1989)

In reference to my work, I believe that Berrypicking serves as an excellent example of how inspiration through an extended notion of intuition could help to make an integral user experience possible. The shift from directed to less directed searcing opens spaces for implicit forms of learning: Area scanning allows for a mix of passive and explorative unconscious learning: through scanning related areas the original focus widens, random dips into the enlarged fields form unconsciously established patterns by taking high-level 'snap shots' to get a 'feel' for the work or the author. Bates essentially includes what I call intuition when she states "Whatever this feel is, it is almost never accessible through any classification or subject description" (1989). Footnote chasing and citation search extends the evolutionary theme into information: How did information emerge from past sources, and how will it further develop in the future? It transcends a simple view of forward and backward chaining of individual references by looking into the context of reference lists which are potentially unrelated or form an unconventional grouping, which in turn could spark serendipitous or creative connections. One could refer to this de- and recontexualisation as defamiliarisation, a technique used to break habitual thought or practice in order to inspire innovation in designers (see Leong, Howard & Vetere 2008). So, both mechanism help to expand or displace closed subject areas into potentially unrelated context areas, which might stimulate creativity or serendipity.

Bates' seminal research on search behaviour, i.e. Berrypicking has finally made it into mainstream IA (Information architecture) literature (Morville 2005, Morville and

Rosenfeld 2007) 16+ years after it was first published. However, it does so in a manner that is symptomatic of my personal dilemma with traditional HCI practice. Hence on this occasion I take passionately sides. Any innovative research is viewed through the lens of the existing instrumental practice, so the incorporation of these studies reinforces and re-establishes already existing methodologies and concepts, instead of instigating change and progress. I will briefly expand on a few points before I move on to some more thoughts about engagement. In "Ambient Findability" Morville credits Bates for forming IA's understanding of information seeking behaviour, yet his citations and interpretations don't substantiate this. In my reading Bates makes strong points for the unpredictability of users' search behaviour, their tendency to find their way through zig-zagging and to make random dives into the information space, constantly interrupting their path though change of action rather then by continually following a linear path of iteratively optimising thier search; users leap forward and backward in time with citation and footnote tracing, they sample in an ambiguous fashion, make space for serendipity and creativity and they engage with a subject matter while trying to get a feel for it in multiple ways and angles. Morville mentions the iterative character of Berrypicking, but fails to point out how this supersedes Salton's idea of an iterative search which aims to optimise a single query. He notes as "relative documents tend to be scattered, users move fluidly between search and browse modes" (59, Morville) implying that users knows about this scatteredness in advance and cleverly adjust their path rather then acknowledging that the user also produce the scatteredness while creating their path.

Morville concludes his discussion of Bates' research on search behaviour by pointing out that in her excursion into evolutionary psychology and information science she laid the basics for Peter Pirolli's concept of Information Foraging, which is an exaptation from food foraging; an (unproven) theory that argues that we gather information in a similar way to how our predecessors gathered food. One interesting aspect of Information Foraging is the notion of Information Scent (IS), an idea that allows for vagueness in search behaviour: animals might follow the vagueness of scent in their food hunt; we follow partial information and cues in information foraging. Pirolli & Card's view however is more quantitative, they actually define IS as "the value of information gained per unit cost of processing the source" (Pirolli & Card 1995). This value can be tested as part of usability evaluations (Saward, Hall & Barker 2004). While I see the idea of information scent as a potential way to integrate implicit aspects in interaction, the authors consider that it is just another model for measuring and predicting user behaviour. Against this I would argue

that Bates' excursions through evolutionary theories lead inherently to the larger human context of social, emotional and even spiritual needs and provide a comprehensive understanding of human learning as predominantly implicit learning (passive awareness) through social structures as opposed to the idea of a purely goal driven "rationally bound" individual. Despite presenting strong evidence for socio-cultural changes through and on the internet throughout his book, Morville shows a constant need to rein back field related progressive research in order to prevent divergence from the view of the human as predictable and rational and reinforce a view of that the non-rational aspects of the mind show the perils of irrationality:

> "We ask the wrong questions, we trust the wrong sources. We substitute data for optimism. And we are influenced by peer pressure and groupthink. Decisions shape our lives, and yet they are often made in the dark, beneath the comforting veneer of rationality" (Morville 2005, p.157)

Bates answer to this is clear in her paper on "An Integrated Model of Information Seeking and Searching" (2002). "In my view, our understanding of information seeking is not complete as long as we exclude the biological and anthropological from our study". She also looks at the human species holistically as being "physically, biologically, socially, emotionally and spiritually" constituted (Bates 2002) and envisages all of these layers of understanding interacting with each other. Her evolutionary approach leads her to conclude that information inherently comes to us in passive way and is rarely intercepted by Berrypicking, the active approach to information searching. Berrypicking relates to prehistoric hunter-gatherer activities. She identifies four modes of information seeking which expand on her 1989 model of Berrypicking:

	Active	Passive
Directed	**Searching**	**Monitoring**
Undirected	**Browsing**	**Being aware**

Figure 3.3. Modes of information seeking (Bates 2002)

To give an idea of the dominance of passive information intake she estimates 80% is being aware and monitoring, 19% is browsing and 1% of the time we actively search. In view of the information overload of the last 200 years (Bates 2002), and of the last 20 years in particular, she concludes that a combination of built-in functions like the conservation of energy and passive information absorption explains falling back on social mechanisms (asking others, using information in close proximity) as means of energy efficient information retrieval. Finally she points to several other meta-theories regarding

information seeking and learning, and comments on their struggle for dominance that this struggle is a feature that needs to be embraced rather then sorted. Each of those meta-theories offers different viewpoints, and the dialogue between the various strands "constitutes a wonderfully enriching means of understanding the human experience" (2002). I wholeheartedly agree that this kind of dialogue and the opening up to differences and diversity could help HCI to evolve as a discipline to deal with the forever increasing complexities of merging software, entertainment, technologies and their use in multiple and changing environments. The constant struggle amongst various strands in the HCI domain indicates that diversity is established and I agree with Bates' advice to embrace it as a potential. A reductive simplification will not help to solve the problems that arise from software penetrating every aspect of western modern life, as Fuller puts it: "Software is always an unsolved problem. We need ways of thinking into an activating this process of becoming, rather then some 'kinder' or more 'creative' design (2003, p.15).[21] An enlarged understanding of intuition opens up to the complexities and unruliness of unconscious knowledge forming and decision making, as well as providing the necessary context for users' situated creativity and/or serendipity, and could serve as a first step towards this aim. Bates' models and suggestions are a working example, that through awareness of and making space for intuition integral user experiences can be possible. Extending Bates model of information seeking modes helps to map some of my design experiments, but not all of them. In order to cater for information creation too, as well as the role of users' creativity, I would suggest the following augmentation:

Information access	Active	Passive
Create information	***author***	***contemplate***
Find information Directed	**Searching**	**Monitoring**
Find information Undirected	**Browsing**	**Being aware**

Figure 3.4.My adapted version of Marcia Bates modes of information seeking, italics denote my additions

This helps to position various forms of intuition as well as to situate my design experiments. The added layer on the top stands for creative or productive modes of information, either active (my experiment Build-Your-Own-Menu (BYOM) explores this scenario, where users can co-author interfaces) or contemplative, where existing information is re-arranged in the process of sense making or even in original or creative arrangements (during evaluation I made a point of not disturbing these phases of contemplation or possibly

[21] I interpret the use of the term creativity here as a design concept producing pre-determined solutions, not an emerging quality of experience, which is how I use it subsequently.

creative modes). Directed searches are well covered by existing HCI literature. Passive monitoring is another shade of intuition which is explored in my Flick-though-browser, while the Colour-Space Explorer investigates active undirected browsing. However before I move on to my practical work, I would like to mention a few of the consequences of the above discussion for HCI.

Consequences for HCI

It is not my aim to lay out specific instructions or develop an exhaustive HCI design methodology 2.0. Also, investigating intuition in this context does not simply extend emotions' recognised role in engaging user experiences into exploratory interaction behaviour, or the usability dimensions 'satisfaction' and 'ease of learning'. Complementing traditional HCI models with qualitative aspects of experience affects all usability dimensions; moreover it also overcomes underlying fundamental thought principles "based on [the] philosophy of the pre-1930's", e.g. instrumental abstraction and scientific rationality (Dourish 2001, p.vii). This section therefore revisits concepts, research and studies considered in both the second and the third chapter to bring them together and create a more systematic account of how an integral view of the user experience can open up and evolve the HCI discipline. Evolving here does not mean an optimised iteration, but a capacity to embrace emergent unpredictable moves and the creations that users make in internet interaction, and to accept Human-Computer Interaction as part of a larger set of interactions amongst technologies, cultures, and social relations.

Throughout this chapter it should have become clear that contrasting a functional view of interaction with Intuitive interaction does not create new binaries, but instead allows for Bergson's 'absolute' or an intertwined view. This view opposes simplifications and abstractions of interaction and their design processes, and unfolds into a multifaceted network of complexities, encompassing not only users and interfaces, but also the interplay between interfaces and underlying media, and the various technologies. The excursion in chapter two into media and interface theory and contemporary philosophy acted as tool to discover and illustrate these complexities. It also provided concepts which overcome rationalistic thought on several levels. Moreover, it demonstrated the struggles of various power mechanisms in the interplay of these multifaceted networks as well as the productive forces of those struggles. In the first section of chapter three Bergson's concept of intuition was introduced, which he positions as a method of creating new concepts or thinking differently, i.e. supporting creative thought. Foucault's and Bergson's work both point at the productive energies in heterogeneous or networked ensembles; Bergson's no-

tion of intuition in particular embraces their emergent properties in human experience. His heterogeneous or qualitative multiplicities relate to the inner or virtual life, and memories, emotions and feelings are part of these multiplicities. So, exploring emotions and feelings is one way to access the complexities in human interaction, at the same time this forms a meeting point with HCI's interest in how humans gather knowledge and learn, as expressed in the usability dimension 'learnability'.

However, investigating the role of emotions more closely reveals that not just one but all dimensions of the usability model are affected by their conscious and non-conscious workings. Moreover, considering that emotions have repercussions for the framework this traditional usability model hinges on, such as assumptions about users' motivations and processes during interaction influenced by rationalistic ideas as well as by the simplicity of cognitive models in terms of interaction as stimulus-response mechanisms. So, if the difference between usability considerations and user-experience design is the integration of human emotions like fun and enjoyment, then the difference between user-experience design and an integral view of the user experience are the larger effects of the qualitative aspects of emotions on this usability model and its framework. Over the next sections it should become clear that including Intuitive modes of interaction would not simply 'optimise' or 'update' HCI models, but open them up to allow user experiences to evolve, or even spin off; in unpredicted directions, as they follow explorative, or possibly even creative, moves they make. In other words, such enriched processes would assist integral user experiences.

The role of emotions in interaction beyond engagement

Overcoming rationality and prediction

Several accounts already exist that critique the traditional rationalistic assumptions of HCI. Similar to one of my earlier chapters, McCarthy and Wright employ Coyne to summarise the main points of this critique. Namely the Cartesian mind-body separation, the cognitive model of the brain as information processor, the assumption that action is solely goal and plan-directed and that problem-solving processes are separable from problem statements and can be abstracted as a means to an end (2004, p.25).

Embodied interaction

In Bergson's introduction to his method of Intuition he states that there are "two profoundly different ways of knowing a thing. The first implies that we move round the object; the second that we enter into it" (1913, p. 21). I understand this as meaning that In-

tuition presupposes engagement. Therefore my focus on intuitive aspects in my investigation of emotions' role in interaction makes a similar assumption: engagement is a necessary precursor for intuition to come into effect. Important publications that support this assumption in the context of HCI are by Dourish (2001) and McCarthy and Wright (2004). Dourish views "[e]mbodied Interaction is the creation, manipulation, and sharing of meaning though engaged interaction with artefacts" (2001, p.126). McCarthy's and Wright's work refers to the importance of situated accounts in interaction, but stresses the role of emotions in embodied interaction as they "are underplayed in situated accounts of action" (p.9). Through their emphasis of emotions' role in situated action and interaction they establish them as vital to embodied interaction, thus overcoming the rationalistic mind-body separation. Emotions are the temporary irreversible element in situated and relational processes of sense-making (no matter if it is conscious, pre-conscious and non-conscious), which in turn escape prediction. Embodied interaction represents situated contextuality and temporality of interaction; hence integrating emotions embraces the emerging and unpredictable interaction behaviour I investigated in Intuitive interaction.

Emotions and information processing

It has now been widely accepted that emotional and intellectual processes are highly intertwined (McCarthy & Wright 2004, Damasio 1995, Picard 1997, Norman 2004). Damasio's work showing that emotions are instrumental in decision making (The Somatic-Marker Hypothesis, Damasio 1995, p.165ff) has already been appropriated by HCI, but only in a reductive fashion. In Picard's concept of *affective computing*, emotions improve efficiency in decision making and in Norman's *emotional design*, they intensify the usability parameter satisfaction into the binaries of loving or hating, or positive or negative affect. My reading of Damasio suggests a different perspective. Indeed, he uses terms like 'reasoning' and 'efficiency' in decision making, yet at the same time distinguishes 'somatic decision making' clearly from 'high-reason' decision making, i.e. applying formal logic (1995, p.171). Elsewhere he explains that emotional reasoning "can promote outcomes [i.e. actions] that could have been derived rationally" (2003, p.150). In other words, emotions can lead to action that is perfectly reasonable, but derives from affective instead of cognitive ways of decision-making. My own research refers to Damasio's later work (2003) which extends the importance of the interplay between emotions and feelings in decision making processes: feelings, our conscious yet vague interface to emotions, enable us not only to respond efficiently but also creatively to everyday encounters (p.80). Moreover, Claxton's work demonstrates that in intuitive modes knowledge or expertise develops long before it can be articulated, that is if it can be articulated at all. In

Bergson's account of intuition, information processing is activated by impulses, a very specific emotion. Finally, Intuitive interaction focuses on playful and experimental approaches to information. All these modes are very different to computational modes of information processing. Hence, an integrated approach assumes that human 'information processing' can be activated by and is intertwined with emotions, is partly or entirely unconscious, and has the potential to emerge into unpredictable or even creative directions.

Emotions drive as alternative motivation to goal oriented interaction

So far, emotions have been merely treated as affective responses. Arguably, Damasio's (and Bergson's) most valuable contribution in the context of my research is to point out emotions' role in initiating action, including original or creative action. Basic emotions such as drives and motivations literally set us (i.e. our body) in motion; emotions-proper such as social and primary emotions enable us to act in the social context of our cultural environment. These emotions include less goal oriented ones which lead to novel action, such as curiosity and exploration. Particularly Bergson's account points towards the active aspect of intuitive processes, comparing them to a motor impulse or the tension of a spring (1913, p.62). In intuitive modes we often can't pin-point the exact cause for a move or a change in direction; if we "try to seize it, it is gone" (1913, p.61), nevertheless we follow these impulses. This is true for interaction with technology too. Marcia Bates' *Berrypicking* tells of the highly intertwined nature of structured and unstructured action in Information Retrieval. Also my own research identifies a fluid space in (internet) interaction where emotions' energies and impulses emerge in the form of curiosity and exploration, and in some contexts even dominate. Two conclusions challenge traditional HCI thought here: Firstly, exploratory, experimental or playful emotions can initiate, interrupt or even dominate directed interaction behaviour, which disputes the idea of purely goal and plan directed interaction. Secondly, when we follow the impulses of curiosity or exploration, we deviate not only from the initial goal, but also from the original motivation, i.e. goals are not determined destinations, but evolve and thus become an emergent property in integral experiences themselves. An integrated approach aims to support both kinds of user motivations, directed and undirected, as well as subsequently evolving user journeys in unpredicted directions. As my design experiments will demonstrate later, one way to support these processes is to displace an abstract concept of control with a more fluid one of more or less control.

Emotions and the procedural relational nature and complexity of interaction experience

Once we accept the embodied nature of interaction, the role of emotions in evolving and changing interaction processes and their power as alternative motivation to purely cognitive ones, it follows that interaction processes are inseparable from the interaction aims. In fact it follows, as paths or aims evolve or change, interaction *is nothing but its processes*. Environments where this view of interaction can come into play need to be an "open, unfinalized and unfinalizable place where every person and thing is always a dynamic process of becoming, always open to the future" (McCarthy & Wright 2004, p.69). This position is in stark contrast to HCI's assumption that interface controls provide access to predicted goals and journeys. As a consequence, traditional HCI designs leave no space for active or exploratory elements in interaction such as detours, random dips, deviations and changes of direction. An integral approach, again, tries to open up these spaces as well as embrace the complexities which unfold during interaction. After all, this is precisely what emotions equip us for: dealing with complex or even counter-intuitive encounters. Integral user experiences embrace a tendency which is already emerging now: users create a multitude of paths through information by means of individual sense-making, learning or exploration processes, thus revealing the idea of streamlined user-friendly step-by-step journeys as the myth they are. An integral approach to interaction views users as the co-authors of their own experiences and searches for mechanisms to enhance that co-authorship.

The quality of affective or emotional relations in interaction

The role of emotions in engaging user-experiences has been mentioned many times now (Quesenbery 2003; McCarthy & Wright 2004; Leong, Howard & Vetere 2008). Traditional HCI practitioners might still be inclined to equate engaging experiences with (personally or generally) immersive interaction environments. Contrary to this, I would argue that dealing with the emotional aspects of interaction is vital in both immersive *and* cognitive contexts (which are always intertwined in my view anyway). I am not alone in holding this view. A study about using shopbots (agent software) in internet banking claims that affective bonds are stronger then cognitive ones. "Cognitive loyalty is a weak form of loyalty and banks want customers which are deeply committed to them" (Pedersen & Nysveen 2001, p.5), i.e. will not leave once interest or product rates change, which would be the cognitively logical choice. "Affect is more deeply encoded [...] then cognition [...]. Affective loyalty is therefore harder to dislodge than cognitive loyalty" (ibid). The design of financial online products is probably most closely related to traditional

software engineering and HCI for security reasons, and the idea of designing for emotional aspects is most challenging in this highly technological context.

Jenny Preece suggests leveraging on the expertise of relevant consumer orientated industries when it comes to rethinking the user-experience. "[C]onsumer products branding is concerned with establishing and maintaining emotional ties, the sense of belonging [...] that differentiates one product from another" (Klein 2000, in McCarthy & Wright 2004, p.11), yet the "emotional-volitional component [of the consumer metaphor] is currently underdeveloped" (ibid) in HCI. It follows that paying attention to emotional elements in interaction processes is not simply the luxury of a philosophical viewpoint, or suited to specific areas of the internet, but needs to be developed for all future internet interaction scenarios, including functional-transactional ones like E-commerce or online banking. I earlier challenged HCI practitioners to consider designing ECOs (Emotionally Competent Objects). One consequence of this challenge could be to transform the role of practitioners from detached observers following scientific methods into accepting emotions exploratory energy and emergent properties as part of HCI design processes. In other words, an integral approach also urges HCI practitioners to review their own position as part of a larger network in internet interaction and the culture to which they subject themselves; it invites them to join users in the exciting and exploratory search for innovative and unexpected interaction and orient themselves towards the potential they have for creation.

Ease of learning vs. Implicit learning

Overcoming simple stimulus-response mechanisms

An integral approach overcomes assumptions about simple stimulus-response mechanisms in interaction on several levels. In terms of interaction, as already discussed, it redefines interruptions, deviations and delays in responding immediately to an interaction encounter from being the users' failure to respond efficiently, to being their opportunity to think or act differently as well as deviate from predicted pathways in interaction. Another level affected is HCI processes such as usability studies. Implicit learning represents unconscious and unstructured forms of learning; it produces unformed, early forms of knowledge, and un-conscious or un-articulable knowledge. This presents usability testing with a twofold challenge: if implicit learning works not through recognition of the familiar, but by exploring and experimenting with the new and /or unfamiliar it can't necessarily be articulated nor measured by the speed of responses, how can one determine the 'ease of learning'? Direct questioning seems the simple answer, but, as noted earlier, if users employed emotional or intuitive informational processing, the people questioned

might be happy to explain intuitive action, but this feedback might not necessarily be correct. Also, attempts to prompt users in this process, such as the "think-aloud protocol" can interfere with the sense-making process and therefore impair conclusions about the actual processes in progress. Even if a user was able exactly to report on the current aspect of interaction when prompted I still would argue that interpretations by an observer based on the fragmented feedback yields a partial view. Current HCI teaching literature groups "think-aloud protocols" under observation methods along with ethnographic methods. The former is suitable in controlled environments, the latter in field studies (Preece 2002, p.365). For me this grouping does not gel, as under controlled conditions users are still testing 'subjects'; usability practitioners act as detached observers, as note-takers and interjectors; the instructions for think-aloud observers read:

> "**Do** sit behind the participant. Keeping out of the participants' immediate view will help mitigate the extent to which the think-aloud session serves as a form of social interaction" (Ericsson & Simon 1980, emphasis in original).

In contrast, ethnographic methods try "to understand practices, relationships and cultures from the inside" (McCarthy & Wright 2004, p.34). This qualitative approach lends itself more easily to studying implicit processes. Based on my own research where users evaluated exploratory, novel and innovative solutions, I would recommend respecting users' silence and the time they take while they are immersed in exploring or intuiting. Once they re-surface (usually they physically lean back), their unstructured verbal accounts provide a rich source of their experience. Further conversation can then take a more structured format such as a set of questions. This approach clearly opposes a questioning style or protocols that interrupt users intuiting or sense-making. In addition, it is recommended not to encourage users to speculate about interactions which they could not actually experience (for example in evaluating only partially functional prototypes). Implicit processes can't be analysed directly, nor can they be rushed. They are bound up with action, so they can't be imagined or predicted. Or to conclude with Bergson:

> "With stoppages, however numerous they may be, we shall never make mobility; whereas, if mobility is given, we can, by means of diminution, obtain from it by thought as many stoppages as we desire. In other words, *it is clear that fixed concepts may be extracted by our thought from mobile reality; but there are no means of reconstructing the mobility of the real with fixed concepts*" (Bergson 1913, p59, italics in original).

Learning as active process

Accepting implicit learning processes as intertwined with cognitive ones and the energy of emotions as an alternative drive to goal orientated action correlates with what has been

known to pedagogy and learning sciences for a while: Learning is an active process. The idea of passive learning by instruction is illusory and has been critiqued by empirically working HCI researchers as well as innovative thinkers. Ted Nelson predicted the impatient user "unwilling to wait for detailed instructions in 1965" (Huhtamo 2001, pp.106/7). I quoted Oborne in chapter one who stated that there is still a procrustean tendency to fit users to the machine by means of instructions (1995, p.2), indeed the publication *Readings in HCI: Toward the Year 2000* contains a study about users learning to use a word processor, which emphasises the active nature of learning and users' role as co-authors in this process. "Learning, as we have tried to suggest, is an active process. It is inescapably directed by the user" (Carroll & Mack 1995, p.712). Facing confusing or unfamiliar situations, "people simply strike out into the unknown", despite having "little basis to act on [...] people do act" (p.699). The authors also note that just as the exploratory actions of users are not predictable, neither is whatever action is taken at a specific time: "Learners wanted to discover how to do specific things at particular times and this did not always accord with the sequence in which topics were treated in the manual" (Carroll & Mack 1995, p.699). This is also true for on-screen instructions in internet interaction, including navigation menus. This explains a phenomenon called 'Navigation blindness' that has puzzled usability researchers and UX designers (Olsen 2005, Hurst 2004, Nielsen 2000): users ignore navigation and instead they 'scan' a webpage in a zig-zag fashion for a possible match to their query. Krug, a usability expert predominantly working empirically, consequently coined the term 'scanability' (2006, p.21) to designate this behaviour.

Such behaviour ceases to come as a surprise once intuitive modes are accepted as part of interaction. As already mentioned, these modes of interaction, especially playful, exploratory and experimental ones, are well suited to deal with complexities, such as unknown (interaction) scenarios. An integral user experience in this context might display all of the shades of intuition which have been discussed so far: passive browsing might be interrupted by exploratory or experimental moves, only to be suspended by phases of contemplation to make sense of their experience. With growing familiarity more structured moves might become part of the interaction. Traditionally the usability criteria 'Ease of learning' reduces learning to the mechanics of recognising familiarity, and judges the efficiency of this recognition by measuring the speed with which encounter and recognition or relevant responses occurs. An enriched or integral approach to interaction enhances HCI design on two accounts: Firstly, it supports all modes of user learning and sense-making processes including intuitive ones, which helps in dealing with innovative design

solutions. Secondly, it frees up future or innovative ideas for interaction designs from conforming to familiar concepts in order to facilitate 'ease of learning'. As intuitive and implicit interaction and exploration are strongly intertwined with a shifted perception of time, the next section will continue to explore the potential of a view of time, that is qualitative and enriched once it has been released from its role as efficiency measurement.

Time: from efficiency measurement to an integral view of time

Traditional usability treats time as an efficiency measurement, as "the speed (with accuracy) with which users can complete their task" (Quesenbery 2003, p.84). This refers to *efficiency in use* as the prompt response between encounter and reaction, as well as *ease of learning*, which currently measures how efficiently users can "build on their knowledge without deliberate effort" (p.88). Freeing time from this role opens the rigid connection between the encounter and the predicted response to the fluid shades of intuition. Claxton calls this non-metric mode of time *slow time* or *unhurried time*, and Bergson refers to it as *Duration*; I call it *experience time.* This context repositions the gap between reaction and action, a space which a functional stance might call 'Delayed reaction' or a failure to respond efficiently or as predicted, as the space for intuition. Claxton fills this space with various forms of implicit learning, like unconscious and unstructured learning, contemplation and rumination, and playful exploration; Bates with the random dips and deviations from linear search paths, where intuitively gathered knowledge evolves an original query; and Bergson specifically connects this mode with an impulse to change direction and think differently or creatively. All these shades are fuelled by emotions' energy to lead, interrupt and change, to zig-zag, dive and re-surface thus connecting conscious and non-conscious tensions, concepts, directions and ideas. Freed from the linearity of Newtonian time, these moves reveal (internet) interaction as a subset of many interactions and as an emergent property in this network of humans, technologies, cultures, and social relations. Thus, a context of qualitative time also augments the traditional focus of HCI on the lineal singular connection between user and application. Finally, the intuitive user journeys that emerge have the potential to produce surprising serendipitous connections, or even inspire original thought. So, a qualitative view of time forms the unhurried background for intuitive modes of interaction, which are fuelled by emotions' energy such as exploration and experimentation and play a role in driving action, and potentially produce difference and creativity.

Situated creativity, co-creation and innovation

Traditionally it is assumed that product (and successful services) innovations are designed and developed by manufactures (Hippel 1998, p.3). Every innovation starts with a creative or original idea; research regarding products or solutions which are considered to be creative elicit responses such as surprise, satisfaction, stimulation and savouring (Kristensson, Magnusson & Matthing 2002). This position views creativity as a property of commoditised solutions, which is produced by design experts, and the consumers or users are seen as their passive recipients. So far, I have contrasted this position with the ideas of users' situated creativity: the moments of interaction in which users' choose to act voluntarily or unpredictably, thus co-creating their own experiences. Put differently, I have looked at the relation between an unhurried timeframe and the emergence of emotions that precede difference or creativity such as curiosity, exploration and playful experimentation, and how these emotions occupy the gaps and delays that distinguish reaction from action, and how user journeys evolve unpredictably as a consequence.

Discussing innovation requires taking into account the larger context of the user experience, i.e. including design and production processes. Rather then suggesting better phases or ways to integrate user in these processes, I propose that a shift from time being regarded as measurement tool for production phases to the idea of an intuitive timeframe founded on a larger scale which blurs the boundaries between design, evaluation, and such product iteration phases as alpha, beta, final version and version 1.01. Applying the qualitative timeframe of intuition in this context could dissolve the fragmentation of production phases, such as design and testing, which are reminiscent of a Taylorist time and motion studies, and add a fluidity similar to agile methods used in software development. The idea of an ongoing dialogue with users as co-creators during the various iterations of a product life cycle - instead of allocated windows -extends the concept of active user involvement of participatory design beyond product development phases and aims towards an ongoing collaborative user - producer partnership. For example, early online-prototype and the launch of the first phase of a large scale project might simply differ by the number of users invited to use it or interact with it, as the product changes continually due to direct (by user modification) and indirect (via feedback) user impact. This approach assumes that users have direct feedback channels, can change informational products directly, and those changes become part of a larger database that notes those changes, monitors them and flags them up to developers if necessary. Utopian as this may sound, Hippel (1988) convincingly illustrates cases in which the users' creativity and innova-

tions have been integrated in a similar way[22]. He states that reviewing and analysing manufacturer logs showed that in some areas 77% of all innovations were due to users' input; in cases where innovations were manufacturers' or suppliers' ideas, a significant percentage of major and minor improvements were due to the users' input. In case of user innovations, Hippel thought it to be crucial that users have means to *diffuse* or distribute information about their innovations (pp.13ff), such as specialised publications or presentations. Manufacturers then reacted either to the designs in publications or to the demand of other users requesting such innovative design. A study related more closely to internet interaction claims that users who worked with expert developers on an innovative convergent mobile internet solution generated more original ideas then the experts and, interestingly, assessed innovative ideas differently from the company (Kristensson, Magnusson & Matthing 2002, p.59). This means that users' input at innovation level can open up the perception of businesses about users' real needs, which might differ from the results of requirements analysis and personas, as well as serve tocounteract their possibly limited perceptions due to company specific sub-cultures.

We can see that dissolving the idea that time is simply an efficiency tool not only makes space for users' conscious or unconscious ways of learning at the immediate moment of interaction, but also allows for the slow development of unconscious processes over the length of (possibly multiple) user journeys. Therefore, thinking about an integral view of interaction, which is inclusive of browsing, exploration and users' creativity and potential of innovation, shifts not only design concepts for an integral user-experience, but also affects production processes. Moreover, it might overcome the mediation and fragmentation of communication process between businesses and users. Their direct connection could add another valuable link in the larger network involved in designing innovative and challenging internet interaction and solutions.

Intuitive interaction beyond the dimensions of usability

What started as investigation of the role of emotions in engaging user experiences, and the interplay between purposeful and non- purposeful interaction behaviour, turns out to affect HCI models and thought on many levels. To start with, not only one, but every single dimension of the traditional usability model, as set out by Quesenbery, is affected. Moreover, an integral approach views Human-Computer Interaction as a subset of interactions in a complex network of relations and tensions involving humans, technical, and non-technical elements, social relations, practices and cultures. This approach then chal-

[22] Ranging from scientific instruments production, semi-conductor and circuit board processes to engineering plastics, etc.

lenges HCI as a design practice to re-invent itself in regards to its methodologies, its position in these networked processes, and the role practitioners play in them.

An enriched view of the usability dimension *satisfaction* includes not only hedonic emotions such as enjoyment or fun; displacing this dimension with *engagement* but can also accompany it with emotions like curiosity and exploration. Also, developing emotionally engaging solutions might help to overcome the challenges of unknown interaction scenarios and innovative solutions. Likewise, e*ase of learning* is complemented by implicit, unconscious and unstructured learning. *Effectiveness* in the context of enriched or intuitive interaction extends from facilitating goal-orientated interaction to supporting the variety of interaction behaviour in integral user-experiences, i.e. deviating, exploring, browsing and co-authoring them. Suggestions already discussed include direct modification possibilities[23] to support users' immediate active creation in a similar way to Participatory Design[24], in addition to Bates' long-standing request for more provision for browsing as well as direct qualitative feedback mechanisms[25]. *Efficiency* measurement then, dissolves in the discussion of an integral user-experience into the unhurried timeframe of slow time or experience time, and thus ceases to be part of discussions about the user-experience. Similarly, the dimension e*rror tolerance* needs to be revised to make sure it does not hinder exploring and difference in user-experiences, but essentially remains a system requirement, and not part of a discussion about the user-experience.

One of the earlier questions asked was about how HCI could cope with the challenges of recent internet developments in terms of merging software and informational products in various 'tainmnent environments, and their constantly evolving hybrids. By now my answer to this question should come as no surprise. I suggest an integral approach to interaction, which complements structured with intuitive interaction. The unfolding of such an approach opens up the complexities of interaction, not only in terms of user-internet interaction, but also in the multiplicity of layers between interfaces, technology and manifestations of social practices. This positions Human-Computer Interaction as a subset of interactions in a complex network of relations and tensions involving humans, technologies, politics, cultures and social relations. So, while this thesis mostly focuses on an even smaller subset e.g. intuitive interaction, the repercussions affect HCI processes, frameworks and, of course, practitioners.

[23] One example for this idea is illustrated by my "build you own menu" experiment explained in the next chapter.
[24] I discussed Participatory Design in Chapter one; a concept of users participating during design phases not only by commenting, but also physical activities such as theatrical or hands-on representations of their needs or ideas.
[25] My online-questionnaire to StumbleUpon users as expert users of random-internet browsing can act as an example.

Viewing the HCI discipline as part of an evolving part of a network could open dialogues with the academic, design and technical disciplines involved in the interdisciplinary field of interaction design (Preece 2002). Moreover, the clashes and contradictions in such dialogues could be embraced as source for change, new development and innovation. As such, an integral approach might permeate the boundaries of epistemic cultures[26] which Knorr-Cetina identifies in disciplines that base their methods on scientific methods including traditional HCI. This in turn would overcome rationalistic and instrumental tendencies which are still present in HCI. With regards to the user experience an integral approach envisions a continuing dialogue with users during design and production processes as well as during a products' life cycle. This process then connects users also directly to businesses. In an integral context users are accepted as productive partners in creating constantly evolving and changing internet solutions and innovations, as well as their own experiences. Moreover, an integral approach not only aims to incorporate users' rich vocabulary of actions, exploration, evolving aims, and their creative potential, but also to enrich the role of HCI practitioners. I mentioned ECO (Emotionally Competent Object) design before and view this suggestion as an invitation to HCI practitioners to detect and develop their potential for creativity and innovation instead of solely guarding principles such as 'ease of use' and 'ease of learning' in their traditional form. Moreover, as the link between both, businesses and technology, HCI's traditionally functional outlook could turn towards guarding creative or innovative developments to extend into the functional layers of interaction. In summary, including Intuitive modes of interaction in HCI practice does not simply 'optimise' or 'update' existing HCI models, processes and thought, but opens them up and evolves them, just as they allow for user experiences to evolve, or even spin off, in unpredictable directions, as they follow explorative, or possibly even creative energies of intuition. In other words, they would assist integral user experiences through integral practice.

Summary:

The idea of an Integral user-experience seeks to complement rationalistic and goal-orientated ideas about interaction with the emotional and supposedly non-purposeful elements in these processes, which I call Intuitive interaction. This work focuses on Intuitive interaction, as goal-directed interaction is well covered in existing HCI literature. Intuitive interaction challenges HCI's traditional use of 'intuitive' as familiar or readily

[26] ... amalgams of arrangements and mechanisms - bonded through affinity, necessity and historical coincidence - which in a given field, make up how we know what we know. (1999, p.2).

available internalised skills. Instead, the enriched view of Intuitive interaction unfolds into a multiplicity of qualitative aspects in interaction, namely emotions' role in embodied interaction and emotions energy as alternative drive to goal-directed action. Also, they open up the space between reaction and action, non-conscious exploration, learning and creativity. Emotions role in embodied interaction is investigated through the work of McCarthy and Wright. Damasio, whose work has served as source material in HCI in affective computing (Picard 1997, Norman 2004), investigates the relation between emotions and feelings, and the space between them for voluntary and/or creative action. Claxton's work looks into emotions role in relation to learning, in particular implicit (unspecific) and non-conscious learning, and introduces an alternative notion of time, akin to Bergson's *Duration*: The time frame for non-conscious or exploratory learning is *unhurried time* or *slow time*. Finally, inspired by my reading of Bergson's *Introduction to Metaphysics* I view intuition as an impulse to change direction and think differently or creatively, and consequently act unpredictably. Bates studies about Berrypicking, the idea of an evolving search interrupted by random dips and deviation into the un-known, helps to apply the qualitative or Intuitive aspects of interaction to internet interaction. Intuitive interaction can therefore support traditional HCI in dealing with the challenge of intertwined, immersive and informational aspects of web-access software. In turn, the integral stance in relation to the emotional and qualitative aspects of interaction enriches some dimensions of the traditional usability model, but dissolves others: Binary *satisfaction* expands into levels of (embodied) engagement; *ease of learning* in the fluidity between explicit and implicit learning including conscious and non-conscious exploration and extends *effectiveness* from functional support in managing tasks to supporting users' evolving user-journeys, their dips and detours into browsing, and voluntary action and creativity. The qualitative framework of slow or experience time not only defies prediction, or supports intuitive modes of interaction, but can also dissolve the rigidity of fragmented design and production processes into an ongoing iterative communication process that includes users as co-creators not only of their individual journeys, but as an active part of the continually evolving and changing network of the internet. In turn, an integrated approach also has the potential to evolve the HCI discipline into an integral practice, and support it "to become conscious of their true scope, often far greater than they imagine" (Bergson 1913, p.54)

Chapter 4, Experimental interface and interaction designs

This chapter introduces my design experiments, which explore contextual aspects and characteristics of playful interaction, and ambiguity in unstructured browsing in internet interaction, and contrasts it with giving users more control in co-designing interfaces. In their evaluation special attention is paid to the role played by emotions, emphasising temporary aspects of interaction in this specific context. The basic concepts for the experiments in non-goal orientated interaction attempt to tap into the intuitive layers of interaction by using random mechanisms and abstract colour interfaces, which detour language limitations in information representation. In order to position the experiments, they are compared to existing internet applications. The *Flick-Through Browser* (FTB), and the *Colour-Space Explorer* variations (CSE I & CSE II) explore browsing, playful and non-goal orientated interaction scenarios. *Build-your-own-Menu* (BYOM) allows users to actively co-author interfaces as well as collecting their finds contextually. The latter experiments, which give users active control over their interfaces, are not necessarily in contrast with the playful applications. They can complement the former applications which allows for the collection of unexpected or serendipitous finds, which can be added to the initially given set of navigational controls.

Exploratory interaction behaviour on the Internet

This chapter continues to explore a different understanding of time, it also continues to look into the space Marcia Bates focused on in her observations about *Berrypicking* as interaction behaviour in IR: unstructured browsing. This exploration takes place in the form of practical design experiments and their evaluation. However, before I start to describe them in more detail, I would like to put the experiments in context.

It is crucial that the time the user experiences in this context, is understood as unhurried and slow time, as experience time, which opens it up to carefree and playful use. One development facilitating this way of using the Internet is the introduction of flat-rate tariffs in broadband connections; another is the development of multi-media and entertainment content on the internet. Flat-rate tariffs not only replaced much slower dial-up modem connections, but also removed the pressure of the 'pay-per-minute' cost of browsing. This points to two important aspects of internet exploration: increased speed, combined with the absence of time pressure. One could say that the arrival of broadband shifted the user from the paradigmatic figure of the radar operator in front of the screen, waiting for something to happen, to Ted Nelson's anticipated impatient user (Huhtamo 2001, p.106).

While true for goal-oriented interaction, this is even more so for exploratory interaction. Exploration's energy is fuelled by fickle emotions such as curiosity and experimentation, which makes the need for speedy returns even higher in this context than in goal orientated interaction, as these emotions cease in the face of negative emotions such as frustration. I will expand on this observation later in the section 'Findings'. So, one aspect of the context in investigating exploration is the assumption of an unhurried timeframe, or experience time, as well as users' carefree yet alert, engaged and active frame of mind that derives from a safe, satisfied and comfortable body.

Another aspect of this context is the multi-faceted nature of internet content. Marcia Bates observations about researcher's shifts between structured search and unstructured browsing behaviour in IR environments, argues for an integrated approach to structured and unstructured interaction. I believe interaction on the internet is in need of a similar argument since internet users too shift between the heterogeneous elements of internet content. Heterogeneous content not only stands for the co-existence of entertainment and immersive content, with purposeful and goal orientated web-access applications like online shopping, but also for their hybrids. Moreover, web-access software is not only informational, as in the case of insurance or mortgage configurations and purchases; informational transactional internet solutions are also surrounded and infiltrated by all kinds of "tainments" such as edu-tainment and info-tainment. For example, while buying a mobile phone online via web access software, users do not only dip in and out of financially related databases such as credit rating and bank details, or functional information sources, e.g. product descriptions and reviews. The phones info-tainment elements also include camera, music compression and social network compatibility information, usually in the form of image and sound samples, animated clips or video clips. In fact businesses, particularly the experience industry, have developed advertising revenue models which make it profitable for them to have users lingering, and browsing, immersive and entertaining content for extended amounts of time. This development poses several challenges to traditional HCI and IA thought: How can goal-oriented navigation systems and mechanisms be augmented to support browsing and exploration? How can user's finds be collected and interfaced, to follow the hunter-gatherer metaphor developed in the last chapter? Finally, there is the question, will accepting the internet as a heterogeneous space for interaction affect HCI's and IA's understanding of time, other as an efficiency measurement in the formula 'work divided by time equals performance'? Such are the

wider and intertwined implications of an integrated view of interaction which surround the investigation of Intuitive interaction and exploration.

Introducing the design experiments[27]

The following sections hope to shed some light on these questions. A recurring theme is experimentation. This includes expanding the design and production process to gather experience with alternatives to traditional HCI routes as well as design solutions, e.g. FTB, CSE and BYOM. This chapter starts out by briefly introducing the role of the various prototypes in the overall process, not only as an evaluation tool but also as a communication and design development tool. The chapter then moves on to describe briefly some key design concepts, such as randomness, colour use and the user as co-author. The following sections then explain the functionality of the design experiments, which challenge goal-oriented interaction via preset navigation from different angles. One set of the experiments explores browsing, playful and non-goal orientated interaction scenarios; another offers mechanisms for actively creating interfaces as well as collecting users' finds through browsing contextually. These experiments are not so much attempts to design a new application, but to explore moments and aspects of interaction which are excluded from mainstream usability and HCI studies.

All of the browsing ideas are thought to be complementary to goal oriented and directed searches, e.g. use of Google, and are solely for those moments where users might feel like alternative modes of browsing, such as unfocused interaction (implicit learning) and or exploring. The interface creation and collection mechanisms can work in combination with these applications; but mainly they position the user as co-author. Although described separately there are overlaps between the two sets, for example the *Palimpsest* function combines exploratory browsing with a fluid concept of user created interfaces. The section on *design concepts* explains how the use of randomness and colour supports the emotional aspects of exploratory design experiments, the section on *the user as co-author* acknowledges users' activity in creating content (UGC) and forecasts a similar activity for internet interfaces.

Both sets have been evaluated by users in interviews as well as online surveys, producing many side-lines and ideas, which could act as exciting ideas towards future research. (Hence the suggestion in the last chapter to include users as a source for creative and innovative designs.) Experiments with the evaluation processes included using online sur-

[27] Al design experiments are described in more detail in appendix I, at the end of this work.

veys as well as a blog. Consequently experts as well as participants were invited to comment on them, and they were amended iteratively. The face-to-face evaluation session took place as *café testing* as opposed to the controlled conditions of lab testing.

The section on *Findings* therefore combines comments on my experiences of taking alternative routes as well as participants' comments on the design experiments. Moreover, the last section on the exploratory experiments in *Findings* moves away from the direct investigation of the experiments. As Intuitive interaction is inspired by Bergson's notion of intuition and his view of inner life as a qualitative multiplicity, in this section emotions are viewed through a 'Bergsonian lens' as the process of temporary states of varying intensity, and their energy as a driving force of (voluntary) action. The last section on *the user as co-author* reconfirms users' activity and potential for creation, and therefore argues for the displacement of an absolute concept of control, with a more fluid one of more or less control. In other words, this last chapter documents my experimental approach to design and development processes just as much as my design experiments and their evaluation; it also relates the research to my source of inspiration in philosophy.

The role of the prototypes in the process

Before I talk about the role of my prototypes I feel I need to position the term in the context of my work, as, though often used in the context of HCI, there are no precise definitions for the various types (Engelbert & Seffah 2002, Snyder 2003), e.g. hi- and low fidelity. Generally "any given prototype is a representation of a design concept" (Snyder 2003, p.259), yet more specific descriptions vary, depending on their position in the production phase, but also the context of their use. A comprehensive discussion is beyond the scope of this section (particularly Preece (1994, pp.537-563) examines a whole host of variations). For the sake of this discussion it is sufficient to point out two communalities of all those prototype variants. Firstly, prototypes usually simulate layers, aspects or partial functionality of specific applications or programs. Secondly, the aim of prototype testing is usually geared towards usefulness in interaction, such as efficiency or learnability.

In contrast to functionally geared prototypes, my prototypes or experiments are designed to highlight concepts of the user experience which could be part of many applications or informational journeys. Moreover, some of these aspects have been traditionally neglected, such as ambiguity or serendipity in interaction, or, as in the example of BYOM, active user control over interfaces. Therefore the visual or functional execution of those design experiments is not supposed to indicate the look and feel or functionality of a spe-

cific product, but to allow users to **experience** certain concepts of interaction, in this case various degrees of ambiguity or control. This is an important difference to the idea of low fidelity prototypes, which can be anything from roughly sketched paper prototypes to otherwise non-interactive click-through scenarios. Though useful at conceptual stages, I find paper prototypes a limited tool in developing interactive solutions as users need to imagine how they would act.

Similarly the format of my design experiments varied considerably from that of controlled experiments in (HCI) testing laboratories, in which "the experimenter is expected to adhere to norms of control, objectivity and distance" (Schön 1991, p.144). Though the sessions with the users followed a structured interview process, users were encouraged to actively participate in the design process, and to voice their ideas, criticisms or suggestions for change. In addition, the open ended questions often lead to mutually inspiring conversations, which also marked the shift away from objective testing to an evaluation method closer to 'participatory evaluation' (see Hills & Mullet, 2000). In other words, the design and evaluation format of my experiments could be viewed as what Schön calls 'exploratory experiments' (ibid, p.145). Participants feedback is not supposed to confirm a predetermined design hypothesis, instead, by providing open and unfinished yet interactive scenarios "action is undertaken [...] to see what follows, without accompanying predictions and expectations" and action is taken "in order to produce an intended change" (ibid, pp.144/5). In the context of my work I view my design experiments as a first step towards developing a means for UX design to support collaborative action based research.

In terms of production processes, the prototype development was highly intertwined with the overall design and evaluation process. All the initial and very basic versions in HTML were hard coded so they could be evaluated and changed easily, and facilitate a highly iterative process while offering some basic interactivity at all times. The prototypes also doubled up as a communication tool with the technical collaborators on this project, who worked on this project remotely. We found using prototypes and short emails superior to lengthy technical and functional specs in discussing the experience. Once the dynamic prototypes were produced I always updated the static prototypes accordingly, so I could fall back on them in case the network failed during evaluation. Early prototypes were evaluated in a "quick and dirty" fashion (few users, informal sessions, etc); due to users feedback they also changed during the several rounds of evaluation. As a team we mutually exchanged and manipulated prototypes which illustrated or tested certain aspects of the experience or technical functionality, in other words we followed a small scale agile process.

The Flick-Through Browser (FTB)

Both the Flick-Through Browser (FTB) and the Colour Space Explorer (CSE) - see below - work with random mechanisms to return internet sites or pages. The FTB is designed as a little widget that plugs into existing browser software, creating an additional button. Users can then click the button, which toggles between start and stop, to view random web pages within a given site, similar to a slide show. In other words, with the click of a button the user could 'play' the site to get an overview or a feel for it.

Figure 4.0.FTB start button

Figure 4.1.FTB stop button

The prototype I created for the design evaluation mimics the way the portal of a UK phone operator works, with the FTB button placed on the top right. This site was purely chosen because of its vast variety of content that includes functional information about phones, tariffs and other products, as well as news and entertainment.

Figure 4.2. FTB button integrated in browser

The Colour Space Explorer (CSE)

CSE is a random browser that features an abstract colour interface. It invites users to choose a colour, and then searches the Internet based on colour associations. The colour "red" might be associated with "fire and blood", so its associations also include energy, war, danger, strength, power, determination as well as passion, desire, and love. It also offers an interface that detours language and might work on a more intuitive level. Once the user clicks on a colour area of their choice, the detected colour is matched to a colour association database and a search string constructed from colour tags and a random selection of association tags searches the internet. So a click on red could produce 'red fire' or 'red energy' or 'energy desire'. Two versions of CSE exist which vary in terms of returns. There are two versions, so they can be easily distinguished. CSE I is called 'DiddlePOP' and returns a randomly chosen website beneath the colour banner. CSE II is actually called 'Colour Space Explorer' and returns image thumbnails which link users to the relevant websites if they click on them. Currently the CSE II engine runs three parallel searches to vary results even more then a single search might do.

Figure 4.3. CSE colour interface

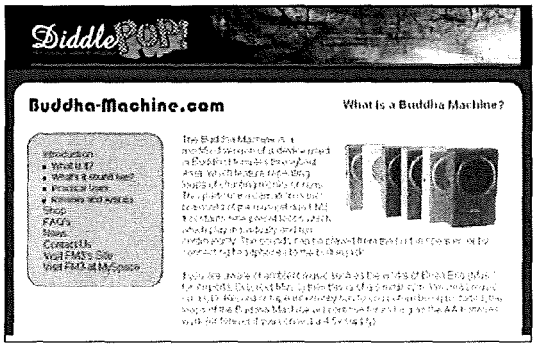

Figure 4.4. CSE I (diddlePOP) return

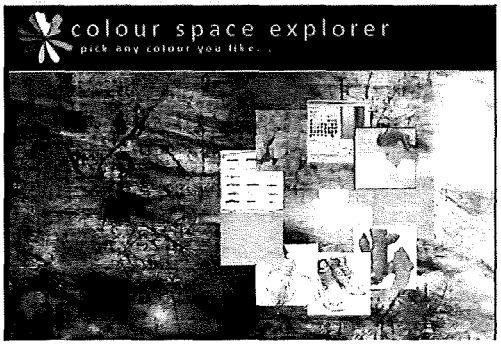

Figure 4.5.CSE II (image) return

CSE offers an innovative way of exploring the Internet, now that many users contribute to Internet content in the form of blogs or as part of communities. These contributions might not be formatted in a structured way according to SEO recommendations, or might be about more personal experiences and therefore use a different language (i.e. feeling blue). Many media products that focus on engaging aspects of user experience might use language that works with colour or mood associations. Obviously, many contributions in the artistic area use colour related language too. Due to the colour match-mechanism, CSE is prone to return proportionally more results in these content areas. But CSE is not simply a novel and perhaps even inspiring browsing experience; I envisage a final version to be an alternative browsing engine that can complement more focused search engines such as Google.

Build Your Own Menu (BYOM)

BYOM offers users three ways to create their own menu or set of interface controls: the menu editor, the button editor and the 'button this' icon. The *menu editor* offers a drag and drop interface that might be used to create the bulk of a menu. Users are presented with a variety of information options / labels and can create their own menu (navigation column left hand side) using a drag and drop (possibly Ajax) mechanism. They can also move the buttons up and down in the hierarchy to prioritise the most accessed links.

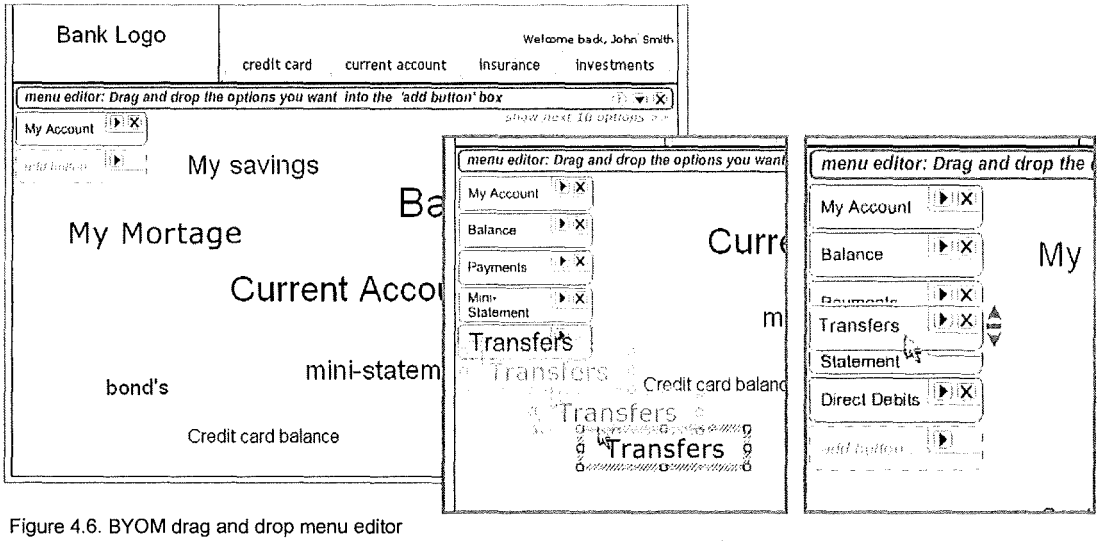

Figure 4.6. BYOM drag and drop menu editor

The *button editor* allows users to create or edit *one* navigation button, such as re-naming or deleting them. It is a means for fine tuning the menu once the majority of the buttons have been created. It also allows external links to be added, so users can 'mash-up' or personalise menus with links they find useful in the context of the site, but that the site might not offer.

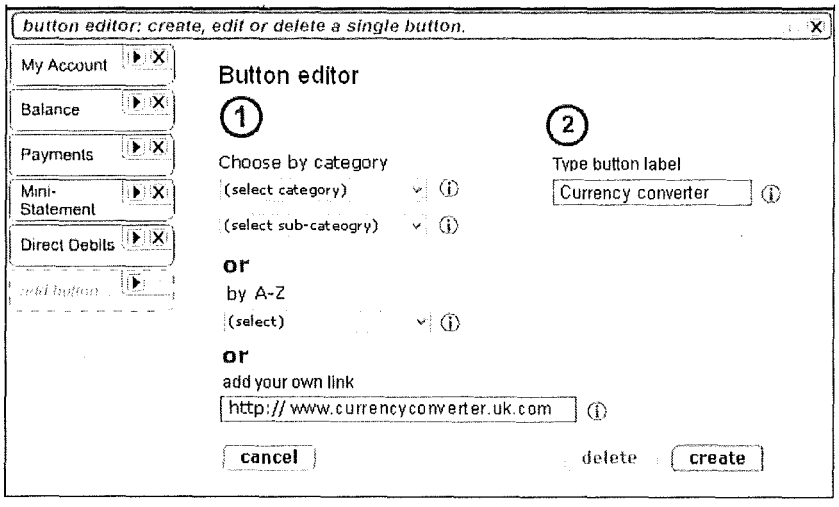

Figure 4.7. Button editor

The *buttons this* icon allows users to add a link to a web page by clicking on a 'buttons this' icon, i.e. a contextual short cut. The click then adds a navigation button to the menu, which proves to be useful when users find something interesting they may want to retain.

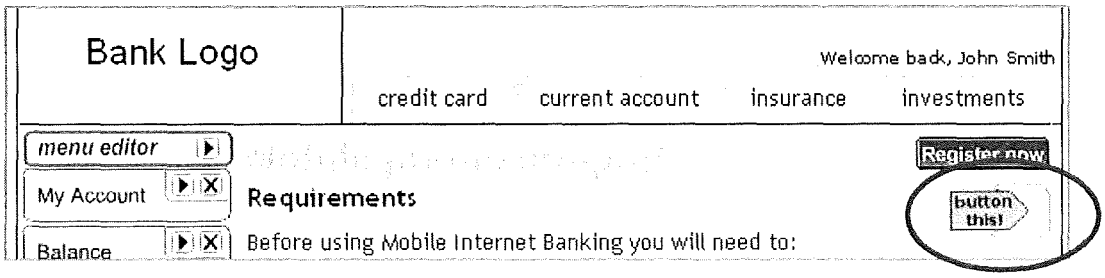

Figure 4.8. Button this icon

The mechanism is not unlike shortcuts, bookmarks or favourites, however it offers several advantages. As it is assumed to be offered within access constrained information areas, i.e. one needs a users ID and password to log in, the mashed-up interface is not bound to one computer or browser, but is available wherever a user chooses to log in. It is thus more discreet then histories, and more mobile then shortcuts. Moreover, BYOM items are highly contextual, personal and individual. This might not only benefit users; businesses could monitor their creation and development as part of their automated tracking systems to find out about user needs and movements directly and dynamically.

Design concepts

Randomness

This short section only touches on a few aspects relevant to randomness and probability research in relation to interaction and human learning, the aim is to illustrate its position in an enlarged notion of intuitive interaction. While challenging in the context of HCI (Leong, Howard & Vetere 2008) the use of random mechanisms in culture is not new; in fact, in the form of gambling it reaches back centuries. Probably the most popular use of randomness in HCI currently is in digital music consumption: the shuffle mode in iPod digital music players. I believe insights from studying this mode apply to random interaction on the internet, such as context sensitivity regarding time and content, and the perception and use of random mechanisms. Digital music consumption points towards the area of entertainment and use during leisure time, or times of multi-tasking that allow for divided attention. The aspects of perception and use of randomness connect well to intuitive interaction. Griffiths and Tenenbaum[28] argue in their paper *reconciling intuition and*

[28] Griffith and Tenenbaum work together in the CoCoSci group, MIT. Their work is driven by trying to achieve a better understanding of learning in computational terms through a combination of mathematical modelling, computer simulation

probability theory[29] that "there is a natural relationship between people's intuition about chance and the normative standards of probability theory" (2001). As "traditional criticism of people's intuition" was based on the failure to predict chance outcomes, they turned the question around and presented people with the results of generated processes and asked then to infer the likelihood of the various probabilities, as "this question may be far more useful in natural inference situations, where it is often more important to reason diagnostically then predicatively" (ibid). Apart from one sequence, the correlation of intuited probabilities compared to computer generated probabilities was a staggering 0.97. However, that sequence (01010) Griffiths and Tenenbaum excluded, is significant for the perils[30] of intuited probabilities in perceived randomness. Steven Levy investigated his iPod's seeming tendency to favour certain artists over others, to find out that we have an expectation that randomness follows an even distribution, and "impose patterns on events that are random" (Kocher, in Levy 2006, p.287). For example while a sequence like xoooooo is perfectly random, it would appear 'more random' to us if it read xooxoox. Probably the most important similarity between iPod listening and casual Internet browsing is the overwhelming amount of choice consumers and users are facing. Choice in this context almost becomes a burden and operating the relevant controls interruptive. One result is an emerging user behaviour that abandons choice in favour of chance encounters (Leong, Howard & Vetere 2008). Shuffling, or random sampling, seems not only suitable as a means of coping with information overload, but also addresses the "non-instrumental needs" or the unspecific feeling of "simply wanting to be entertained or engaged" (ibid); shuffling also provides an un-interrupted experience, customised by the skip button. A notable difference, however, is that users usually know the content of their music collection or iPod; randomly browsing the internet, however, is a stab into the unknown. So while the studies on iPod shuffling provide support for the idea that random mechanisms enhance implicit and unstructured interaction, and suit non-instrumental needs in the context of media consumption, the question remains how well these observations transfer to online interaction as well as, are other aspects of implicit interaction, such as playfulness and exploration, supported by these mechanisms.

The prototypes which investigate implicit browsing and exploration on the internet, e.g. FTB & CSE, use or mimic some kind of random mechanisms. At the same time, the prototypes harness these mechanisms by applying them within more or less constraint

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and behavioural experiments (MIT Computational Cognitive Science Group). Another one of their papers acts as source material in Myers *intuition*.

[29] The experiment involved evaluating 6 digit random configurations in terms of their probably of occurrence.

[30] In reference to Myers *perils of intuition* in chapter 3

boundaries, this in turn renders their effect to one of *relative randomness* or *ambiguity*. So the hard-coded FTB prototype mimics an even random distribution across *one* website, e.g. several returns per category. Both CSE prototype variations use *a vague colour relationship* to contain the effects of the random engine. CSE I is hard coded too and optimised towards the final experience: returns are more or less vaguely colour related, via either design, content or images. CSE II is live online; Python, the query language, uses a Pseudo-Random Number Generator to pick terms from the colour association database at random and generate the search strings. To be able to position my prototypes I benchmarked them against sites that use some form of randomness as part of their navigation, like Wikipedia *random article*, Amazon *surprise me* and *StumbleUpon*[31]. This allows me to investigate a scale from hardly random to entirely random as the space for exploration and serendipitous discoveries, Bates noted in Berrypicking. So while the use of random mechanism in HCI is neither new, nor is their use on the internet, what is new about my design experiments is that their evaluation and benchmarking allows us to learn about the context and degree in which randomness relates to, and plays a role in, an augmented understanding of intuitive interaction and supports an integral user experience.

Serendipity

"Serendipity is the effect by which one accidentally discovers something fortunate, especially while looking for something else" (Serendipity-Wikipedia 2008). So, serendipity is not actually a design concept and it is in its very nature that it cannot be reliably achieved or predicted; but arguably, it is possible to make more space for the possibility of chance encounters. Random mechanisms in interaction turn user expectations on their head: While conventional navigation systems breathe authority and might be disappointing when they fail to deliver the goods, i.e. the precise link to specific information, random mechanism can produce unexpected surprises and thus turn otherwise mundane encounters into memorable experiences (Pine & Gilmore 1999, p.97)

Colour as interface

Although it would exceed the scope of this thesis to discuss studies on colour - or its use in HCI - in detail, the sole use of colour in CSE's interface warrants some notes on the subject. Therefore this section on colour remains concise, although colour has occupied numerous areas of study, and the debates continue. Varela lists theories of colour in relation to neuroscience, psychology, artificial intelligence, linguistics, genetics and anthro-

[31] Please find a more detailed description on those benchmark applications in the section *the fluid space of exploration* later this chapter

pology (1993, p.157), Riley (1995) adds philosophy, painting and architecture, literature and music as contributing disciplines. Despite all these attempts to tame colour, Riley states:

> The first thing to realize about the study of colour in our time is its uncanny ability to evade all attempts to codify it systematically. The sheer multiplicity of colour codes attests to the profound subjectivity of the colour sense and its resistance to categorical thought (p1).

Though colour systems exist, they only work under highly controlled conditions. Commercial printers match signed-off colour samples on special light tables set to the correct Kelvin value, calibrate screen settings to the correct gamma values and print paper is coated with the specified white and finish. Gombrich confirms that "colour lends itself more to the irreversible making process than is does to matching" (in Riley 1995, p.12), Varela agrees, as we see a little later. Colour perception has a physiological aspect, yet the "exact nature of [the visual channels'] embodiment is still a matter of debate (Varela 1993, p.159) as all knowledge about these visual channels derived from psychophysical experiments and not neurophysiological ones (ibid). Human colour vision developed 500 to 800 million years ago, and full colour vision including red, about 50-60 millions years ago (King 2005).Yet colour perception doesn't occur solely through our eyes, we can perceive light through our skin, and with perfect illumination, even perceive colours (Birren 1978, p.28). So it is no surprise that perceiving or being exposed to coloured light causes physiological effects in the body: red increases blood pressure, pulse rate, respiration and skin responses and also excites brain waves (p.24). Varela takes the concept of embodied colour perception further. He refutes a simple stimulus-response mechanism in colour perception by demonstrating that there is "no one-to-one correspondence between perceived colour and locally reflected light" (1993, p.160). Rather there are complex and not fully understood processes "among multiple neural ensembles" and the retinal image at play which assign colour as an emergent property to objects (p.161). Furthermore, colour perception is embedded in a larger context of perception, intertwined with other sensory activities, and intrinsic in embodied perception. "Perception and action, sensorium and motorium, are linked together as successively emergent and mutually selecting patterns (p.163). This means colour perception plays a larger role in our experience then simply giving us an idea about light-reflections off objects surrounding us, or to colour our external world.[32] The philosopher Walter Benjamin argues along similar lines about

[32] Varela demonstrates this with a dramatic example of an artist who loses the ability to perceive colour due to an accident. Not only his perception changed, his behaviour and his whole world changed as a result of this loss: "everything looked distasteful...he found foods disgusting and sexual intercourse impossible. [...] His appreciation of music was also impaired, ..." (1993, p.164). Mr I, as Varela calls him, now avoids sunlight and lives his life at night as a consequence.

the role of colour in experience, but extends this thought into the notion of a qualitative intensity.

> [Colour is not] the misleading coating of individual particular things in space and time. Where colour provides the contours, objects are not reduced to things, but are constituted by an order consisting of an infinite range of nuances: the colour is individual, but not as a dead thing fixed in individuality, but as winged, flying from one pattern to another. (1914b, p.50, in Caygill, 1998, p.83)

Benjamin develops this angle on experience by contrasting a child's experience of colour with the ones of an adult. His wider concern however is, similar to that of Bergson, to replace the Kantian forms of intuition, i.e. space and time, "with colour as a (transitive and shifting) medium of intuition" (Caygill, 1998, p.83). Indeed King traces colour as archaic medium of communication not only in animals but also in plants (2005, p.3). "To humans, the use of colours as a channel for communication is as old as art [as demonstrated by] the earliest examples of human art" (p.7). Thus, similar to emotions "Colour precedes words and antedates civilization, connected as it is to subterranean groundwater's of the archaic limbic system" (Shlain 1991, in Riley 1991, p.6).

Colour evades categorisation, i.e. a crucial design criteria in IA's approach to internet interaction. It precedes and detours language and thus has the potential to tap directly into emotions, including exploration and playful experimentation. By this direct and possibly more intense connection, colour is conducive to engaged and embodied interaction. Indeed, in my opinion participants' comments in the section *Findings* substantiate my assumption that a purely colour based interface can relate more directly to emotions, however it does so in an unpredictable and temporary manner.

The User as co-author

Build you own menu (BYOM)

Traditional HCI literature speaks often about empowering the user and facilitates this by designing control elements in interfaces; their design, however, seems to be reserved to the experts, e.g. HCI practitioners, information architects, interface designers, graphics designers and web developers. Considering that user generated content (UGC) increasingly merges with content provided by the media industries, it seems fit that users should have a similar impact on the representation of content in the interface, particularly as the technologies are now in place. AJAX, a set of scripting technologies can be used to add dynamic features to web interfaces, similar to direct manipulation in software or operating systems. One example is iGoogle, a customisable version of the Google search inter-

face, which allows users to place, move and adjust little applets by a simple drag and drop mechanism. BYOM tackles this limit to user contribution; it invites users to actively create their own navigation system. User generated control interfaces could then mash-up and mix with pre-set navigation, akin to a user activity we see now frequently in terms of internet content. A mechanism like this would work well with the predominantly observed user behaviours on the internet: direct search, and structured and unstructured browsing. Indeed, if *findability* on the internet is a "critical success factor" for usability on the internet (Morville & Rosenfeld 2007, p.5), BYOM offers a convenient means for collecting informational finds on the internet in a highly contextual, integrated and personal way, and independent of browser variations or personal location. Search engines cut through information hierarchies and layers, flattening them into a dynamic subjective stratum based on the users query. Likewise, browsing, particularly unstructured browsing, creates subjective and unpredictable paths through information, as opposed to following objective pre-set paths of navigation menus. BYOM is well suited to collecting finds in this subjective sphere of information gathering and hunting, to continue Bates metaphor. BYOM buttons' easy creation and delete functions also suit the temporality of users collections and adds a fluidity to navigation controls, that structured contextual navigation cannot offer. Having said that, I believe there are many more ways to allow users to co-create navigational means on the interface level. This means in the case of BYOM, though I was interested in what participants had to say about the prototypes, I was more interested in finding out users actually want to take initiative in some interaction scenarios, invest energy to create their own interfaces, and if so how they feel about it. Prototyping a few ideas and having them evaluated helped me to find out how users feel about these questions in general and therefore the results are less focussed on the usability of the actual mechanism or specific implementation, then the larger context of their use.

Palimpsest feature of CSE interface

The palimpsest feature of the CSE II interface is another way to think about interfaces as a fluid and temporary manifestation of user activity. The difference to BYOM is that this feature works via communal rather than individual interaction. "A palimpsest is a manuscript page, whether from a scroll or book that has been written on, scraped off, and then used again" (Palimpsest - Wikipedia 2008). It means past writing continues to co-exist in a residual form with the most up-to-date version of information in the foreground.

Figure 4.9. Georgian palimpsest of 5th/6th century (Palimpsest – Wikipedia 2008)

The CSE II interface retains past image results of user's exploration in a residual form, these then adjust the colour image of the interface continuously. The scripting renders almost transparent versions of the image return onto the existing interface image while applying sometimes additive, sometimes subtractive colour effects which affect the hues of the original image. In this way the palimpsest interface continuously changes its appearance, e.g. the interface image is transformed by users' interaction. This dynamic creates a dialogue that constantly develops layers between the original design, users communally design through their action, the fading of those layers, their collapse into a flattened layer and the beginning new layers.

Both, BYOM and Palimpsest support users' active participation in shaping the appearance of the interface, however in very different ways. While BYOM can address individual needs and may produce many different interfaces, CSE's palimpsest function means users shape CSE's interface collectively by their interaction.

Design evaluation

This section introduces several ways to involve users in the prototype evaluation[33]. All evaluation sessions, conducted online and in person, lasted about 30 minutes. Users would be offered incentives in the form of vouchers to the value of £5. Since I experimented with alternative ways to conduct these evaluations and emphasised qualitative aspects, the yields are not as consistent as traditional usability testing results. For example if users wanted to take a long time to explore the interfaces I would let them do so, I however would still offer to finish after 30 minutes. Consequently, I sometimes did not manage to ask all the questions or skipped questions when prompts had been covered in previous qualitative feedback. The results might also vary as when the WIFI was unstable, I would resort to off-line mock-ups to continue testing. On a more personal note, it was an opportunity for me to experiment with alternative evaluation methods instead of controlled tests in usability laboratories.

Access-constrained blog

Though not successful on this occasion, experimenting with an access-constrained blog as a tool for the early online evaluation of prototypes resulted in a valuable personal learning curve. Given the chance, I would still recommend them as a safe playground for early stages of iterative prototype design. Blogs can be made available to a small user group via invitation and by issuing a user id and password, which can suit companies need for confidentiality regarding early testing phases. The "add comment" functionality means users may provide their own contributions as well as comment on other users' contributions, which could activate an interesting dialogue. In my research I attempted to use an access-constrained blog to collect informal feedback in the early stages of the prototypes, sometimes called "quick and dirty" testing in industry jargon. However, fearing I could constrain feedback by being too specific, I left the questions quite open, with the unfortunate effect of confusing the participants. This issue became clear to me later on during private conversations with the initially invited participants, which in turn provided me with the feedback I was initially interested in.

Café testing

Café testing is (rather fittingly) a more random approach to field studies then lab testing.[34] After having gained approval by the manager or supervisor of the testing location, a laptop, a big sign to invite participants, an incentive system, a WIFI connection and will-

[33] More information on the format of the questionnaires and the design evaluations in general can be found in appendix II
[34] More information about this way to conduct design evaluations can be found on the internet: *Want Free Beer* Burns 2004

ing participants is all that is needed to facilitate user evaluation. Users are not filtered by screeners (a list of yea's and nay's in terms of users age, attitudes and computer skills) with the result that I had to exclude two (of 20) users.[35] Still, I believe I managed a significant representation of relevant age groups for exploratory and participative internet interaction as well as a good ratio between students and professionals. The three locations I used were Starbucks, a youth hostel that offers one hour free WIFI included in the room rent, and the common study area at my university. One of the reasons why I refer to this phase as design evaluation rather then testing, is that even though I followed a structured questionnaire with participations, I kept the tone of the involved dialogues deliberately conversational to encourage critical and open feedback. This also emphasised the role of the participants as co-designers.

Online questionnaire

Besides the evaluation blog, I experimented with online questionnaires, an evaluation form I had no previous experience with at all. The online questionnaires used the same structure as the offline versions so they could be compared in terms of user's feedback and the results merged for reporting the findings. With the exception of the StumbleUpon (SU) questionnaire all face-to-face and online questionnaire ran in parallel.

Comparison online-offline questionnaires

Though the sample sizes are small (55 participants in total, 20 offline & 35 online) I believe the online surveys are well suited to iterations or evaluating material users have already had some experience of. As all the prototypes presented novel ways of internet interaction, or modes of interaction users don't normally admit to (as browsing for fun is equated with wasting time) or resort to unconsciously, it was easier to re-assure users, to get them to open up or to get into the right frame of mind during conversations. I also believe this helped to convey user's feedback as constructive co-production in the design process, while I felt online participants adopted a more reactive stance. Certainly more innovative or improvement ideas occurred during the personal interviews. Another difference is that the same questions come across differently in different environments. For example, prompts presented during a conversation facilitated an animated conversation, while presented as check boxes in an online context constrained users feedback. As online participants were encouraged to not only comment on the question in the survey,

[35] One user had never used a track pad, the combination of random applications and difficulties operating the laptop caused significant distress. The other user was on a dial-up tariff, and as a result never considered to user the internet for exploring.

but also on their own experience with filling-in the questionnaire I have direct feedback from a user on this matter as well as expert advice. As a result, in subsequent evaluations I designed the online questionnaires to be more open-ended, and this design lead the face-to-face surveys.

StumbleUpon questionnaire

The first 20 questionnaires demonstrated that hardly any users had conscious experience of exploratory browsing supported by random mechanisms. So I would not solely present 'first impressions' as in the evaluation (even though they have their value), I designed an online survey for an online community that uses a mechanism like this regularly. As it turned out, *online questionnaires are superior in this scenario* since expert users participate completely contextual (i.e. the survey invitation was placed in StumbleUpon, a browsing environment and surveyed browsing behaviour) in their 'natural interaction environment' (e.g. online) in their own time. Users seemed happy to share their experience and expertise, as 25 invitations resulted in 11 speedy responses without offering incentives. In my opinion this result eliminates any of the excuses usually employed for the lack of user involvement or UCD-evaluation. Any business could easily facilitate a continuing dialogue with a loyal users group(s), supported by an incentive system like freebies, special previews or product discounts in a shared and protected area. Online questionnaires can be designed to be secure, access constrained, password protected, time locked and, given users consent, tracked for further analysis.

Cultural Probes and on-line probes

Originally, cultural probes are a "design-oriented way to acquire inspirational glimpses of communities targeted for design" (Boehner *et al.* 2007). Physical probe packs contain "open-ended tasks [...] to provoke inspirational responses [...] to support participant engagement with the design process" (ibid), such as post cards, single use voice recorders or cameras. This concept inspired me to try an online version of probes, in the form of a random snap shot of the users' situation. I started cautiously, as I had no experience of using probes and did not want to jeopardise the overall results or exhaust the users' energy prematurely. So I asked few questions, clearly marked as optional, such as "please name five items close to you right now, no matter how mundane they might be", "what are the last urls you browsed and you are ok to share them with me" or "is there anything red close to you" and "Have you stuck anything to your monitor like postie-notes?". I can't be sure how users felt about the probes; however all of them answered in detail. While cultural probes are supposed to engage participants, it definitely helped me as an

analyst who wishes to engage more with the otherwise anonymous online participant, and get a 'Gestalt sense' or feel for the context of the users at the time of participation. I find it an exciting idea to possibly have found a way to support social intuition in online communication, and incorporate probes in an integral experience design and evaluation concept. To substantiate this impression more research would be required, in particular it would benefit from an understanding of how users feel about them too. In short, I believe all experimental approaches towards designing evaluation tools resulted in valuable learning experiences, which I hope to implement and expand on in my future work.

Findings

It is an old truth that every research opens more questions than it answers, which is true for this research too. A further note of caution: due to the sample size and the choice of evaluation methods this section presents tendencies, not firm results, and approximations, not general truths. These tendencies support my assumptions about the contextual and temporary complexities of emotions in exploration and non-purposive interaction. Overall, I believe there is enough evidence to argue for a notion of enlarged or intuitive interaction in the understanding and development of internet interaction, as well as the necessity of an integral understanding of the user experience. The initial part of *Findings* focuses on the exploratory experiments, the sections *the user as co-author* focuses on user's potential for (creative) action, though there are overlaps. The next sections combine the presentation and discussion of the findings, not only about the experiments, but also in view of the larger questions of my work.

When quoting participants, comments from face-to-face questionnaires are marked with (I), while those from online questionnaires are marked (O). StumbleUpon users are experienced 'random explorers', so their comments are marked (SU) to distinguish them from the 'first time random explorers' of all other surveys. The graphs included are obtained either by various structured Likert scale[36] (LS) questions about user's feelings, or multi-choice checkbox (MC) questionnaires with multiple answers being possible. LS questions regarding emotions were optional, so users only needed to choose the ones they felt to be applicable, instead of rating every single option. They are marked in the graphs. Sample sizes are abbreviated as SS, all figures denote percentages (e.g.00=00%).

[36] Likert scales are the four, five, six, seven, eight or nice point scales much used in various fields of research. Often the scale is used as *semantic differential*. (Sclove 2001). A statement judged on various scales from 'agree strongly' to 'disagree strongly'.

The context of time

As mentioned several times, a crucial factor in an integral user experience is time. The user comments in this section confirm the need for experience time to be unhurried time, but also put demands on the speed of systems responses in this mode: Systems need to be able to keep up with the impulsive nature of exploratory emotions. Finally time allocated to exploratory journeys seem to be relatively short, which might be the reason why they escaped traditional HCI's radar so far.

The explortory interaction behaviour explored here only emerged with flat-rate broad-band tariffs, i.e. unlimited time usage. Users frequently comment on this direct relation.

> *"I rarely use the internet for entertainment; I am on a 'pay per minute' tariff (O)" This is new and interesting [FTB], now that I am on a weekly pass" (I). "I never encountered something like this [FTB], my behaviour might change now that I will change my internet tariff from pay per minute to a flat rate" (O).*

Of the participants that used flat-rate tariffs 14 out of 15 (AM/Wi/FTB/BYOM) reported they browse the internet, feedback about the actual activities included *"watch youtube, listen to music, research personal interests, read web comics, play games, read gossip".* Exploratory or unstructured interaction behaviour occurs in time gaps, either larger ones like spare or leisure time, and micro ones like breaks and drifts, voluntary or involuntary.

> *"When I m bored it [Wiki] might be good for a laugh, or just interesting facts" (O) "[I use StumbleUpon] for fun, [or] when I am compiling"(SU). "[I use SU] twice a day to treat myself" (SU). [I use SU] for a few minutes here and there through out the day" (SU). [I use SU] Typically for 1-3 hours as entertaining. [...] I prefer it to TV" (SU). "I would use it [FTB] in breaks like my lunch break, may be for 5 minutes" (O). "I would use it [Wikipedia] for 5-10 minutes" (O).*

Therefore unlimited time broadband tariffs form part of the framework of unhurried time and add a dimension to internet interaction that is not recognised in any HCI literature I know of, despite having an enormous impact on interaction behaviour.

A frequently reoccurring statement in the context of browsing and exploration is users' impatience. While a known issue to HCI (Nielsen 1999), this seems even more important for exploratory interaction; slow responses are even less tolerated in this context:

> *"I am too impatient to wait for the pictures to download" (I). "I would not continue [CSEII], I want instant results" (I) "it sure has to be fast" (I).*

Therefore, solutions designed for immersive or exploratory interaction need to match its fickle and temporary nature in terms of speed and potential for evolving change.

Time spans allocated to exploratory interaction seem relatively short, almost as if users interrupt themselves to have a break from tasks or chores, to relax or make space for stimulation, inspiration or serendipitous encounters. At the same time, to some users short means 1-3 clicks, to others about 15 minutes. This observation coincides with the results of an early paper on online browsing strategies Catledge and Pitkow (1994)[37], which states that serendipitous user journeys being relatively short compared to focused interaction. This illustrates that research on exploratory or serendipitous user journeys has been available for a while. Maybe an explanation as to why implicit interaction behaviour seems to have been overlooked by most HCI studies is given by Bergson who acknowledges that the moment of an intuition is easily missed as "the act that creates the method lasts but a moment" (1913, p.53).

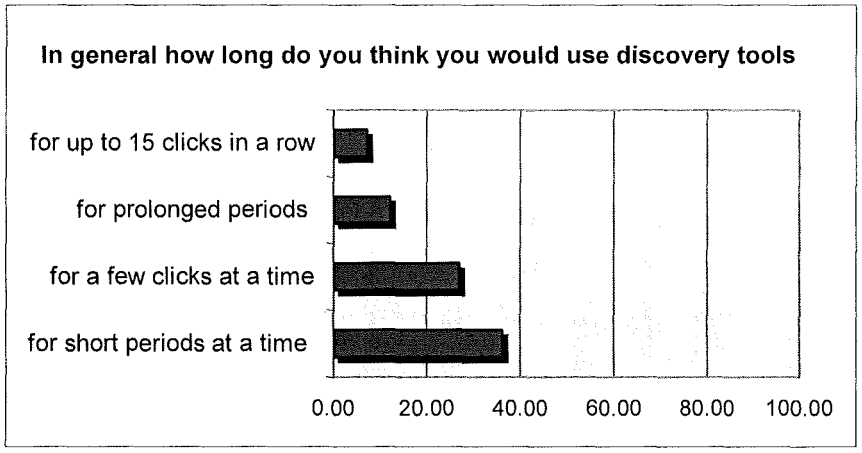


Figure 4.10. How long would you use discovery tools for? (MC, optional, SS=35, scale=%):

Contextuality of randomness in internet interaction

Berrypicking on the internet – shifting between focus and ambiguity

Bates' observations about professional researchers shifting between structured and unstructured searches in IR, which she termed Berrypicking, are echoed in internet interaction. Users shift between those behaviours in similar way on the internet. All users stated that they deviate in varying degrees from initial goals or tasks they set out to do on the internet; the majority stated they deviate *sometimes* or *often*.

[37] Catledge and Pitkow investigated web logs (tracked user journeys) to analyse user behaviour by quantitative criteria such as number of connections and length of session.

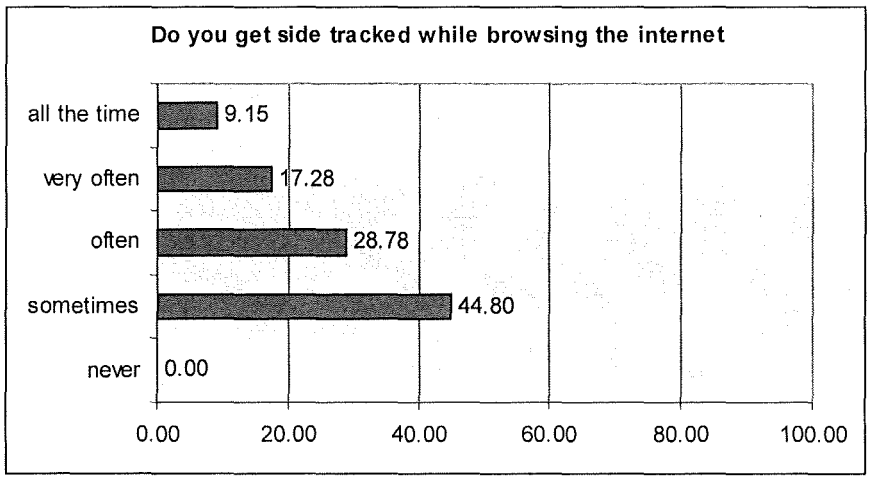


Figure 4.11. Do you get sidetracked on the internet? (LS, mandatory, SS=55, scale=%)

The majority of users mentioned *Hypertext* links and *related* links as the navigational tools they use for browsing, and in particular in this process of shifting and drifting. It seems these tools are conductive to an interaction behaviour similar to Bates Berry-picking, and thus to potential query variations which are at the heart of that concept. Morville and Rosenfeld argue that Hypertext is confusing, as users "simply can't create a mental model of the site organisation" (2007, p.77), equating complexity with a confusion that needs to be avoided. Yet Bates is prepared to deal with complexities and places them at the heart of browsing: not having a mental model doesn't mean offering browsing features is a simple matter. Indeed, "making effective provision for browsing capabilities involves its own complexities" (1989). The common trait in her suggestions regarding browsing provision encourages the exploration of related information in the form of random dips and snapshots, yet in relatively close proximity to the query at stake. This harnessed or relative randomness makes space for serendipity and the searcher's creativity. According to Bates, subject related random dips, or ambiguity, in IR lead to serendipitous discoveries or connections, on the internet this seems to relate to unexpected, surprising or pleasant informational finds,

> *"The other day I read the news about the Zimbabwe elections and found an agreement called the Lancaster group.[...] That was a good and unexpected find" (I).*

According to Pine and Gilmore, a pleasant surprise lifts an otherwise satisfactory encounter to a memorable event and thus creates an engaging experience (1999, pp.96-99). In other words, including a means for browsing, digression and active exploration adds a potential for user experiences on the internet not only to become more engaging and thus integral experiences, but also evolve in a similar way to Bates' Berrypicking.. .

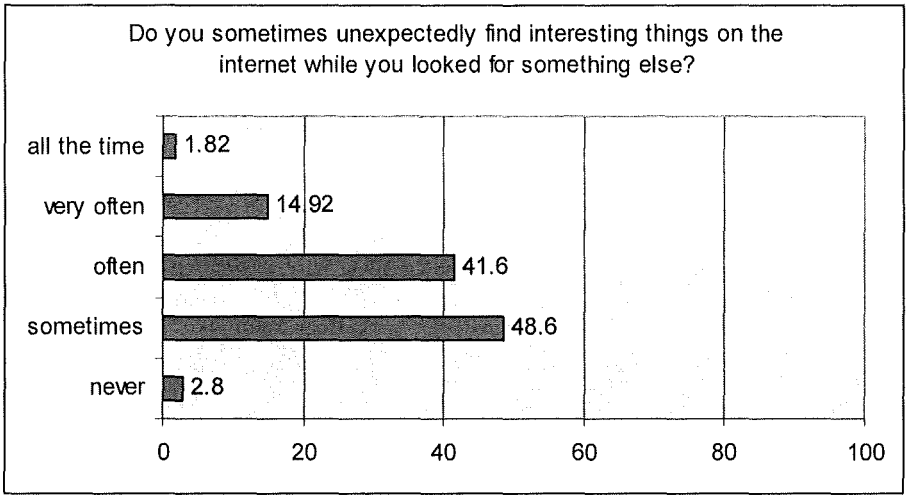


Figure 4.12. Serendipity on the internet (LS, mandatory, SS=55, scale=%)

The fluid space of exploration

The evaluation of random mechanisms showed that users welcome their integration; yet their perception also depends on the interplay of narrow or vague proximities to the original query, the context of use in interaction and content. As the underlying mechanism is always the same, *degrees of randomness* in my discussion relate to this proximity. To understand these degrees better, and the emotions that accompany them, I benchmarked my experiments against internet applications that currently use some kind of random functionality. Amazon.com 'surprise me' offers a link that randomly flicks through books and randomly presents pages. Similarly, Wikipedia's 'random article' presents entries from its entire, vast and growing database by chance. StumbleUpon (SU) is a user driven website rating system, where participants initially set a few parameters and choose some topics to indicate their interests, and subsequently click a 'Stumble' button whenever they feel like exploring. This displays websites loosely related to the initially set parameters. All applications work with various degrees of randomness. Amazon's is clearly refined to one book; SU's is a combination of users' parameters and ratings, Wikipedia's mechanism is closest to a random-proper experience. FTB's ambiguity is similar to Amazon *surprise me*, i.e. contained in one webpage, whereas CSE versions' randomness is more vague as it is colour related. Contrasting randomness in Amazon's 'surprise me' with Wikipedia's 'random article' to start with reveals some interesting tendencies.

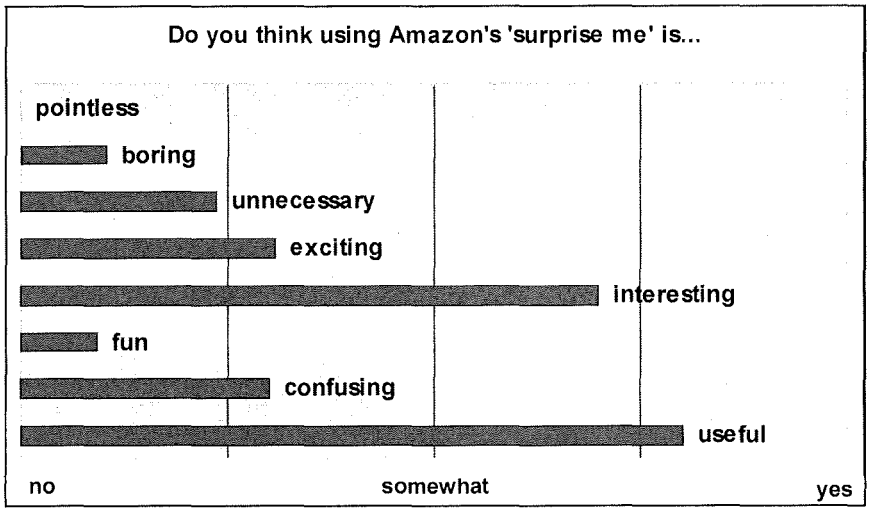
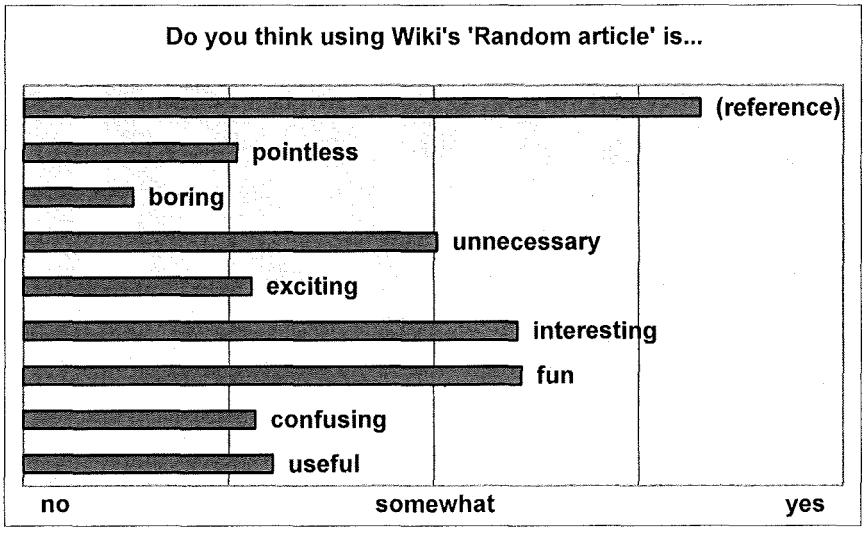


Figure 4.13 Amazon evaluation (LS, mandatory, SS=20)



4.14. Wikipedia evaluation[38] (LS, mandatory, SS=20)

Although emotional statements offer only a temporary glimpse which is difficult to quantify, both random functions seemed to be perceived as quite interesting. Amazon's closely subject related random dips are perceived to be more useful, while Wikipedia's *random article* appears to relate to more exploratory emotions like fun and inspiration.

"Amazon is really useful, Wiki is more for inspiration" (I)

One users comment points at less-purposeful emotions to be more engaging to him /her.

"I like the Wiki tool, Amazon is quite useful" (O).

StumbleUpon combines both elements of randomness which are contrasted above. Usefulness rates quite high due to users being able to set parameters and favourite categories. However, as results can be widely varied across many categories, and thus unpredictable, random browsing evokes non-utilitarian emotions, e.g. curiosity and exploration, along with feelings of excitement and adventurousness which makes the experience intriguing.

[38] The parameter reference has only been included to be able to compare the two graphs visually in correct scale.

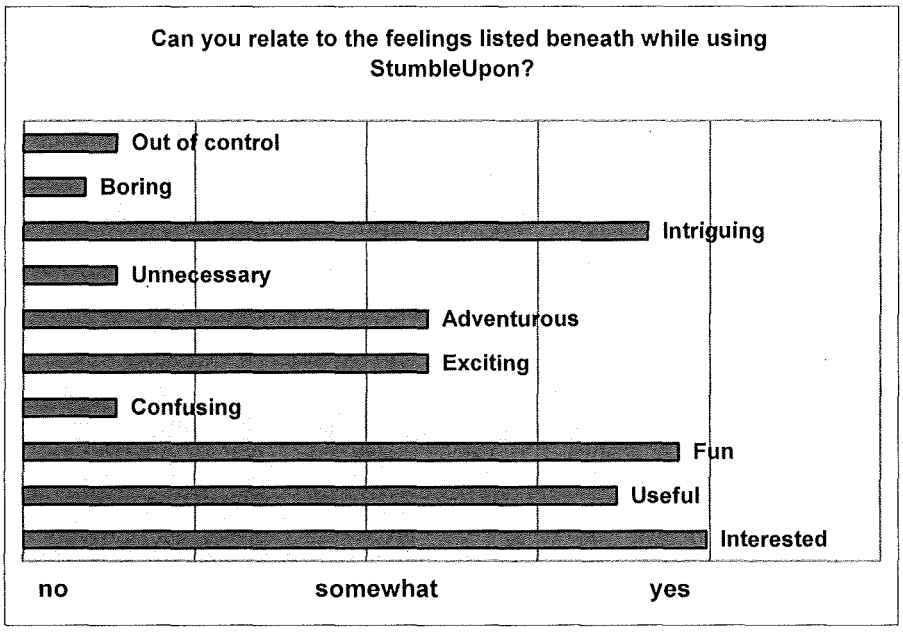


Figure 4.15. StumbleUpon graph (LS, optional, SS=11)

The graph beneath contextualises randomness in relation to perceived usefulness and the potential of exploration. The scale only illustrates some tendencies in a stylised way. It doesn't represent data, but a conglomerate of application analysis and user comments.

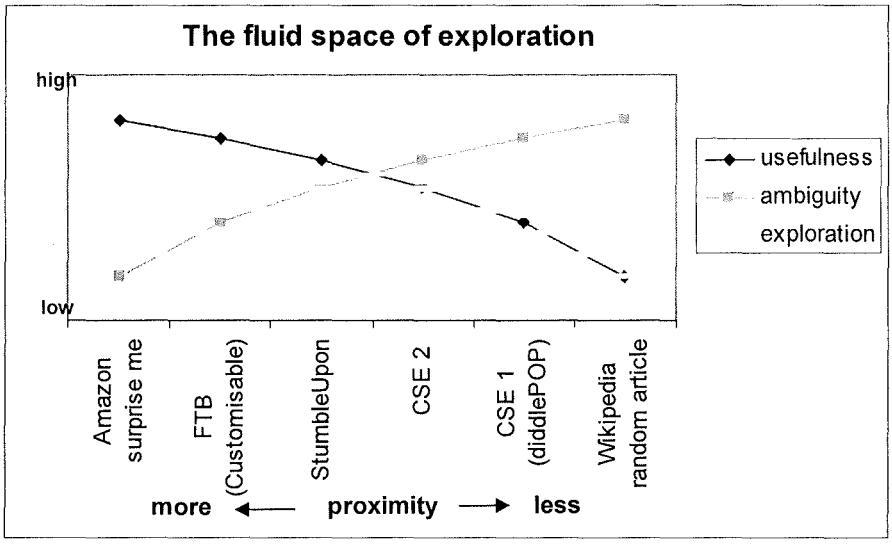


Figure 4.16. Stylised graph about the fluid space of exploration

"Wiki seems more random, as it covers all articles" (O). Amazon is not random and I like it, Wikipedia is random and I don't like it" (I). "..., Wikipedia random article could be fun, depends on the articles" (I). "Wiki is very random" (SU). "I prefer the second version [CSE2], as I found it a little more controllable [then CSE1]" (O).

The perception of random mechanisms seems dependent on their deviation and proximity to the original context. Closely subject related random deviations are perceived to be more useful; the less subject related they are, the more they open up to other, more absorbing or intriguing modes of engagement, e.g. exploration, fun, or to counter act boredom. Yet, deviating too far from the original query can overstretch this connection and undermine exploration. Related to the evaluated applications and experiments that means FTB, SU and both CSE versions were more exciting then Amazon's surprise me and Wikipedia 'random article'. Amazon is not ambiguous enough to be exciting, while Wikipedia overstretches the connection for many users. Again, I present tendencies here, relative groupings not absolute ones. Nevertheless as we will see, the support of such ambiguity in interaction, i.e. exploration's fluidity, shifts an abstract concept of control of the user-experience though the interface towards a more fluid one of more or less control. Before I move on to explore this aspects, I need to make a few more points about the integration of such support functions.

Integration and proximity of random functions for spontaneous access

Access to navigation mechanisms supporting exploration needs to reflect the intertwined spontaneous, even interruptive, nature of browsing and random dips in particular, and the fickle, multi-tasking and unpredictable nature of user behaviour, in general.

> *"I would not get out of my way to use Wiki random article, but if it is easy I would use it in my breaks" (O)*

Effortless and seamless access means integration of random functions in proximity of the navigation menus, to support users' shifts between goal-directed and unstructured interaction. As demonstrated earlier, *Hypertext* and *related links* are conducive to these shifts, by either being directly embedded in the body of the text, or in close proximity to it. Amazon and Wikipedia integrate the relevant links on the periphery of their contextual menus, i.e. as the last link; SU appears in a slim button bar as part of the browser bar after installation, as does FTB. This concept is also eminent in Bates suggestions for browsing features, such as embedding links to summaries, lists of sections headers, re-ordering groups unconventionally, etc (1989), thus facilitating a variety of options for a more intuitive experience such as a gestalt sense by random snapshots, defamiliarisation (though she does not use this term) and unconscious learning. Her suggestions are also reminiscent of Ted Nelson's original and much richer idea of *Hypertext*, as

> A body of written and pictorial material interconnected in ... a complex way [that] may contain summaries, or maps of its contents and interrelations [as well as] annotations, additions and footnotes from scholars who have examined it. (1965, in Wardrip-Fruin & Montfort 2003, p.144)

Both, Bates' and Nelson's ideas as well as the examples above, envisage an integrated augmented relational network. While integrating a variety of contextual linking structures of varying proximity might add to the complexity of interaction, the possibility to browse them easily in an integrated way could be a useful and/or intuitive addition to existing navigation tools, while making space for an integral uses experience. As we will see in the next section, StumbleUpon can act as an example of this prognosis.

The fluid notion of control in the integral user experience

This section discusses two issues which are closely intertwined: the idea of a more fluid concept of control and the contextuality of navigation mechanisms. Certain contexts invite browsing for its own sake, i.e. social and entertaining content of the internet, marked by dedicated time spans, such as "*in my spare time, after duty, in the evenings*" (I). Particularly in the latter context, users comment positively on the use of random tools like FTB.[39]

> *"it is a good way to get an overview of a site quickly or find other material that might be buried there" (O). "useful, I would definitely use it" (O).*

As the evaluated FTB prototype included all categories of the website, including product, technical and account information, some users specified the context of their preferred use, while others just stated a preference to be able to adjust the categories.

> *"good for getting an overview of a website – probably especially useful for news" (O). "after a while it is boring, I didn't like the phone information in there. It works well for the news section" (O). "if you go into entertainment and use it within the entertainment section only (I). "it goes over too many categories" (I).*

So Bates hunch, that flicking randomly through a book gives searches a *gestalt feel* for the content seems true for 'flicking though' internet pages too. All but one participant (out of 30) reported they *got a feel* for the site after having used it. Similar to the participants in the study about shuffling on the iPod (Leong, Howard & Vetere 2008), FTB users seemed quite unconcerned about giving up choice or control in this non-goal oriented context. Some commented favourably on being relieved from the *workload* involved in browsing.

[39] That is if users are open to browsing. Some users are suspicious or dismissive of browsing, and as a consequence dismissive of random exploration tools.

"it is convenient...there is a lot of clicking involved in browsing..." (I). "it does the work for you" (I). "Saves time" (O). "it gives you a good overview, is convenient, you don't need to click a lot to explore" (O). quite relaxing. You are not responsible for looking for yourself... clicking here and there and everywhere" (I).

It seems, firstly, random mechanisms like FTB can aid passive browsing Bates calls *directed monitoring (see Figure 3.3, chapter 3)*, and secondly, purely goal-oriented navigation controls, like multi-tiered menu systems presenting categories and sub-categories, can get in the way of browsing, and their sole use is insufficient in the context of entertainment. That is not to say that control is entirely abandoned in browsing. Similar to the study about shuffling on the iPod (ibid) users sometimes want to adjust aspects of the experience during this kind of interaction. As above, this might be about the categories the browser presents; or the control might relate to the timing of the experience (all comments beneath refer to the FTB prototype):

"Speed should be user adjustable" (O). I like the control; you can stop when you need to (I). " although I like the simplicity, I'm not sure a back button could help" (O).

The last comment not only makes a point about control, but also re-iterates the necessity about integration I mentioned previously. Judging by the comments, the area of news and entertainment seem to be a more generally accepted context for (random) browsing, however there is also the context of personal interest areas. StumbleUpon successfully combined this obvious context in terms of content with random browsing. The SU community currently exceeds 6 million subscribers (October 2008), and offers about 490 topics of interest, which can be chosen from a list, but also added on the fly (for example if one spotted an interesting category while browsing another SU member's finds).

"[with] StumbleUpon you never know what's going to come up and gives you things closer to your interest"(SU). I think StumbleUpon is more focused on "my interests". On the other hand a fully random selection might put me on to something new I never thought about" (SU).

Users can also actively adjust the proximity of random dips within chosen subject areas by setting tags to narrow or widen connectivity at the same time, as well as rate the returns. In this way, they engage emotionally, intrigued by a surprising yet more personal user experience as well as cognitively by a high relevance to their interest areas. Thus StumbleUpon's navigation reflects an integrated approach to browsing and control: The majority of the immediate navigation is relational, with structured navigation at the periphery. In other words while non-goal oriented contexts like entertainment and news seem to be more suited to random browsing, Bates Berrypicking and StumbleUpon show that any interest area can invite deviation, exploration and implicit browsing. Integrating

support for these intuitive modes of interaction introduces shades to the question of interface control: low-choice contexts benefit from more intuitive navigation mechanisms, as the sole use of structured navigation mechanism hinders exploration. In an integral user experience control ceases to be a binary question of 'either-or', instead it gives way to the flexibility of a temporary contextual 'more or less', and extends beyond interface instantiations.

Emotional context in random functions

Last not least, this section discusses the emotional context of unstructured browsing. Though short, ignoring this section might render any use of navigation mechanisms geared to support exploration or browsing, such as random browsers into mere gimmicks, which barely scratch the surface of emotional engagement. I employed Damasio's (2003) work in the last chapter to disentangle some of the complexities of emotions. As a result, we know that one of the emotional prerequisites for browsing, curiosity and exploration is the satisfaction of 'background emotions', e.g. motives and appetites, pain and pleasure behaviours, etc (2003, p.44ff). The feeling I am talking about is trust, which borders on that of safety. O'Reilly (2005) included in his proclamation about Web2.0, or the participative web: "Trust your users". I would turn this around into: honour your users trust. Several users commented that they would not trust random mechanisms in commercial applications.

> *"I would expect it [Amazon surprise me] to be tampered with to show certain pages" (I) "Amazon is trying to sell me something" (O).*

I mentioned in the last chapter, affective loyalty is stronger then cognitive loyalty (Pedersen & Nysveen 2001, pp.5/6). This means internet businesses need to be able to value and foster the emotional relationship between them and their users.

Emotional engagement in intuitive interaction

The previous section viewed emotions simply as part of the dynamic of the varying degrees of proximity in the use of random functions, and their role in an engaging and intuitive user experience. This section will focus on them and explore their multifaceted qualities, in particular during interaction. It illustrates the temporary interpenetrating interplay of their various qualities and their role in intense or immersive experiences. CSE's colour interface in particular helps to tap into these more intense layers of emotions in exploration, i.e. in more intuitive layers.

The temporality and ambiguity of emotions and feelings

Reporting on emotions faces several difficulties. Their temporal nature makes it hard to catch them; also, there is an ambiguous relation between language and emotions or feelings. Graphs such as the ones used here, can only act as temporary snapshots and approximations of how users might have felt at the time. They might feel differently next time they use the same functionality for various reasons: possibly familiarity grows, or a different overall context in terms of personal emotional state and external circumstances. The unruliness of emotions does not stop there. Different users refer to their emotions differently, such as view *interesting* and *intriguing* as synonymous, or connect different feelings with different emotions: 'out of control' can have a positive connotation as in "it's fun to see what happens" (I), or a negative connotation. Particularly enquiring about something being *boring* triggered a variety of meanings. There is the temporary nature of interest *"it [Wikpediai] gets boring after a while"(O),* it can refer to a lack of control *"boring is when you can't stop if you want to" (I),* or act as indicator of needed change or stimulation. The temporality of emotions and feelings and their role in grounding (inter)action irreversibly in the moment it occurs has been discussed in the context of embodied perception and interaction (Varela 1993, pp.63ff; Damasio 2003; McCarthy and Wright 2004). The ambiguity in user comments about their feelings supports Damasio's view of feelings as an imprecise interface to the bodies' emotions, as feelings appear into consciousness as conglomerates of complex emotional interactions. This is a potentially frustrating insight in terms of gathering qualitative feedback, as it prevents researchers from accepting emotional statements at face value. Personally I think it shifts the emphasis from individual subjective judgements to the emotional processes involved, a thought I investigate in the next section.

Qualitative multiplicity as a process

The danger of presenting emotions or feelings in graphs is, besides positioning them as absolutes, they might come across as a list of product or solutions related attributes. To find out more about the processes of emotions, I asked users to explore CSE's colour interface for an uninterrupted period of time, and then to talk about their feelings in the process of exploration, instead of what they thought of a function or application. I also offered varied prompts with the option to comment on them in order to maximise the amount of feedback on their feelings. The result shows that every user went through a more or less intense emotional succession of conflicting feelings, no matter whether they ended up liking or disliking the design experiment. The sole use of colours might correspond more

directly to feelings, but the colour interface was also a *novel* way of interacting for the users. So, I believe the emotional succession as illustrated in the graph beneath applies to some degree to any exploration of unknown interaction situations and the emotions involved in the process of (unconscious) learning.

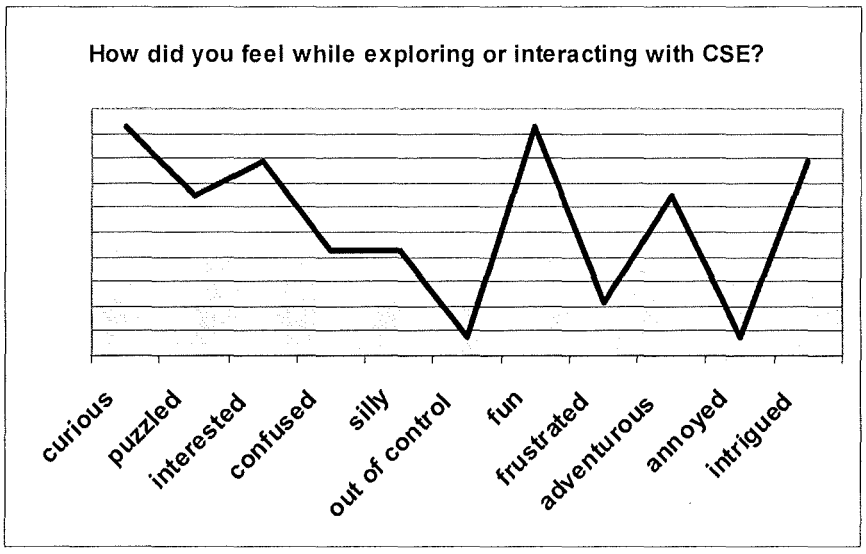


Figure 4.17. Merged graph (mcc) all questionnaires – How did you feel while exploring CSE

Bearing in mind that Sloman and Croucher, as well as Damasio state that emotions interact and interfere with each other, I would argue, that the variety of meanings of a feelings, such as the responses to *boring* above, are not only due to their temporary nature, or their ambiguous relation with language but also depend on their position in an emotional process, and interpenetration of any surrounding emotions. The graphs also illustrates that a direct question about the users' feelings at any time during interaction would interrupt the flow of emotions and might yield only the specific emotion at the time, such as 'confusing' or 'fun' which would not be representative for the overall process. Despite the danger of belabouring the point, the context of unhurried time is crucial for intuitive, unconscious and emotional processes to work.

Colour as direct access to intuitive layers

Colour and emotions play a part in archaic modes of communication (King 2005), below and before consciousness and language. Some users commented on that connection when they talked about their feelings, or first impressions, of the colour interface of the CSE.

> *"it relates to emotions, something you might not be fully aware of. It's a quite subtle feeling you get" (I). [I get a] nice calm feeling, good first impulse. [...] I love the interface, it engages my feelings and emotions, it is a lot more personal" (I).*

This intensity is not always perceived to be positive. One user commented:

> *"it has strong colours, is very busy, crowded.... It might do a lot for an artist. [I feel] a bit suspicious because I had bad experiences in the past". (I).*

The combination of CSE's colour interface with the random exploration mechanism seems to enhance internet exploration for some users:

> *"its more like Wikipedia ['s random article], quite random, but more visual.... the colour input is good, also that is unpredictable. It's fun and different." (I). "It can open a new door, is good for exploring" (I). "I really like the colour interface. It's visually pleasant and what I'll get from clicking and picking the colours is unclear, which is also pleasant" (O).*

Again, the emotionally more intense relation is not always perceived positive:

> *"this can be quite hypnotic... I try not to loose myself into things like this" (I).*

Interestingly, one user commented on the colour interaction in terms of its energy.

> *" If you click on the very inspiring yellow, you expect something that vibrates the same way. [BK: you mean in terms of energy?] yes, absolutely!"(I).*

Though not all users were as outspoken as the users quoted above, most of them were intrigued or curious enough, or felt safe enough, to click into the interface to explore it (18 out of 20). Shorter comments included *"amazing"(I)," inspiring" (I), "unusual" (I), "different" (I)* and [the] *"Colour input is good" (I).* Colour is only one means of tapping into intuitive layers of interaction and invite browsing, exploration, or experimentation. Due to colours more direct correspondence to feelings and emotions, this experiment demonstrates their role in intensifying engagement in intuitive interaction.

Playful exploration

CSEII prototyped a limited dynamic interface featuring an enlarged square colour magnifier, and returned static images. To find out how users feel about a more dynamic interface and returns, we asked users to evaluate Etsy's colour finder. This interface creates a colour track in the shape of increasing and fading bubbles when following mouse movements. Clicking on a colour returns colour related art and craft objects as image thumbnails. Users commented about interacting with the interface itself:

> *"Its very light, it introduces a playful state of mind" (I). "It is nice, it makes me play" (I). The bubbles are fun, its playful, like being a kid again" (I).*

Also, the returned images were dynamic and invited play: users can move, even twirl them about and throw them off the screen. On a more functional level, images can be enlarged for a better view and also offer a short product description in this mode.

> *"I like that you can move them about, it makes using it more fun" (O). "... the pictures are nice for exploring" (I).*

However, this playful feature also made it easy to lose returned images.

> *"I find it annoying that you can throw images too far. [...] (O). It is first funny, but hard to keep it up. When I was playing I lost it [the image] for instance" (I).*

This, again, points at the balance of more or less control that is needed for exploration. The use of colour might have intensified users' emotions but being able to participate actively in creating the experience played a large part too:

> *"I like the Etsy interface best, because of the dynamic interface, then diddlePOP because of the instant speed" (I). "Animation in the [Etsy] interface is best, it is good to play" (I).*

The combination of a colour interface and its individual and temporary creation via interaction certainly tapped into the users' potential to explore and play, an emotional state often associated with children. Follett (2007) states that playfulness is an often "underappreciated, and rarely measured component of user experience" in UX design, and that it plays an important role in users' engagement and creative enjoyment in the interaction experience. I would agree that the strong emotional involvement and ease of creative action intensely engaged users making this an Intuitive interaction. At the same time, this experiment in particular might make playful exploration appear as a quality of the interface or its design. I would argue that the use of colour makes it easier to access those layers, but playfulness, and certainly exploration, is inherent in every interaction that offers support for these modes - and against or in the face of those that try and constrain them.

Seduction of exploration

All users stated that they get sidetracked on the internet to varying degrees, mostly by following related links of some kind. It seems information has a potential to draw or *pull* users in; it has a seductive quality, an effect usually associated with the visual interface.

> *"I get sidetracked all the time, there is too much on the net [] to pull me off focus" (SU). "I might start reading the comicbook related news [...] and then get pulled into watching trailers online for comicbook related films" (O).*

Some users give in and follow the flow, others actively fight it:

> *"I generally float from hyperlinks to eventually fork out to something interesting" (SU). "It is a problem that I loose track, I allow myself to follow a process of associations.. you loose yourself, you forget yourself. It is a sort of fascination.... I try not to do this" (I)."*

To consider information to have seductive qualities blurs the categories between functional content, such as information, and rich graphically designed content, HCI veterans like Don Norman still reiterate (2004). Rather, the idea of information being seductive as

such restates the point I made in the last section. I don't believe that interface design, be it visual or by way of related links, generates exploration on its own. Curiosity, exploration and experimentation are emotions that emerge as a form of active Intuition, and are inherent in any interaction.

Emotions are a challenging aspect of Intuitive interaction due to their complexity, temporary nature, ambiguity in meaning and vague representation of feelings, yet they are vital in an integral understanding of the user experience. Though, in research, this prevents them from being solely taken as absolute qualitative statements, they shift the attention to the intense interplay of their processes. For users, though gappy and incomplete as forms of knowledge they can aid quite intense forms of engagement. Exploration and creative enjoyment are fuelled by emotions energies, which are geared towards action.

The user as co-author

The discussion of StumbleUpon touched on offering users the chance to actively personalise their interaction environment, whereas this section focuses on it. BYOM is less a discussion of specific functions, than a general sensing if users would like to actively adjust interfaces to their personal needs, and if so, in what context. Overall many users seemed eager and capable to tailor some interfaces to their individual needs. At the same time it seems that at certain points users divide into browsers and searchers, and just as searchers are dismissive of browsing in general, it works the other way round too:

> *"I liked the random tools better" (O). "I don't do anything where I would need this"(O).*

The majority of evaluations were positive (18 of 20), with some of them quite excited:

> *"I love it, I would use it" (O). Really useful – a great way of personalising websites that you use often to have exactly what you need, when you need it." (O). "Great, can I buy it now!? ... " (O).*

User can image to use functionality like this in many contexts.

> *"pretty much most of them" (O). "my online bank, travelling websites, movie websites, and sites with new stuff (like new technology)" (O). "[...] also as a general internet start page" (O). "shopping sites, utility bills etc... " (O).*

Users grasped that they could personalise the navigation of websites not only to their preference, but also in the context of use, and access it where ever they are.

> *"if you use this in an internet caf[e]' in Thailand, you don't need to remember, you log into this, and you have all the things you usually use, so you don't spend time to remember what you have to check, all the addresses... "(I;).*

One user that uses bookmarks extensively, also to bypass internet navigation, noted:

> *"Good idea, it's similar to bookmarks. I always use bookmarks, its my life... "I don't go randomly* into the internet. I have things I use on a daily bases - or hourly basis like my email - in *bookmarks. (I)*

There was a preference for the first BYOM option in terms of ease of use and practicality (the *Menu Editor,* a drag and drop mechanism to create and prioritise menu items):

> *"very easy to use" (O). "very useful" (O). "Its very easy to use, and a bit fun initially. It' s a bit limited at the same time" (O).*

Despite requiring more effort by the user, the second option was not far off from the *Menu Editor* in regards of the ranking of the three options, which means several users must have chosen this option as their first choice. The *Button Editor* allows creating or adding single buttons to the menu, including links to external websites.

> *"I need this for my online banking now" (O). "liked it. Takes getting used to" (O). "this is less limited, better for customisation, not limited to given options. A bit more knowledge is needed to operate it, which I have no problem with and I am happy to do" (O). It is very good that you can add your owns links like the currency converter" (O).*

The last option *Button This* was viewed as convenient too, but not as useful as the others. Having said that, users had to speculate here, as this part of the prototype was static: they could view the steps by clicking from screen to screen but not actually interact with the functionality.

> *"Quite useful" (O). "not so necessary" (O). "its very easy to use, there is a danger of going over board, like short cuts you never use. It's not strictly necessary" (O).*

On a side note, I think it would be worthwhile evaluating this option in conjunction with CSE as a collection mechanism, as one CSE user asked:

> *"Once you find something you like, and you click on something else, its gone. How do you find it again?" (I).*

To conclude this section I would like to present a users contribution who explained in great detail, how and why BYOM would be useful to them:

> *"[...] Normally I bookmark pages that I want to see later, and I end up forgetting them. It just happened now, while I was doing the test I saw a very cool thing in amazon, but because its already late and I want to sleep, I'm going to bookmark it. But probably tomorrow I would not remember anymore, but if it was on amazon's page I will see it next time I open it. :P this will make my life much easier (and my bookmarks shelf smaller – now its so big that I cant find nothing there :P)" (O).*

Users seemed interested and partly very keen to take up something like BYOM. Most users had experience with bookmarks or favourites as shortcuts on the internet and used

them in three ways: to personalise their access to the internet, as a collection mechanism for interesting finds and as a temporary buffer, to store promising finds until they have time to investigate them further. Though a popular tool, it soon gets unwieldy due to de-contextualising access in terms of time and context of use. The idea of using a mechanism like this contextually should appeal to HCI as one of Nielsen's usability rules is *recognition is better then recall*, or *ease the users memory load.* The frequent mentioning of bookmarks also shows that, given the chance, users act as co-authors of their own internet journeys. The various contexts of imagined use for BYOM shows that users' needs are not entirely meet by current navigation tools. Also, it seems users are confident to go beyond given controls and even through the effort of a small amount of scripting to add their own links to external sites. Though this is an action on interface level, users not only change the appearance of the interface, or personalise sites or journeys, but also actively create their own connections in the network of the internet.

Summary:

The always-on mode of the internet in the form of broadband connections had a significant impact on user's online behaviour. It opened the internet use up to non-purposeful behaviour like browsing, online music listening, and gambling. The increased bandwidth capacity also enabled entertainment to feature more immersive (and bandwidth-consuming) material like online videos or games. This investigation focuses on browsing, and in particular implicit, unstructured and random browsing and active exploration as alternative interaction behaviour to goal orientated motivation to inform a notion of enlarged interaction, or Intuitive interaction. Intuitive interaction behaviours can appear in any area of interest. Either intertwined with directed search behaviour as in Bates Berrypicking as subject related random dips and excursions to gather intuitive impressions of related contexts, as ambiguous exploration in relatively close proximity to various interest areas or relatively wide spread in areas where there is no clear preference for a particular choice such as entertainment.

Intuitive explorations yield the potential of unexpected or serendipitous finds. Navigation mechanisms or functions that use randomness can support passive browsing in this context. Giving way to random mechanism does not mean abandoning control entirely. Just as intuitive interaction adds fluidity to journeys by deviations from (assumed) linearity of directed interaction, it shifts a fixed idea of control into a fluid concept of more or less control. Less control involves giving up control temporarily or adapting journeys by setting personal preferences; more control can involve creating personal or new connections

and manipulate interfaces to reflect these connections. Besides being able to manipule the framework, immediate and embedded controls are necessary too to adjust the user experience on the fly, as in changing speed or topic areas. The interplay of ambiguity or randomness in relation to subject matter, and a concept of more or less control forms the fluid playground of exploration.

The emotional context of exploration is a general state of wellbeing, and an absence of pressure by time or tasks. Deviating from the close proximity of the original query or topic alleviates utilitarian aspects of browsing, which can be intriguing and evoke curiosity, a sense of adventure, and exploration. However, straying too far from the point of departure by using randomness without a means to harness it can overstretch this connection. Intuitive interaction makes space for these dynamics of emotions. Though temporary and fickle, they connect interaction irreversibly to time; moreover, they also connect users more intensely to an interaction then cognitive reasoning. Emotions are not just the subjective judgement about an experience; they are a constant dynamic internal and relational process engaging the user in the experience. An intuitive approach to interaction is inclusive of emotions and replaces a simplistic binary concept of user-friendliness with the intensity and complexity of their processes, where positive as well as conflicting emotions interact with and interpenetrate each other. Accepting the drive of emotions as integral in user experience, means accepting Intuitive interaction defies prediction. It also means, Intuitive interaction positions the user as a co-author of their experience on multiple levels. In the absence of pressing tasks or needs, implicit browsing can emerge as the passive subconscious monitoring of situations or areas where preferences for choices are yet apparent, or in a more active form as random dips and detours in the closer or wider proximity of any area of interest. In its most active form, users adjust and shape their own experience, and create their own personal interaction environment.

Conclusion:

The research for this thesis started in 2001. Since then several strands of critical approaches towards traditional HCI have simultaneously developed which are not acknowledged in this work, but that I will briefly introduce now. The term 'critical practices' in this short listing acts as an umbrella term for a variety of approaches, similar to the "3rd paradigm of HCI" mentioned earlier. Philip Agre (1997) coined the phrase 'critical technical practices' to propose that technical design and production processes are a means for reflexive inquiry which could expand the understanding of the conditions and goals of technical work (p.23). Sengers et al. too stress the importance of critical reflection in design processes; in addition they make a point of making users part of this reflection in order to bring "unconscious aspects of experience to conscious awareness, thereby making them available to conscious choice (2005). In terms of how to achieve this reflection, Sengers et al. suggest participatory design methods. Both Agre and Sengers et al. strive for augmented processes and improved design solutions in their work, while Anthony Dunne and Fiona Raby work on a more conceptual level. Some of their critical designs are produced and distributed to galleries, some remain conceptual which in themselves are thought to encourage reflection. They position their concept of critical design as an alternative to 'affirmative design', a term they use to indicate unchallenging and conventional designs. William Gaver's 'ludic design' (2002) is of particular interest to my work as it acknowledges unstructured or playful human activities as a potential 'mechanism for developing new values and goals, for learning new things and for achieving new understandings" (2004). This approach encourages exploration, and views the subsequent processes of meaning making both as a space for reflection and engagement. Ludic design is united with the critical approaches above by a notion of reflection and the desire to integrate tacit or unconscious aspects of human behaviour or ways of understanding in (interaction) design. Other parallels I see between Gaver's and my work are the emphasis on experiential engagement, or, to use Schön's expression, on 'reflection-in-action', and an openness in designs that allows users to own or appropriate technologies. Finally Gaver's suggestion of innovative qualitative methods of 'requirements capture' such as probes (1999) are highly inspiring to my future work.

Therefore I believe that my work on intuitive interaction and its role in integral user-experiences joins progressive strands of HCI research that attempts to overcome traditional HCIs paradigms, namely the rationalistic stance and thought models of early engineering and cognitive science and their purely functional view of interaction. These mod-

els equate human information processing with the simple feedback mechanisms of homeostasis and the human mind as an information processor similar to a CPU. Another point of critique is the collapse of the complexities of interaction in interface design.

Founded in the early 1980s as an interdisciplinary practice, struggles amongst followers of HCI's earlier originating disciplines still continue, only now within a larger pool of contributing disciplines. After tracing the roots of these models in ergonomics and military history, in other words through 1st wave cybernetics and Taylor's time and motion studies, I then investigate the supposed simplicity of interface interaction with the help of media and interface studies: their rationalistic undercurrent, the multiple layers between interface and software as medium, and the space between those layers as an arena for strategies and tensions between older and newer media. A reading of the focus on the interface in light of contemporary philosophy reveals a power mechanism involved in these tensions, yet also reveals their productive capacity. As IP number logging and link tracking reveal users' resistance, rejections and ruptures, which - just the same as purchases do - join the data stream covering their journeys, surveillance ricochets, and puts HCI under pressure. Traditional HCI seeks to address the supposed failure of uncompleted journeys by forever improved or optimised design models *for* users, while an integral understanding of the user-experience encourages the idea of having designs improved *by* users on a continuous base. This extends the role of users' input, action and evaluation from dedicated phases during the production process to a continuing communication process between users and producers. In turn, this could transform the restricted energies of power struggles inherent in traditional HCI design into more creative and active ones, which actively include users in the design and interaction processes. Though touching on the repercussions upon production models and processes using this approach, this work focuses on the user journeys and experiences in Internet interaction.

I term experiences which allow for users' productive and creative energies 'Integral User-Experiences' and interaction which specifically derives from the emotions and energies that drive implicit leaning and exploration 'intuitive interaction'. An Integral User-experience incorporates intuitive interaction to complement traditional theories of HCI on several levels. Goal-orientated interaction may be interrupted, delayed and accompanied by various forms of browsing; thus it makes space for early non-conscious forms of knowledge, and for gappy and partial knowledge as well as serendipitous discoveries. The inclusion of emotions produces embodied and engaged modes of varying intensities in interaction, all of which escape prediction. An integral view of the user experience po-

sitions users as co-authors of their experience in varying degrees, as they delay, interrupt, explore, adjust, evolve and create their own experiences. It dissolves an absolute notion of (interface) control into fluid concepts of more or less control. It also displaces rigid pre-determined step-by-step processes or hierarchical approaches to information with the unpredictable dance with the complexities of the unknown, something that emotions equip us so well for. Accompanying goal orientated interaction with intuitive interaction not only overcomes traditional HCI's inherent rationalistic orientation, it also overcomes a purely functional understanding of interaction as a simple stimulus-response mechanism. Therefore, an integral view embraces emotions on a far more fundamental level of user-experiences than do notions of engaged or even embodied experiences; although they integrate them as hedonic element or means of creative adaptation in experiences, essentially both leave a reactive position for users in interaction intact. Yet, my point is not an argument for the freedom of a liberal subject in software interaction - as including users' activity or creativity will not free users from the limitations and interferences in technical communication - rather it aims for a more active role for the user in this complex communication.

The larger context of thinking about an integral user-experience hopefully continues to open discourses and potentials which evade traditional HCI. This context relieves time from its function as efficiency measurement and opens it up to the drifting of immersive and exploratory moments of interaction. It embraces the diversity of continuously changing hybrids of intertwined explicit and immersive Internet solutions, such as informational web-access software and infotainment, as well as the Internet's potential as an experiential medium, as currently the Internet is "the greatest force for commoditization known to man" (Pine & Gilmore 1999, p.10). In order to design for an 'experience economy' (ibid) new dialogues need to be opened amongst the larger circle of (Internet) interaction design. Preece (2002) recommends that HCI liaise with businesses with established knowledge in immersive and entertaining experiences; similarly, in a Bergsonian fashion (in my opinion) Bates (2002) proposes to overcome struggles of superiority amongst meta-theories in this context, and instead use points of differences and clashes to open multifaceted and enriching dialogues about the human experience. I agree; such dialogues would enlarge the idea of integral individual technology interaction into a fruitful interdisciplinary interaction that acknowledges the complexities and non-linearity of evolving the Internet, and complete reductive or relative perspectives with absolute ones given in intuition (Bergson, 1913, p.23).

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Appendix:

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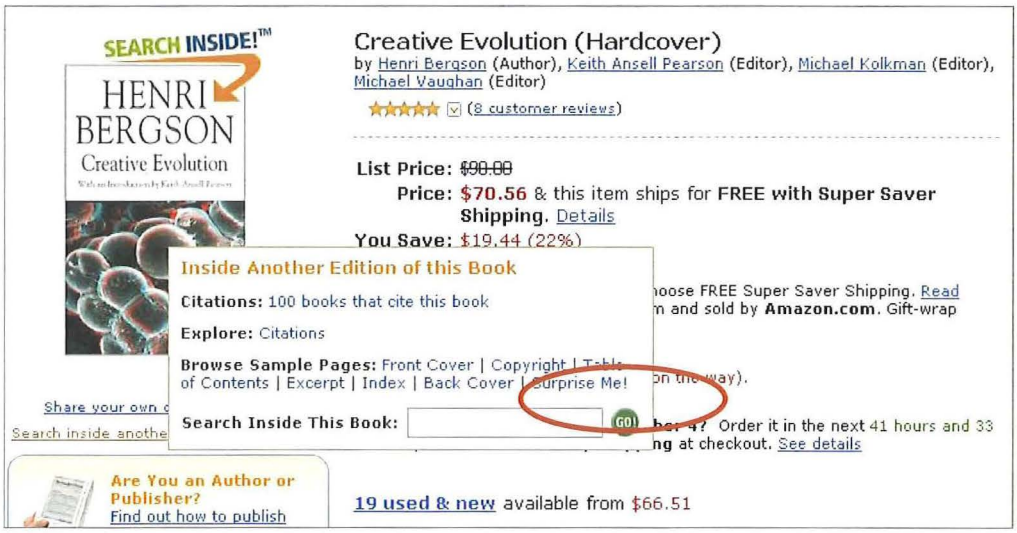
Table of Figures

Design experiments

Benchmarking applications

Amazon 'surprise me'



1.0. Amazon 'surprise me' screen shot with preview options including 'surprise me'

Amazon 'surprise me' is currently live on Amazon.com on selected books[1]; it is not available in this functionality in the UK. It utilises a random mechanism that presents pages of a selected book allowing viewers to 'flick' through a book to get a feel for it. Therefore its randomness is highly subject related, i.e. contained in one book. Many of my users have never come across random functionalities before. So I used it at the start of the evaluation sessions so users could experiment with a random based functionality before they evaluated my experiments. By the time users had answered related questions, interacted with, explored and thought about an application that works with random mechanisms, they usually had spent about 10 minutes. Traditional testing vocabulary would call Amazon 'surprise me' a benchmark application, or a means of comparing other applications. However, my reason for including the Amazon functionality also lies in my intuitive approach: Assuming that most users found random support in interaction novel, I wanted them to interact with this kind of functionality for a while so their intuitive levels could develop 'a feel' for them. For the same reason I included Wikipedia's 'random article' which is described next.

[CD]:\Design experiments\Benchmarking applications\Amazon

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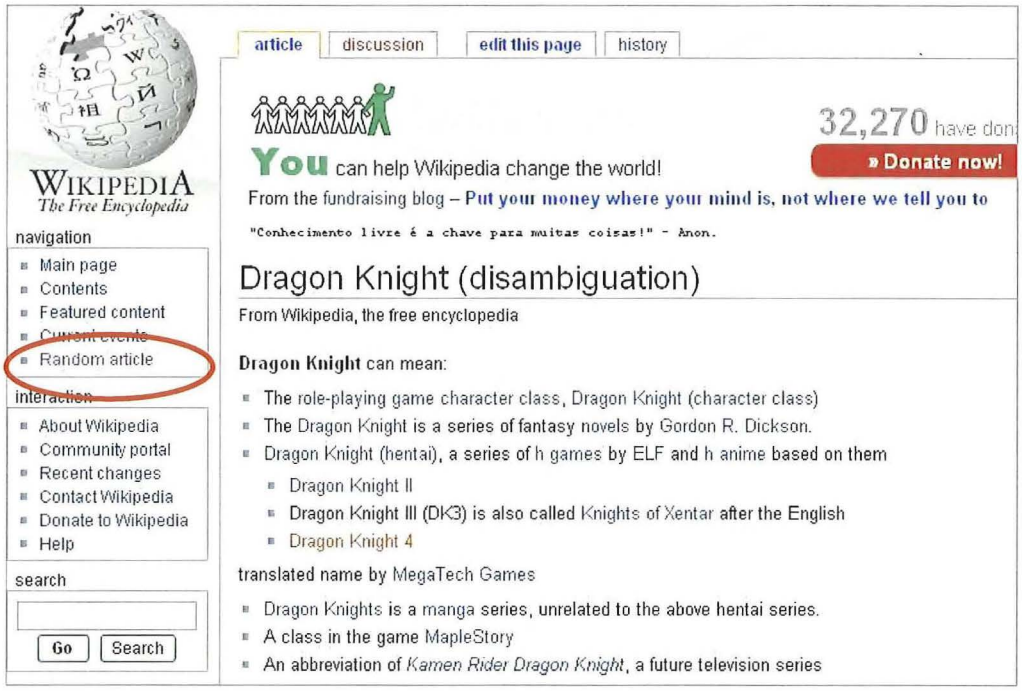
[1] I found out later that the selection of available books depends on the individual purchase history of the user.

Benchmarking applications

Wikipedia 'random article'



1.1. Wikipedia 'random article' screen shoot

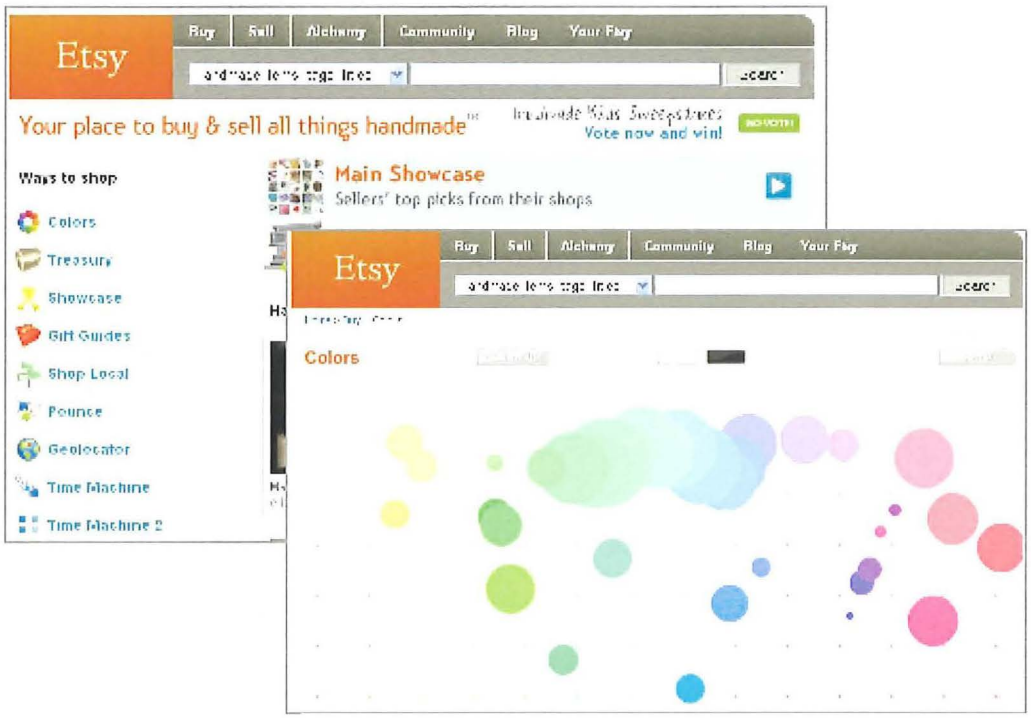
Wikipedia's 'random article' is also an existing website and its functionality is technically very similar to Amazon 'surprise me', in that a random generator produces 'random picks', in this case randomly selected articles. However, as the random picks are distributed over the entire encyclopaedia, i.e. a vast database of informational articles, returns come across as entirely random, an effect almost opposite to the Amazon functionality, which, of course, produced highly related returns.

Similarly to Amazon 'surprise me' it took users about 10 minutes to interacted with, and explore the functionality and answer related questions, so after trying both functionalities they had spend about 20 minutes with two similar and yet quite diverse applications using random functionality.

The url to this functionality on Wikipedia's website is: www.wikipedia.com/en

Benchmarking applications

Etsy.com, all things hand-made



1.2. Etsy screen shoot menu selection 'colour'

Etsy.com is a global distribution hub for artists to sell their arts and crafts objects. One way to find these objects on the site is by colour match. Though conceptually very different from CSE, some aspects of the interface helped me to understand certain issues better, which also applied to CSE, in particular regarding the image return. Therefore, Etsy's colour finder interface was benchmarked against CSE II's image return and interactivity. Etsy's returned images appear stacked onto each other in a small thumbnail format. Users need to pull them apart to view them; also they can twirl and enlarge them, throw them about on the screen and even throw them off the screen. However, as interface functions are highly intertwined with content, it was sometimes difficult for users to keep the different design concepts in mind. So, some commented on Etsy's functionality as a shopping interface as such, instead of the functionality of the image returns. The colour finder is live and can it can be found on www.etsy.com/colour.phd.

[CD]:\Design experiments\Benchmarking applications\Etsy

Benchmarking applications

StumbleUpon: Online questionnaire for 'experienced random browsers'

1.3. StumbleUpon screen shot start page, not logged in

StumbleUpon (SU) is a community that finds and recommends websites to its members. On sign-up an additional browser bar is installed with several icons, such as 'thumbs-up' and 'down' for rating sites, or in the case a site has not been submitted before, submitting it. Sites can also be blogged or reviewed, etc. The main button however is the 'stumble button' which presents randomly selected websites on click, according to pre-set tags or topics or interest and community ratings. One can choose from just under 500 topics, create new topics or tags, or choose sites used by other stumblers. In other words, SU works with a mix of randomness and communal and individual personalisation.

SU was not benchmarked against other applications. I used SU as a standalone online-evaluation by stumblers for several reasons. Firstly, to get feedback from experienced random-functionality users about this kind of functionality, secondly, to explore for my-self how online-surveys with expert communities could work with the view of including this as an evaluation tool in my future work. To my delight, it worked extremely well, as described in my thesis earlier. Therefore, I will pursue this route of evaluation in view of ongoing user-producer communications in future.

The url for this website is: www.stumbleupon.com

My Design experiments

The Flick-Through-Browser (FTB)

FTB is a static prototype of a little widget that browses a specific website in a random fashion, has been described as part of chapter 4. Users can then click the button, which toggles between start and stop, to view random web pages within a given site, similar to a slide show. 'Static prototype' means that the journey users' experienced was hard-coded in HTML; therefore every user evaluated exactly the same experience. The prototype mimicked a journey of 25 screens, evenly distributed across all categories on a telecom operator's website, as people expect an even distribution when it comes to random probabilities (Griffiths & Tennenbaum 2001; Levy 2006, p.206ff).The re-fresh rate between the screens was set to 4 seconds.

1.4. FTB Start button v0.1

1.5. FTB Stop button v0.1

The next iteration would see the following changes based on the user comments: the start button will have a little 'back' button added, in case users stopped the widget too slowly, and allowing them to navigate back. Also an 'edit category' pull-down would be added, so the widget can be customised. The stop button will have links added, so the speed can be adjusted.

1.6. FTB Start button v0.2 (iteration)

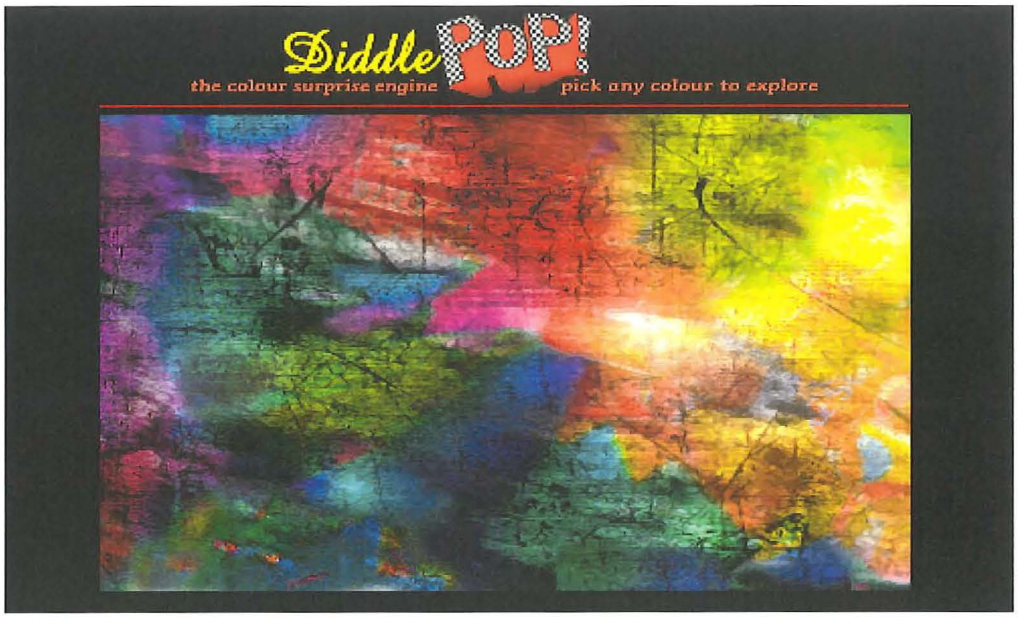
1.7. FTB Stop button v0.2 (iteration)

In view of possible production more research is necessary. Firefox's Greasemonkey community offers a similar tool that needs downloading and integrates in the browser bar, similar to StumbleUpon. However, both suffer from the same problem regarding cross-browser compatibility in that a different version is needed for every browser. Another possibility would be to design the widget as a component that integrates in the navigation as depicted in the current prototype. This way it could be very easily customisable for users, but would need to be slightly adjusted for every website that integrates it.

[CD]:\Intuitive_interaction_DVD\Design experiments\my design experiments\FTB

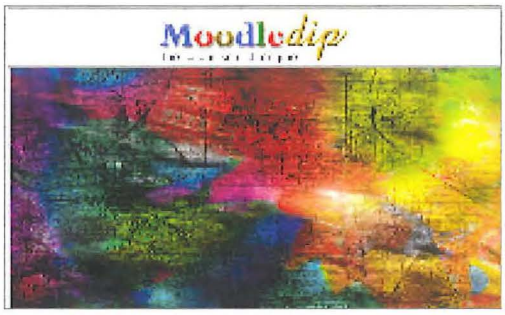
My Design experiments

The Colour-space explorer (CSE) I

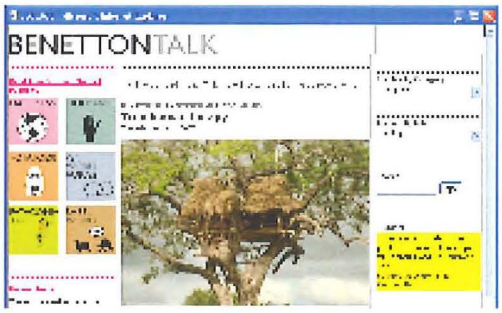


1.8. CSE I (DiddlePOP) screen shot start screen

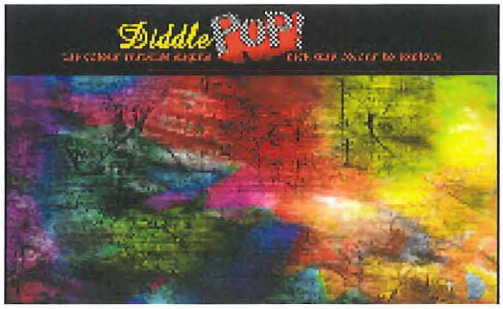
The idea of the CSE is that users explore and interact with the internet vie a different means than a text based interface, or categorised information. Instead, they choose and click on colours. The functionality is loosely based on colour-associations as well colour use in language. So, red might be associated with love, blood, action, war, etc, as well as phrases such as 'red tape' or 'red cross'. I will talk more about this in the section on CSE II, as that version actually has a dynamic 'backend' which connects live to the internet. For now, I will return to describing the static versions, which went through a few iterations and developed in different directions. A static version means the links were hard-coded in HTML as image-map links relative to the colour areas. So a red area would contain a few links to 'red' content which was manually produced by typing a few terms from the database I will later describe. Both, MoodleDIP and DiddlePOP work with the idea of an instant return: a click on a colour produces a (more or less) colour related website. They differ in the way they present the returns: MoodlePOP simply disappears and refreshes with the return, DiddlePOP shows the return beneath a DiddlePOP top panel. (Technically this is a frame based HTML solution with the DiddlePOP panel as parent frame.) This top panel allows users to continue exploring the colour interface as well as the returned sites. Initial 'quick and dirty' testing showed, that users where very particular about the colour they chose and wanted assurance that they they clicked the right one, which resulted in the 'colour magnifying square' featured in CSEII.



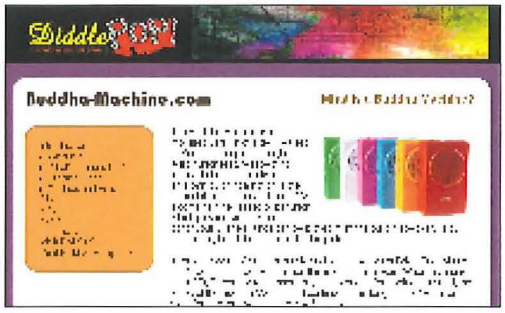
1.9. MoodleDIP interface start screen



1.10. MoodleDIP return



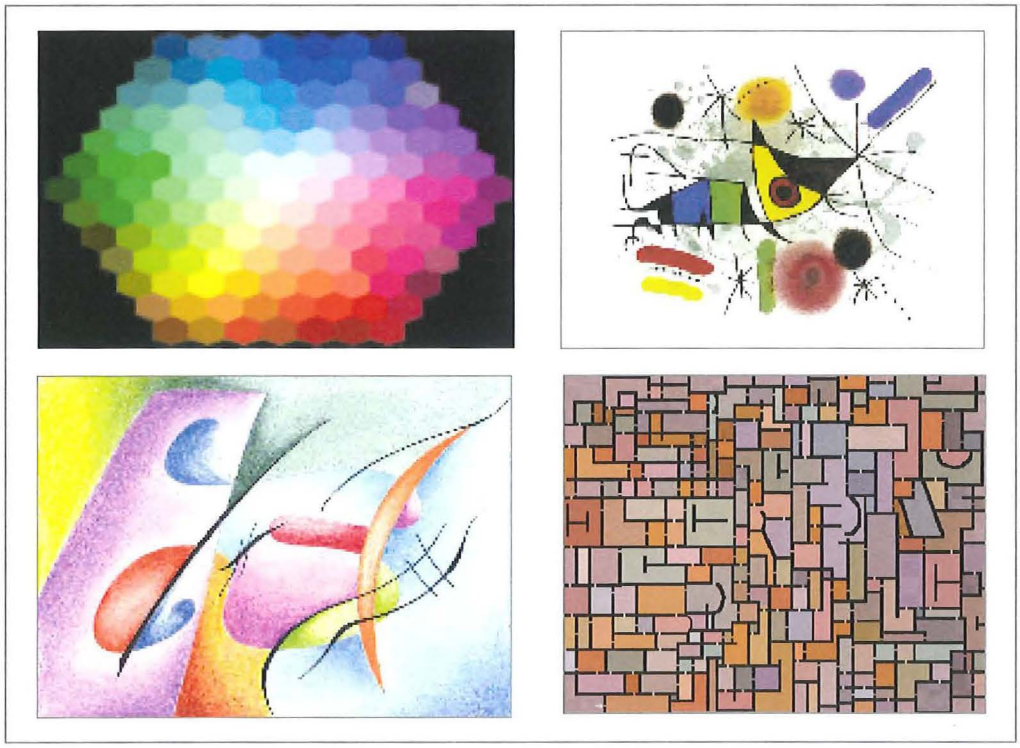
1.11. DiddlePOP interface start screen



1.12. DiddlePOP return

This is also why DiddlePOP was preferred over MoodleDIP. Though MoodleDIP offered a very fast experience, and later comparisons showed that several people preferred DiddlePOP over CSE II because it was more instant, MoodleDIP was *too* fast. Users could not remember where they clicked in the interface, i.e. which colour they choose, and then were at a loss as to how this related to the results. Rephrased in view of my shift towards a notion of more or less control: users were happy to explore the internet this way for a while, and abandon the control a text-based interface offers, yet some control is needed to nudge and shape the experience that vaguely revolves around the relations to colour. Also, MoodleDIP users were taken aback by results which were very text-based. Having started from an image based interface, they preferred to stay in this more visual mode. DiddlePOP's top panel helped to carry the visual approach into exploring subsequent journeys, which was found preferable. MoodleDip was therefore abandoned after the 'quick and dirty' evaluation and DiddlePOP was developed further for evaluation by a larger group of participants in comparison to CSEII. Before we move into this comparison, a few more comments on DiddlePOP though. Due to the static-manual set-up DiddlePOP offered the opportunity to evaluate the concept of searching the internet by a mechanism that returns a proportionally higher amount of 'alternative' information such as art related news and reviews or self-publication/blogs, political art, niche publications, 'green' information, or simply 'weird stuff' (like a scary push-cycle driven insanely high rollercoaster in Japan, or people's own rollercoaster's in their backyard (Blue flash) in-

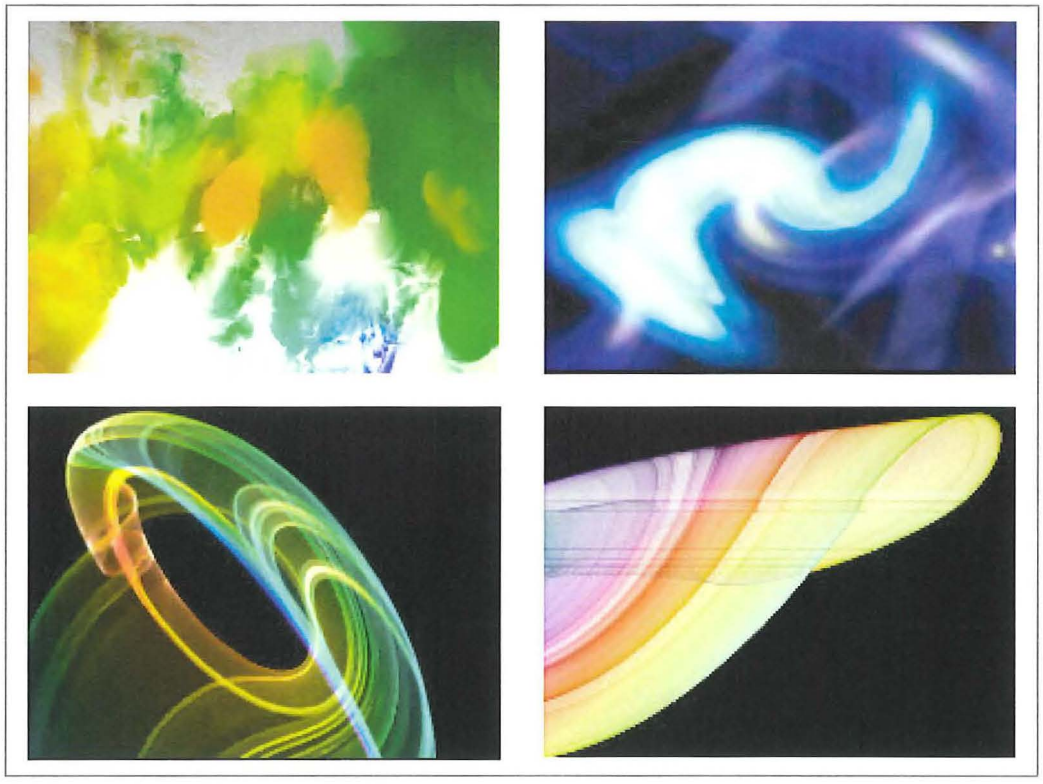
cluding DYI-build instructions). In other words, the design concept of finding niche or alternative information is almost entirely contrary to Google, which works by weighted link popularity and page ranking. (Weighting links is a way to describe links by their connectedness: the more connection the more popular (in a quantitative way). 'Heavily' connected links then rank higher, and are consequently displayed higher-up in a link hierarchy, i.e. Google's return list.) DiddlePOP's design concept was received very well; though users did not necessarily understand the colour match mechanism in detail (which was not a prerequisite), most of them perceived the functionality as positive. Some assumed every colour stands for a different 'arti' or 'alternative' category, some found searching by colour interesting, particularly as some matches were quite vague and therefore challenging (e.g. grey market = illegal art), some did not care how the mechanism worked at all, they just loved having a mechanism to explore non-mainstream content in an enjoyable way. In order to find out if users liked the mechanism or the interface as such, alternatives were presented, including animated or computer generated interfaces. Users picked different favourites, most of them did not mind if a different interface would randomly come up every time they used, while a few wanted to look at different interfaces, but have the option to choose a favourite, like a gallery. Animated interfaces needed to be rich in colour, so one would not have to wait too long for preferred colours to come up.



1.13. Alternative CSE interfaces, static

Alternative interfaces, animated

These examples are screen shoots from animated interfaces which develop different colour schemes over time. Apart from one example, the interfaces were presented to users as stills. Though this was not ideal in order to have users evaluate their preferences for a particular interfaces, it helped to establish that users are principally interested in other, possibly animated interfaces, and are not wedded to the CSE interface in particular.

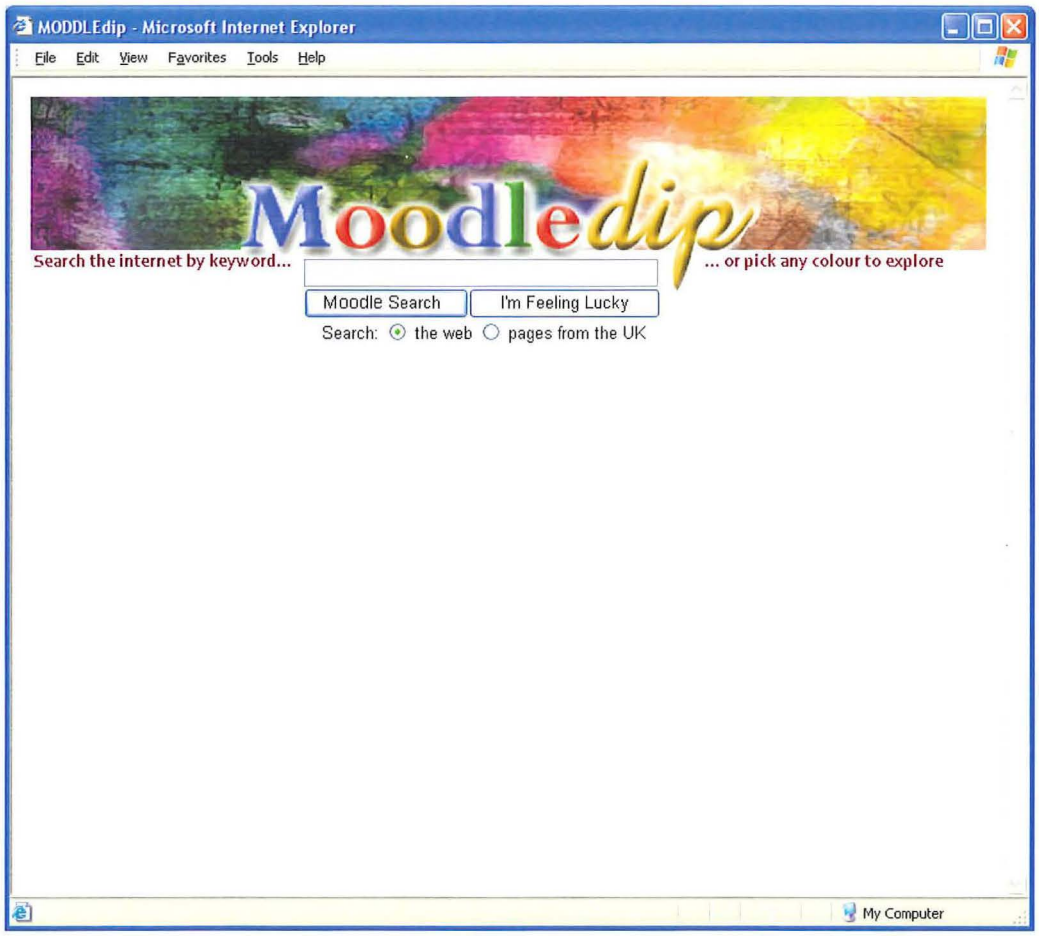


1.14. Alternative interfaces, animated as still shots

1.15. Alternative interfaces, animated, screen shots

MoodleDIP iteration

This iteration of the MoodelDIP version has only been evaluated informally with a very small sample size (2). The iteration attempts to address a need that was clearly indicated in evaluations: integrating support for browsing or exploratory interaction with goal-orientated navigation mechanism is more beneficial to these interaction modes then providing them as stand-alone applications. The design beneath is one possibility to address this need and was positively received, but more feedback is needed based on a working prototype.



1.16. MoodleDIP iteration, integrated explicit / implicit interface

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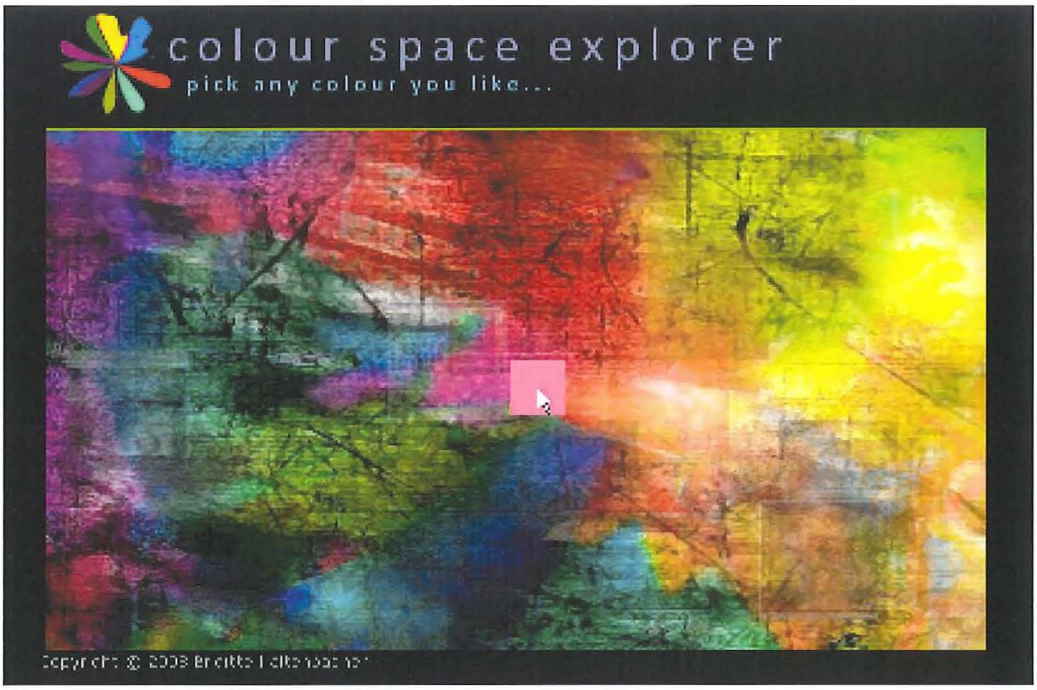
My Design experiments

The Colour-Space Explorer (CSE) II



1.17. CSE II (Colour Space Explorer) screen shot start screen

CSE II is a more advanced prototype in terms of dynamically querying the database, but it is also restricted in different ways. I introduce the dynamic functionality on a high-level in this paragraph, however a technically more detailed description by the programmer follows in the next section. When a user explores the screen, a square colour magnifier appears instead of the mouse cursor, so users are very clear about their colour choice. Once the user clicks on a colour area of their choice, the detected RGB colour is matched to the closest HTML colour in the association database. Then a search string is constructed from a random selection of related colour association tags. A total of three tags is chosen, which are then combined in three two-word text strings. For example, a click on a red area could produce the search strings 'red fire' or 'red energy' or 'energy desire'. CSE II runs these strings as three parallel searches to vary results even more then a single search might do. The search strings are submitted to Google's API, the results are presented as image thumbnails in a circle around the initial point of click. Each search is therefore represented by three images, as the total of returns is nine images. Each image links to the related website on a click. Currently the link description shows the url, however the final version should feature several options on rollover as depicted in the CSE II click-though prototype.

[CD]:\Intuitive_interaction_DVD\Design experiments\my design experiments\CSE II (Colourspace explorer Palimpsest)\CSE II static click-through_PT

Though using Google's API was a good way to develop the interface dynamic in a short amount of time, in terms of search results this forms one of its restrictions: As Google's search is geared towards popular links, it clashes with the design philosophy behind CSE and the results are not as alternative or exciting as they could be. We tried filtering the top mainstream results before they appear as an image return, however that produced serious speed problems, so we dropped filtering from this version of the prototype. For the same reason duplicate image returns have not been filtered out in this version. Another feature that has not been integrated yet, it that returns would shuffle through the first 15 returns of each search string, so the results would be even more varied. This means, even if the user chooses exactly the same colour twice and the random mechanism picked exactly the same association tags, the results would still be different, as instead of displaying 3 times results 1-3, this time it would return results 4-6. One exciting feature we did develop is the Palimpsest, but before we move on to this, first here are some technical details about CSE.

[CD]:\Intuitive_interaction_DVD\Design experiments\my design experiments\CSE II (Colourspace explorer Palimpsest)

Technical description CSE (by Toby Watson)

Introduction

CSE is developed using two major technologies. Turbogears and Adobe Flash.

Turbogears is a modern web site development framework written in the language Python. It makes it easy to develop a new site and interface that site with back-end processes written in Python. In the case of CSE substantial use is made of network libraries and an image processing library named PIL (Python Image Library).

Adobe Flash was used to develop the 'smart image' which is at the centre of the CSE user experience. This image component knows how to display the search results atop the main background image.

Turbogears is a site generator. As such it automatically generates a large number of files, many of which are only of cursory interest. I will restrict discussion to those files of interest.

Review

Before discussion of the components a quick review of the CSE request-response cycle within the context of a user session :-

1. User navigates to the home page. (demo at http://bcse.thetobe.com)
2. Turbogears generates a regular HTML page with the Flash component in the centre. It also caches the main image for quick results processing.
3. A user clicks at a particular (x,y) location on the main image.
4. Flash dispatches a HTTP-GET request to the web application of the form /isearch?x=300&y=200
5. In a complex operation the web application decides which colour (and hence terms) this location represents. This in turn is used to formulate a query against Google Images. Some of the results are further treated and returned in the body of the response to the Flash 'smart image'. The resulting images are resized and cached for subsequent retrieval.
6. The smart image receives the response and asks the web app for the related images (which have already been cached by the web app). It displays the images in a circle around the original click-location.
7. The user may choose to select an image. (They may also click in a different location in which case steps 1-6 are repeated.) Each thumbnail image is aware of the webpage that it represents.

8. The URL for the page in question is sent to the web app. The web app formulates a new HTML page containing the CSE header and a preview of the page in question.
9. Finally the user may choose to remove the header, in the process navigating their browser directly to the page in question.

bcse/controllers.py

Each page is associated with a function (or method) in the controller class that does the processing for the results of that page.

/index - this is the main and default page of the site. The index method simply directs the framework to produce the main page using the template in welcome.kid .

/isearch - the main entry point of the system - the processing of a search request.

The search is achieved by transforming the original location first to search terms and then to image results. This transformation is aided by a number of custom libraries; colourlib, glib & ip. The broad steps are as follows.

1. The colour of the main image is sampled at the search location.
2. A tuple of hexcol, name, keywords, phrases, cultural & matchedRGB is retrieved from the colour database. [function ColourSearch::search in colourlib.py]
3. The isearch controller develops a list of candidate search terms, namely
- name + keywords
- only name
- only keywords
4. Function ImageAll in glib.py is called to perform a search on Google Images for the search terms. All 3 searches are run in parallel and the results interleaved to produce one larger list of results.
5. The order of the search results is randomized (using Python's choice operator). This provides some protection against users seeing just the top few results.
6. The Boss class in ip.py is asked to retrieve and process a fixed number of these results (9). It is given the entire list in case any of the results cannot be retrieved. 4 retrieval threads are run in parallel to speed operation. Successful results are reduced to thumbnail size, cached and have their average colour, associated site and image source URL are recorded in a Results object.
7. Finally the list of Results and metainformation resulting from the search (location, colour, terms etc) are passed to the results.kid template. This formats an XML response which is returned to the Flash 'smart image'.

/show - arranges for the display of a particular search result within the context of the CSE site (preview).

bcse library modules

colourlib.py - The ColourSearch class produces the best-matching colour from the colour database using a simple distance metric (Euclidean) in the RGB space. The information associated with this colour is returned to the main search system; of key interest is the colour name and the keyword terms associated with the colour, e.g. 'dark red brown': 'autumn spirit, earthy, primitive art, quixotic'. Note that the comma separated terms may consist of multiple words per term, e.g. 'primitive art' vs 'earthy'.

glib.py - g-lib is designed to interface with Google Images, extracting the site and image source URL for each result associated with a particular set of search terms. The class Imager conducts a single search. ImageAll can run a number of searches in parallel. The convenience function 'interleave' combines the results from a number of searches, preferring those at the top of each search, i.e. [A1, B1, C1, A2, B2, C2, ...]

ip.py - the ip library retrieves and processes images. Given a particular image source URL the Processor class will download the image, create a thumbnail and calculate the average colour. The Boss class can reliably retrieve a fixed number of results given a list of potential image sources. The Result class represents an image and all its associated information.

templates/

welcome.kid - Presentation of the main search interface. Note the debug flag is passed along to the Flash 'smart image' to enable debug display of search terms and matched colour name.

results.kid - Generates an XML document representing the successful search results. The name and keywords associated with the matching colour are transmitted along with an image source (pointing to the web app's image cache), site URL (of the associated website) and average colour (of the thumbnail).

show.kid - Preview of a particular search result in an iframe within the context of the CSE site.

Flash 'smart image':

App.as - The main controller of the Flash component. This is responsible for formulating and dispatching /isearch queries to the web application. It also receives the XML results documents, parses it and creates 'Things' representing the search results.

Thing.as - Each search result is reified as a search 'Thing' object. They are 'tangible' display objects knowing the site to which the refer and equipped with interactive behaviour. If a user clicks one of these items they direct the web app to preview the related site using a /show?site=... request.

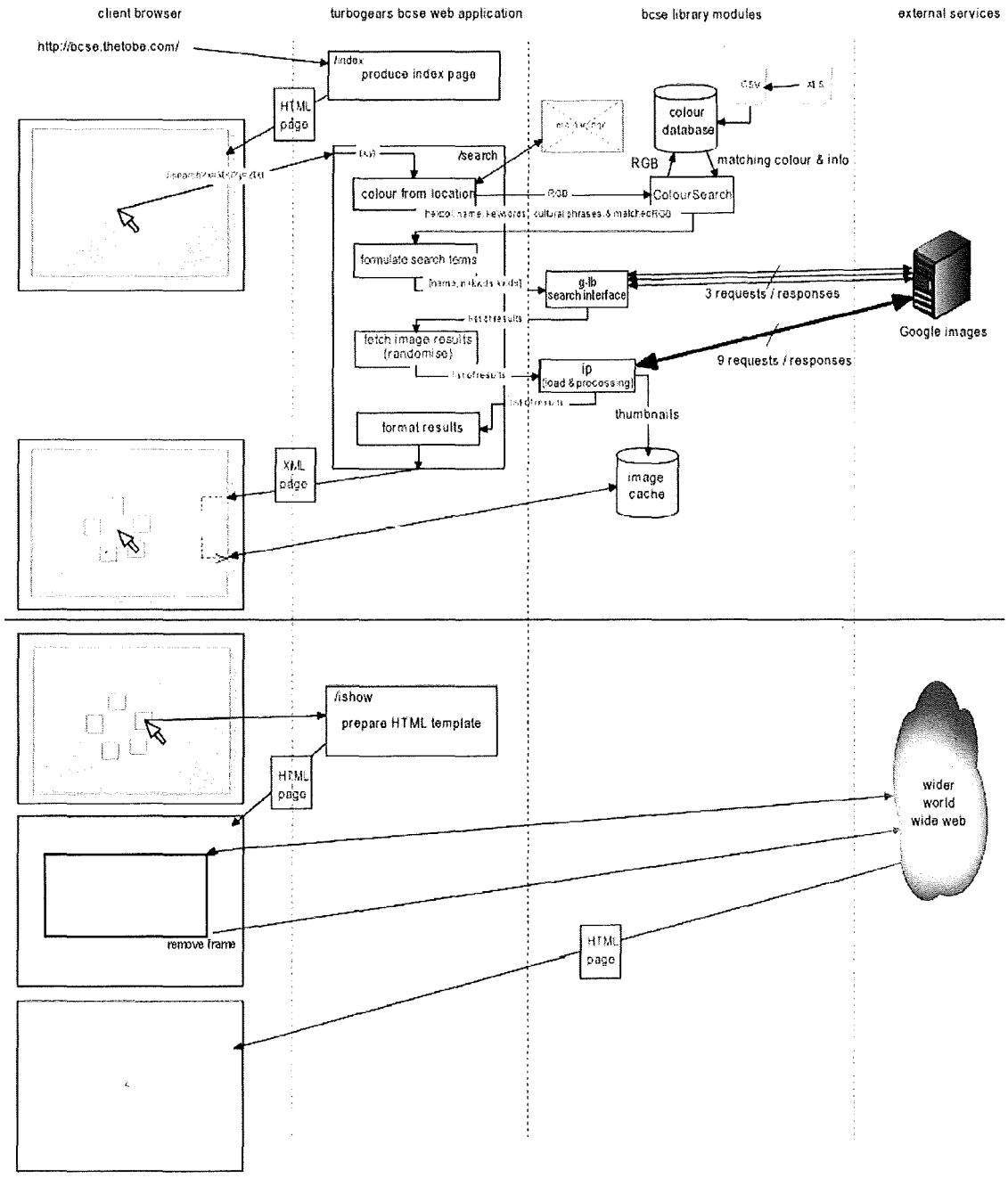
ThingSpace.as - A convenience to ensure that all search results float above the main image but below the Magnifier cursor.

Magnifier (inside smartimage.fla file) - Displays a representation of the main image for easy colour location. It tracks the users' movements using a masked and much magnified version of the main image.

On the Preparation of the Colour Database.

As delivered the colour database is an Excel format spreadsheet. This is first converted to CSV (Comma Separated Value) format for easy processing in Python. The script import_colours.py reads this file and produces a 'pickled' python data structure suitable for rapid lookup in the web application. This data structure resides in the file colours.pickle.txt and is loaded when the first search occurs.

CSE Data Flow Diagram (by Toby Watson)



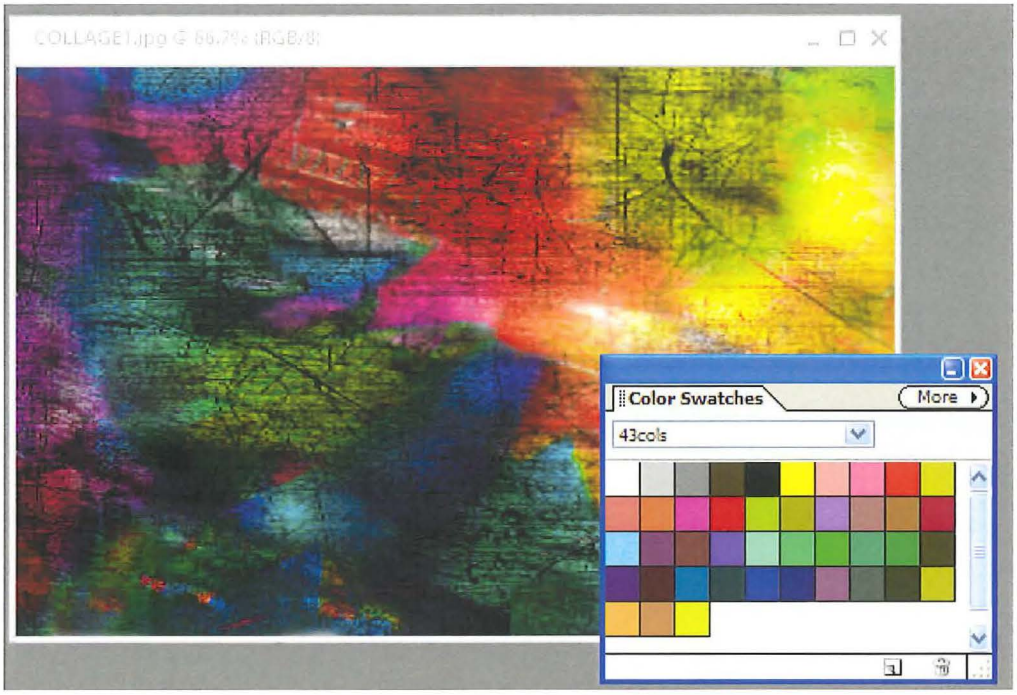
1.18. CSE Data Flow Diagram (by Toby Watson)

The colour association database

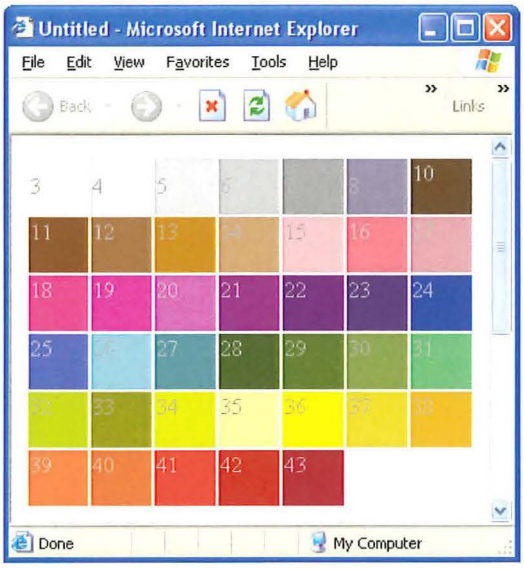
The database (DB) was the first element developed in CSE's production cycle. The idea of working with colour associations derives from a book by Eva Heller *Wie Farben wirken* (1999, How Colours work (my translation)). Social scientist and psychologist Heller investigated the emotional responses to and associations with colours in culture, advertising and language through history until today. Although this is a limited way to work with cultural assumptions I integrated it initially without further judgement. Informal research showed that some associations did not translate well (blue is associated in Germany with being drunk, while in the UK with being depressed or low), so the initial database of colour descriptions and words has been expanded with use of Google's phrase finder (service has ceased since then) and wordnet (wordnet.princeton.edu), a more intuitive approach to lexical DB according to the founders, i.e. a mix of dictionary and thesaurus. Since the distinction between colours are partly quite arbitrary, there are overlaps between some shades of colours and associations.

Initial tests of the concept were simply manually typed random strings made from a very basic version of this DB (red, green, blue, yellow, black) into Google, and monitoring the results. Nevertheless the first version was already formatted exactly as the final version beneath (4 columns, single words comma separated, fixed phrase and phrases exceeding two words in quotation marks) which enabled my technical collaborator Mr Watson's to start with the development of the random search string generation mechanism while the DB population was still developed and expanded. Admittedly the selection of phrases and associations is skewed towards finding alternative, artistic and or user-generated internet content to counteract Google's tendency to produce the most popular (in terms of weighted links that is) websites according to their amounts of inbound links as results. All links in the colour panel of CSE I, the static prototype, derive from this manually derived results list.

Matching the colour names to their bin-hex values (e.g. white to #FFFFFF) was an iterative process between rendering palettes of the interface image and the development of the colour DB. Adobe Photoshop allows the render adaptive palettes from graphically rich images so they could be presented relatively truthful, when computers could only display 256 colours, web imagery went though a similar process in the early days when images needed to adapt to web-safe colours. So after indexing the interface image to 43 colours I exported the resulting palette as an .aco file, which then formed the bases for the HTML colour table.



1.19. Interface image, indexed to 43 colours and imported .aco file



1.20. HTML colour table for CSE DB, based on .aco file

The DB query mechanism Mr Watson developed reads the colour a users chooses by clicking a colour in RGB, matches it to the closest colour in the bin-hex colour table and then moves on to the content cells (association & cultural phrase) to choose the 3 terms which form the 3 two-words combinations (a&c, a&b, b&c) which are submitted to Google's API.

CSE Colour database (Excel file)

Colour bin-hex values	Colour name	Association	Cultural phrase
#FFFFFF	white	unicorn, purity, virginity, cleanness, faith, "white innocence", innocence, cool, crystal, cream, art,	"white as snow", "white elephant", "White bread", "White Rabbits", "Mighty White of You", "White Knight", "white lie", "White noise",
#FEF5F0	off-white	pearl, cream, art, ivory, bleached bones, oriental alabaster, onyx marble, statue, sculpture,	"pearls of wisdom", "Ivory tower", "Ebony and Ivory ", "Bone up on"," Bone dry", "Bone idle",
#ECECEC	silver	silver, modern, ancient silver Jewellery, honour, festivity, expensive	"silver lining -cartoon", "Silver Swan", "On a silver platter",
#DCDCDC	light grey	abandoned, square, emptiness, loneliness, isolation, mood,	grey feeling, feeling grey, shades of grey,
#C0C0C0	medium grey	modern art, fading, dull, forlorn, grey cold, lonely, imprisoned, ancient, hopeless, despair, mood,	grey man, grey market, shades of grey,
#73738C	grey blue	stamina, consistency, trust, loyalty, art,	mystical journey, "shades of grey",
#8F8F8F	dark grey	elegance, distant, mystical, journey, sadness, grisaille, scary, ghost, mould, darkness, mood,	mystical journey, "shades of grey",
#000000	black	black power, black elegance, black formal, dying, mystery, black humour , fear of unknown, fear art, mourning, bloodless, art,	blackguard, black market, black magic, black out, film noir, black holes, "blacklisted - punk", "Black sheep ", "black mark", "pitch black",
#502C07	dark brown	poverty, stupidity, Mediterranean impressions, sinful, rotten, captivity,	brown nose,
#6D3603	dark red brown	autumn spirit, earthy, primitive art, quixotic,	"brown wood -panel"
#895534	red brown	exotic, brown, poor, artistic, red brown,	chocolate-brown,
#B37105	orange brown	lazy art, emotional, gluttony, pleasure	
#B89061	light brown	secret, square, commonplace, medieval, art,	
#F1ACBF	pale red	romance, friendship, feminine, femininity, images intimacy,	
#FB608B	pink	sweet, tender, feminism, loveliness, charming, pink, vanity, celebration, pink fluffy, pink exotic, pink plastic, retro pink,	Tickled pink, "In the pink", pink panther, pink power,
#CC8899	puce	mauve, mauve grandma, mauve elderly,	
#DC32A7	pale pink	soft, femininity, passivity, sentimental, liturgy, loveliness, charming, affection, seduction, pink,	Tickled pink, "In the pink", pink panther, pink power,
#FF00FF	fuchsia	magnificence, artificial, extravagance, kinky pink , pandora, romantic, nostalgic, feminine, gems,	"forget-me-not -plants"
#BF4EC6	purple	mystique, ambition, purple decadence, purple sins, vanity, purple devil, purple evil, fashion,	purplerain, purple elephant, purple patch, Purple prose,

#791084	dark purple	purple spirituality, loss, mystery, magic, symbolic, Amethyst, purple,	purplerain, purple elephant, purple patch, Purple prose,
#55066F	violet	wealth goddess , extravagance, exotic, violet, burlesque, violets,	shrinking violet, wilting violet, "Violets are blue...",
#31145D	darkest blue	deep ocean, dark blue, wisdom, technology design, longing, blue rain, Eternity, alien, innocent desire, power, blue, god, marine bay, sea, power, ultramarine, depth,	"light in the darkness", deep blue, "deep royal blue", "blue in the face", "blue collor",
#0F0FA9	blue	power, integrity, distant, distance, faith, truth, heaven, cool, calm, focus, blue hour, Mermaids, blue, traditional art, dream, stability, relaxation , divine, tropical, blue hour,	"moody blue -elvis - semex -the moody blues", "bolt in the blue - showboaters", Blue moon, blue flash, "Once in a blue moon", True blue, "blue in the face", "blue collor",
#3E3EF4	lighter blue	fresh, water, stream, Oxygen, Nymphs, tranquillity, healing, freshness, emotional healing, trust, self confidence,	"Once in a blue moon", True blue, "blue in the face", "blue collor",
#00ffff	turquoise	aquamarine, jewellery, healing, calming , turquoise, clear water, mood, sky, sea, Siren,	
#188B8A	blue-green	blue-green, healing, protection, water, freshness, pure, cool, algae, spring forest, sophistication, mint, wood Nymphs,	
#264804	dark green	forest , soft, witch craft, witch, magic, magical, sorcerous,	
#40631D	warm green	organic, solid, fresh breath, jungle, wild, natural art, stability, endurance, forest , soft, witch craft, witch,	"green-eyed monster", Fiddler's Green,
#698D44	medium green	forest soft, recreation, shoots, hope, nature, green, spring, growth, harmony, freshness, fertility, demon, magical, sorcerous, alternative,	"green with envy", green light,
#38CC6C	light green	spring, 'greenhorn', "spring meadow juicy", healthy, envy, springtime , emerging, envy, green, alternative,	"green with envy", green light,
#ACD312	lime green	healthy, breathing, environmental, green, alternative, Organic, Fairtrade, Eco,	green light,
#84840B	olive green	olive, peace, camouflage, "olive peace", healing,	olive branch,
#DCF02D	green yellow	decay, jealousy, decline, decomposition, envy, emotion,	"green-eyed monster"
#FAFA99	light yellow	intellect, freshness, joy, frolicsome, rays of light, sparkle,	
#FBFB00	bright yellow	sunshine, happiness, bright, peace, optimism, cheerfulness, honour loyalty, unstable, spontaneous, krishna	
#E9D03A	honey-gold	gold, sweet, special, love, golden, gold dust, high quality, sunrise, gilding, Fairies, fairy, prosperity, "fortunate - gutenberg",	"sweet as honey", "land of milk and honey",
#E6A914	orange gold	prestige, illumination, wisdom, autumn, sunset	

#FAB00F	bright orange	orange modern, cheap, buddhism, Buddha eastern spirit, orange plastic	latin dance, latin spirit,
#FF681F	orange	orange, fascination, orange creativity, attraction, encouragement, bonbon, desire, passion, pleasure, flamboyant, social, dance, expression, Halloween,	"riot of colour", bitter sweet,
#D75D2D	warm red	terracotta, bronze, warm, Mediterranean culture, joy, dominance, aggression, deceit, home, family, cosy, fire, fever,	heat is on, "red letter day" , "red light district", red rag, red handed
#F4153A	bright red	movement, connection, bloody, seduction, dirty dance, tango, dangerous, demonic, erotic, spicy , divine fire, seductive, art, mood,	heat is on, "red letter day" , "red light district", red rag, red handed
#BD0F0F	red	red, energy, war, danger, strength, determination, passion, desire , destructive, spontaneous, anger, emotional, explosion, explosive, home, family, cosy, fire, fever,	"red letter day" ," red light district", red rag, red handed, "paint the town red", See red,
#920727	dark red	warrior, red passion, passion, warmth, strength, dynamic, spirituality, "red seduction -flowers -gifts", anger, evil,	"heat is on", "red letter day" , "red light district", red rag, red handed, "paint the town red", "red herring -fish", smoke screen,
#6E0707	burgundy red	red peril, divine fire, passion, warmth, strength, dynamic, spirituality, "red seduction -flowers -gifts",	blood moon, "red herring -fish", smoke screen, "paint the town red",

1.21. Excel database

My Design experiments

CSE/Palimpsest

1.22. CSE II / Palimpsest screenshot, 10 clicks (i.e. 10 residual images)

The idea of the palimpsest is another attempt to create an interface that allows for users' actions and interactions to affect the interfaces they are working with. CSE's interface acts as a canvas that is transformed every time a user investigates a colour, by clicking on it. Every image return is retained in residual form which alters the colours and textures and therefore forms a fluid and temporary co-created space between producers or designers and users. As explained earlier, a palimpsest originally denotes manuscripts which have been frequently re-used, defaced and re-written, merging layers of the past and the present. The idea for the final experience is that residues of image returns imprint colour effects that subtract as well as add colours to facilitate an ongoing change in colouring. A video demo of this functionality is provided on the CD, location path as beneath.

The current prototype demonstrates this functionality slightly differently. It renders an alpha-layer of the image return, set to 10% of its original opacity, on top of the original image. It then merges the alpha-layer with the original image which it is why currently briefly flashes to white. It's possible to reset the system to the original background image and this also provides a snapshot of main image at that time. The palimpsest/CSE prototype is life on **palimpsest.thetobe.com (no www),** video files are provided in case the url cease to work, location as beneath:

F:\Intuitive_interaction_DVD\Design experiments\my design experiments\CSE II (Colourspace explorer Palimpsest)\CSE II demos

How Palimpsest works by Toby Watson

An archaeological dig conflates depth with time, an open shutter captures a mass of headlights and tail-lamps; markers of lives streaming through a city. Who has been here before? How did they feel? What choices did they make? Our aggregate behaviour shapes the landscape and these ideas are behind palimpsest.

Technically we need to overlay some memory of each individual visit without prejudicing the normal interaction with CSE.

The main idea is this: if we put the search results (circle of images) on the main background in the place where they fit best then disturbance will be minimised while subtly altering the main image over time. We get change because unless the results _are_ pieces of the main image they will never fit perfectly. Hence a subtle imprint of each result is possible.

What does fit mean?

The first (unshown) prototype laboriously tried each search result at each position on the main image - sliding the result across and down the main image, at each point comparing the difference with the background. In pseudo code the algorithm is:

```
width' = background width - width of search result (96 pixels)
height' = background height - height of search result (96 pixels)
for y in 0 - height'
    for x in 0 - width'
    cut out 96 x 96 pixel piece from background
    subtract search result image from the cut out piece
    reduce resulting difference image down to 1x1 pixel (calculating average difference)
    add (average difference, (x,y)) to list of candidates
```

sort the list of candidates so the location with the minimum difference is at the top pick the top location and place the search result there. While it provides excellent matching locations for search results this algorithm is very slow. Hence a simpler approximation was developed which works in real-time:

calculate the average pixel colour of each search result

sub-sample the main image at a lower resolution (divide by 8 in height and width, calculating the average pixel colour for each 8x8 pixel block).

width' = background width / 8

height' = background height / 8

for y in 0 - height'

    for x in 0 - width'

    compare the average colour of the search result with the sub-sampled pixel at x,y

    add (difference, (x,y)) to list of candidates

sort the list of candidates so the location with the minimum difference is at the top

pick the top location and place the search result there

In this second case difference is calculated as the Euclidean distance in RGB space, i.e.

diff = sqrt((r2-r1)^2 + (g2-g1)^2 + (b2-b1)^2)

Blending

A 20%/80% mix of foreground (result) and background (main image) was chosen in order to leave a recognisable imprint while controlling the rate of change of the main image.

Filtering

As a practical matter images on a white background, for instance pictures of products, or on a solid black background cause unacceptably large disturbances in the main image.

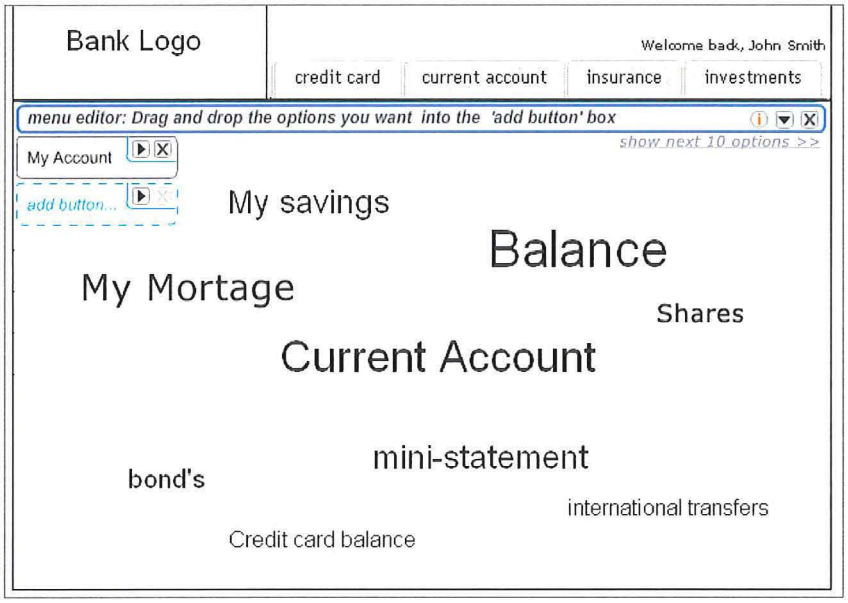
Practical matters

Image location choice and placement is always calculated relative to the original background image. This acts as an anchor; ensuring sufficient diversity in the main image and controlling run-away feed-forward effects whereby the most average colours overtake the whole image - the grey goo effect.

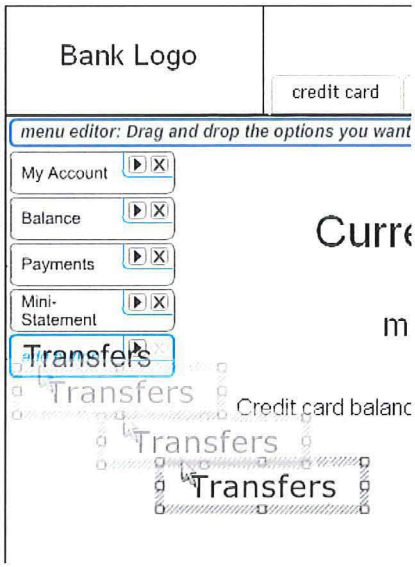
My Design experiments

Build you own menu (BOYM)

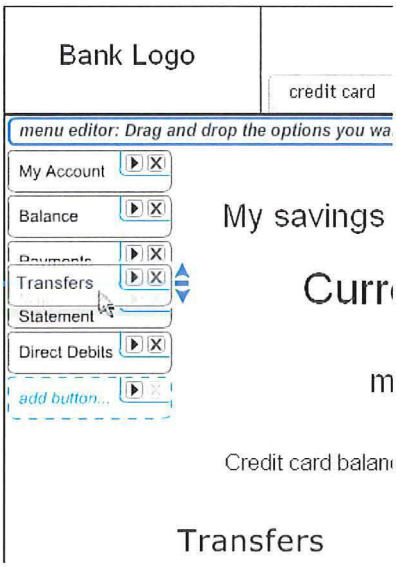
BYOM offers users three ways to create their own menu or set of interface controls: the menu editor, the button editor and the 'button this' icon. The *menu editor* offers a drag and drop interface that might be used to create the bulk of a menu. I have created two prototypes, one flash-version, which allows for the actual drag and drop to be part of the evaluation experience, the re-arrangement of the menu buttons or deleting them, and a click-through version. All static elements trigger roll-over elements, explaining their functions.



1.23. Menu editor, start screen



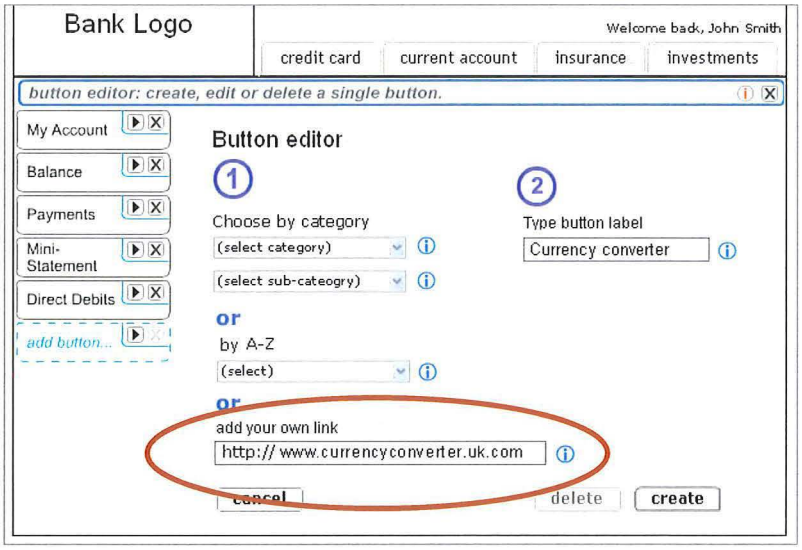
1.24. Drag & Drop



1.25. Re-arrange Menu Button

The prototype starts with the assumption that a user has an account, has logged in and starts the journey from the point where they can choose to personalise their menu-options. If the user chooses 'create menu', the menu editor opens: a header extends along the top of the screen, and a blue background covers the current screen. While the user is in the menu-editor, the entire screen is headed by a little blue indicator listing the editor's name, a short description and an information icon as well as more options to customise the display and a close icon. At the same time, the background changes to a blue gradient to indicate that this editor is currently taking over the screen. The menu editor allows for up to 9 buttons to be added, labelled and positioned. The information icon explains the functionality; the pull-down allows the adding of more options to choose from on-screen or other preferences. The close button closes the editor, both header and background re-cede and reveal the original screen. The delete and re-arrange functionality of the buttons works outside the menu editor too.

The second option the user has is to choose 'create button'. However, this option is al-ways available by clicking 'add button' too. Similar to the menu editor, a blue back-ground appears and the editor is headed up with a blue indicator and editor description. It is assumed that 'add button' is used to fine-tune the menu once the bulk of the persona-lisation is done, or adjust the menu at a later stage. This functionality allows users to choose an internal category, sub-category or low-level content item by category or A_Z pull-down as well as adding their own *external* link and label the new menu item.



1.26. Button editor, function used: 'add your own link'

The 'button this' icon is part of the content area, and collect links on the fly, similar to short cuts. However, as it adds the links to the menu, it is more contextual then those. The functionality is very simple: a click on the icon adds a link to the left hand menu. Unlike the other editors, no blue background or header appears. The idea was received well enough, but it was also accompanied by comments for improvements: it could be positioned closer to the header in question and act like a drag and drop mechanism to be consistent with the 'menu editor'. Another idea is to make this a little stand-alone widget, similar to FTB, and may be use it with CSE to collect finds on the fly, but in a contextual way.

1.27. Button this icon

This prototype is currently online at http://hompages.gold.ac.uk/Brigitte/BYOM.

[CD] :\Intuitive_interaction_DVD\Design experiments\my design experiments\BYOM

Testing matrix

Test set	Amazon	Wiki	Flick-Through	CSE-I	CSE-II	BYOM
Observation / interview	**16***	**23***	**15**	**13**	**3**	**5**
Online questionnaire	**	**22**	**15**	**11**	**11**	**15**

1.28. Testing matrix

Observation / interview:	Amazon / Wiki / FTB / CSE-I :	8 participants
Observation / interview:	Wiki / Amazon / FTB / CSE-I :	2 participants
Online questionnaire	StumbleUpon	11 participants
Observation / interview	Wiki / CSE I/ CSE-II / Etsy	3 participants
Online questionnaire:	Wiki / CSE I/ CSE-II / Etsy	11 participants
Observation / interview:	Amazon / Wiki / FTB / BYOM:	5 participants
Online questionnaire:	Amazon** / Wiki / FTB / BYOM:	15 participants
Observation / interview:	Amazon / Wiki / exit: 1 user	

Total ***55 participants***

** One user was excluded after testing Amazon 'surprise me' and Wikipedia 'random article' as she was on a dial-up connection and therefore used the internet for short periods and very specific tasks.*

*** Please ignore the Online feedback for Amazon 'surprise me' in the questionnaires. I found out that the access to 'surprise me' depends on the purchase history of the user. Some users had similar access to me and could comment on the functionality, several however didn't. Those users were presented with recommendations and the invitation to create an account.*

CD inventory (3 levels)

1) Intuitive_interaction.html (Click to explore DVD via browser interface)
2) Table of contents
3) Read_me
4) Design experiments
    a) Benchmarking applications
        i) Amazon
        ii) Etsy
        iii) StumbleUpon
        iv) Wikipedia
        v) read_me.txt
    b) My Design Experiments
        i) BYOM
        ii) CSE I (DiddlePOP)
        iii) CSE II (Colour Space Explorer /Palimpsest)
        iv) FTB
    c) read_me.txt
5) Questionnaires
    a) Interview_Recordings
        i) AM_WI_FTB_BYOM
        ii) AM_WI_FTB_CSEI
        iii) WI_CSEI_CSE2_ETSY
        iv) Online_version
        v) Questionnaires_word_files
    b) Online_Surveys
        i) OS_AM_WI_FTB_BYOM
        ii) OS_StumbleUpon
        iii) OS_WI_CSE1_CSE2_Etsy
6) read_me.txt

DISC INCLUDED IN THIS THESIS.
PLEASE NOTE THAT NOT ALL FILES ON THE DISC COULD BE COPIED .