

Antti Pirhonen

Human Conceptualisation Processes as a Perspective on the Design and Evaluation of User-interfaces



JYVÄSKYLÄ STUDIES IN COMPUTING 167

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To the friendly people of Glasgow

ABSTRACT

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The motivation and approaches to the study of human-computer interaction are many and varied. When computers were primarily used in offices, the main motivation was to enhance the productivity of individuals. Nowadays, as computing takes place in our homes and even in our pockets, the whole concept of computing is so diverse that the traditional approaches are no longer as relevant.

This thesis proposes human conceptualisation processes as a perspective on the design, analysis and evaluation of the interaction between a technical device and its human operator. The central concept is metaphor, which is analysed from various points-of-view. It is argued that the use of the term metaphor in the context of graphical user-interfaces is actually in conflict with metaphor theories. This conflict has resulted in a reduction in the power of metaphor as a design principle. The conclusion is that understanding metaphors as the basic constituents of all human thought and communication would benefit all phases of product development, from concept design to the fine-tuning of individual user-interface elements. The arguments are illustrated with reports of case-studies.

The notion of applying human conceptualisation processes as a central perspective to design is supported by the outlining of a practical design method called Rich Use Scenario. The core of the method is creative group work, in which individual conceptualisation processes are embodied in the form of design concepts. The application of the method is illustrated with design cases in contexts ranging from assistive technologies to operating theatres.

The thesis concludes with an ethical statement discussing humanity in the context of human-computer studies.

Keywords: Human conceptualisation processes, metaphor, design

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PREFACE, INCLUDING SINCERE ACKNOWLEDGEMENTS

Creating interactive technology for human beings is meaningless without involving human beings. The outcomes of the various research and development projects relating to this thesis are therefore largely a product of the people involved in them. In the domain of this study – human-computer interaction – we argue that we learn about technology by interacting with it. Likewise, our view of human nature is developed through interactions with other people. I argue that this thesis, including the technical implementations, tells a lot about the people with whom I have collaborated. Now that I have completed the thesis, I have a lot of reasons to express my gratitude to them.

Firstly, I am grateful that Dr Alan Blackwell could act as an opponent of my thesis. Professor Gilbert Cockton's and Professor Chris Baber's pertinent review statements were a valuable help when finalising the text. It has been a privilege to have Professor Seppo Puuronen as the first supervisor – his experience on the PhD process has been more than helpful. I am grateful to my second supervisor, Professor Stephen Brewster. Without the numerous discussions with him while running along the Glasgow West End canal towpaths, the basic ideas of this thesis would probably never have been formulated.

As can be seen in the acknowledgement sections of the individual publications of this thesis, most of the studies have been carried out in close cooperation with the Finnish ICT-industry. That, in turn, has been enabled by the Finnish Funding Agency for Technology and Innovation (TEKES), which has funded most of the studies and guided me as a researcher to cooperate with industry. In TEKES, gentlemen like Jari Kovanen and Kari Ruokonen have generously given their time and energy to help realise these projects.

Some of the collaborations with Finnish industry have exceeded formal project cooperation. This is largely due to the people who have made collaboration more personal. Sami Ronkainen, Karoliina Tiuraniemi and many others have contributed to my research.

My home university, University of Jyväskylä, has gradually become an important part of my professional – and perhaps even personal – identity. Having worked and collaborated with several faculties and departments, I feel that I know this organisation very well. I'm committed to contribute to developing it to a place where truth and lie are separated from each other. I also know that I'm not the only one with this mission, which makes me positive. I believe that people who I'm talking about understand what I mean.

An essential part of the work that is reflected in this thesis has been conducted in Scotland, in the University of Glasgow. Not only for me, but for my whole family the years in Glasgow were extremely important experience. I have to say that the computer science oriented perspective to human-computer interaction at Glasgow is very different from mine, but my colleagues there have mastered how to deal with other human beings. The people of Glasgow are different. I hope I brought a touch of that spirit to Jyväskylä with me.

I usually try to keep work and leisure apart from each other. Therefore, I am usually not eager to engage with colleagues outside work. However, some of my colleagues in Glasgow and other parts of Britain and Ireland have become much more than colleagues. Stephen Brewster from Glasgow, Liz Sillence from Newcastle, Chris Roast from Sheffield and Emma Murphy from Dublin appear in the author lists of my research articles, but they have also become close family friends. These ties bear regardless of research activities.

The important colleagues in Jyväskylä are numerous. If I have to highlight some of them, I am unable to pass by Kai Tuuri, with whom I have had several interesting projects since 2007. I am also grateful for all those people in the Department of Computer Science and Information Systems, who maintain a good spirit even when times are hard and the sky is cloudy.

When I began the research relating to this thesis, my children were young, now they are practically grown up. My attitudes towards the development of technology and its societal reflections are closely connected to personal observations of growing up in this era. I therefore owe gratitude to my family, both personally and professionally.

Jyväskylä, 10th April 2013
Antti Pirhonen

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1 INTRODUCTION

In the maelstrom of information and communication technology (ICT), new products and services are introduced with increasing frequency. In order to successfully introduce any new technology, the producers have to consider how to familiarise people with the new technological applications. Designers need to be able to understand the setting in which the human being is brought face-to-face with a new device or application and their attempts to conceptualise it, i.e., to adapt it to their own conceptual system.

When designing for humans, the designer's conception of a human being is the most important thing that guides the design process. In user-centric design methods (originating from the work of Norman and Draper from 1986) the user should be the focus throughout the design process. Therefore the crucial issue is how the designer perceives the user – or human being as a whole.

The tradition of human computer interaction (HCI) design is deeply rooted in the information processing approach (IP) to human cognition, which reflects mathematical information theory (Shannon & Weaver 1949) as the primary paradigm of communication. The IP approach nicely encompasses the concepts of computing and cognition. However, contemporary cognitive science represents a more multifaceted approach to human cognition (e.g. Gibbs 2005). In addition, as personal computing has expanded from an office environment into all branches of life, new approaches to the relationship between a smart device and its human operator have emerged.

Despite the emergence of novel approaches, many still find it tempting to draw upon the deep rooted analogy between IT and IP and this can be seen even in some of the most recent HCI-studies. It should be noted that even some articles of this thesis are firmly bound to the input-output paradigm, as well as to the concept of a human cognitive system consisting of central neural system which is connected to the outside world via sensors and actuators.

This thesis analyses human conceptualisation processes and design methodology. The aim is to provide novel perspective for designers for understanding users of interactive applications. The articles that make up this thesis express the development of certain themes over a number of years from an initial

fairly mechanical view of interaction through to a far more delicate one. The reader of this thesis is thus encouraged to interpret the sequence of articles as a story about the maturation of central concepts. In other words, the early articles have different role in the thesis from the later ones. The remainder of this introductory section comprises of four parts. Firstly a brief background summary leads to the research tasks of the thesis. Here the structure of the thesis as a whole is then outlined highlighting the central themes of the included papers. The second section introduces an overview of the key theoretical concepts within the thesis. This covers both the issues surrounding the use of metaphors as well as introducing the novel Rich Use Scenario design method. Section three illustrates how these two main themes can be tied together, linking the theoretical perspective with a practical design methodology. Section four provides an ethical lens through which to view the work of the thesis as a whole and finally section five presents an overview of the included articles.

1.1 Background

This thesis is about the design of interactive applications. It is based on a relatively long period of user interface (UI) design related studies, starting in the mid 1990's when I prepared my doctoral thesis in educational sciences. That thesis was a monograph titled "Redundancy as a criterion for multimodal user-interfaces" (Pirhonen 1999). The current thesis is based on my research activities after that period, but there is a link between these two theses; they both deal with communication and UIs. More specifically the majority of the studies on which this thesis is based concern the use of non-speech sounds in UIs.

Typically UIs are ambiguously defined, for example, Smith & Mosiera 1984, p. 1:

[UIs] include all aspects of design that affect a system user's participation in data handling transactions.

Where more specific definitions are employed (e.g., Watson 1976, p. 357), the *interaction* between the user and a technical device has been emphasised:

The user interface has two sides: the input side by which the user inputs information, indicating by various conventions and controls what he wishes accomplished; and the output side by which the machine provides feedback and other assistance to the user in command specification, and provides various forms of information portrayal. Man has many motor and other capabilities that could be the basis for input and command specifications; similarly he has his full range of senses that could be targets for system output.

The later definition reflects the traditional approach of human-computer studies, pertinently formulated by Card, Moran and Newell (1983); the human operator is expected to be a seamless component of a system. The primary concern of

human computer studies has been the fact that the human being is not a machine. The traditional five usability factors, for example, indicate this concern: Time to learn, speed of performance, rate of errors by users, retention over time and subjective satisfaction (Shneiderman 1998, p. 15). Likewise Nielsen's (1993, p. 26) widely used list of attributes for usability: Learnability, efficiency, memorability, errors, satisfaction. These qualities – or at least most of them – denote the *human* as a limitation, like in the expression *human error*: “imperfect, fallible” (OED 2011). In an information system, the human operator is often seen as a risk and a performance bottleneck.

The traditional view of usability issues raises a number of interesting questions. For instance, what is an error? In usability evaluations, a very standard criterion is error rate. If the participant of a usability evaluation behaves differently from the intended behaviour, is it an error of the user (Booth 1991)? As Lewis and Norman (1986) pertinently state, error as a concept assigns blame. If the user of an application with a graphical user-interface (GUI) simply perceives the situation differently from the way in which it was originally perceived by the designer, are we right to talk about error at all? If an *error* has occurred then it was not made by the user but the designer: she failed to communicate with the user through the GUI. In terms of the user, Lewis and Norman (1986) propose substituting *error* with more accurate concepts such as misunderstanding, problem, confusion or ambiguity.

The criteria for usability indeed reflect the history of human-computer studies. In industrial settings, quality and standards are paramount to production. On the other hand, quality and standard are strongly interrelated; quality means the fulfilment of given standards (e.g. Ronnen 1991). This is appropriate for large scale industrially produced products but in everyday language *quality* usually takes on different meanings. Whilst within industry, good quality means the fulfilment of predefined minimum criteria (i.e., standards), in everyday terms quality is assessed in terms of subjective criterion. In an industrial setting, the correct or incorrect behaviour of the human machine operator can be defined on the basis of desired production. Avoiding errors and performing the predefined task effectively is what is expected from the user.

The role of information technology in the development of the effective production of goods and services is pivotal (e.g. Benjamin, Rockart, Scott Morton & Wyman 1984). Information technology has revolutionised the manufacturing industry by replacing routine work with effective technology. However, now that information and communication technology is in the main used by ordinary people in their everyday lives, the criterion for usability has to be reconsidered. The discussion of the concept of error above has completely different connotations when applied to the use of large industrial machinery, computer games, surgical equipment, or to the mobile phone. For most consumer products, the avoidance of errors or other easily measurable issues are no longer the primary criteria for human-computer interaction. Usability may no longer be a credible measure/term within consumer based ICT. Instead more sub-

jective concepts such as user experience (UX) have recently become increasing popular in the field (Law, Roto, Hassenzahl, Vermeeren & Kort 2009).

Despite the changes in ICT settings and whether we talk about usability in an industrial context or the user experience of household apparatus, the design and use of a technical device can in both instances be seen as a communication issue between the designer of an application and its user. This communicative view of interaction design has been applied by Norman (1986), and later articulated by Neale and Carroll (1997) in terms of *UI-metaphors*. In their idea, metaphors are a central means of communication between a designer and a user.

This thesis is a proposal for a novel perspective on UI-design, in which the focus is on the conceptualisation processes, metaphors in particular. The collection of articles includes theoretical reasoning as well as reports about the development of a design methodology.

1.2 Research tasks and thesis structure

The current thesis approaches UI-metaphors in the sense described above. Applying different theories of metaphors to UI-design provides a new context and perspective through which the theories themselves are developed and elaborated accordingly.

This thesis is not a report of a single, strictly defined research effort but rather a research portfolio spanning a relatively long period of time. The related studies stem from different motivations and practical opportunities. In other words, there has not been one single, distinct, theme underpinning these studies. Rather, this is a collection of research projects which reflect the gradual development of a theoretical framework and a practical methodology for the needs of interaction design. The common denominator throughout the series of studies is formulated in the title of this thesis as “conceptualisation processes”. The research tasks of individual studies could be summarised as follows:

1. What are the basic constituents of human conceptualisation processes that should be utilised in design?
 - 1.1. How should metaphors be conceptualised in order to apply them in user-interface design?
2. How to design interaction ‘from scratch’?
 - 2.1. How structuralism could be applied when creating a framework for creative, design oriented group work?

The first task (1 and 1.1 above) provides an analysis of the way in which a human interacts with their environment in terms of metaphors. This analysis is formulated and elaborated in such a way as to be usable within interaction design. The second research task (2, 2.1), in turn, tackles the difficult question of human-computer interaction design: from where should we draw the initial design ideas which then form the basis for further development?

In terms of the structure of the thesis these research tasks map onto the publications in the following manner: Metaphors are the central theme of publications #1-#3 of this thesis. In the first two, metaphor theories are an object of research, while in the third article metaphor theories have a more instrumental value while analysing learnability. In all three papers metaphors are handled as *central constituents of human conceptualisation processes*. In other words, metaphors are seen both from the point-of-view of thought and communication.

Publications #4-#7 introduce a method, which approaches human conceptualisation processes in HCI from the point-of-view of practical design. While publications #1-#3 analyse the concept of metaphor in UI-context, publications #4-#7 are about the implementation of the actual UIs. The method introduced in these papers draws on structuralism; the UI is dealt with as a whole consisting of different elements. The underlying theme in this method can be seen as the conceptualisation of the UI. The same theme continues in the 8th publication. It summarises the arguments contained in the previous papers by proposing a holistic, embodied view of human cognition as a basis for interaction design.

Publication number nine works as an ethical statement about the use of ICT in our culture. Rather than contributing to theory, the role of this publication in the thesis is to connect all the other papers in a sense to the bigger picture; to remind us that the design of a “good” UI whether we define that in terms of being highly usable, easy-to-learn, pleasing and effective or in terms of some other meaningful criteria - has ultimately only an instrumental value in the use of an application. Whether the application itself contributes to the construction of a civilised society is a completely different issue. When designing a highly usable launching system for a missile, are we more concerned about the ergonomics of the sender or the missile’s intended recipient? This kind of ethical discussion inevitably leads us back to the most basic issues of human-computer interaction. These kinds of ethical issues are discussed in section 4.

2 THEORETICAL CONSTITUENTS

2.1 Metaphors and user-interfaces

The advent of personal computing shifted the focus of user-interface design from professional use to the needs of consumers. Basically, the challenge of making a computer useful for the man-in-the-street became a communication problem. Computation in the computer's processor is invisible to the user, and the underlying structures are highly abstract in nature. The setting thus lends itself to the use of metaphors as a communication strategy between the designer of a UI and the user; since the days of Aristotle, metaphors have been seen as an effective way of introducing new, unfamiliar concepts through the assistance of ones that were already familiar (Aristotle 1984).

Metaphors are – and have always been – an important part of human communication. Their role in terms of human behaviour more broadly comes down to the issue of definition – and is a question that has been central to the development of metaphor theories throughout the 20th century. Being such an important issue in everyday language, arts, and especially in philosophy, the reasoning about metaphors is unavoidably closely linked to the prevailing scientific paradigms of each particular era. Indeed, it can be argued that strictly following Kuhn's (1970) concept of scientific paradigms, theories within different paradigms are incommensurable. In other words, the theoretical reasoning about metaphors is not a cumulative process but a series of incompatible point-of-views. However, metaphor as a concept is not solely or even primarily, – a scientific nor philosophical concept but rather a mundane one, being deeply rooted in our cultural heritage. Therefore, the mundane content of the concept of metaphor has largely served as the backbone for all theoretical reasoning. In scientific debate, the content of each concept is a matter of explicit definition; scientific reasoning is fundamentally a game with concepts (see e.g. the excellent analysis by Herbert Blumer, 1931). In contrast, in everyday communication, concepts have a mostly instrumental value. Agreement about the content of each concept is thus a communicative issue. In other words; in science, concepts

have value by themselves, while in everyday communication, the value is instrumental and depends on its communicative power. The very fact that the concept of metaphor has remained in everyday communication over the centuries, suggests that there are communicative needs for it. For the same reason, it is probably not wise to override the mundane meaning of the concept even in scientific reasoning. Actually, the development of metaphor theories in the 20th century can be seen to respect the Aristotelian heritage. While interaction theories (Black 1962) shifted the focus from similarities to the analysis of semantic contents (Searle 1993), they can be seen as a conceptual analysis or elaboration of the Aristotelian view rather than a contradictory approach. The contemporary view of metaphor, originating in the work of Lakoff and Johnson (1980), can be seen as an expansion of the traditional view, albeit a radical one. The theoretical main branches are briefly analysed below in relation to the use of the term metaphor in the context of UI design.

2.1.1 Aristotelian view of metaphor

The ancient definition of metaphor by Aristotle (1984) summarises in *Poetics* (1457b 6-9) the basis of the everyday, mundane concept of metaphor:

Metaphor consists in giving the thing a name that belongs to something else; the transference being either from genus to species, or of from species to genus, or from species to species, or on grounds of analogy.

This definition includes a reference to the modality: it talks about the names of things. The books in which metaphors are dealt with by Aristotle, *Poetica* and *Rhetoric*, also refer to the fact that Aristotle used metaphor as a linguistic instrument. Indeed, public speech was a central political means in ancient Greece. When free men gathered together in the Agora of Athens, rhetorical skills were highly valued. It was natural that Aristotle thought of metaphors in terms of the available medium. However, if he had have lived in our society, he could have applied his ideas of metaphors to other modalities as well. Skills in speaking do have, however, an important role even in contemporary media. For instance, the studies that have focussed on the televised debates of presidential elections in the US since 1960 show the significance of classical rhetorical skills (Benoit, Hansen & Verser 2003).

For Aristotle, the central rationale for using metaphors was *persuasion*. Indeed, the same rationale still holds true today for the presidential debates or for other appearances via mass media. Although the television has been the major medium for politicians to present their agenda, the Internet, in particular online news, plays an increasingly important role in the attempts to influence voting behaviour (Drew & Weaver 2006). In election campaigns, as well as in advertising in general, persuasion can be seen as a focal function (Chaudhury & Buck 1995). It is therefore still highly appropriate to analyse metaphors as a means of persuasion in contemporary media. At the conceptual level, persuasion can also be seen to be closely related to if not closely synonymous with – the concept of

affordance, which is widely used in the literature concerning the usability of computer systems. Affordance, coined by J. J. Gibson (1977) and applied to human-computer interaction by D. Norman (1988), is a central concept in interaction design; a property that persuades the user of a technical device to act in an appropriate way. In terms of physical design, this usually means visual cues which guide the user. For instance, a door handle which persuades the user of the correct kind of grip and rotation direction needed, provides affordances in the way Norman (*ibid.*) defined them and later (Norman 1999) elaborated. The communicative function of affordance is thus similar or at least analogous to that of Aristotelian metaphor. Inasmuch as the design of affordances is a pivotal challenge in the pursuit of usable UIs, the Aristotelian view of metaphor would be an excellent basis for practical design.

When applying the Aristotelian view of metaphor to UI-design, it is important to stress what Aristotle wrote e.g. in *Poetics* 1459a5-7 (Aristotle 1984, pp. 2332-2333):

But the greatest thing by far is to be a master of metaphor. It is the one thing that cannot be learned from others; and it is also a sign of genius, since a good metaphor implies an intuitive perception of the similarity in dissimilars.

This quote should indicate conclusively that the so called desktop metaphor and all related attempts to introduce metaphor as a term to capture current GUIs and their design principles are based upon a major misapprehension. When Aristotle writes about creating metaphors, he talks about a highly delicate, innate ability. In Aristotle's texts the process of creating metaphors appears to be more a creative or artistic process than an analytic one that could be divided into discrete phases (proposed by e.g. Erickson 1990, Neale & Carroll 1997). I will return to these conclusions having first analysed a number of more recent conceptualisations of metaphor.

2.1.2 Interaction view of metaphor

It is clear from Aristotle's text (Aristotle 1984), that he found metaphors to be an important and powerful means of human communication. Metaphors would naturally appear in our language and all communication regardless of whether we identify them as a discrete phenomenon or not; the concept and related term just enable us to analyse communication. Giving a name to the phenomenon is thus a crucial step towards making it a part of our conceptual system.

The semantic content of the concept of metaphor arises from the context of use. For Aristotle, the context was a public speech. The linguists and philosophers of the 20th century made it a topic for academic discourse. HCI researchers and practitioners reprised its instrumental role for practical communication needs.

Interaction theorists, notably Max Black (1962), constructed a conceptual framework around metaphors. His work was based on the ideas of Ivor Armstrong Richards (1950), in which metaphors were analysed in terms of source,

target and the combining link. In Richard's work, these were labelled as *vehicle*, *tenor* and *ground*, respectively. It appears that the coining of new terms led to the theoretical stance; Richards tried to introduce a sound theory and one element of that was the development of a number of exhaustively defined basic concepts.

The crucial difference between the Aristotelian view and interaction theories was that the interaction theorists were not content with a simple analysis of similarities or any other comparison of source and target domains. Interaction theorists stressed the emerge of the link (ground) in the interaction between the vehicle and the tenor. (Richards 1950, pp. 93, 95):

...when we use a metaphor we have two thoughts of different things active together and supported by a single word, or phrase, whose meaning is a resultant of their interaction.

...fundamentally, it is a borrowing between and intercourse of *thoughts*, a transaction between contexts.

Richards (1950) thus stresses the co-presence of the constituents of a metaphor. The ground of the metaphor is not some pre-existing, evident similarity or analogy among source and target domains, but a result of an active interpretation process. In other words, the ground does not exist before the interpreter *creates* it (Black 1993; Gibbs 1994); or, as Black (1962) puts it, "...the metaphor creates the similarity" (p. 37). In the metaphorical expression, tenor and vehicle may even work on the basis of disparity, instead of resemblance (Richards 1950, p. 107-108). Gibbs, however, would probably have categorised these kinds of tropes as oxymora rather than metaphors (Gibbs 1994).

In their emphasis of interpretation process interaction theorists clearly shifted the focus of the construction of metaphor theories from the analysis of metaphorical expression to subjective conceptualisation processes. Even if the primary domain of interaction theories was still linguistics, the emphasis of interpretation inevitably resulted in discussion about the occurrence of metaphors in thought processes rather than in sentences. Despite Black (1993) still writing in 1993 about metaphorical thinking as a separate case of metaphors, it can still be argued that the work of interaction theorists as a whole set the scene for the contemporary metaphor theory, which will be examined in the following subsection.

2.1.3 The contemporary theory of metaphor

George Lakoff's and Mark Johnson's book "Metaphors we live by" (1980) is pervasive within the contemporary literature of linguistics, communication studies or analysis of cultural phenomena. The Google Scholar search engine found more than 20 000 references to this classic. It can be argued that Lakoff and Johnson have managed to communicate their conception of metaphors and their nature and role in our lives in a way that can almost be characterised as a

scientific break-through, if not a Kuhnian scientific revolution (Kuhn 1970). In proposing that our conceptual system is largely metaphorical, Lakoff and Johnson make metaphors a central phenomenon of human perception and action. If, as they argue, all we think, experience and do are largely metaphorical issues, studying metaphors implies studying the very core of the nature of human existence and interaction with the environment.

Frequently, Lakoff and Johnson's (1980, 1999) construction is referred to as conceptual metaphor. However, there is a risk of confusion here: if we adopt Lakoff and Johnson's view, then do any other kinds of metaphor, other than conceptual ones exist? Labelling Lakoff's and Johnson's theory as conceptual metaphor may be interpreted as a special case or instance of metaphor – and this is in fact contrary to what Lakoff and Johnson apparently meant. Therefore, the adoption of this conception of metaphor inevitably results in the definition of metaphor within a scientific context. In other words metaphor is simply defined as a conceptual entity and subsequently this entails labelling concrete things, like verbal expressions which we used to call metaphors, as something else. As proposed in my previous work (Pirhonen 2005b, article #2 in this thesis), the most appropriate term to denote concrete things which result from metaphors would be *metaphorical expression*. The term metaphorical expression is close to Black's (1962, 1993) *metaphorical statement*, but the deficiency of term statement – in the context of the current study – is that it has been predominantly used in a verbal context. *Metaphorical expression* can be any form of manifestation of human thought.

The title of this subsection is the title of George Lakoff's chapter in Anthony Orthony's book *Metaphor and thought* (1993). Labelling Lakoff's and Johnson's (1980) theory as the *contemporary* one stresses the strong position of the theory when trying to apply a metaphorical view to the design and analysis of human-computer interaction. Given that "Metaphors we live by" (ibid.) was published thirty years ago, its contemporary nature could justifiably be called into question especially when being applied to the design of information technology based products. I will justify the using the term contemporary in relation to Lakoff's and Johnson's view below in an analysis of the applicability of metaphor theories in interaction design.

2.1.4 Metaphor as a concept and its value in interaction design

The brief introduction to different views of the concept of metaphor above is far from being an exhaustive review of this topic. It was intended to present some key issues which need to be understood in order to apply a metaphor approach to interaction design. In other words, the intention is not to contribute to the development of metaphor theories *per se*, but to articulate their contribution to a specific application area. On the other hand, the application of metaphor theo-

ries to interaction design does reveal new issues¹, thus having the potential to contribute to development and elaboration of theory as a by-product.

When starting to discuss the application of metaphor theories to interaction design, we are inevitably faced with the problem of comparing different theories. Which one is the most applicable to interaction design, which one should we use? The answer to this question depends, above all, on the relationship that exists among these theories. Are they simply a continuum within one theoretical-philosophical framework or have there been major reorientations, comparable with scientific revolution (Kuhn 1970)? As discussed above, I approach metaphor theories as being different perspectives to the intriguing phenomenon of human thought and communication. Just as the expansion of the application of metaphorical analysis from a purely verbal context to various modes of expression has contributed to the development of interaction theories, so interaction design has the potential to contribute to the theoretical development surrounding the concept of metaphor.

Even though I argue that different views of metaphor can be seen as different perspectives on the same phenomenon, clear discrepancies can be identified among different theories. In terms of interaction design, a major discrepancy is the understanding of the nature of the metaphor creation process. For Aristotle, metaphor creation meant a highly creative or artistic process such that creating good metaphors was a privilege held by people with relevant talent (Aristotle 1984, pp. 2332-2333). Interaction theorists, in turn, analysed the process down to the level in which metaphor creation was merely an application of a given framework, thus supporting the intentional use of metaphors in all communication (e.g. Black 1962). The contemporary metaphor theory, however, shifted the focus from the form of metaphorical expression to the conceptual level (Lakoff & Johnson 1980).

Despite the discrepancies or differences in focus between the different metaphor theories, there has to be a link between them; something that has, for instance, justified the use of the term metaphor to be used both in everyday language and different scientific and philosophical analyses of the phenomenon over the years. The most promising candidate for the link between the different views is actually what I call the contemporary theory of metaphor. Bringing the analysis of metaphor to the conceptual level raises the level of abstraction. The contemporary view of metaphor can therefore be used as a general theory of metaphor, through which even the older views of metaphor can be analysed. Therefore I argue that, even and especially when dealing with interaction design,

- 1) the contemporary theory of metaphor is an applicable starting point for the analysis of design and that
- 2) the older metaphor theories contain many applicable insights about the nature and use of metaphors.

¹ Phenomenon already noticed by Kuhn (1970): Anomalies and other issues are often discovered when approaching a theory within another discipline.

As argued above, the application of metaphor theories in new contexts has the potential to contribute to theoretical development. However, as I have strongly stated in my articles (Pirhonen 2002, 2003, 2004, 2005b; Pirhonen & Brewster 2001; Pirhonen, Brewster & Holguin 2002), the use of the term metaphor in HCI significantly differs from its use in other contexts; even to the point of contradiction. In terms of the discussion thus far the central contradictions are as follows:

A) *Aristotelian view*. In the Aristotelian view, metaphors are a powerful means of introducing new concepts in terms of existing ones. Indeed, this motivation for the use of metaphors is highly relevant in the computerised world. New concepts emerge frequently, and they often lack a real world counterpart. On the other hand, in the Aristotelian view, metaphors are seen as an effective means of learning. Learnability, in turn, is a central factor of usability (Nielsen 1993). In other words, metaphors appear an obvious strategy for designing usable ICT products and services. However, what is contradictory with the Aristotelian view is the conception of the design of metaphorical expression. While Aristotle found it a creative process which would require some sort of ingenuity, in the HCI-literature it has been introduced as a more or less mechanical process which can be broken down into phased design guidelines, as discussed earlier. I interpret the contradiction as reflecting the different motivations for using metaphors, perhaps even contradictory conceptions of the concept itself. For Aristotle, the core of creating metaphor was a deep understanding of the human being in context in order to activate her to discover the new concept (target of metaphor) in appropriate manner. In other words, metaphor does not explain everything but activates human beings to find out more. Discovering something that would at the same time be inspiring, motivating, intriguing *and* relevant is certainly far from being a straight forward process. This then is the real challenge of creating metaphorical expression. Facing this challenge brings into sharp relief Aristotle's claim about the level of difficulty and the high requirements for creating good metaphors.

B) *Interaction theory view*. In interaction theories, the essence of emergent metaphorical meaning is the interaction between two concepts; the source and target of the metaphor. The metaphorical meaning is a mental entity that is constructed by the mind. The dynamics or power of metaphor largely arises from disparity, not similarity, between vehicle and tenor. Richards (1950) calls this a *tension* between the two:

That tension is the spring of the bow, the source of the energy of the shot... (p. 125)

I have called a typical strategy of GUI design as *imitation* and *simulation* of real world entities. In relation to the interaction theories of metaphors, it becomes evident that the imitation of a real world counterpart has nothing to do with metaphors. The power of metaphor is in the dis-

similarity while the power of simulation is in similarity. Let's consider a virtual calculator on the virtual desktop; the design task has apparently been to imitate a physical calculator in as detailed a level as the available technology allows. There is neither need nor opportunity to parallel the virtual and the real in order to create a concept on the basis of their interaction.

C) *Contemporary metaphor theory*. In the early days of GUI, metaphor was introduced as a method to achieve high usability-learnability in particular. At the start of their classic text Lakoff and Johnson (1980) propose that

...metaphor is pervasive in everyday life...Our ordinary conceptual system, in terms of what we think and act, is fundamentally metaphorical in nature. (p. 3)

Taking the notion of Lakoff and Johnson seriously would mean, in terms of human computer interaction, that metaphors are not just another means of communication. On the contrary, according to this theory, the perception and action of the user of a computer is metaphorical to the core. The designer of a user-interface does not have a choice to either use or discard metaphors; even the thought of the designer is metaphorical. Acknowledging this would imply that the task of the designer is not to invent metaphors but to support the metaphor creation of the user.

In brief, it can be concluded that understanding metaphors as basic constituents of human conceptualisation processes as well as communication, would hugely benefit interaction design. On the other hand, we should as far as possible discard the typical misuse of the term metaphor in HCI.

When appropriately applied, metaphors as an approach to interaction design would open up quite new kinds of opportunities for understanding the nature of HCI. For instance, I argue that the solutions for elderly computer users have so far been sought from the wrong places. When talking about usability and older adults, the bulk of the relevant literature focuses on the decline of physical and cognitive performance when aging. Little attention has been paid to the fact that the contemporary computerised world has been constructed by younger people who have lived in a completely different kind of world to their grandparents. From a metaphor point-of-view, this can be expected to result in significant differences between the metaphor creation process of young and old computer users. Turning back to the quiddity of metaphor – constructing a concept in terms of another concept – it can be said that the basic constituents of the concepts of older adults are simply different from those of their grandchildren. Designing highly usable applications for our senior citizens would require a deep understanding of the world in which they grew up and constructed their conceptual system.

The rationale for applying a metaphor-approach when designing for older adults goes for any user or user group. When designing applications to be used

in different cultures, the translation of the language is simply the tip of the iceberg when striving for usability.

2.2 A structuralist view of the design and use of user-interfaces

Historically a large proportion of HCI related research is fundamentally the evaluation of prototypes or products. However, these kinds of studies are often technology driven; someone has an idea, she implements it and then carries out a user study. The basic idea or concept is usually very intuitive by nature. Since intuition as a basis of design does not sit comfortably within the hard sciences, the scientific status for human-computer interaction studies is pursued through the strictly analytical, typically quantitative evaluation process.

There is a wealth of applicable research on the needs of interaction design. However, the complexity of the design of contemporary, multimodal UIs vastly exceeds the currently available, scientifically verified information relevant to design. Long before the advent of GUIs it was argued that system design cannot be purely analytic (Nadler 1967). It can be argued that there is a wide gap between the practical design needs and the available scientific knowledge. This implies that most of the decisions concerning interaction design are based on intuition or other forms of tacit knowledge on the part of the designers. This is quite obvious; design is and has to be led by both formal, research based guidelines as well as the expert artistic, creative approach. Given the nature of the design process and its risks and high levels of complexity, in order to avoid “bad” design and in the pursuit of “good” design it may be simply a case of needing to “make our best” effort to inform design (Buxton 2007, p. 38).

In terms of practical design, should we then wait for research to gradually fill the existing gap of knowledge? No doubt, all information about the human way of interacting with our environment has the potential for being applicable in interaction design. However, instead of simply waiting for some final truth about design to emerge it is more appropriate to support the inevitably creative design process. Acknowledging the creative and subjective qualities of the design process would focus our attention towards the essence of design rather than the daydreaming of purely analytic interaction design.

To meet the needs of holistic design we created a novel design method, Rich Use Scenario (RUS, reported in detail in articles #4-#8). This method does still allow analysis to be applied where feasible but importantly encompasses the context of use.

2.2.1 Rich Use Scenario (RUS) in a nutshell

Use scenarios are not a new method within interaction design. They have been found to be an effective method of revealing use related issues which would have otherwise gone unnoticed (Carroll 1997, 2000). On the other hand, scenario based design has been characterised as a simple, rapid and cost-effective way of

concretising design ideas (Rosson & Carroll 2002). Scenarios include a variety of generic user characters, which are supposed to represent potential users (Cooper 2004).

There are, however, a number of potential issues in relation to the traditional use scenario approach. Use scenarios tend to describe a *typical* user using an application for a *typical* task in a *typical* context. The clear aim of adopting a generic approach to the development of use scenarios is to cover as wide range of uses, users and contexts as possible. This approach is not without difficulty; as Carroll (2000) notes the central challenge of creating a use scenario is to find a balance between concreteness and flexibility (p. 54). In other words, the aim is to appear to be generalisable but still describe sufficient detail. It is proposed that this contradiction can be managed e.g. by providing several use scenarios (Carroll 1997, Bødker 2000).

There is, however, a danger that if we try to please everyone, we end up pleasing no one (Eccher, Hunley & Simmons 2005, p. 6). We therefore created an alternative use scenario method, the Rich Use Scenario. The word “rich” stresses the fundamental difference between RUS and what we usually understand by use scenarios.

The principal objective of creating the RUS method was to provide a tool for generating creative design ideas. For instance, when creating a concept or UI element from scratch, it was expected that RUS would provide a better starting point for design than the pure intuition of an individual designer.

The core feature of the method is a story in which the use of the object of design has an important role. The story is vivid, aimed at inspiring the imagination of the listener. The main character of the story should also be inspiring and enable the listener to identify with them. In reference to the earlier discussion about use scenarios, RUS is clearly stressing concreteness at the expense of generalisability. This is due to the fact that it is not even aimed at being developed as a comprehensive design method; rather it is used to provide a sound basis for design. The difference between traditional scenario based design (SBD) and RUS is presented in TABLE 1. Since the nature of SBD and RUS is completely different, they should not be seen as exclusionary or competing strategies. Rather, they should be seen as different approaches for different purposes. In the design process, they could even complement each other.

TABLE 1. Scenario based design (SBD) vs. Rich Use Scenario (RUS)

	SBD	RUS
Rationale	Illustrate	Inspire
Outcome	Rapid, sketchy	Finished
Nature	Typical	Specific, unique
Versions	Several	One
Focus	Use of an application	Character, “persona” in the context

In RUS, the ideas are generated in a series of design panels. Within the panel sessions, the story is presented as a starting point for brainstorming. In the case studies reported in this thesis, the story was either read aloud by the moderator of the panel (article #4) or recorded in advance and played back in the panel session (#5, #7). In these case studies, the objects of design were UI sounds, and the sounds were part of the story, or *radio play* as it was usually referred to. In other words, the radio play consisted of an orally presented story and other sounds. The utilisation of the radio play in each design case study varied and is reported in detail in above mentioned articles.

RUS method draws on the tradition of *structuralism*, originating from the work of the linguist Ferdinand de Saussure (1983). With its models about the relationship between detail and context, structuralism works as an appropriate basis for comprehending the interaction among user interface details, such as single user interface elements, and the whole UI or even the whole context of use. In the studies reported in the articles of this thesis, the details to be designed were individual UI-sounds, and the whole was the story. In theoretical terms, sounds constituted the *paradigmatic* dimension and the encompassing story was the *syntagmatic* dimension of design (see e.g. Nöth 1990, p. 195). In the original context of this model syntagmatic analysis concerned the sentence and paradigmatic analysis the word choices.

The phases of RUS were not identical in each case study. We instead tailored the method to the requirements of each design case whilst also developing the method itself throughout the sequence of design cases. The basic principles remained the same. The studies revealed that these principles worked well. In terms of creative group work, the idea of using one single story as a reference point for brainstorming, proved successful: The panellists in the brainstorming session spent the majority of their time discussing the story from the point-of-view of the character, the *persona* (Cooper 2004) rather than focussing their attention on the application or on other technical issues. Directing the attention of the panellists of a brain storming session to the character and the story instead of the application has at least two important advantages. Firstly, design teams are typically interdisciplinary by nature; talking about the story and the life of the character provides an equal starting point for all, compared to a setting in which people with different backgrounds face difficulties in understanding each other's point-of-view. Secondly, if the radio play is successful in inspiring the participants then talking about it is probably a much more fruitful basis for the generation of creative ideas than a more formal description of the use of an application.

Finally, it has to be stressed that the development of RUS has not been a cumulative process in which it has been sequentially improved and cultivated to become an even better, improved design method. Neither is it a method with strictly defined phases or organisation. Therefore, different usages of RUS which have been reported in the publications of this thesis should not be interpreted as a gradual development of the method but rather as an illustration of how the same principles can be used in various different contexts for different

purposes. Perhaps it would have been more appropriate to call RUS a set of principles for the construction of a context specific design method.

2.2.2 RUS and human conceptualisation processes

A key concept in the development and use of RUS is *creativity*. Creativity itself is a somewhat ambiguous concept. In terms of RUS one interesting issue concerns the notion of creativity both as a quality of an individual and in relation to how it could be utilised in group work. Although it should be noted that the contribution to the development of creativity theories is beyond the scope of this thesis.

The most common way to conceptualise creativity is typically to associate it with a specific skill or quality possessed by certain privileged individuals. For instance, we think that being an artist requires creativity. The seminal work of Mihály Csíkszentmihályi (1997) analyses creativity from this point-of-view. Another, common approach is to comprehend creativity as a fundamental human quality (in NACCCE 1999 this is referred to as the democratic definition of creativity).

In the development of the RUS method the assumption is that there is creative potential in all of us. The analysis of group creativity (e.g. Leonard & Swap 1999) posits that each member of a work group is able to contribute to a creative process. In RUS, creative group work is utilised in the brainstorming of design ideas.

In terms of human conceptualisation processes, the contribution of RUS can be seen from the point-of-view of both the design and use of an application. In design, the creative group work of RUS supports the emergence of metaphorical expressions in the course of conversation and action. These metaphorical expressions are then realised in the user-interface and – if successful – support the conceptualisation processes of the user. RUS is thus a channel through which creative individuals (design panels) are in mediated interaction with other creative individuals (users). Providing that metaphor creation is the core of conceptualisation processes, RUS can be seen as a way to apply the theoretical points of this study to practical design.

3 CONCLUDING STATEMENTS

This thesis focuses on two themes, which may at first glance appear unrelated:

- 1) metaphors as basic constituents of our conceptual system and
- 2) interaction design methodology.

However, since these themes have risen from practical needs in practical case studies, practical interaction design thus provides a perspective from which to view the whole thesis under one single conceptual framework.

In order to construct an extensive framework, I have articulated the design process as being an *interaction between a designer and a user* of an application. FIGURE 1 illustrates the proposed framework.

In the illustration, there is a designer and a user and a number of different arrows combining the two. The starting point is taken from Norman (1986). In it, the designer and the user are interacting through the user interface. Norman's approach provides a perfect basis for discussing user-interface metaphors as they are approached in this thesis. The strength of the illustration, in terms of metaphor theories, is its emphasis on interaction. I will now explain the figure from the point-of-view of metaphors.

Since metaphors in this thesis are taken as the basic constituents of our conceptual system, the figure does not illustrate the creation of UI-metaphors (metaphorical expressions in the user-interface). Instead it shows how the inevitably metaphorical concept creation of the designer and user can be understood in the context of human-computer interaction. The figure aims to encompass the main three theoretical approaches to metaphors:

- a. *Aristotelian view*: The source and target of metaphor have something in common (labelled as *gist* in the figure). The choosing of the source of the metaphor so that the common content is both a) relevant in that it reflects something very essential about the new concept (referred to as *emerging* in the figure) and b) inspiring, thus motivating the discovery of the metaphorical expression is a demanding task. Creating such a metaphorical expression requires a deep understanding of the culture and human communication. Given this, Aristotle's arguments about the need for a particular kind of talent in this creative process

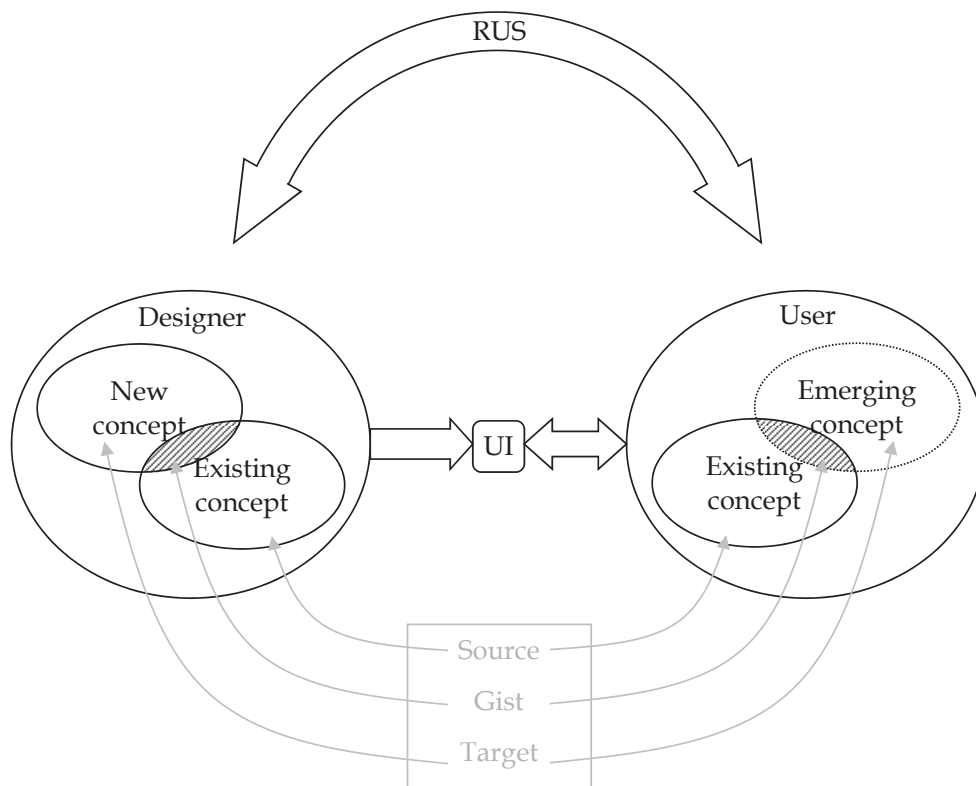


FIGURE 1. Design process as interaction between the designer and the user

begin to sound quite pertinent. Interpreting the figure in an Aristotelian way, would mean the shadowed intersection would reflect the similarity between the source and target of the metaphor.

b. *Interaction view*: in the interaction view of metaphor, the *tenor* of a metaphor (analogous to *target* in the figure) takes shape over the course of the interaction with the vehicle (*source* in the figure). The link that enables the interaction, the ground, could be interpreted as *gist* in the figure. However, since interaction theory does not assume a pre-existing similarity on which metaphor is founded, the figure should in fact be interpreted differently; the shaded area, the ground, thus illustrates the actual interaction.

c. *The contemporary view* of metaphor: Contemporary definitions of metaphor, e.g. "...understanding and experiencing one kind of thing in terms of another" (Lakoff & Johnson 1980, p. 5) or "cross-domain mapping in the conceptual system" (Lakoff 1993, p. 203) can be interpreted as being a maturation of the concept of metaphor on the basis of the Aristotelian and the interaction view. As such, the same illustration (FIGURE 1) works with the contemporary view of metaphor. The

labels within figure 1 (such as *existing concept*, *emerging concept*) specifically fit with the conceptual view, i.e. contemporary view of metaphor.

In terms of communication, the task of the designer is to support the concept creation of the user so that the emerging concept is relevant to the use of the application. The designer needs to be able to express her metaphor(s) through the user-interface.

To be able to communicate her metaphors to the user, the designer needs to have a realistic view about the content of the conceptual system (in the figure, the *existing concept*) of the intended user. Acquiring this kind of knowledge is pivotal for all efforts labelled as user-centred design (UCD), a central concept in HCI since Donald Norman's and Stephen Draper's ground-breaking book (Norman & Draper 1986). Knowing the user implies a deep understanding of amongst other things the pertinent social and cultural issues. There are indeed endless sources of information from which the designer can construct relevant knowledge. However, in this thesis I propose the Rich Use Scenario method as a systematic method for contributing to the construction of relevant knowledge. In FIGURE 1, the two-ended arrow illustrates the method as a way to interact with the users directly – as opposed to the interaction being through the user-interface, which is mediated in nature and usually lacks direct feedback to the designer. Strictly speaking RUS does not necessarily allow interaction with plausible users of the application but rather ordinary people. For instance, when we applied RUS in the design of UI-sounds for an anaesthesia workstation (publication #7; Pirhonen & Tuuri 2009), we used volunteering university students from various departments. These people were complete amateurs in terms of subject matter, as informants and thus their role was to represent users as human beings rather than as experts in medicine.

The framework illustrated in Figure 1 is not a step-by-step design process. It conceptualises the design of interactive applications as a process consisting of human meaning-makers (designer and user), the user interface and a method (RUS) for interaction between a designer and a user. The aim is to help to see the role of different actors within a bigger picture. If we widen the perspective further, we can see the role of the designer as a designer of the information society, as we recently proposed (Pirhonen, Maksimainen & Sillence 2012).

4 ETHICAL DISCUSSION

The articles that make up this thesis come under the discipline of human computer interaction. Within the discipline, there are several, related expressions referring to the human centricity of related R&D; user-centred design (UCD), human-technology interaction (HTI) and so on.

However much human or user centricity is stressed within HCI the activities themselves are usually driven by forces which should make us stop and consider the basics of the discipline: Fundamentally what do we mean by 'human' or 'user'?

As previously discussed in section 1.1 the origin of human computer studies can be found within industrial settings, in which the human operator was supposed to work as effectively and accurately as possible. Under those circumstances relevant information for design could be found principally from studies of cognitive psychology; perception, memory and capacity for instance, were of primary interest. The role of the human operator in those settings could be characterised as one of cognitive machine. The applied cognitive models represented the IP-approach (information processing). In those studies, the term *user* was probably pertinent.

What about using the term *human* then? It certainly denotes far more than *user* does. There is no analysis of these terms within the HCI related literature. However, some conclusions can be drawn from the usability literature e.g. Jakob Nielsen's Usability Engineering (1993). In it, the efforts for enhancing usability are predominantly justified by commercial arguments; high usability is argued to result in high sales. In this context the term *human* or even better *consumer* would appear to be far more accurate than *user*. That would, in turn, however, reveal the uni-dimensional role granted to the human being. In this setting the human's value is not absolute, as is the case within our culture more generally (United Nations 1948). Instead, the value of a consumer is dependent on her potential to consume. Therefore I argue it is questionable to talk about human-computer interaction or human centricity in any form if we are not first and foremost aiming at making life better for human beings.

This thesis contributes to the construction of highly usable ICT products and services. However, usability *per se* does not make this world a better place. Actually, if we aim at enhancing the usability of military systems, the outcome is probably destructive. In that case, high usability is by no means 'human'. Therefore I find it contradictory to talk about, for instance, military applications under the remit of in human-computer interaction studies.

Military applications are of course only one extreme example of destructive applications. All technology should be exposed to ethical discussion before launching. In our ICT-hype laden culture there seems little interest in questioning the impact of new innovations on our societies and individual lives.

I sincerely hope that the ideas of this thesis are utilised constructively, in terms of humanity.

5 OVERVIEW OF THE INCLUDED ARTICLES

- I Pirhonen, A., Brewster, S. & Holguin, C. 2002. Gestural and audio metaphors as a means of control for mobile devices. In Proceedings of CHI2002, 20-25 April 2002, Minneapolis, Minnesota. New York (NY): ACM Press, 291-298.

Background

My first (except a workshop paper in PC-HCI2001, see Pirhonen & Brewster 2001) and most cited metaphor related publication. The related study was based on practical design task: To design gaze-free controls for a portable music player. The design solution was a set of simple gestures across the touch screen of a PDA device. In addition, we aimed at developing and applying usability evaluation methods suitable for mobile applications.

Methodological issues

The design was argued to be based on the application of gestural metaphors. However, in fact the first ideas of gesture based control resulted in creative brainstorming on the part of the researchers. No doubt, the ideas presented in those sessions were full of metaphorical expressions, but no one deliberately referred to metaphors. Only when the basic principles of the UI had been decided did the researchers start to handle them as metaphors. In other words, the design of the application and the development of the theory of metaphors were in a reciprocal relationship with each other.

Contribution

The outcomes in relation to the paper's stated objectives were twofold: 1) A prototype of a portable music player (TouchPlayer) which could be controlled with simple gestures, without the need for gaze; 2) usability evaluation methods for mobile applications, which were also applied to the evaluation of the music player. However, from the point-of-view of this thesis, the central contribution was the theoretical reasoning of metaphors as a design approach. The paper questioned the common idea of user-interface metaphors as clumsy imitations of their real-world counterparts.

My role among the authors

The construction of the theoretical framework, the whole of study 2 (there are two empirical studies reported in this paper), and the majority of the text.

- II** Pirhonen, A. 2005. To simulate or to stimulate? In search of the power of metaphor in design. In Pirhonen, A., Isomäki, H., Roast, C., & Saari-luoma, P. (eds.) Future interaction design. London: Springer Verlag, 105-123.

Background

A synthesis of the theoretical points of metaphors, reported in the context of two case studies (TouchPlayer and GestureJukeBox). Extensive discussion about the nature of metaphors and, above all, the concept of the metaphor life-cycle.

Methodological issues

Drawing upon the literature and two experiments, which have been reported in detail elsewhere (Pirhonen 2002, Pirhonen 2004) this book chapter provides theoretical reasoning about the concept of metaphor and its power as a UI design principle.

Contribution

A compact presentation about metaphors in UI design.

- III** Pirhonen, A. 2005. Supporting a user facing a novel application: learnability in OOBE. *Personal and Ubiquitous Computing* 9(4), 218-226.

Background

This paper presents an application of metaphor theories to learnability. Two design cases (TouchPlayer and GestureJukeBox) are utilised to illustrate the applicability of the metaphor approach to practical UI-design. The article looks at the concept of learnability from the point-of-view of metaphor theories. Different learning theories are utilised to analyse learnability in the context of UIs and the introduction of new products (so called out-of-box experience, OOBE).

Methodological issues

In this study, different theoretical frameworks of metaphors and learning are synthesised for the needs of understanding the complex process in which a new product is explored.

Contribution

The study provides a conceptual framework for designers to unpack the complex process by which the user is learning to use an application. The framework is not only useful during all stages of the design of interactive, multimodal applications, but also demonstrates the applicability of the metaphor approach presented in previous papers.

- IV** Pirhonen, A., Murphy, E., McAllister, G. & Yu, W. 2006. Non-speech sounds as elements of a use-scenario: A semiotic perspective. In Stockman, T., Nickerson, L. & Frauenberger, C. (eds.) Proceedings of International Conference on Auditory Display ICAD 2006, Queen Mary University of London, June 20-23, 2006. CD-ROM format.

Background

This was the first publication concerning the Rich Use Scenario (RUS) design method, which was originally created for the needs of this case study.

Methodological issues

The RUS method was founded on the basis of structuralism. The method was then applied in a practical design case and the experiences were analysed.

Contribution

The central contribution of this study was the production of the first version of the RUS-method. It was later applied in a variety of contexts going beyond the initial audio design setting.

My role among the authors

The construction of the theoretical framework, half of the empirical work (the part organised in Glasgow), and much of the text. Authors 3 and 4 had only a formal role as the supervisors of the second author's PhD work.

- V** Pirhonen, A., Tuuri, K., Mustonen, M.-S., & Murphy, E. 2007. Beyond clicks and beeps: In pursuit of an effective sound design methodology. In Oakley, I. & Brewster, S. (eds.) Haptic and Audio Interaction Design. Proceedings of the Second International Workshop, HAID 2007. Seoul, Korea, November 29-30, 2007. Lecture Notes in Computer Science 4813, Berlin/Heidelberg: Springer Verlag, 133-144.

Background

A further developed version of RUS was applied to an application called Physical Browsing; a concept in which information about real world objects can be acquired with the help of RFID (radio frequency identification) tags. The design task concerned the UI-sounds of the application only.

Methodological issues

A sophisticated version of RUS method was created on the basis of the previous study. RUS was then applied in the design case.

Contribution

The production of a second version of RUS in a format that can be applied to various contexts.

My role among the authors

This study was highly cooperative among authors 1-3; author 4 helped in the reporting stage since she had been involved in the early stages of the development of RUS. My role was central in that ultimately RUS was originally my personal creation.

- VI** Pirhonen, A. & Murphy, E. 2008. Designing for the unexpected: the role of creative group work for emerging interaction design paradigms. *Visual Communication* 7(3), 331-344.

Background

Discussion about RUS-method in various contexts. The special issue in which the paper was published concerned wearable technology.

Methodological issues

A post-analysis of the first experiences of using RUS.

Contribution

Manifestation of the applicability of RUS in the creation of new technologies.

My role among the authors

The article was prepared in close cooperation among the authors; my personal contribution was central in the formation of the basic idea of applying RUS to a variety of, while the second author had an important role in the actual writing of the article.

- VII** Pirhonen, A. and Tuuri, K. 2010. Communicative functions of sounds which we call alarms. In Brazil, E. (ed.) *Sonic discourse: Expression through sound*. Proceedings of the 16th International Conference on Auditory Display (ICAD 2010), Washington DC, June 9-15. International Community for Auditory Display, 279-286. CD-ROM format.

Background

The case study reported in this article concerned the design of warning sounds for a safety critical context (operating room).

Methodological issues

Modified version of RUS.

Contribution

- Demonstrates the applicability of RUS in the design of alarm sounds
- Analyses the nature of alarm sounds in terms of conceptualisation

My role among the authors

The paper was based on intensive, cooperative study. I deserved the first author's role as the founder of RUS. Most of the empirical research efforts as well as the actual writing were equally shared among authors.

- VIII** Pirhonen, A. & Tuuri, K. 2008. In search for an integrated design basis for audio and haptics. In Pirhonen, A. & Brewster, S. (eds.) *Haptic and Audio Interaction Design. Proceedings of the Third International Workshop, HAID 2008*. Jyväskylä, Finland, September 15-16, 2008. *Lecture Notes in Computer Science 5270*, Berlin/Heidelberg: Springer Verlag, 81-90.

Background

Theoretical discussion about the interaction design approaches. Manifestation of a holistic approach, in which design ideas are based on corporal experience rather than UI-technology.

Methodological issues

Theoretical and conceptual reasoning.

Contribution

This article proposes mental imagery, or metaphors, as a core object of interaction design. In this thesis, the role of this particular paper is to bring metaphor theories and design methods together under one single design framework.

My role among the authors

The paper summarises much of the theoretical work of the research project which I led. Both themes of this paper, the metaphor point-of-view and RUS, were very much my areas of expertise. The second author had an important role in expanding the conceptual analysis.

- IX** Sillence, E. & Pirhonen, A. 2011. ICT for consumers or human beings: What's the difference? In Lumsden, J. (ed.) *Human-computer interaction and innovation in handheld, mobile and wearable technologies*. Hershey (PA): IGI Global, 260-267.

Background

An epilogue of the thesis. The article acts as a reminder that all the efforts described in these articles aim at supporting design for human beings, not to promote ICT related business as such. This book chapter is an updated version of a journal article published two years before (Pirhonen & Sillence 2009).

Methodological issues

Ethical and conceptual discussion.

Contribution

This article provides the bigger ethical picture through which to view the previous publications. Even if openly techno-critical, it is not aimed at manifesting a Luddite attitude. Rather, it challenges the constructors of technology to an open discussion about the role of technology in human culture: which one is the master and which one the servant.

My role among the authors

The study was highly cooperative and roles among authors are hard to distinguish. In the older version of the same paper the names of the authors were in reverse order. Because of the equal contributions it was natural to swap them in this update.

YHTEENVETO (FINNISH SUMMARY)

Ihmisen ja tietokoneen välisen vuorovaikutuksen tutkimuksessa painopiste ja lähestymistavat ovat aikojen saatossa muuttuneet teknologian muutosten mukana. Tutkimusalueena HCI (human-computer interaction) syntyi aivan erilaisiin tarpeisiin kuin mitä esimerkiksi nykyaikaisen kulutuselektronikan käyttöliittymien suunnittelijoilla on. Siksi HCI tutkimusalueena ei voi pysähtyä paikoilleen, vaan uusia näkökulmia ja metodeita täytyy kehittää jatkuvasti.

Tämä väitöskirja esittelee yhden näkökulman vuorovaikutussuunnittelun ja sitä koskevan tutkimuksen tarpeisiin. Työ keskittyy ihmisen käsitteellistämisen prosessien analysointiin. Tavoitteena on lisätä ymmärrystä siihen prosessiin, joka käynnistyy, kun ihminen kohtaa jotain itselleen uutta, kuten uuden teknisen laitteen, jota hänen pitäisi käyttää.

Keskeinen teoreettinen käsite työssä on metafora. Käsitteen erittely perustuu havaintoon, jonka mukaan metafora-sanan käyttö graafisten käyttöliittymien kontekstissa on ristiriitainen metaforan käsitteen sisällön kanssa. Väitettä perustellaan refleктоimalla metafora-teorioita eri aikakausilta metafora-sanan käyttöön käyttöliittymäkirjallisuudessa. Graafisten käyttöliittymien yleistyessä tyypillinen suunnittelustrategia oli jäljitellä tietokonegrafiikalla reaali maailman objekteja. Näitä reaali maailman objekteja jäljitteleviä käyttöliittymäelementtejä kutsuttiin metaforiksi. Nimeäminen ei ollut kovinkaan onnistunut, koska metaforan – sanan alkuperäisessä merkityksessä – voima on pikemminkin metaforan kohteen ja lähteen erilaisuudessa, ei samankaltaisuudessa. Käyttöliittymissä taas pyrittiin jäljittelemään olemassa olevaa mahdollisimman yksityiskohtaisesti. Johtopäätöksenä esitetään väljähtyneen ja väärin ymmärretyin metafora-käsitteen uudistamista käyttöliittymäsuunnittelussa.

Metaforat käsitteellistetään työssä ihmisen käsitejärjestelmän perustaksi. Siten myös ihmisen vuorovaikutus ympäristönsä kanssa voidaan ymmärtää metaforien rakentamisena. Tämän ymmärtäminen vuorovaikutussuunnittelussa olisi erittäin tärkeää.

Jotta ihmisen tapaa jäsentää ympäristöään metaforisesti voitaisiin hyödyntää myös käytännön vuorovaikutussuunnittelussa, työssä esitellään metodi, jota on onnistuneesti sovellettu tutkimusartikkeleissa raportoiduissa suunnittelu-tehtävissä. Kyseinen metodi, Rich Use Scenario (RUS), perustuu kertomukseen käyttäjän arjesta. Väitöskirjan suunnitteluesimerkeissä metodia on käytetty käyttöliittymä-äänien suunnitteluun. Niissä kertomus laadittiin kuunnelman muotoon ja kertomuksessa esiintyvä sovellus, erityisesti sen äänet, olivat tärkeässä osassa. Kuunnelmaa työstettiin muutaman hengen amatööripaneeleissa, joissa panelistien tehtäväksi muodostui kuunnelman äänien suunnittelu. Näin työstetyt ääni-ideat voitiin hyödyntää toteutettaessa ääniä myöhemmin itse sovellukseen.

Käytöskenaariot ovat perinteinen ja paljon käytetty suunnittelustrategia. Skenaariot on todettu hyväksi strategiaksi paljastamaan monia käyttöön liittyviä seikkoja, jotka olisivat ilman skenaariota jääneet havaitsematta. Koska käytöskenaarioiden tarkoitus on ollut paljastaa sovelluksen käyttöön liittyviä on-

gelmia, ne on pyritty perinteisesti laatimaan mahdollisimman kattaviksi. Käytännössä kattavuus on yleensä merkinnyt sitä, että laaditaan useita käyttöskenaarioita. Samasta syystä skenaarioissa esiintyviä henkilöahmoja on useita, kattaen mahdollisimman monenlaisia käyttäjätyyppejä. RUS-metodi poikkeaa näistä perinteisistä käyttöskenaariomenetelmistä monessa suhteessa. Siinä skenaarioita on vain yksi. Henkilöahmojakin on tyypillisesti yksi ainoa, paitsi jos itse skenaario vaatii useampia. RUSin tavoitteena ei olekaan kattaa mahdollisimman paljon käyttötilanteita ja käyttäjätyyppejä. RUS pyrkii sen sijaan tukemaan tarinaan eläytymistä ja tarinan henkilöahmoon samastumista. RUS tarjoaa monialaiselle suunnitteluryhmälle yhteisen tarttumapinnan; suunnittelun keskeiseksi näkökulmaksi tulee tietyille henkilölle tarkoitetun sovelluksen suunnittelu. Suunnittelun lopputulostakin voidaan arvioida sillä perusteella, miten se täyttää kyseisen tehtävän.

Väitöskirja päättyy muistutukseen siitä, että kun suunnitellaan teknologiaa ihmisille, täytyy ihminen kokonaisuudessaan ottaa huomioon suunnittelun eri vaiheissa. Jos ihminen mielletään kapea-alaisemmin, esimerkiksi kuluttajana, voidaan suunnitella tarpeetonta, jopa vahingollista teknologiaa ja oikeuttaa toiminta sillä, että kuluttaja haluaa ostaa kyseisen tuotteen. Myös ihmisen rajaaminen käyttäjäksi on kapea-alainen lähestymistapa: Suunnittelija voi suunnitella vaikkapa käytettävyydeltään korkeatasoisen, tappamiseen tarkoitetun ase.

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