Proceedings of the Third Danish Human-Computer Interaction Research Symposium

Roskilde, Denmark

27th November, 2003

Edited by

Morten Hertzum, *Computer Science, Roskilde University*

Simon Heilesen, *Communication Studies, Roskilde University*

Writings in Computer Science, No. 98

Roskilde University, Roskilde, Denmark, 2003

Preface

Roskilde University is happy to host the *Third Danish HCI Research Symposium*. The aim of the symposia is to stimulate interactions among HCI (Human-computer Interaction) researchers from academia as well as industry. Like the two preceding symposia, held at University of Aarhus in 2001 and at University of Copenhagen in 2002, this year's symposium reflects a broad range of HCI research.

These proceedings comprise 23 papers submitted to the symposium by 41 authors. In addition to presentations of these papers, the symposium included two keynote presentations. Abstracts of the keynotes are appended to the proceedings. We wish to thank all the contributors.

Morten Hertzum and Simon Heilesen

Roskilde, November 2003

Table of Contents

Programme

9.30-10.00 Registration

10.00-11.00 Keynote I

E. Aarseth, *The dark side of the source code: games and HCI*

11.15-12.15 Papers I

N. Schultz, *Affective computing used in an imaging interaction paradigm*

T.T.-Y. Jørgensen, L.J. Christensen & A.H. Jørgensen, *Applying usability methods in computer game development: the case of Takkar*

O.S. Iversen, P.G. Krogh & M.G. Petersen, *The fifth element – promoting the perspective of aesthetic interaction*

G. Strom, *Combining participant-observation and questionnaires to determine differences in cultural values between Denmark and the Philippines*

12.15-13.15 Lunch

13.15-14.00 Keynote II

B.B. Jacobsen, *www.dr.dk/kroeniken*

14.00-14.45 Posters

(see list on next page)

14.45-15.45 Papers II

O.W. Bertelsen, *Activity walkthrough: a cognitive walkthrough in activity theory terms*

B.S. Als, R.T. Høegh, J. Kjeldskov, M.B. Skov & J. Stage, *Comparing usability evaluations of mobile systems*

J. Nielsen & C. Yssing, *Getting beyond the disruptive effect of think aloud*

E. Frøkjær & K. Hornbæk, *The metaphors-of-human-thinking usability evaluation technique compared to heuristic evaluation and cognitive walkthrough*

16.00-17.00 Papers III

H.H.K. Andersen, H. Albrechtsen & B. Cleal, *Structuring collaborative research: experiences from an evaluation study of a collaboratory*

K. Bødker & K.B. Bøving, *Implementation of groupware technology in a large distributed organization – lessons learned*

A. Lunzer & K. Hornbæk, *Subjunctive interfaces: visualisations for parallel display and control of alternative scenarios*

N.E. Wille, *Legibility of text meant to be read from a computer screen – a key factor in e-publishing*

List of posters
(posters are displayed all day and presented during the poster session)

M.S. Christensen, *Usability and beyond – the challenge of understanding aesthetics and affect in HCI*

T. Clemmensen, *HCI knowledge, software engineering knowledge and system development practice*

J. Donovan, J. Pedersen, M.V. Jensen, W. Sperschneider & J. Lorenzen, *Exploratypes: expressing and provoking actions*

L. Frølunde, *Learning, gender and ICT: involving young people in design*

J.M. Larsen, *Computer clubhouse: informal learning spaces where adolescents experience and create with ICTs as tools and exchange artwork via a network intranet*

K. Levinsen & R. Orngreen, *Sorry… 1.5 X to the left: experiments with written interaction*

L. Nielsen, *A model for personas and scenarios creation*

R. Nørager, *Ecological cognitive ergonomics*

J.K. Pors, *Studying the integration of ICT infrastructures in problem-oriented project groups – a research proposal*

J. Simonsen, *From systems design to CSCL?*

J. Villadsen, *User interfaces for automated reasoning systems*

Comparing Usability Evaluations of Mobile Systems

**Benedikte S. Als, Rune T. Høegh, Jesper Kjeldskov,
Mikael B. Skov and Jan Stage**

Department of Computer Science, Aalborg University, Denmark

1. Introduction

Established approaches to design and evaluate usable systems are challenged by systems for wearable, handheld, or mobile devices. There are extensive methods and guidelines that describe how the usability of stationary computer systems should be evaluated [4,6]. This is complemented with experimental evaluations of the relative strengths and weaknesses of different techniques [1,3]. However, in relation to design and evaluation of mobile systems, such methods, guidelines, and experimental evaluations are yet to be produced.

Mobile systems are typically used in highly dynamic contexts and their use often involve several people distributed in the user's physical surroundings. Therefore, field-based testing seems like an appealing or even indispensable approach for evaluating mobile systems. Yet usability testing in the field is difficult. Firstly, it can be complicated to establish realistic studies that capture key situations in the use-context. Secondly, it is far from trivial to apply established techniques such as observation and think-aloud in the field. Thirdly, field-testing complicate data collection and limits control since users are moving physically in an environment with a number of unknown variables. When usability tests are conducted in a laboratory setting, control and collection of high quality data is not a problem, but one of the drawbacks is the lack of realism. Existing approaches to laboratory-based usability testing of stationary computer systems try to solve this problem by recreating or imitating the real use context, e.g. by office furnishing [6]. However, when mobile systems are tested in a laboratory setting, activities in the user's physical surroundings can be difficult to recreate realistically [5].

We explore laboratory and field-based approaches to usability evaluation of mobile systems through a number of comparative usability studies involving different experimental design. Two of these studies are illustrated below and the experiences from these studies are compared.

2. TramMate

In early 2003, we designed a context-aware mobile information service (TramMate) [2]. This service supports the use of the tram based public transport system of Melbourne by keeping track of contextual factors such as the user's physical location, upcoming appointments and real time tram information. The design is integrated with an electronic calendar. We designed and conducted two usability evaluations of an early prototype. The first evaluation was conducted in the field. The second evaluation was conducted in a usability laboratory. The two evaluations were identical in terms of tasks and the profiles of the test subjects. The users had to complete three tasks involving route planning prior to catching a tram. All tasks were realistic and achievable within the time frame. Five subjects participated in the experiments in the field and laboratory respectively. Half the users were male and the other half were female, balanced across the field and laboratory studies. Users were aged between 21 and 42 and were all frequent computer users and familiar with the tram system of Melbourne.

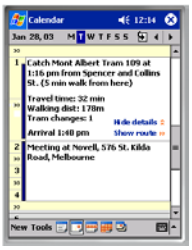


Figure 1: TramMate

Figure 2. Field evaluation

Figure 3. Lab evaluation

Field Evaluation

The field study focused on use of the prototype in realistic surroundings. In this study, the users had to both look up necessary information on the mobile device according to the tasks and then perform the tasks "for real" (e.g. catching a tram to a specific destination). The prototype accessed live timetable information via the Internet but GPS positioning was simulated. During the evaluation, three researchers observed the user: an evaluator encouraged the user to think-aloud, one took notes and one recorded the evaluation on a handheld camcorder (figure 2).

Laboratory Evaluation

In the second study, the user was only required interact with the prototype system. The user was seated at a desk, with the mobile device in his hand. An evaluator was seated next to the user and encouraged him to think-aloud. The usability laboratory facilitated video recordings of the display of the

mobile device and overall views of the test subject and the evaluator (figure 3). To ensure a good view of the mobile device, the user was requested to hold it within a limited area indicated on the table. Two researchers observed the evaluation through a one-way mirror. One took notes. The other operated the video equipment.

3. MobileWARD

During a five months project we designed MobileWARD, a context-aware mobile system running a PDA supporting work at a Danish hospital ward. MobileWARD is context-aware as it automatically keeps track of e.g. physical location of patients and staff, upcoming appointments and schedules. Physical location was simulated through a control unit operated by the participating researchers. We designed and conducted two different usability evaluations of the system. The evaluations were similar as they involved trained, registered nurses as test subjects, and they should conduct standard morning work routines. However, they were different in their data collection. The participating subjects were between 27 and 54 years old and they had diverse experiences with nursing. All of them were novices with PDAs.

Figure 4: Laboratory evaluation


Figure 5: Evaluation at the hospital

Field Evaluation

The field evaluation focused on using the system in a realistic environment. The evaluation took place during morning procedure at a hospital ward. Prior the evaluation, we entered data on the committed patients at the ward. The use of the system was not controlled by task assignments. The test subject should merely conduct her standard morning procedure (figure 5). Three committed patients were involved in the morning procedure at the day of our evaluation. We conducted an interview with the test subject afterwards to identify opportunities and limitations of the mobile system.

Laboratory Evaluation

The laboratory evaluation took place at the usability laboratory at Aalborg University. The idea of this evaluation was to evaluate the mobile system in

an environment where we could closely monitor all actions and situations (figure 4). Three test subjects participated in the study and they were instructed through assignments and were told to think-aloud while using the system. Three students acted as patients for the evaluation. One researcher acted as test monitor while another controlled the equipment from the control room.

4. Lessons Learned

- Collection of sufficiently detailed and precise data in the field is difficult because of motion and work-related conditions, e.g. usability evaluators could not follow the nurses into the ward.
- Field testing requires several test monitors and loggers, it takes a considerable amount of time, and it is physically demanding.
- The largest number of usability problems is detected when test subjects are sitting down by a desk in the laboratory.
- The problems that are detected in the laboratory focus on interaction and interface design.
- The problems that are detected in the field focus on the relation between the system and the real world that it is supposed to have awareness about.
- A laboratory set-up that imitates the real context of work facilitates detection of problems that do not occur when sitting at the desk, e.g. when the system changes screen because of motion to a different context, the nurses think they have done something wrong.

References

1. Karat, C. M., Campbell, R. and Fiegel, T. (1992) Comparison of Empirical Testing and Walkthrough Methods in User Interface Evaluation. In *Proceedings of CHI'92*, pp. 397-404. New York: ACM.
2. Kjeldskov J., Howard S., Murphy J., Carroll J., Vetere F. and Graham C. (2003) Designing TramMate - a context aware mobile system supporting use of public transportation. Proceedings of DUX 2003.
3. Molich, R., Bevan, N., Curson, I., Butler, S., Kindlund, E., Miller, D. and Kirakowski, J. (1998) Comparative Evaluation of Usability Tests. Proceedings of the Usability Professionals Association Conference.
4. Nielsen, J. (1993) *Usability Engineering.* Morgan Kaufmann.
5. Pirhonen, A., Brewster, S. A. and Holguin, C. (2002) Gestural and audio metaphors as a means of control for mobile devices. Proceedings of CHI'2002, pp. 291-298.
6. Rubin J. (1994) *Handbook of Usability Testing*. Wiley.

Structuring collaborative research: Experiences from an evaluation study of a collaboratory

Hans H.K. Andersen, Hanne Albrechtsen & Bryan Cleal

Risø National Laboratory

Introduction

Since the introduction of the notion of 'collaboratories' in the late 1980s a number of systems for supporting distributed collaboration amongst scientists with shared instruments, databases and communication technologies in diverse disciplines have been developed (Finholt, 2001; Wulf, 1993). The evaluation of collaboratories has, however, lagged behind this development. Thus, the study by Sonnenwald et al (2002) points to the fact that of 31 collaboratories identified, only 8 have been formally evaluated or are undergoing evaluation. In this paper we will present a qualitative empirical evaluation of a web-based collaboratory for film research named Collate. The collaboratory is intended to support interactive cross-cultural film research (Pejtersen et al, 2001). This intention has been realised through enabling shared access to a common field of work, in terms of i) a structured discourse module for handling annotation content ii) a module for structuring communication based on a conversation for action approach iii) search facilities to support shared access to a database of film censorship documents. Cataloguing and indexing facilities support collaboration by allowing actors the possibility to change the state of affairs in the common field of work. The results of the evaluation of these latter facilities are discussed in (Cleal et al, 2003). This paper will discuss the results of the evaluation of collaboratory's annotation facilities.

Methodology

The empirical evaluation of the Collate prototypes was conducted in a user-workshop. Each archive sent two representatives and in each case these individuals were those most actively involved in the project at the respective archives. The workshop addressed real-life collaborative work tasks. The archives were asked to choose two films that could serve to illustrate different collaborative tasks. The films chosen were "Die drei Von der Tankstelle" and the 1930 version of "Panzerkreuzer Potemkin". For these films a realistic scenario was devised in which the archivists were asked to create the censorship history for the two films. The overall task required that the archivists work through a number of sub-tasks and it is in these sub-

tasks, that the collaborative element of film archive research was set into relief.

The workshop was conducted as two laboratory sessions, one session for each film, involving participant observation, with the participants encouraged to 'think aloud' as they worked with the Collate prototype. The participants worked with the films in two groups, which each consisted of one archivist from each archive. Two Risø employees observed each group. The data collected from the field experiments and the meetings at the evaluation workshop were recorded on videotape and transcribed.

Structured comments and discussion on annotation

The evaluation identified diverse reactions to the module for structuring communication. The module supports a selection of communicative acts (figure 1) identified through analysis of early discussions amongst the archivists, logged from their use of a web based collaboration tool named SharePoint[tm]. These discussions addressed the initial set-up of the shared activities amongst the archives, including the coordination of their efforts

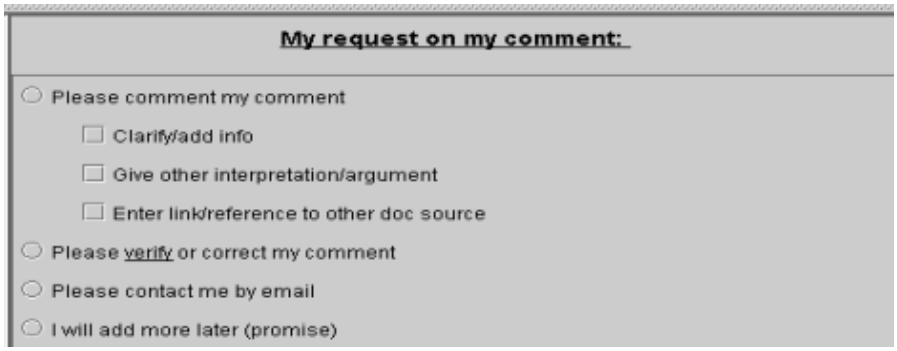


Figure 1 shows a section of the annotation module

and the conventions that should be used for cataloguing and indexing. In only one instance was SharePoint[tm] used to discuss a film research related question. The current module for structuring the archivists' communication is a reflection of this analysis. One archivist said:

> "It's not so useful for us. I think that these four questions were made for people who have read our Sharepoint discussions. Because if you read our SharePoint discussions there could be these four questions. But we don't need it this time. Because SharePoint was living in our test time."

From the archivists' perspective, the main problem is the module lacks explicit reference to current and future common field of work in making requests and promises. In other words, the work semantics has changed. This means, that it is difficult for the archivists to establish a coherent

analysis of a given situation and identify the relevant information entities that might smooth the progress of the coordination activities. On the other hand it was also brought forth from one archivist that s/he sometimes would:

> "use my request on my request [on my comments – ed]… But sometimes we have found something that could clarify us to previous documents. And we could go back and put here other information. But I think if I found new information, which is also good for all documents, I use maybe mostly only keywords…"

Notice that the archivist speaks about an alternative choice, to use keywords instead of annotations to annotations. This is, then, a good example of how users organize their work along a continuum, going from individual work to collaborative work. Only if they have the expectation that the work is only possible in terms of scale, timeliness, complexity, quality, etc. by involving more people, will they enter into collaborative constellations.

Reflections

Within studies of collaborative work much debate is devoted to the feasibility of applying formal structures for supporting collaborative activities especially focused on communication and coordination. On the one hand, it is argued that collaborative work is embedded in a sphere of social patterns of non-formal interaction; regardless of the existing formal prescriptions for work, actors are engaged in and depend on non-formal activities in carrying out their tasks (e.g. Suchman, 1987). Moreover, as Middleton (1996) has shown, informal work activities are required in order to maintain consistent interpretations of the course, structure and contents of collaborative work tasks. On the other hand, it is argued that to reduce the complexity of the coordination and communication and to handle these activities in an efficient way it is necessary to have some sort of support mechanisms in the form of communication models or structured discourse relations. The function of such models of interaction is based on a set of procedures and conventions that stipulate and mediate collaborative activities and thereby instrumentally reduce the complexity of these activities (see e.g. Winograd and Flores, 1986). To some extent our evaluation shows that discourse models only seem to capture surface phenomena of work. The models seem not to be able to encompass the social richness of the everyday annotation activities that are performed in the very open ended and non-structured collaborative work arrangements of film research characterized by a high degree of collaborative problem solving and decision-making. The concerns related to the list of

communicative acts could, however, be assuaged if the archivists maintained the communication structure on a collaborative basis.

Conclusion

A collaboratory has to adapt to and support the differences and diversity of behaviour that derives from the actors' various competence and ways of working-influenced by their own work style and the work environment. To foster a useful collaboration in work domains that will thrive on bringing together differences and diversity, it will be necessary to analyse and explicitly consider the differences and diversity that it will be worthwhile to support in the collaboratory and how to support it. It will also be necessary to identify the commonalities and the minimum of common ground that is required for a collaboratory to be a meaningful solution as a support tool.

References

Cleal, B et al (2003). Collaboration, Communication and Categorical Complexity: a Case Study in Collaboratory Evaluation. In: *Proceedings from the 1st International Conference on Web-based Collaboratories*, held 8 November 2003, Algarve, Portugal (in press).

Finholt, T.A. (2002). Collaboratories. In B. Cronin (Ed.), *Annual Review of Information Science and Technology,* Volume 36 (pp. 73-108). Medford, NJ: American Society for Information Science and Technology/Information Today, Inc.

Middleton, D. (1996). Talking Work: Argument, Common Knowledge and Improvization in Multi-disciplinary Child Development Teams, In Yrjo Engeström & David Middleton (Eds.) *Cognition and Communication at Work*. Cambridge: Cambridge University Press.

Pejtersen, A.M. et al (2001). *A web-based multimedia collaboratory. Empirical work studies in film archives*. Roskilde: Risoe National Laboratory (Risø-R-1284 (EN) - CHMI-02-01).

Sonnenwald, D.H., M. Whitton, and K. Maglaughlin, (2003). Evaluating a Scientific Collaboratory: Results of a Controlled Experiment. *ACM Transactions on Computer Human Interaction* (in press).

Suchman, L. A. (1987) *Plans and situated actions. The problem of human-machine communication*, Cambridge University Press, Cambridge.

Winograd, T., and F. Flores. (1986) *Understanding Computers and Cognition: A New Foundation for Design*. Ablex Publishing Corp., Norwood, New Jersey

Wulf, W.A. (1993). *The Collaboratory Opportunity*. Science, 261, pp. 854-855.

Activity Walkthrough
a cognitive walkthrough in activity theory terms

Olav W. Bertelsen

Dept. of Computer Science, University of Aarhus

Introduction

Ideally, HCI provides methods that can be applied easily by engineers and systems designers, to ensure that measurement of and concern for the use situation is brought into the design process (Card et al. 1983). At the same time conceptually rich approaches, like the human activity framework (see Bertelsen & Bødker 2003), have been proposed as alternatives to the mechanism of the prevailing cognitivism in HCI. However, it appears to be somewhat complicated to commit such alternative approaches to the production of engineering methods because they typically acknowledge that the design problem at hand most often is to complicated to be solved at the back of an envelope.

The cognitive walkthrough (Lewis et al. 1997) is a prominent example of a theory-based method that is readily applicable for practical assessment of a design specification without building the interface and without involving real users in the assessment. The cognitive walkthrough is based on a theory of exploratory learning, but the use of the method does not require that the inspector is knowledgeable in that theoretical framework. All he needs to do is to identify some typical tasks, break these tasks down to a sequence of steps. For each step, he then make clear if the appropriate action is obvious to the user, if the user can connect the correct action to the desired outcome, and finally if the user will get appropriate feedback.

In reality, however, the steps of the cognitive walkthrough are far from simple to complete. In some cases typical tasks to be supported by the system are specified in the requirements, but often the use situation is far more open. Furthermore, it may be easy to determine the sequence of "commands" to invoke to complete the task seen from the point of view of the computer system, but it is most often far from obvious what sequence will fit the actual work setting. The cognitive walkthrough in its present form does not give the analyst any tools for finding out what would be understandable and what would make sense for the user. Even the seemingly simple question number one in the cognitive walkthrough about visibility cannot be answered without detailed knowledge about how users

interpret what they see. In a variety of well-documented cases this does not seem to be a big problem, but when teaching the cognitive walkthrough to students it is obvious that this interpretation process is important and not very well supported by the method. Furthermore, as the application of computer technology is penetrating more aspects of life, it becomes increasingly important to be able to address interpretability in expectation.

From the point of view of user centred and participatory design (see e.g. Greenbaum & Kyng 1991) it would probably be pointed out that the basic problem with the cognitive walkthrough is the absence of the real context of interaction. Based on activity theory (Bertelsen & Bødker op. cit.) it is possible to discuss these difficulties in further detail and to point to a possible solution retaining some of the efficiency of the cognitive walkthrough and at the same time provide more systematic help for the inspector.

The primary problem is that the task analysis is "hypothetical" in the way that it is broken down based on the sequence of machine operations required to complete the task. According to activity theory the basic unit of analysis is activity, i.e. the level of human conduct that is motivated and directed to human needs. Activities are realised through conscious goal directed actions that in turn are realised through unconscious operations. Thus, the activity perspective takes human action as a meaningful unit of analysis rather than sequences of machine operations.

At a superficial level there seems to be some similarity between the way a task is broken down into machine operations in the cognitive walkthrough and the way actions are realised through operations in activity theory. However, the important difference is that the division between actions and operations is not stable in activity theory. Actions become operations through learning and operations can become actions again if the conditions change.

Thus, the way an action is realised through operations depends on the users repertoire op operations, the conditions in the environment, the structure of the action and possibly the activity the action is realising. This immediately leads to two questions supplementing the cognitive walkthrough procedure: Firstly, do the typical tasks correspond to purposeful actions realising users activities? Secondly, do the machine operations trigger operations in the users repertoire?

The fact that the above questions can only be fully answered through empirical investigations has traditionally lead activity theory informed HCI

research to refuse the cognitive walkthrough. While this refusal is correct in principle, it is not very practical.

Activity walkthrough

Practical situations may call for quick assessments without involving real users. Therefore, I will briefly outline an activity theory based walkthrough.

First phase: preparation and contextualisation

In preparing the cognitive walkthrough the inspector identifies the typical tasks to analyse, based on the requirements specification.

The activity walkthrough, in addition, conceptually situates the artefact in the context of use by identifying users and activities in which the typical tasks are supposed to become embedded. The checklist for situating artefacts in use applied in the focus shifts analysis (Bertelsen & Bødker 2003) may be a resource (Situate work and computer application historically. -- Situate the computer application in a web of activities where it is used. -- Characterize use according to the stereotypes of systems, tools and media. -- Consider the support needed for activities going on around the application, and its historical circumstances. -- Identify the objects worked on, in or through the computer application. -- Consider the web of activities and the contradictions in and between activities.)

Second phase: verification of tasks

Based on the contextualisation of the artefact in use the inspector assesses to which extend each task corresponds to purposeful actions in the activities in which the artefact is going to be embedded. If the early design has been done in a proper way there will be a high degree of correspondence. However, the purpose of this phase is more importantly to align and remind inspector to be prepared for the next phase.

Third phase: task analysis

The task analysis is carried out by breaking each task down into atomar operations at the interface, just as it is done in the cognitive walkthrough.

Fourth phase: walkthrough

For each step in the task analysis ask the following questions.

CQ0: what is the user supposed to do? (from the task analysis)

AQ1: will the appearance of the interface, and the structure of action, condition (or trigger) relevant established operations in the user that will activate the correct machine operation? It is both relevant to consider

operations in general and more specifically the specific flow of operation during interaction.

CQ1: is the correct machine operation sufficiently visible to the user?

CQ2: will the user connect the correct machine operation with the wanted result?

AQ2: does the interface support the development of new operations if appropriate operations are not established or sufficiently developed? (see Bardram & Bertelsen 1995)

QC3: will the user notice that progress has been made?

Fifth phase: Task analysis verification

Finally, the task analysis is reviewed critically based on the walkthrough. Special attention is directed to how well the sequence of machine operations matches the users operations and actions, and the consistent flow of operations throughout the task is considered.

Conclusion

The above outline addresses the conceptual and practical difficulties with the cognitive walkthrough. This approach has not yet been tested, but experiments with a dedicated method for website analysis, the WAW (Bertelsen & Godsk, in progress) build on the same basic idea, have yielded promising results.

References

Bardram, J. E., Bertelsen, O. W. (1995). Supporting the Development of Transparent Interaction. In Blumenthal, Gornostaev, & Unger (eds.). *EWHCI `95, Selected Papers*. Berlin: Springer Verlag, 79-90

Bertelsen, O.W., Bødker, S. (2003). Activity Theory. In Carroll, J.M. (ed.). *HCI Models, Theories, and Frameworks: Toward an Interdisciplinary Science*. Morgan Kaufman Publishers.

Bertelsen, O. W., Godsk, M. (in progress). WAW — an activity theory based tool for early website usability assessment.

Card, S. K., Moran, T. P., Newell, A (1983). *The Psychology of Human Computer Interaction*. Hillsdale, NJ: Lawrence Erlbaum Assoc

Greenbaum, J., Kyng, M. (eds) (1991). *Design at Work: Cooperative Design of Computer Systems*. Hillsdale, NJ: Lawrence Erlbaum Assoc

Lewis C., Wharton, C. (1997). Cognitive Walkthroughs, In Helander., Landaur, Prabhu (eds.) *Handbook of Human-Computer Interaction, 2nd, compl. rev. ed*. Amsterdam: Elsevier/North Holland, 717-732.

Implementation of Groupware Technology in a Large Distributed Organization - Lessons Learned

Keld Bødker and Kristian B. Bøving

Computer Science, Roskilde University

Introduction

This paper deals with implementation of groupware technology. Based upon an extensive empirical study of the introduction and use of a groupware application – Lotus QuickPlace™ – in a large Scandinavian financial organization we discuss implementation issues of groupware. Lotus QuickPlace was introduced to support collaboration between geographically dispersed organizational units and groups working together in a newly merged company (called Summa in this paper).

Lotus QuickPlace is a flexible technology that offers users a web-based shared workspace (called a QuickPlace, hereafter QP, while we refer to the product as a whole by LQP) with a folder structure, notification functions, support for custom document types and support for simple workflows. Lotus QuickPlace presents itself on the web as being very easy to implement - "A QP is a place that you can create on the Internet in 30 seconds to communicate with your team, share resources, and keep track of your project". As known from the literature, the implementation of this type of technology is often difficult. CSCW researchers like Bullen and Bennet (1990), Orlikowski (1992), and Grudin (1994) have early identified technological as well as organizational and social factors influencing the implementation. According to Grudin (1994) groupware requires a careful implementation in the workplace - implying that consultation on how to use the product should go hand in hand with the acquisition of the product, and/or be integrated in the product (built-in support). In the paper we describe the implementation process of LQP in Summa and reflect on some of the problems encountered.

The paper draws on data from an extensive study of LQP in Summa. The first part of the case study was primarily based on semi-structured interviews with managers and users of three selected QPs, and with persons involved in the implementation process. In addition it also involved analysis of the technology, and an analysis of the documents in the three selected QPs. Later the case study was supplemented with a questionnaire and an analysis of server log files.

The implementation of Lotus QuickPlace in Summa

The decision to introduce Lotus QuickPlace to support the post-merger organizational units and projects in Summa was taken quickly without thorough studies of needs and possibilities. QP was a "quick and dirty" solution: it was web-based, needed no integration with the existing IT security infrastructures of the pre-merger companies, and could thus be implemented very quickly. One month after the merger, the Communications Department was commissioned to distribute LQP in Summa.

Our study showed that the number of active QPs had been growing steadily within its first year at Summa. In the first month of our log-period there were 805 active users in 80 QPs. The growth continued during the 10-month log-period to 1618 active users in 126 QPs in the last month. Further analysis of the log-files has shown that the activity measured in terms of the various operations grew by 275% in the 10-month log-period; measured in terms of the average number of operations in a QP the growth was 138% in the same period. The study further showed that the application was used for quite different purposes: To support communication and coordination in organizational units, to support different recurrent tasks like translating the quarterly financial reports and the corporate news letter, and to support communication and coordination in projects or professional interest groups, like Java programmers.

However problems arose: three months into our study the Communications Department told us that LQP was probably going to be closed down. According to IT Security, LQP had some features violating Summa's IT security policy. Eventually LQP was not shut down. A compromise was agreed and IT Security took over issuing QPs. We briefly outline three main conflict areas.

When the opening of a new QP is granted, at least two QP managers are assigned centrally by IT Security. Hereafter, the appointed QP managers define the structure and access rights to "their" QP. The distributed security model also enables a manager to create new "sub-rooms" potentially without access from the other QP managers originally appointed by IT Security. The author of a document solely defines who is able to read and edit it. It is obvious that LQP hereby compromises the hierarchical and centrally managed security model normally used in Summa. The central security unit, IT Security, does not have any way of controlling access to rooms or documents,

nor does a QP manager have any means of controlling what is in “his” QP, or have access to all documents.

Each IT-system in Summa has designated a system owner. The system owner is typically the manager of a business unit responsible for the system. The role of the system owner is to define the purpose of the system, and rules for its proper use. However, it has been rather difficult to find someone willing to play the role as system owner of LQP. This is due to the difficulties of exercising the system owner’s role in LQP because of its decentralized and distributed security structure. Nobody but the managers of the individual QP have access and define who have access to their QP and the various rooms in the QP. Thus we see that the system owner role used in Summa is not very useful for LQP, as it is reduced to formulating criteria for starting and closing down QPs.

IT systems in Summa have a Standard Operating Procedure (SOP) attached to its use. The SOP describes what the system should be used for, by whom and how it should be used. Each time an IT system is put to use, a SOP is written by the system owner for the use of the system. The SOP contains guidelines on how the system should be used, as well as the rights and responsibilities of the various user groups. It has been very hard for the people responsible for the implementation of LQP to actually formulate a SOP for LQP. One year after LQP was introduced, a 5 page SOP was issued containing information about how to open and close down a QP. As a comparison, the SOP for the Intranet of a pre-merger company is a 50+ page document.

Lessons learned

We have described how LQP in terms of its security structure, finding a system owner, and formulating a SOP has created problems for Summa's IT Management. How can we account for these problems? What we see in Summa's IT management is a policy of centrally managing both technology and the use of the technology. This model is not geared to handle a technology like LQP where both access rights, decisions about what the system should be used for, and how it should be used is defined at the level of the individual QP.

An important lesson is that the implementation of a QP takes place at two different levels. There are activities at a central level to establish the QP-server, initiate the individual QPs, etc., i.e. establishing the infrastructure at a server level, or a macro level. And there are activities at a local level, or a

micro level, when an individual QP is set up, i.e. defining its structure and access rights, and the dynamic reconfigurations of the structure and content when the QP is in use. We can thus explain Summa's problems with LQP as being caused by only identifying and providing guidelines for the macro level of implementation and ignoring activities at the micro level.

In retrospect we can say that Summa to some extent failed to understand what kind of technology they were dealing with. They treated it as a traditional bank IT application with a system owner controlling the use, and a SOP for its proper use. Hereby, the open-ended nature of the application is not well captured. With the understanding of QP as a traditional IT application follows the intended use of traditional IT management, or implementation, models that only provide very superficial guidance for the implementation process for LQP.

Our case study of the implementation and use of LQP has illustrated some difficulties with implementing open-ended, context-specific IT applications for communication and collaboration in a large organization. We think that the difficulties are typical and prevalent in organizations with bureaucratic traditions for centrally managed IT systems with a strong emphasis on IT security and stability. We would like to draw a general conclusion from our study that is both relevant for organizations that already have, or are planning to implement open-ended communication technologies like LQP. Implementation efforts should be directed at two levels: towards a macro level (establishing infrastructure, general information about availability), and towards a micro level (guidelines for facilitation and for establishing local use patterns).

References

Bullen, Christine V., and John L. Bennett (1990). Learning from User Experience with Groupware. In *Proceedings of the Conference on Computer-Supported Cooperative Work,* pp. 291-302, ACM, New York.

Grudin, Jonathan (1994). Groupware and social dynamics: Eight challenges for developers. *Communications of the ACM*, Vol. 37 (1), 92-105.

Lotus QuickPlace (2001). www.lotus.com/home.snf/welcome/quickplace (November, 2001)

Orlikowski, Wanda J. (1992). Learning from Notes: Organizational Issues in Groupware Implementation. In *Proceedings of the Conference on Computer-Supported Cooperative Work* (J. Turner and R. Kraut Eds.), pp. 362-369, Association for Computing Machinery, New York.

Usability and beyond - the challenge of understanding aesthetics and affect in HCI

Martin Sønderlev Christensen

IT-Universitetet København (mach@itu.dk)

Introduction

The HCI field is at a threshold. For some years now it has been common to approach the interface as a matter between the user and the system, as a matter of productivity and efficiency in order to reduce the potential and critical frustration on users. For this purpose Usability heuristics has been the leading paradigm to steer the improvement and the evaluation of ease-of-use interaction, and Usability has been highly successful doing so. Now it seems obvious that computers has proliferated vastly beyond the sphere of *tools*, becoming a ubiquitous part of our living and working environment. And as users are becoming increasingly savvier towards using interfaces and computers as a part of everyday life, the need for Usability as the sole "satisfier" has diminished.
This paper seeks to justify why notions of aesthetics and affect are becoming key topics to address in order to understand the use of interfaces. By looking at the societal and cultural field that users are a part of - the paper argues as to *why* interaction with user interfaces must go beyond usability in order to satisfy users, not only for the sheer fun of it all, but also to stimulate the conditions in which *productivity* is to be found today.

According to Human Factors specialist Patrick Jordan usability in fact entails a "dehumanization" [5] of the products we acquire use-purposes. Though usability still is crucial for interaction, subtler factors seem to be calling for attention when looking at user-interfaces in a contemporary context. This question is not entirely new i.e. the aesthetics approach to human-computer interaction made by Bertelsen and Pold [1] declaring that the human-computer dialectic or dichotomy should not always run smooth, automatic and seamless, but rather be assessed as an artistic enterprise. So in order to enhance the user-experience and ultimately the *satisfaction* of interaction, we should look not only for *conventional* interaction form, but rather towards *interesting* interaction form. This entails a view were human-computer interaction and user-interfaces must be assessed also for aesthetics *qualities*. We can expect that the use of any designed object live in three distinctively different categories, namely *practical* use, *social* use, and

aesthetical use. Aesthetical use then is not just the "icing on the cake", but in fact subordinates both practical and social use, as aesthetic use concerns our most immediate use or evaluation of any product, as it is steered by our immediate perception of things in terms of i.e. like/dislike etc. This paper follow this aesthetic thread and double it by looking at *affect* as well, because affect has a large influence on how we evaluate products for more *hedonic* reasons, and give reason to why this may be of interest to the field of HCI.

Aesthetics and affect

It seems appropriate that the *use* of interfaces must be reviewed in a new context as users use interfaces for a multitude of purposes i.e. playing games, gazing the internet, navigating social, to support mobility, and communicating across time and space. This context must go beyond assessing the user as a logical, effective and functional seeking entity. Instead aesthetical properties of use are crucial. While some research has been done in the area of how i.e. computer games produces an affective "flow" building on immersion and joy [7] little research has been done to see how productivity software can work in this direction.
In a sense HCI has brought about the focus of the aesthetic and affective issues of interaction with technology by securing the interfaces [3]. There is a current, but rather general, employ to understand why products *also* are used for more than just as usability factors (Jordan [8] and Norman [9]) but for also enjoyment as i.e. the design paradigm of "Funology" [2] testifies.

This calls for a broader understanding of *why* HCI should be occupied with designing and evaluating for aesthetical and affective fine-tuning. Fortunately we can turn to the culture we live in for a possible answer.

In contemporary society we are witnessing a transition from functional to emotional work-cultures mirrored in the socio-economic aspects of modernity. The rigid work/life distinction is blurring. Work is increasingly a "working life", embracing both effective, functional, task oriented work process, and the affective/aesthetical work as a pleasurable, an emotional activity or a creative process. Organizations as such are increasingly seen as *aesthetical* entities where communication, creativity and knowledge are the main output. In this context our social practices must be seen as reflexive as pronounced in theories of late modernity. And therefore our "tools" must develop the ability to be adaptive, pliant and sensitive to our shifting tasks, interests, communications, and indeed our affective and aesthetical tunes (see also [4]). This can also be witnessed in popular cultural domains where

consumption products increasingly is vended for aesthetical qualities for the purpose of intensifying the subjective matter in order to differentiate the material basis i.e. users can customize and personalize their interface.

Late modernity approached

Research in i.e. affective computing is looking to make computer interfaces more emotional sensitive, though somewhat to hardwired, we can at least observe an advent interest in understanding of how interfaces affects user. The awareness on affect and aesthetics is mirrored in theories of the social frame wherein the HCI field exists and operates. One of the core issues of late modernity, that the occupation with affect and aesthetics could be said to be a reaction to, is arguably the increasing societal complexity, a tendency described by theorists of late modernity such as Giddens [6] and Castells [5]. Both point towards the fact that the post-traditional order brings increasing complexity to all aspects of social life and to the notion of culture. A focus on affect and aesthetics is arguably an attempt to deal with the rising complexity. As environmental complexity can only be dealt with by increasing internal complexity, our conception of the computer as a tool is being challenged by increasingly "fuzzy" and complex theories where emotions and affect are not merely disturbances to the rational thought, but indeed necessary resource for sorting-out and making decisions. Thus, affect and aesthetics could be seen as both the product of, and the reaction to the complexity of the post-traditional order and should therefore be viewed in this relation.

The fact that users seek pleasure, and increasingly apply for products that features more than just functional purposes is not just a happy coincidence or part of a commercial venture to sell the emperor's new clothes. Nor are aesthetics and affective design goals a surface-by-product just made by loony designers. Rather, the emergence of aesthetic and affect could be seen as a result of the interplay between late-modern institutional factors, the separation of time-space and the dis-embedding process, and a new mentality that positively values affective and aesthetical judgements, thus transcending the enlightenment ideals of the traditional order (the industrial society and rationality of man).
Already some productivity software is supplied with "funny" assistants or agents (best known Microsoft's Office assistant), and being increasingly supplied with playful features (for instance Mac OS X bouncing icons).
The reasons for using a computer in post-traditional society is rarely the sole purpose of crunching a specific task, but also or at the same time a way to communicate, a social activity or an experience. So the user-interface needs

to come alive and seek to stimulate senses and create more *interesting* interaction.

Conclusion

This paper has claimed that aesthetical and affective expressions are becoming a key topic to understanding in relation the use of interfaces, and why usability do not account for this. On this tentative ground I would dare to suggest that perspectives of affect and aesthetics are becoming a crucial interfacial element to investigate. The suggestion is that affect and aesthetics can be used to capture the hedonistic features of an interface and make interaction more lively, playful and artful. And also that attending to these questions will make interaction suitable for satisfying the apparent needs of users for having individual self-reflected and expressive tools, that are more in line with the demands of creative productivity that is entailed in late modern society.

References

[1] Bertelsen, Olav W & Pold, Søren "Towards the Aesthetics of human computer interaction" Proceedings of the second HCI research symposium, 2002

[2] Blythe M.A, Overbeeke, K., Monk, A. F., & Wright, P. C. "Funology from usability to enjoyment" Kluwer, 2003

[3] Brave, Scoot and Nass, Clifford, Emotion in Human-Computer interaction, in The Human Computer Interaction Handbook, ed. Jacko and Sears, Lawrence Erlbaum, 2003

[4] Bødker, Mads; Christensen, Martin Sønderlev, and Helms Jørgensen, Anker "Understanding affective design in a late-modernity perspective proceedings of the Designing Pleasurable Products and Interfaces conference Pittsburgh, ACM, 2003

[5] Castells, Manuel: "The Rise of the Network Society", Blackwell Publishers 1996

[6] Giddens, Anthony: "The Consequences of Modernity", Polity Press, Cambridge 1990

[7] Johnson, D., & Wiles, J. Effective affective user interface design in games. the International Conference on Affective Human Factors Design, Singapore 2001

[8] Jordan, Patrick W. and Green, William S. "Pleasure With Products: Beyond Usability", Taylor Francis, 2002

[9] Norman, Donald. Emotion & design: attractive things work better, in Interactions, volume IX, issue 4, pp. 26-42, July 2002

HCI knowledge, Software Engineering knowledge and System Development practice

Torkil Clemmensen

Copenhagen Business School,
Howitzvej 60, DK-2000 F
tc.inf@cb.s.dk

Introduction

In spite of the obvious need for Human-Computer Interaction (HCI) knowledge, usability professionals do still not have enough impact in the system development process. This exclusion of HCI from system development is reported even by very experienced usability professionals (e.g. Lindegaard, 2002). Why is it so? Why is HCI still excluded from system development activities?

Some kinds of system development may be quite amendable to HCI thinking. The concepts and underlying philosophy of HCI seems to be relatively easily integrated into the web development approaches related to MIS and e-commerce activities (Chan, Wolfe, & Fang, 2003). In this field, it is assumed that *'web-based systems emphasize effective user-interface design and information architecture'* (Chan et al., 2003). That web based development is essentially different (and more HCI oriented) that system development in general may, however, depend on the particular kind of web development approach chosen (Holck, 2003). Therefore, it is likely that HCI in general will fare just as bad (or good) in web development as in any other kind of system development.

The exclusion of HCI from system development activities may be explained by factors internally to HCI, e.g. by the fact that the HCI discipline has not done a good job of explaining how user-interaction goals are related to business goals (Kaasgaard, 2003; Lindegaard, 2002). However, analysis of business cases show that even when usability is cost–justified, HCI programs may be addressed by management as unnecessary 'fluff' (Lindegaard, 2002). Apparently cost issues alone cannot explain the exclusion of HCI from system development.

Other explanations on the exclusion of HCI from system development may therefore be sought. In this paper, I take a knowledge-oriented approach and discuss the relation between HCI knowledge and SE knowledge as the cause to the exclusion of HCI from system development.

Background

Some system developers believe that HCI activities are or should be a kind of software engineering (SE) activities. The most known proponent of the view that HCI is a kind of SE activity is probably the IFP working group 13.2 (*IFIP WG 13.2 Methodology for User Centred System Design*, 2003). Furthermore, this conception of the role of HCI knowledge in system development has been proposed on several conferences (e.g. Ferre, 2003; Gulliksen, Blomkvist, & Goransson, 2003; Lindegaard, 2002; Paech & Kohler, 2003; Sousa & Furtado, 2003), though less radical viewpoints has also been suggested (Clemmensen & Nørbjerg, 2003; Walenstein, 2003).

Explicit HCI knowledge is, however, not easily integrated with SE activities. While software engineers may work fine on the assumption that HCI is a SE activity, a broader view of HCI's potential contribution is extremely important for system developers and project leaders who are managing software development teams and e.g. deciding on the business value of HCI.

Two arguments for NOT integrating HCI and SE knowledge

First, we cannot integrate HCI in SE, because there is no theoretical understanding or agreement of what SE is (Bennetts, Mills, & Wood-Harper, 2000; Gregg, Kulkarni, & Vinze, 2001). A large proportion of SE research papers concerns methods/techniques related to systems or software concepts (Glass, Vessey, & Ramesh, 2002). Developing new interface techniques or using particular system development methodologies is, however, not central for HCI (Hartson, 1998). As is evident from textbook definitions, HCI is about the interaction between human and computers (e.g. Booth, 1989; Preece, Rogers, & Sharp, 2002). To make it clear: HCI is design of behavior, e.g. consumer behavior (Kaasgaard, 2003).

Second, experience shows that HCI knowledge and competence is excluded from system development by SE practitioners. A citation from a proposal to integrate HCI and SE illustrate this common experience of SE professionals excluding HCI professionals (Faulkner & Culwin, 2003):

Frequently, HCI appears primarily as a masters degree course, often delivered under the guise of conversion courses to people with diverse backgrounds. Many of these students have little or no training in software engineering and, unfortunately, this means that newly qualified HCI practitioners lack credibility when attempting to influence the activities and attitudes of commercial programmers. They are perceived as lacking software development and other essential skills.

It is worth considering whether integration of HCI and SE is seducing exactly because of the existence of such exclusion mechanisms.

Future research

We may - this is pure guesswork and a question for future empirical research - see exclusions of HCI professionals in three different ways in current system development practice:

- First, only newly graduated are hired as usability professionals in software companies. They are needed to cover the basic needs for training of other system developers in HCI.
- Second, if experienced HCI people are hired, then they are hired on time-limited contracts to manage or give input to specific programs. When the program is finished, the HCI person is not employed anymore.
- Third, when HCI professionals are involved in the system development process, it happens so early in the process (e.g. in the first vague analysis of target groups/usergroups) or so late (e.g. to evaluate a ready-to-ship product) that the HCI angle do not influence the major design decisions.

References

Bennetts, P. D. C., Mills, S., & Wood-Harper, A. T. (2000). Role-play in inquiring systems and information systems development. *Systems Research and Behavioral Science, 17*(3), 231-242.

Booth, P. A. (1989). *An introduction to Human-Computer Interaction*: Lawrence erlbaum.

Chan, S. S., Wolfe, R. J., & Fang, X. W. (2003). Issues and strategies for integrating HCI in masters level MIS and e-commerce programs. *International Journal of Human-Computer Studies, 59*(4), 497-520.

Clemmensen, T., & Nørbjerg, J. (2003, May 3-4, 2003,). *Separation in Theory- Coordination in Practice.* Paper presented at the Bridging the Gaps Between Software Engineering and Human-Computer Interaction, International Conference on Software Engineering, May 3 to 10, 2003., Portland, Oregon, USA.

Faulkner, X., & Culwin, F. (2003). Enter the Usability Engineer: Integrating HCI and Software Engineering. *ACM SIGCSE Bulletin , Proceedings of the 5th annual SIGCSE/SIGCUE ITiCSEconference on Innovation and technology in computer science education,, 32*(3).

Ferre, X. (2003, May 3-11). *Integration of Usability Techniques into the Software Development Process.* Paper presented at the Bridging the

Gaps Between Software Engineering and Human-Computer Interaction, Workshop, ICSE'03, Portland, OR.

Glass, R. L., Vessey, I., & Ramesh, V. (2002). Research in software engineering: an analysis of the literature. *Information and Software Technology, 44*(8), 491-506.

Gregg, D. G., Kulkarni, U. R., & Vinze, A. S. (2001). Understanding the philosophical underpinnings of software engineering research in Information Systems. *Information Systems Frontiers, 3*(2), 169-183.

Gulliksen, J., Blomkvist, S., & Goransson, B. (2003). *Engineering the HCI profession or softening development process.* Paper presented at the HCI International 2003, Crete.

Hartson, H. R. (1998). Human-computer interaction: Interdisciplinary roots and trends. *Journal of Systems and Software, 43*(2), 103-118.

Holck, J. (2003). *4 Perspectives on Web Information Systems.* Paper presented at the HICCS - the 36th Hawaii International Conference on System Sciences - 2003, Hawaii.

IFIP WG 13.2 Methodology for User Centred System Design (2003). Retrieved, from the World Wide Web: http://www.ifip-hci.org/WorkingGroups.html#Anchor-WG-33173

Kaasgaard, K. (2003). Copenhagen.

Lindegaard, G. (2002). *The business Valuse of HCI: How can we do better?* Paper presented at the CHI 2002: changing the world, changing ourselves, Minneapolis, Minnesota, USA.

Paech, B., & Kohler, K. (2003, May 3-11). *Usability Engineering Integrated with Requirements Engineering.* Paper presented at the Bridging the Gaps Between Software Engineering and Human-Computer Interaction, Workshop, ICSE'03, Portland, OR.

Preece, J., Rogers, Y., & Sharp, H. (2002). *Interaction Design: Beyond Human-Computer Interaction*: John Wiley & Sons.

Sousa, K. S., & Furtado, E. (2003, May 3-11). *RUPi - A Unified Process that Integrates Human-Computer Interaction and Software Engineering.* Paper presented at the Bridging the Gaps Between Software Engineering and Human-Computer Interaction, Workshop, ICSE'03, Portland, OR.

Walenstein, A. (2003, May 3-11, 2003). *Finding Boundary Objects in SE and HCI: An Approach Through Engineering Oriented Design Theories.* Paper presented at the Bridging the Gaps Between Software Engineering and Human-Computer Interaction, Workshop, ICSE'03, Portland, OR.

Exploratypes: Expressing and Provoking Actions

Jared Donovan[1], Jesper Pedersen[2], Mads Vedel Jensen[3], Werner Sperschneider[4], Jens Lorenzen[5]

[1] The University of Queensland, [2] Danfoss Drives A/S, [3, 5] MCI, University of Southern Denmark, [4] Danfoss A/S User Centred Design Group

Introduction

Information technology has seen only limited up-take in industrial work practices compared to its wide-spread adoption in office work. In industrial plants, like breweries, information technology is mainly used to support administrative and communicative aspects of daily work. The skilful actions of specialized brewery workers, the actual doing, is an area still left untouched. In this paper we report on recent work aimed at exploring new ways of supporting brewery workers' skilful actions through applied pervasive computing technology.

If we are to move beyond current visions of information technology and empower people's skilful *actions* we require new modalities of interaction design. Concomitant with this, is a need for new expressions and explorative tools that engage a range of physical and social skills. In this paper we describe how the development and use of 'exploratypes' helped the design team to explore the social and technical relations between design themes grounded in field studies, and existing pervasive computing technologies.

Themes from the field

Field studies were carried out in Denmark and Australia from July 2002 until October 2003. Preliminary work-studies were conducted at a brewery in Denmark. A base on the Australian brewery was established, and video observations and field design sessions were carried out for a 4-week period. Final full-day observations at the Danish brewery wrapped up the work-studies. Themes were developed from the field material using methods such as the video card game (Buur, Binder et al. 2000; Buur and Soendergaard 2000). Three of these themes were chosen to explore further, they are described below.

Awareness; Brewery workers maintain an active awareness of what their colleagues are doing and their immediate environment. This awareness allows them to coordinate their work efforts and respond purposefully to changes in the situation.

Force Feedback; Brewery workers rely heavily on their senses. Turning a valve is not only a question of open or closed. The direct feedback embedded in the action of turning the valve adds meaning to the situation at hand as well, for instance the vibrations of the handle, the temperature of the handle and the friction in the valve.

Rhythm; Work is performed in rhythms, e. g. footsteps on the floor, fingerprints on buttons. The sound of work performance reveals a unique rhythm of its own, thus creating a sense of situated awareness (Suchman 1987), eg. a worker opening and closing a number of valves in one choreographed action-sequence.

Expressing themes as exploratypes

We organised a workshop to which we invited several fellow researchers. The workshop was called 'Feel the Force' and the purpose was to investigate the themes outlined above. We designed five activities to investigate different aspects of these themes, (four of which are described here). For the activities we made physical models to let people experience the activity through their senses. We used the term 'exploratypes' to describe these devices because they weren't intended as final design ideas, but as tools for exploring a theme in order to reveal design potentials.

4 Hands on the wheel; This activity was based on the awareness theme. Each person in a group of four was given responsibility for a different part of a radio-controlled car (forward, reverse, left and right) and asked to drive the car in a circuit. The task was repeated with variations in the amount and type of communication as well as the view of the car.

There were a number of surprising results from the activity. It became clear that the physical affordances of the exploratype affected how participants were able to cooperate and maintain awareness of one-another's actions. Participants also became aware of different zones of responsibility depending on the position of the car. When participants were restricted in one sense modality they relied more on their other senses. For example sound was mentioned by several participants as being important when the car was not visible.

Secret Admirer; The secret admirer was another activity built around the theme of awareness. In this activity participants were asked to wear a Radio Frequency Identification tag during the workshop. Everyone was given someone to admire. When a person went near a tag sensor the system would show who they admire. Participants were asked to figure out who their

secret admirer was by watching the system's output and trying to see who was causing it.

Two tag readers were placed next so that they could be inadvertently activated and the other one was placed in a central position and required a more deliberate activation. Participants found the different tag readers to be good for different uses. The one that made a sound was good for getting an immediate response, but was sometimes hard to decipher. On the other hand, the one that showed text messages was less noticeable but easier to grasp.

Handling Actions; In response to the force feedback theme we developed an exploratype that allows people to explore possible active uses of feedback. For instance to amplify, restrict, force, direct, or inform the operator's actions. The setup consisted of a lever, a set of different shaped handles, a shield and a tray hidden behind the shield. It was possible for people to move the lever up and down, push it back and forth, and turn it in both directions. The 'operators' were asked to think aloud and discuss their experiences while operating the handle. The facilitator placed different objects in the tray and restricted the movement of the handle.

From this activity we learned several things. First of all the laboratory-like setup missed out on the game element and thereby the explorative atmosphere needed. The increasing play in the mechanism throughout the day made people uneasy because it was difficult to distinguish between play and feedback. There were some instances where the participant's reaction inspired new ideas for us. For example, when one participant broke an egg shell with the handle she was clearly surprised and afterwards the handle acted differently.

Coffee Cha Cha Cha; This activity emphasised the rhythm theme. In groups, participants were asked to design the rhythm of actions necessary to operate a coffee machine. To do this they were provided looped brewery video clips and a sound tinker tool with which they could record and loop sequences of sound for inspiration. A variety of different materials was also at hand, such as foam blocks, cardboard boxes, rubber bands, different pins and sticks. For a final presentation the teams enacted their interaction rhythms using one or more of these resources.

The outcomes of the 'Coffee cha cha cha' activity were quite poetic. While the sound-tinkering tool seemed to be very useful for one of the groups, the other two had not used it. We were surprised by the notion that materials don't only afford actions, but also rhythms. We also realised that rhythm is also related to social cooperation.

Conclusions

In this paper we have presented the idea of exploratypes. Unlike more traditional prototypes these are directed towards cooperative exploration with and between participants. People make sense of exploratypes by learning from the results of their own actions and simultaneously their interactions with other people. This is particularly important when we are designing for networks of people and products because it emphasises social dynamics. Further, exploratypes emphasise dynamics between people and technology, in particular, how technology influences the way people act. This is also important when designing webs of technology.

Of course, to say that exploratypes encourage social interaction and exploration in and of themselves is a simplification. This also relies on the facilitation and set-up of the workshop and the involvement of participants. It is necessary to build a co-operative and game-like spirit of engagement.

Acknowledgements

We gratefully acknowledge all the participation all who attended the 'Feel the Force' workshop including our colleagues and students from the ITPD program and the Danfoss User Centred Design Group.

References

Buur, J., T. Binder, et al. (2000). Taking Video beyond 'Hard Data' in User Centred Design. Participatory Design Conference, New York, CPSR.

Buur, J. and A. Soendergaard (2000). Video Card Game: An augmented environment for User Centered Design discussions. Designing Augment Reality Environments, Elsinore, Denmark, ACM.

Suchman, L. A. (1987). Plans and situated actions : the problem of human-machine communication. Cambridge ; New York, Cambridge University Press.

The Metaphors-of-Human-Thinking Technique for Usability Evaluation Compared to Heuristic Evaluation and Cognitive Walkthrough

Erik Frøkjær & Kasper Hornbæk

Datalogisk Institut & Naturvidenskabeligt ICT Kompetencecenter,
Københavns Universitet,
erikf@diku.dk & khornbaek@nik.ku.dk

Introduction

This paper reports results from two comparative studies where the metaphors-of-human-thinking usability evaluation technique, MOT (Hornbæk & Frøkjær 2002; Frøkjær & Hornbæk 2002a) are compared to heuristic evaluation, HE (Molich & Nielsen 1990) and cognitive walkthrough, CW (Wharton et al. 1994), and thereby follow up on our paper on the utility of Naur/James inspired psychology in HCI (Frøkjær & Hornbæk 2002b) presented at last years symposium.

HE Compared to MOT

To understand the effectiveness of metaphors of human thinking as a usability inspection technique, we conducted an experiment comparing MOT to heuristic evaluation (Hornbæk & Frøkjær 2003). Eighty-seven computer science students used either HE or MOT to evaluate a web application (http://punkt.ku.dk). Each subject individually performed the evaluation supported by scenarios made available by the developers of the web application. Forty-four subjects received as description of MOT a pseudonymized version of (Hornbæk & Frøkjær 2002); 43 subjects received a description of HE from (Nielsen 1993, 19-20 and 115-163). In all, subjects identified 911 problems.

In order to find problems that are similar to each other, we undertook a consolidation of the problems. In this consolidation, the two authors grouped together problems perceived alike. This resulted in a list of 341 consolidated problems. Next the client (i.e. the person who manages the development of the web application and is responsible for developing the design) assessed each consolidated problem. We asked the client to assess for each consolidated problem: severity (on a scale from 1 to 3), if design ideas were gotten from the problems (yes or no), if the problem was novel

	HE (N=43)	MOT (44)
Number of problems	11.3 (6.2)	9.6 (5.7)
Severity ***	2.4 (0.9)	2.2 (0.5)
Complexity ***	3.2 (1.0)	3.00 (0.8)
Novel problems***	3.8 (2.8)	2.0 (1.5)
Design ideas	2.5 (1.9)	2.2 (2.2)

Table 1: Usability problems identified with heuristic evaluation (HE) metaphors of human thinking (MOT). Severity was graded 1,2 or 3, where 1 was given to a very critical problem and 3 was given to cosmetic problem. Complexity was graded from 1 to 4, where 1 was given to a very complex problem and 4 to a simple problem. All other rows refer to the average number of problems found by a subject. ***=significant difference between techniques.

(yes or no), and the perceived complexity of solving the problem (on a scale from 1 to 4).

Table 1 shows some results from the experiment. By analysis of variance, we find no difference between the number of problems subjects identified with the two techniques, $F(1,85)=1.76$ $p>.1$.

Analyzing the client's assessment of the severity of problems, we find a significant difference between techniques, $F(1,85)=15.51$, $p<.001$. The client assesses problems identified with MOT as more severe ($M=2.21$; $SD=0.73$) than problems found by HE ($M=2.42$; $SD=0.87$).

The complexity of the problems identified is significantly different between techniques, $F(1,85)=12.94$, $p<.001$. The client assesses problems found with MOT as more complex to solve ($M=3.00$, $SD=0.80$) compared to those found by HE ($M=3.21$, $SD=0.96$).

Concerning the number of novel problems, HE identifies significantly more than MOT does, $F(1,85)=14.59$, $p<.001$. For both techniques, novel problems on the average are less severe ($M = 2.31$; $SD = 0.75$), are less complex ($M = 3.48$; $SD = 0.71$), and 41% are only found by one subject, suggesting that novel problems are mostly cosmetic and somewhat esoteric problems.

For reading and performing the inspections, the subjects reported spending for MOT on average 4.0 hours ($SD=2.3$) and for HE 5.8 hours ($SD=3.8$).

This difference is significant and large (Mann-Whitney U=546.5, z=-2.88, p<.01).

CW Compared to MOT

The aim of this second study is to compare the effectiveness of inspection by metaphors of human thinking with cognitive walkthrough. As a supplement to quantitative data from the evaluations, participants are required to keep a diary during the evaluation to shed light on problems and insights experienced when using the techniques. Data from the experiment will help improve MOT and CW, and identify strengths and weaknesses of the techniques. 20 participants evaluate and redesign web sites using MOT and CW. Each of the techniques was used to evaluate and redesign an e-commerce web site. The site evaluated in the first week was http://www.gevalia.com; in the second week http://www.jcrew.com. Both sites are included in a large professional study of e-commerce sites (Nielsen et al. 2001), which offers insights into usability problems of e-commerce sites. Below, we give initial quantitative results of the study; the qualitative results will be reported later.

Analysis of variance show that participants identify significantly more problems using MOT compared to CW, F(1,19)=8.68, p<0.001. On average, participants identify 11.8 (SD=7.52) with MOT and 9.0 (SD=8.18) problems with CW, that is 31% more. In raw numbers, 13 participants find more problems with MOT, 3 identify the same number of problems, and 4 identify more with CW.

We find no difference in the severity ratings assigned by participants to the usability problems, F(1, 19)=3.35, p>.05. On the average participants using MOT assess the severity of the problems as 2.31 (SD=.72); using CW average severity is 2.25 (SD=.69).

We compared the usability problems found by participants to a reference collection of usability problems of particular relevance to e-commerce web sites (Nielsen et al. 2001). Both techniques succeed in finding problems that hit the reference collection. In combination the two techniques achieve 51% coverage of the collection (note that only two of the web sites studied in Nielsen et al. 2001 were used here).

Using MOT, participants identify usability problems covering a broader group of problems in the reference collection, F(1,19)=4.48, p<.05. Among all evaluators, MOT identifies 36 problems (17%) in the reference collection that CW did not find; CW finds only 21 problems (10%) in the reference collection that MOT did not find.

These two experiments show that the metaphor-of-human-thinking technique can be an effective and convenient alternative or supplement to the two well-known usability inspection techniques, heuristic evaluation and cognitive walkthrough.

References

Frøkjær, E. & Hornbæk, K. (2002a), "Metaphors of Human Thinking in HCI: Habit, Stream of Thought, Awareness, Utterance, and Knowing", *In Proceedings of HF2002/OzCHI 2002*.

Frøkjær, E. & Hornbæk, K. (2002b), "Studying the Utility of Metaphors of Human Thinking in HCI", *Proceedings of the Second Danish Human-Computer Interaction Research Symposium. DIKU Technical Report no. 2002/19,* 19-21.

Hornbæk, K. & Frøkjær, E. (2002), "Evaluating User Interfaces with Metaphors of Human Thinking", *In Proceedings of ERCIM Workshop on User Interfaces for All Proceedings of 7th ERCIM Workshop "User Interfaces for All".* Also in N. Carbonell & C. Stephanidis (2003) "Universal Access"*, Lecture Notes in Computer Science 2615,* 486-507, Berlin: Springer-Verlag.

Hornbæk, K. & Frøkjær, E. (2003), "Metaphors of Human Thinking: A new Tool in User Interface Design and Evaluation", *In Proceedings of Interact 2003 IFIP TC13 International Conference on Human-Computer Interaction,* 781-784.

Molich, R. & Nielsen, J. (1990), "Improving a Human-Computer Dialogue", *Communications of the ACM,* 33, 3, 338-348.

Nielsen, J. (1993), *Usability Engineering,* San Diego CA: Academic Press.

Nielsen, J., Molich, R., Snyder, C. & Farrell, S. (2001), *E-commerce User Experience,* Fremont CA: Nielsen Norman Group.

Wharton, C., Rieman, J., Lewis, C., & Polson, P., (1994), "The cognitive walkthrough method: a practitioner's guide", 105-140, *in* Nielsen, Jakob and Mack, R. L., *Usability Inspection Methods,* John Wiley & Sons.

Learning, Gender and ICT: Involving Young People in Design

Lisbeth Frølunde

Project Leader, Research Assistant
Computer Clubhouse Project, Play & Learning Consortium
LEARNING LAB DENMARK, Emdrupvej 101, 2400 Copenhagen NV,
www.lld.dk

Background

I work with the international Computer Clubhouse youth project, which aims at providing a stimulating creative environment for youths between 12 and 18 years old, where they can play and learn with computer-based technology and physical materials and gain social, creative and aesthetic competencies. The idea of bringing the project to Denmark emerged from a collaboration between Learning Lab Denmark and MIT Media Lab.

My professional background covers fine arts, design, illustration, clinical art therapy, psychology, education and human-computer interaction. I have applied participatory design methods to work with e.g. LEGO Mindstorms (robots and software) and LEGO Studios (digital camera and software).

Proposed PhD project

I am waiting for a reply on an application for a PhD project from The Danish Research Council. The following is a shortened version of the proposed project. The software program referred to is Nasser/EasyCat, a tool invented by an animation studio in Copenhagen, which can be downloaded from www.tv-animation.com.

Learning, Gender and ICT: Involving Young People in Designing ICT Learning Materials

The empirical research project seeks to influence the quality and design of products available to young people in informal and formal settings by actively involving adults (arts instructors and designers) in a participatory design process alongside young people. The project also addresses the phenomenon that there is lower interest among girls for IT (Drotner 2001, Kafai and Turkle 2000). It is apparent in informal learning settings that IT activities usually attract young men, while creative activities in the arts are more popular with young women. This project looks at gender factors and

the transference of adolescents` different motivations for aesthetic learning in informal learning settings, in regards to animation film activities. The focus of research is on understanding the interactions in the "creative or aesthetic" learning process, by looking at the complex relationships between: a young person (learner), the professional adult (the adult is considered a co-learner, whether in the role of schoolteacher, arts workshop leader, or designer) and a learning tool (the term tool is used for devices that aid in communication and creative expression, encompassing art materials, as well as IT-based multimedia applications).

Theoretical Framework

Theoretically, the project is cross-disciplinary and eclectic, with an emphasis on broad socio-cultural, artistic and narrative approaches. It has reference to theories within the fields of action research, play, educational research and design. Action research implies that knowledge production is produced in the context of application, and that there is a wish on the part of the researcher to make a direct difference on the object of inquiry. This is relevant to participatory design as "empowerment" for the learner (youth) and co-learner (adult professional) and serves to influence the design of learning materials. Applicable theories about the social and cultural effects of design come from the theories on how innovations are adapted in cultures (Rogers 1995). Children are in a sense "early adaptors" due to their flexible play culture and lack of pre-conceived notions (Huizinga 1950, Druin 1996). This relates to theories on the multistability of technologies, the given variances in cultural embeddedness and possible "revenge effects", as described in the philosophy of technology (Ihde 2002) as well as interaction design field (Norman 1999). The researcher´s ability to reflect on his or her influence on the object of research and own limited perspective is crucial (Ackerman 2001). The researcher will ground reflectivity on the role of the researcher and relation of object and subject with reference to Feminist Social Studies and critical reflections on the notion of knowledge, identity and gender in culture (Bordo 1998, Ihde 2002, Søndergaard 2000).

Also applicable to the project is the learning philosophy "Constructionism", a theoretical framework developed in the 1970´s by Seymour Papert. It builds on the work of Piaget and Dewey and suggests that learning works best when students are actively constructing personally meaningful projects. It considers the correlation between gender and epistemology, and argues for a pluralistic approach (regarding gender, culture, style of learning) to educating with IT tools (Turkle and Papert 1991, Bers 2001).

Methodology and Empirical Data Collection

The process of creating a result in the form of an animation tool, is the object of the research. The approach is contextual and participatory design, stemming from the field of Human-Computer Interaction, as influenced by Activity theory; how humans interact with each other and the world in the search to fulfill distinctive motives (Druin 1996, Beyer and Holtzblatt 1998) and methods include prototyping (Gaver 2002, Schrage 2000).

The project examines two interwoven aspects: the learning process related to animation activities in different contexts and if and how can a participatory design process assist in designing IT-based learning materials. The project takes an ethnographic approach. The empirical studies take place at various settings: The Youth Media School (Viborg), Computer Clubhouse (Copenhagen or Ringsted) and a selected 9th grade. Documentation of the field studies includes: the resulting "artefacts" (animated films) and reflections on the process (by young people), such as video diaries showing "animation tips and tricks" and dialogues about the artefacts. Iterative participatory design sessions are to involve the researcher, the learners (young people), the co-learner (programmers and designers), in order to work on designing and prototyping the ultimate animation tool. Documentation is in the form of video, transcripts, design boards and prototypes.

Resulting Development of New Learning Materials

The animation tool is to be available for use on DR SKUM (the web site for youth made by the Danish Broadcasting Company). The resulting animation films are to be shown on www.dr.dk. Educational materials are to be developed with TV-Animation and as yet unknown publishers.

References

Ackerman, E. (2001), Piaget's Constructivism, Papert´s Constructionism: What is the Difference? http://learning.media.mit.edu/publications.html

Bers, M. Umaschi (2001), Doctoral Thesis: Identity Construction Environments: The Design of Computational Tools for Developing a Sense of Self and Moral Values, MIT Media Lab, Cambridge, Mass. url: http://xenia.media.mit.edu/~marinau/bers_thesis.pdf

Beyer, H., and Holtzblatt, K. (1998), Contextual design: Defining Customer-centered Systems. San Francisco: Morgan Kaufmann

Bordo, S. (1998), "Bringing Body to Theory", in Welton, D. ed., Body and Flesh: a Philosophical Reader, Oxford: Blackwell Publishers.

Cassell, J. and Jenkins, H. (1998), From Barbie to Mortal Combat: Gender and Computer Games, Cambridge: MIT Press.
Center for Children & Technology (2002), "Evaluation of the Computer Clubhouse, Year Two report", Center for Children and Technology, New York City.
Drotner, K. (2001), Medier for Fremtiden: Børn, Unge og det nye Medielandskab, Copenhagen: Høst & Søn.
Druin, A. (1999), "Cooperative Inquiry: Developing New Technologies for Children with Children", Paper, CHI '99, USA. ACM, New York: 1999.
Druin, A. and Solomon, C. (1996), Designing Multimedia Environments for Children. New York: John Wiley & Sons, Inc.
Holm Sørensen, B. og Olesen, B. R. (2000), "Et Børnekulturelt Perspektiv", Holm Sørensen, B., Olesen, B. (Eds.). In Børn i en digital kultur, Copenhagen: Gads Forlag.
Huizinga, Johan (1950), Homo Ludens: A Study of the Play Element in Culture. Boston: Beacon Press.
Ihde, D. (2002), Bodies in Technology, Minneapolis: University of Minneapolis Press.
Jessen, C. (2000), "Det kompetente børnefællesskab", Holm Sørensen, B., Olesen, B. (Eds.). In Børn i en digital kultur, Copenhagen: Gads Forlag.
Kafai, Y., Turkle, S. et.al., (2000), Tech-Savvy: Educating Girls in the New Computer Age, Washington, D.C.: American Association of University Women (AAUW) Educational Foundation Commission on Technology, Gender and Teacher Education.
Norman, D. A. (1990/ 99), The Design of Everyday Things, Cambridge: MIT Press, 1999.
Pavey, Don (1979), Art-Based Games. Norwich, UK, Methuen & co.
Resnick, M., Rusk, N., Cooke, S. (1998), "The Computer Clubhouse: Technological Fluency in the Inner City", Schon, D., Sanyal, B., Mitchell, W. (Eds.). In: High Technology and Low-Income Communities, Cambridge: MIT Press.
Rogers, E.M. (1995), Diffusion of Innovations, (4th ed.). NYC: Free Press
Schrage, M. (2000), Serious Play: How the World's Best Companies Simulate to Innovate, Boston: Harvard Business School Press.
Søndergaard, D. M. (1996, 2000), Tegnet på Kroppen. Køn: Koder og Konstruktioner blandt Unge Voksne i Akademia. Copenhagen: Museum Tusculanums Forlag, 2000.
Turkle, S., and Papert, S. (1991). "Epistemological Pluralism and the Revaluation of the Concrete". In Harel, I. & Papert, S. (Eds.), Constructionism. Norwood, NJ: Ablex.

The Fifth Element
- Promoting the perspective of aesthetic interaction

Iversen, Ole S.[1], Krogh, P. G.[2], Petersen, M. G.[3]

1) Department of Information and Media Studies, University of Aarhus, Helsingforsgade 14, DK-8200 Aarhus N, oiversen@imv.au.dk

2) Institute IV, Design, Aarhus School of Architecture, Nørreport 20, 8000 Århus C, peter.krogh@a-aarhus.dk

3) Department of Computer Science, University of Aarhus, Åbogade 34, DK-8200 Århus N, mgraves@daimi.au.dk

Introduction

Within human-computer interaction, there is a well-established understanding, both theoretically and methodologically of how we design transparent and efficient work artifacts. However, as technology moves beyond situations and domains dominated by ideals of optimization and efficiency and into the domestic and cultural realms of life, the roles and ideals of information technology must reflect the experiential aspects of life. Through designing aesthetic interaction we wish to make technology serve and enrich people's everyday life. Aesthetic interaction aims for creating involvement, experience, surprise and serendipity in interaction with everyday artifacts and interactive spaces. We do not wish to claim that previous perspectives on Human-Computer interaction are no longer useful, but we argue that these views are insufficient to deal with the challenges of new application domains. Therefore we propose an aesthetic perspective as a fifth interaction perspective. In the following, we present existing four perspectives on interaction, next we explain the perspective of aesthetic interaction. Finally, we exemplify how we work with aesthetic interaction in design.

Existing interaction perspectives

In 1984, Bødker & Kammersgaard (1984) reviewed different perspectives on human-computer interaction and coined four different but co-existing perspectives on interaction styles. Subsequently, these perspectives have been applied to provoke new design ideas through taking the different perspectives to the extreme in design brainstorms (Nielsen 2002, Bødker et al. 2000). The four perspectives system, tool, dialogue partner and media are inevitably important perspectives on interaction. However, when designing

IT artifacts for e.g. domestic use, the perspectives seem insufficient. In the following paragraph, we will present the four perspectives in short. For a more thorough discussion, see Nielsen (2002)

In the 80s, the *system perspective* was far the most dominant perspective on IT use. When viewing IT use as a system, man-machine interaction is characterized by the user being an integrated part of the system. Bødker and Kammersgård (1984) suggest a cash register system as a key example of the system perspective. The cashier is just another part of the system by scanning groceries at the register and thereby reducing the stock on a particular item. The human task is reduced to a system operation comparable to simple machine actions. Thus man and machine is viewed as being parts of the same system with basically the same characteristics. In this perspective, the ideal for interaction is efficient and error-free performance.

The *tool perspective* is characterized by practitioners being in control of the machinery. As the lumber masters the hammer and the plane as a part of his trade, so can an IT artifacts be seen as a tool for obtaining a certain goal. A fundamental characteristic in the tool perspective is the user's ability to master the tool, and for him to employ his skills in doing so. As opposed to the system perspective the human task is not comparable with machine operations. The initiative is on the users' side. The user acts through machine, and ideally, the computer artefact is transparent for the user.

The *dialogue partner perspective* represents early optimism in the direction of artificial intelligence research. Here, man and machine are considered as equal communication partners. The dialogue partner perspective emphasizes a man-man like communication between the user and IT artifact. The IT artifacts should be a walk-up-and-use application with a human-like interface. The implication of the dialogue partner perspective is further discussed by Engeström (1996).

Finally, the *media perspective* assumes that all communication takes places between people. IT can mediate this communication by processing data created by a sender and interpreted by a recipient. In this way the interaction between man-man is mediated by IT artifacts. A prevalent example of the media perspective is the communication mediated by email clients. Data files are processed by the email client and thereby the client mediates the communication between a sender and a receiver. The ideal for interaction

here is to support communication allowing both sender and receiver to express them selves and interpret each other.

The perspective of Aesthetic Interaction

We propose an aesthetic perspective as a fifth interaction perspective. The aesthetic interaction perspective is inspired by the work of Dunne (1999) and Gaver (2003) who advocate a focus on the aesthetics of use and Djajadiningrat (2000), who sees aesthetics and interaction as interwoven concepts, stressing " Dont think beauty in appearance, - think beauty in interaction" (ibid, pp. 132). The aesthetic perspective call attention to, how we can design for emotionally rich interaction (Wensveen et al. 2000) and for creating engagement, experience, surprise and magic in the interaction with artifacts and interactive spaces.

By stressing the need for a perspective of aesthetic interaction we emphasize the experiential elements of interacting with computational artifacts i.e. the concept is not only addressing the e.g. visual and tactile qualities of an artifact, it is an attempt to focus on the aesthetic relations between physical artifacts and how they are used to control computational systems.

Aesthetics are often historically closely related to either the art world or the idea of beauty and is typically connected to an individual personal experience. However, Richard Shusterman (1992) argues for another important aspects of the concept of aesthetics in his book “Pragmatist Aesthetics” (Shusterman 1992). His main arguments are that:

- the concept of aesthetics is closely related to the current socio-cultural and historical context - aesthetics are bound to the life lived and learned
- aesthetics is experienced with the body - it is felt and the sensations are stored in the body
- the aesthetic experience is not only a momentarily experience - it can be recalled and is integrated with the pool of knowledge and experiences constituting a human, altering the basis for future knowledge and experiences
- the aesthetic experience is a potential result of a use relationship as the artifact or how it is handled is considered instrumental to the aesthetic experience.

The aesthetics is not something a priori in the world; it is based on valuable use relations influencing the construction of our everyday life. Our ability to

have aesthetic experiences is based on our social context, manifested in a personal bodily and intellectual experience prolonged beyond the immediate experience. Based on Shusterman's work on pragmatist aesthetics (Shusterman 1992), we suggest that an aesthetic perspective on interaction takes into consideration the improvisational, socio-cultural dimensions of human living as interaction becomes an end in itself. The interaction should satisfyingly integrate expression to both our bodily and intellectual dimension.

Perspective/	**System**	**Tool**	**Dialogue Partner**	**Media**	**Aesthetic Experience**
Man	system component	master	equal partner	communicator	Improvisator
Man Machine Interaction	between equal partners	mediated by machine	Man machine dialogue	Supporting human-human dialogue	Play
Interaction ideals	efficiency	transparency	human dialogue	Communication	Expressiveness

Table 1. The five interaction perspectives summarized and contrasted

Our work this is not the only work in this direction. There is a growing body of research struggling to find alternative ways and perspectives on interactive technologies. But our approach differs in a number of ways. E.g. the work of Djajadiningrat et al. (2000) focuses a lot on creating intuitive interaction using a tangible interaction approach, and focuses a lot on objects. We on the other hand aim to bridge not only to our bodily dimensions but also to our intellectual (Shusterman 1992), and we aim to design not only objects but interactive spaces.
Other groups work closer to an art tradition creating installations that are more detached from the practice of everyday life than what we aim for. Indeed the work presented above are welcome provocations, but once we have recognized the challenge, there is a need to establish a solid basis for designing aesthetic interaction and for defining how this approach relates to the existing body of research within human computer interaction.

Working with aesthetic interaction

We currently work in a three year project on InteractiveSpaces (www.interactivespaces.net) which is an interdisciplinary research center bringing together architecture, engineering, and computer science with the research mission to create new concepts for future interactive spaces.

InteractiveSpaces brings together companies and public researchers in R&D activities leading to new products and services for specific domains. The application domains studied within the center include schools, libraries, specific workplaces and homes.

Playful interaction

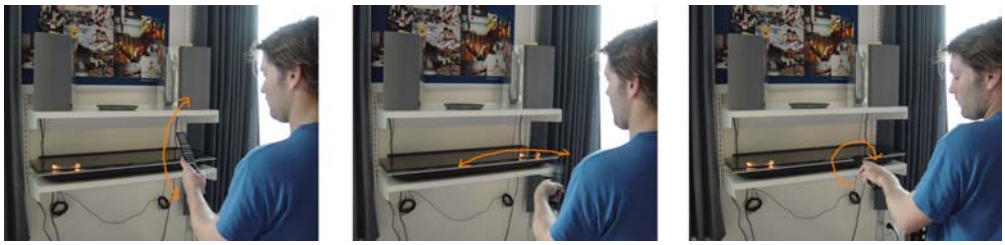
Playful interaction [Eriksen et al. 2003] is a video prototype envisioning a future workplace for architects. The aim of the prototype is to explore new ways of interacting focusing on the experiential qualities, rather than pursuing design ideals of efficiency and optimization. In the video prototype, a ball is used as the prime means of interacting with digital material in physical rooms. What characterizes the way humans handle a ball is that we inevitably start to play with a ball improvising game-like activities. We use our tactile and kinesthetic senses to manipulate the ball, and we establish relationship with others when we throw them a ball. The use of a ball as means of interaction emphasizes the involvement of bodily expressiveness and the intellectual capacities needed for establishing the rules of a game. The ball invites for interpretation of use, and creates room for unanticipated use.

Fig. 1. Playful interaction

eMote

The idea of the eMote is to provoke present design of remote controls which neglectes our body expressiveness and senses by asking us to relate to music and other media through button pressing. The design of the eMote allow the user to draw upon the richness of our gestures allowing Andrea to turn the music off as the remote is turned upside down, skip a track through making a throw gesture and turning the volume up an down through vertically tilting the remote itself. The present prototype of the remote realizing these features is but a first step in establishing a new relationship with music through giving people an instrument for interaction allowing them to relate

to music with both their body and intellect and allowing people to gradually build up a virtuosity in the way they are able to interact with media.



Volume up and down Skipping tracks Mute

Fig. 2. eMote in use

In both prototypes, the aesthetic qualities are released through interaction The prototypes are not tools, but merely instruments that enable the user to develop expressiveness in relation to manipulating and controlling computational artifacts and environments.

References

Bødker, S. & Kammersgaard, J. (1984): Interaktionsbegreber, internt arbejdsnotat, version 2.

Djajadiningrat T., et al. (2000): Augmenting fun and Beauty: A Pamphlet, in proceedings of DARE 2000, Designing Augmented Reality Environemnts, ACM,2000, Elsinore, Denmark pp. 131-135

Engeström; Y.. (1996): Mundane Tool or Objects of Affection? The Rise and Fall of the Postal Buddy in Nardi, B. Context and Consciousness, The MIT Press, Cambridge, Massachusetts pp.325-374

Eriksen, M. A.; Krogh, P. G.; Ludvigsen, M. (2003) *Playful Interaction.* Proceedings of the First International Conference on Appliance Design, May 2003 Bristol UK. Pp 119 - 121

Gaver, W. Et al (2003):Ambiguity as a Resource for Design, In proceedings of CHI 2003, April 5–10, 2003, Ft. Lauderdale, Florida, USA. pp.233-240

Nielsen, C. (2002). *Designing to support Mobile Work with Mobile Devices.* PhD dissertation, University of Aarhus.

Shusterman, R. (1992): Pragmatist Aesthetics, Living Beauty, Rethinking ArtBlackwell Publishers Inc. Cambridge, Massachusetts

Wensveen, S., Overbeeke, K., Djajadiningrat, T. (2000) Touch me, hit med and I know how you feel: a design approach to emotionally rich interaction. In DIS2000 Designing Interactive Systems: Processes, Practices and Methods. ACM Press pp. 48-52.

Applying usability methods in computer game development: the case of Takkar

Thomas Tae-Yang Jørgensen, Laust Juul Christensen, and Anker Helms Jørgensen

Center for Computer Games Research Copenhagen
Dept. of Digital Aesthetics and Communication
IT University of Copenhagen, Glentevej 67
DK - 2400 Copenhagen NV
{ljc, thomastj, anker}@itu.dk

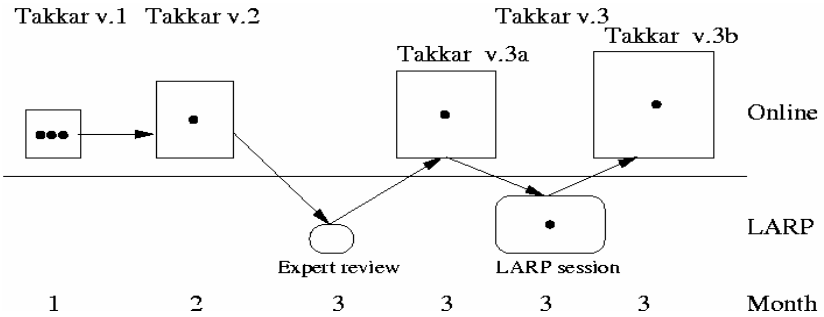
Introduction[1]

In development of computer games, usability has so far been playing a very limited role as user involvement has largely been restricted to user feedback on beta versions (Rouse, 2001) - with Microsoft Playtest being an exception (Pagulayan et al, 2003). This paper reports on the development of the role playing game Takkar while using a range of usability and PD methods. Takkar is unusual in that it combines a computer role playing game with live action role playing (denoted LARP) taking place in an outdoor setting with physical playing activities, dresses, objects, characters, roles, script etc. The idea in Takkar is to create two guises of the same game: the computer game bridges the gaps between LARP sessions as these only take place a few times a year due to the considerable practical efforts involved. This raises the questions: How do we ensure that players have a sufficient experience of "sameness" of their character in LARP and online? How should one go about developing it? In order to answer these questions we developed Takkar in an iterative fashion while employing PD and usability methods, informed by contemporary theories of LARP (Gade et al, 2003), computer game design (Rouse, 2001) and embodiment in virtual environments (Taylor, 2002).

The Development Process

We developed three versions of Takkar as illustrated below.

[1] The present paper is a brief version of (Christenen et al, 2003).



We employed the following techniques: concept testing, prototype testing, user interviews, observations, and expert review. In each iteration a number of user sessions were held each lasting about an hour, except for the LARP session which lasted about five hours. After each session we held semi-structured group interviews which were audio taped. All users were LARP and computer game players of mixed levels of experience. Their age ranged from twelve to twenty-five. The table below shows how selected features developed and matured.

Feature	***V. 1***	***V. 2***	***V. 3a***	***V. 3b***
Character skill system	√	√√	√√√	√√√
LARP rule set porting	√		√√	√√√
Richness of communication	√	√√	√√√	√√√
Player customised characters			√	√
Player Portraits				√

In the first iteration the users found that the physical feeling of being one's character was the basis for feeling connected with one's LARP character. The results also showed that the game engine used was lacking in features; we therefore ported Takkar to the game engine Neverwinter Nights (NWN), as this allowed us to focus on generating game content and provided most of the relevant features. In the second iteration the observations and interviews confirmed our choice of NWN and revealed that besides the physical experience sheer time spent developing a character also generated a feeling of connection for a LARP player.

The third iteration consisted of three play sessions, an online (v. 3a), a LARP, and another online session (v. 3b). The same group of LARP players was used for all three sessions and as far as possible they played the same characters (some character deaths occurred though). The interviews showed several missing or poorly implemented features and underscored the importance of certain considerations such as consequences carrying over from online to LARP and back as well as character deaths being costly in

player time. However, the users felt that the concept was generally sound. We tested player character customisation and received positive feedback from the players who found it a great help in mapping the LARP representation of the other characters to their online counterparts. The customisation consisted of creating a virtual costume that matched the LARP costume and having pictures of the players associated with their character. It turned out that the users had some difficulty using the controls which resulted in conversations where one or both characters were facing away from the other. The last major complaint was the lack of support for concurrent actions: it means that players cannot walk and talk at the same time - they were unable to move as a group while having a conversation.

Conclusion

A key concept throughout was *embodiment*, seen as a player experiencing his or her character as a natural or at least acceptable extension of the player. This poses a special problem when combining the two parts. We found the following key factors to be important: *concurrency of actions* and *rich communication*. As to usability and PD, applying the methods has undoubtedly added to the quality and richness of Takkar, not least because bridging the computer game realm with the LARP realm is absolutely non-trivial. User participation at concept forming stages helped us to change or abandon flawed concepts while user interviews helped us gain a better understanding of the needs and ideas of our users. Finally, we believe that it would have been beneficial to involve users even more in the concept and rule design stages by having workshops with the players as co-designers.

Acknowledgements

We thank Susana Tosca for co-supervising the original work. We also thank her and T.L. Taylor for helpful comments to an earlier version of this paper (Christensen et al, 2003).

References

Christensen L.J., Jørgensen, T.T-Y., and Jørgensen, A.H. (2003): Developing a hybrid of MMORPG and LARP using usability methods: the case of Takkar. To be presented at the DIGRA conference "Level Up", Utrecht, Holland, Nov 4-6, 2003.

Gade, M, Thorup, L. and Sander, M. (eds) (2003). *As LARP grows up – theory and methods in LARP*. Projektgruppen KP03.

Pagulayan, R.J., Keker, K., Wixon, D., Romero, R. and Fuller, T. (2003): User-centered design in games. In J.A. Jacko & A. Sears (eds.) *The*

Human-Computer Interaction Handbook: Fundamentals, Evolving technologies and Emerging Applications (pp. 883-906). Mahwa, NJ: Lawrence Erlbaum Associates.

Rouse, R. III (2001): *Game design – Theory and practice*. Wordware Publishing.

Taylor, T.L. (2002): Living Digitally: Embodiment in virtual worlds. In R. Schroeder (ed.) *The Social Life of Avatars: Presence and Interaction in Shared Virtual Environments* (pp. 40-62). Springer-Verlag, London.

Computer Clubhouse: Informal Learning spaces where adolescents experience and create with ICTs as tools and exchange artwork via a network intranet

Jane Møller Larsen

Research assistant, Learning Lab Denmark
Emdrupvej 101, 2400 Copenhagen NV
tel: +45 39559933
jml@lld.dk

I hold a MA in Social Science on basis of Communication & International Development studies (IDS) at Roskilde University. I have worked intensively with computer-, and media literacy, digital divide problematics and North/South information dialectics over the past 6 years.

Introduction

In the sphere of international development, learning with ICTs and adolescents in urban societies; my present research orientation deals with questions related to adolescents' access to and use of information and communication technologies (ICTs) vis a vis digital divides and how these raise different challenges in cultural, moral, social, regulatory, economic and political perspectives. Looking into infrastructure divides, connectivity divides, educational/learning divides, digital content divides, industrial capacity and democratic divides my project evolves around the case Computer Clubhouse (see below).

Discussions about the new technologies range from a variety of positive approaches related to the supposedly great benefits ICTs can offer humanity to a more severe scepticism evolving around potential reinforcements of existing patterns of inequality and hierarchial power relations. Different digital divide patterns set up different challenges and in relation to e.g. the enthusiasm about the Internet, Cees Hamelink states that *"a very popular information myth proposes that once people are better informed about each other, they will understand each other better and be less inclined to conflict. A very attractive assumption but not necessarily true. Deadly conflicts are usually not caused by a lack of information. In fact they may be based on very adequate information that adversaries have about each-other* […] *One could well propose the view that social harmony is largely due to the degree of ignorance that actors have vis a vis each other."* (Hamelink 2002,

Prepcom 1/WSIS). To this Hamelink concludes, that the world does not need an information society. Rather, what seems of utmost importance to him is the creation of a communication society where diverse societal groups get access to participate in social dialogue.

In relation to new methods for learning UNESCO states that: "*Technologies make it possible to visualize creating and link up diverse learning communities. More immediately, these technologies, and their breaking down of barriers, present us with a window of opportunity to question fundamental assumptions and goals, to rethink existing approaches* […] *to catalyse social and institutional change."* (UNESCO, New Horizons for Learning 1997). Hence to serve the basic learning needs of all UNESCO calls for expanded visions about and development of new learning spaces. E.g. spaces where ICTs are looked upon as a possibility to build distributed information and communication networks and where learning with ICTs provides the opportunity for greater relevance and socio-cultural specificity in content and activities. It is believed that ICTs can support the development of local knowledge systems, allow people to work with others in different ways, leading to individuals' changing their perception or attitudes about themselves and others.

However, this leads back to the above-mentioned problematics evolving around digital divides and the dialectics of North/South systems. There is in the so-called North (e.g. amongst international experts and donors DAC/OECD, UNDP, IBRD etc.) an increasing preoccupation, that the South – if not linking up to the information society – will be let out of the contemporary dominant market-forces and that the socio-economic consequences will be insurmountable, especially for the poorest countries in the world. However looking to the South where not so few nation-states are struggling with e.g. low or no water supplies, lack of food, severe poverty, inadequate health-systems, lack of primary and secondary formal schooling, local conflicts etc. the calls for broad scale connectivity and ICT training might seem as a yet another stack of 'lacks' in the pile of urgent developmental issues. Hence it is important to study some of the learning spaces/cases where initiatives have been taken to overcome digital divides, in order to be able to grasp whether the benefits justify the costs involved, to study who has access to these places and who are (still) left out and to see what types of training and learning are required in relation to the broader socio-cultural context etc. The computer clubhouse is such a case:

The international Computer Clubhouse network

Computer Clubhouse is an international network of innovative, informal learning environments. An objective of a Computer Clubhouse is to facilitate a creative setting, where young people (10 to 20) can explore their ideas and practice their skills in information and communication technologies (ICT) and multimedia. The members are offered an opportunity to become active creators rather than 'passive' consumers of media. The members receive guidance on developing their own concepts and producing them, for example: texts, Power-point presentations, home pages, music, comics, animated movies, robots, computer games, multimedia presentations, computer-mediated art etc. This empowers the learners to (be able to) participate in their local communities and national societies by contributing to public discourse with their respective projects and productions. At the same time the Computer Clubhouse functions as an informal capacity-building learning-setting where the learners can build competence and qualifications for future careers on the labour market.

Computer Clubhouse staff consists of regular staff and mentors, who support the creative efforts of the members. Anyone between the ages of 10 and 20 is welcome in a Computer Clubhouse, but the primary target group are those adolescents who are termed underserved youth. Depending on the local setting, the target group includes: poor children, tough guys, school drop-outs, first and second-generation immigrants and/or girls who would not otherwise use ICTs.

The Computer Clubhouse project started in collaboration between the MIT Media Lab and the Boston Museum of Science. The first Computer Clubhouse opened in USA in 1992 and a global network has since been established. Today, more than 70 Computer Clubhouses exist under the umbrella of the Intel Computer Clubhouse Network and another 30 clubhouses will be established worldwide over the next two years (at present there are clubhouses in USA, India, South Africa, Mexico, Brazil, Palestine, Philippines, Europe: Ireland, Holland, Germany etc.) The first Danish Computer Clubhouse will open in the town Viborg in October 2003. The clubhouses all become members of the global network and this membership opens up for great synergy and cultural exchange potential where young people exchange art-work and production *know how* on the CC intra-net 'The Village'. Thereby clubhouse members gain opportunities to communicate and exchange thoughts and ideas across regions and between countries – either via the Internet and/or by visiting each other.

Field of analysis and central questions

Where are the clubhouses situated? What country, society, community, organisation embeds the clubhouse? Who is running the computer clubhouse and why? (Computer clubhouses under scrutiny are situated in New Delhi/India and Johannesburg/South Africa)

What are practical, relevant and sensitive ICT learning programmes in these societies and why? What can be the pros and cons of introducing informal learning-environments such as e.g. Computer Clubhouses?

How do the adolescent members of the non-formal learning environment use computers and applied technologies such as video- and photo cameras, scanners, electronic microscopes, sound recorders etc. as tools for learning and obtaining technological skills and media reflexivity? And how/do the adolescent members utilise the Internet (and the computer clubhouse intra-net 'The village') for communicating ideas, knowledge, *know how* and media productions with other members of the international network?

How/do the respective clubhouses include participatory approaches linked to local realities in order to absorb and apply local knowledge in the learning-process and content more successfully?

How/do the local computer clubhouse empower the learners as democratic citizens? How/are learners empowered to participate in their community/ society and how does that influence their rights to information and freedom of speech? How/do the local computer clubhouses facilitate that learners build relevant and needed competence and qualifications for future careers?

References

Castells, Manuel: The Information Age: Economy, Society and Culture, volume I-III. Blackwell publishers, 1996

Fraser, Matthew. Free For All: The Struggle for Dominance on the Digital Frontier. 1999. New York: Stoddart Publishing Co.

Garson, G. David. Social Dimensions of Information Technology: Issues for the New Millennium. 2000. Hershey: Idea Group Publishing.

Hamelink, Cees J. The Politics of World Communication. 1994. London: SAGE Publications Ltd.

Lessig, Lawrence. The Future of Ideas. 2001. New York: Random House, Inc.

Mansell, Robin and Uta When, eds. Knowledge Societies: Information Technology for Sustainable Development. 1998. New York: Oxford University Press, Inc. ETC….

SORRY... 1.5 X to the left
Experiments with written interaction

Karin Levinsen & Rikke Orngreen

HCI-Research Group, Department of Informatics, Copenhagen Business School, Howitzvej 60, 2000 Frederiksberg, Denmark

Introduction

At the Copenhagen Business School we run a course, *E-learning in a challenging perspective* directed towards graduate students. The objective is to provide the students with a detailed theoretical foundation and through exercises inspire them to explore the appropriateness of different learning theories when applied in specific contexts.

In order to experience online communicative problems in practice, we designed a series of exercises. Some produced a surprising outcome, and therefore we decided to repeat them this semester, while collecting systematic observations and data. This paper is about one of these exercises.

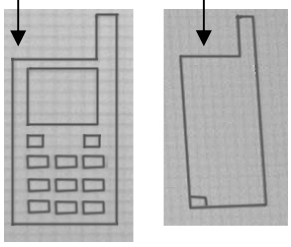
Experiments with written interaction – the exercise

The students communicated using Microsoft Messenger. They were split in pairs and placed in different rooms. One student was given a simple drawing of a mobile phone on squared paper. The other was given a piece of squared paper and a pencil. The task was, within 15 minutes, to reproduce a copy of the drawing by communicating online, using every mean except discussing the motive. After discussing the experience online, the roles were changed and the exercise was repeated with a more complex motive of a person on a staircase. The idea was to produce awareness of the difference between communicating unambiguous information and complex equivocal topics.

In the first exercise we had chosen a simple motive tied to the squares of the paper, because we expected our students to be able to solve the task without complications. They study business economics and computer science and are thus used to numbers, coordinate systems and programming. Further, they often chat in Messenger even using the Messenger icons with expressiveness (irony, fun). We were therefore rather surprised when the task turned out to be difficult. All the copies resemble the original, but only 2 out of 11 were correct copies. Even one group displaying an exemplary communicative approach (they agreed upon roles and premises, the receiver of vague messages reacted) ended up having problems. This happened when

they had finished the outline of the mobile and were starting to draw the buttons inside the outline. Then, they could not find a shared starting point (extraction from chat between two students, authors' translation):

A says:	Now we are going to draw inside the outline – OK?	Original drawing (photo)
B says:	yes. (mobil)	
A says:	If you start in the left corner	Students copy (photo)
A says:	(the starting point)	
B says:	at the bottom	
B says:	ok	
A says:	1 X + 1 Y	
B says:	yes	
A says:	draw 1,5 X	
A says:	draw 1 Y	
A says:	... up	
A says:	1.5 Y to the left	
A says:	SORRY... 1.5 X to the left	
B says:	ok, from (1,1) I continue to draw 1.5 X and 1 y up	
A says:	START OVER	
A says:	YES	
A says:	exactly	
B says:	okay...	
A says:	1.5 X to the left	The students have finished drawing the outline and tries to place the first button.
B says:	what?	
A says:	1 Y down	
B says:	Start over from startingpoint!	
A says:	OK	
A says:	1.5 X to the right	
A says:	1 Y up	The students cannot agree upon the position of the starting point for drawing the buttons.
A says:	1.5 X to the left	
A says:	1 Y down	
B says:	And start is the startingpoint is the corner'	
A says:	?!?!?	
A says:	That is startingpoint is the first startpoint	
A says:	Hereafter you go 1 X to the right and 1 Y up (Without drawing)	The students think they agree, but the button is misplaced (see the drawing), and they do not manage to proceed from here.
B says:	yes. So I make a small square down in the left corner	
A says:	Yes	



Between the two exercises, the students discussed their experience, using Messenger. The following is a selection of reflections from different chat sessions (authors' translation):

> We didn't know whether we should produce a precise copy or just a resemblance

But, they did not discuss their own priority at any point in the process.

> What the communicator takes for granted must be made clear. I.e. whether the line should be drawn up or down, I drew it downwards. …

Even if they did try to be exact, they produced misunderstandings.

> People have different approaches to things … … some are more mathematical, others are more artistic, maybe.

This is a good reflection, and attempts to meet this challenge can be seen in some chats from the second exercise.

> This is what I mean, if we all had known the problematic in advance, we could have avoided a lot of the more expressive descriptions … …

This statement demonstrates that the belief in the existence of a distinct unambiguous language referring to all aspects relevant to a situation is indeed strong.

We have compared the chat and the drawings in order to identify where and how it went wrong. We can see that the students learned something about not to underestimate an apparently straightforward communication. We could observe changes in the communication from exercise 1 to exercise 2. The groups became more aware of the need to define premises and agree upon the basis for communication. They agreed upon what they considered important and they defined linguistic markers in order to compress the language. During the interaction, the process changed from resembling the classical model of communication model (Shannon & Weaver 1949) into an authentic dialog where the participators collaborate on the mutual understanding (Dysthe 1996). Extracts from chat (authors translation):

Exercise 1 : Sender ⇒ receiver relation		**Exercise 2: Authentic dialog**	
X says:	go :	Y says:	Its gonna be quick, say stop if your lost!
Y says:	draw vertical line ca. 9cm in right side of paper	X says:	ok hit me!
		X says:	w means wait - ok?
Y says:	say done when your finished	Y says:	Put the paper with the long side horizontal
X says:	done	X says:	Ok
…	…	Y says:	start in bottom left corner
Y says:	connect the nethermost point with a horisonal line to the left. The line is ca. 5 cm	X says:	ok
		Y says:	draw 1,5 cm up
X says:	ok	X says:	k
		Y says:	from here a line to a point 2 cm to the right and 0,5 up
		X says:	ok
		Y says:	repeat these two types of lines twice, from the point where you stand right now. Straight up first, and then to the right. Same lengths
		… …	… …
		X says:	A kind of staircase?
		Y says:	Yes, but there is more

What can we learn from this?

There is a growing awareness of the importance of mastering communicative skills in online communication. However, there is also a tendency to focus on ambiguous topics and situations of complex dialog and negotiations involving mediation or weaving (Feenberg 1989, Laurillard 2002, Salmon 2002, Sorenson 2000), and thus give a lower priority to the problems related to what is considered straightforward communication.

Our experiments demonstrate two important issues:

1: That communication about plain facts and straightforward instructions are also subject to communication breakdowns. Considering the type of situations where this kind of communication is most common – constructing, controlling processes, instruction people in procedures etc. – it

should be obvious that training of online communicative competencies is an important issue.

Apart from training the ability to express oneself clearly, which is in focus in the literature, the receiver's role as an active participator should be given a higher priority. Here we draw a parallel between *active listening* (Conflict Research Consortium 1998) and what we would call *active reflecting reading* of other people's written communication. There is a tendency to neglect training this part of the competencies in most guidelines and heuristics for online-communication.

2: This is an area, which is relevant for HCI – professionals. It is important to gain knowledge about the ways in which even the simplest and most straightforward exchanges of information can cause communication breakdown. It is important not to neglect this problem, and to be aware that we have a traditional habit of categorizing these situations as subjects of the classical communication model.

HCI research should expose knowledge of the patterns associated with communication and interpretation in relation to simple exact information. This kind of knowledge is a precondition when designing interfaces and interaction that supports the process of communications also on this simple level of exchange. HCI research can contribute with knowledge that can support both the aim of clear expression and *active reflecting reading* in online communication.

References

Conflict Research Consortium 1998**,** *International Online Training Program On Intractable Conflict – active listening*, from University of Colorado, USA, available at http://www.colorado.edu/conflict/peace/treatment/activel.htm (visited 27 Oct. 03)

Dysthe, O. 1997, *Det flerstemmige klasserum,* Klim. [The Multivoiced Classroom]

Feenberg, A. 1989, The Written World, in *Mindweave – Communication, Computers and Distance Education*, Mason & Kaye (eds.). Pergamon.

Laurillard, D. 2002, *Rethinking University Teaching,* RoutledgeFarmer.

Salmon, G. 2002, *E-tivities*, Kogan Page

Shannon & Weaver 1949, *The Mathematical Theory of Communication*, University of Illinois Press.

Sorenson, E. K. 2000, Interaktion og Læring i virtuelle rum [Interaction and learning in virtual spaces], in *At Undervise med IKT [Teaching with IKT]*, Heilesen (ed.), Samfundslitteratur.

Subjunctive Interfaces: Visualisations for Parallel Display and Control of Alternative Scenarios

Aran Lunzer & Kasper Hornbæk

Natural Sciences ICT Competence Centre, University of Copenhagen, DK-2100 Copenhagen, Denmark, {alunzer, khornbaek}@nik.ku.dk

Introduction

Comparison of alternative scenarios can be indispensable in computer-supported work – whether in information exploration, such as when comparing travel plans that use different airlines; in design, when investigating the influence of image placement on the layout of a web page; or in simulation, when testing how alternative population growth scenarios would affect a country's economy. Especially for complex tasks, which require non-trivial problem solving and have no fixed route to their solution, there is a need for what-if exploration of scenarios of interest, and for interfaces that support comparison of those scenarios.

Many applications do support some degree of comparison between scenarios: information visualisation interfaces (Card et al. 1999) may be used for building visualisations that highlight differences, and in direct manipulation interfaces (Shneiderman 1983) the user can explore alternatives with the help of reversible actions that give immediate, visible feedback. However, Terry and Mynatt (2002) point out that most applications are still anchored to a 'single-state document model' that makes parallel and flexible exploration of alternative scenarios difficult. They suggest that new, generally applicable interface mechanisms are needed to give users better support for experimentation, variation and evaluation. One effort towards such mechanisms is subjunctive interfaces (Lunzer 1999; Lunzer & Hornbæk 2003), which help users to set up, view and control alternative scenarios based on different input-parameter values.

A Subjunctive Interface

We introduce the principles of subjunctive interfaces by showing two census-data browsers. Figure 1 shows a browser based on the 'simultaneous menus' interface used in (Hochheiser & Shneiderman 2000), for browsing data on commercial activity in the state of Maryland. The data set contains 828 records, holding the statistics for nine industry areas in each of twenty-three counties over four successive years. Each record specifies the number

of employees, the number of establishments, and the total annual payroll. The user specifies a record by making selections in three menus (1.1 to 1.3); the statistics appear as results in area 1.4.

Figure 2 shows a subjunctive interface for browsing the same data set. Its facilities exemplify the three principles of subjunctive interfaces, as follows:

First, the user should be able to set up multiple scenarios, that differ in arbitrary ways. When browsing census data, a scenario comprises a set of selections (county, industry and year) and the display of the corresponding results. Say a user wants to compare the results from different years. With the browser in Figure 1 (which we refer to as the 'simple interface', because it supports just one scenario), the user must click each year in turn and read off that year's results. With the subjunctive interface, the years can be set up in parallel scenarios. Panels b and c in Figure 2 show how a user sets up new scenarios as copies of existing ones.

Second, the scenarios should be viewable simultaneously, in a way that helps the user to compare them and to see which values belong to which scenario. With the simple interface, comparing census results requires the user to remember result values. In the subjunctive interface, the results appear side by side; Figure 2a shows four scenarios (for two counties in each of two years). Correspondence between the menu selections and the results for each scenario is shown by position and colour cues in the result displays and in the markers next to menu items.

Figure 1. The simple interface for browsing census data. It is based on the simultaneous-menus design that was shown by Hochheiser & Shneiderman (2000) to be more effective than sequentially presented menus. For a selected county (1.1), industry (1.2), and year (1.3), the results area (1.4) shows the number of employees, total annual payroll, and number of establishments.

Third, the user should be able to control scenarios in parallel, so that an adjustment to an input parameter can be applied to more than one scenario at a time. In census browsing, the input parameters are the menu selections. With the simple interface, a change to a menu selection updates the single scenario that the interface supports. In the subjunctive interface, any change affects all scenarios that the user has currently selected as 'active'. In Figure 2a the bottom two scenarios (those for 1994) are active; if the user wishes to change the year of these scenarios to 1996, this requires just one click on 1996. Additionally, by holding down the Alt key the user can force all scenarios to be changed at once; for example, changing them all from Construction to Manufacturing with a single Alt-click on Manufacturing.

This is just one example of a design implementing the three principles of a subjunctive interface. Other approaches are possible, such as overlaying the scenarios' displays or using different visualisations of the results. For descriptions of such design choices see (Lunzer 1999; Lunzer & Hornbæk 2003).

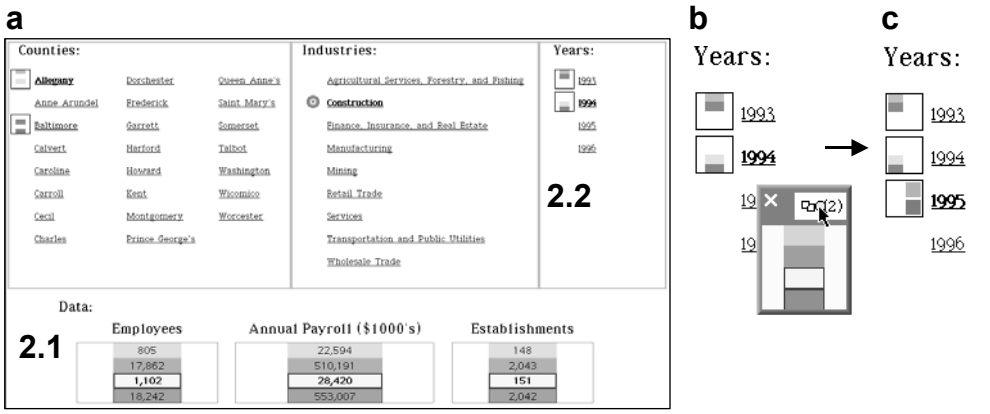


Figure 2. The subjunctive interface, with four scenarios holding the Construction statistics for both Allegany and Baltimore, in 1993 and 1994. Correspondence between menu selections and result values is indicated with position and colour cues in the result displays (2.1) and the markers next to menu items (e.g., 2.2); for example, the values 805, 22594 and 148 at the top of the result displays are for Allegany in 1993. The bottom two scenarios are currently 'active', i.e., affected by mouse operations. Panel b shows the user copying these two scenarios, by clicking and holding the mouse on 1995 and selecting the copy icon at top right in the resulting pop-up; panel c shows how the Years menu will appear with the new scenarios for 1995.

Preliminary Evaluation Results

We have run two experiments that assess the usability of the above style of subjunctive interface as compared to the simple interface. In the first experiment, twenty subjects were each given sets of tasks to complete with each interface. The subjects significantly preferred the subjunctive interface, and rated it as being more satisfying to use. With the simple interface, subjects depended to a larger extent on writing down or remembering data, as suggested by more interim marks made on paper and by reports of higher mental workload. They also used fewer interface actions to complete the tasks when using the subjunctive interface. However, we found no corresponding reduction in task completion time, mainly because some subjects encountered problems in using the facilities for setting up and controlling scenarios.

The second experiment involved seven subjects. Based on detailed analysis of subjects' actions in the first experiment we modified the subjunctive interface to alleviate frequent problems, such as accidentally adjusting only one scenario when the intention was to adjust them all. The subjects used this redesigned interface over five sessions, each lasting approximately one hour. In the fifth session, subjects were completing tasks 27% more quickly with the subjunctive interface than with the simple interface.

The experiments show that a subjunctive interface, with careful design, can give performance benefits that are both statistically significant and large.

References

Card, S. K., Mackinlay, J. D. & Shneiderman, B. (1999), *Readings in Information Visualization,* San Francisco CA: Morgan Kaufmann.

Hochheiser, H. & Shneiderman, B. (2000), "Performance Benefits of Simultaneous over Sequential Menus as Task Complexity Increases", *International Journal of Human-Computer Interaction,* 12, 2, 173-192.

Lunzer, A. (1999), "Choice and Comparison Where the User Wants Them: Subjunctive Interfaces for Computer-Supported Exploration", *In Proceedings of INTERACT '99,* 474-482.

Lunzer, A. & Hornbæk, K. (2003), "Side-By-Side Display and Control of Multiple Scenarios: Subjunctive Interfaces for Exploring Multi-Attribute Data", *Proceedings of OZCHI 2003*.

Shneiderman, B. (1983), "Direct Manipulation: A step beyond programming Languages", *IEEE Computer,* 16, 8, 57-68.

Terry, M. & Mynatt, E. (2002), "Recognizing creative needs in user interface design", *In Proceedings of C&C 2002,* 38-44.

Getting beyond the disruptive effect of Think Aloud

Janni Nielsen
Carsten Yssing
Department of Informatics
Copenhagen Business School
janni.nielsen /cy.inf @cbs.dk

Abstract: Test and evaluation of users´ interaction with computers, often employ Think Aloud. The assumption is that we get access to what goes on in the users´ minds. But interfaces are multi modal with visualizations as the essential feature, and what happens when users are required to verbalise their visual perceptions and interactions? Reflecting upon Think Aloud, we argue that it may have a disruptive effect. We suggest that other techniques be considered and develop a frame for test of visual interaction.

Introduction

Thinking Aloud (TA) stands out as unique in the HCI community and research techniques are often positioned in relation to thinking aloud (11). Also in HCI practice is TA popular (1) and often referred to as the usability method. In a survey of methods and techniques used by Danish HCI practitioners/researchers (about 75/25% of respondents) TA came out as the single most frequently applied technique (4). This is not a surprise as the technique is included in the HCI curriculum taught at universities (5). Besides, Jakob Nielsen (9) has tirelessly promoted TA and argued for its cost effective benefits. The technique is tempting because only a few users are needed, it may be used by non-specialists and it promises access to people´s minds. Using TA in usability testing rests on the understanding that the technique gives access to mental behaviour (11), hence insight into thinking "..that may not be visible at all" (7). Branch (2) argues that TA provides "the most complete and detailed description of the information-seeking processes …". However, she points out that concurrent verbalisation is problematic "… when the information is difficult to verbalise because of its form ..". According to Karsenty (8) TA puts a cognitive load on the user, requiring a cognitive involvement that may interfere or compete with the cognitive requirements of the task, and Preece (12) cautions us about the added strain on users. What do we get when we ask people to think aloud?

Thinking Aloud

In the classic text on protocol analysis from 1984 Ericsson and Simon (6) discuss the use of introspective data in the study of task directed cognitive behaviour. They state that most performance measure rely on some kind of verbal data and argue that a sentence is the verbal realisation of thought. They assume we can verbalise what we are learning while in the process of learning and we can verbalise what we know if questioned shortly after the process has taken place. Because it is still retained in our Short Term Memory (STM). However, if there is a time span before recall, we will produce descriptions and explanations – not report our immediate thoughts.

In their model they distinguish between three kinds of cognitive processes: 1) *Talk aloud* is a vocalisation of thoughts which are already coded in verbal form (internal speech), 2) *Think aloud* which is verbalisations of thoughts held in STM and coded in other forms, e.g. visually and 3) *Retrospective reports* which are verbalisations of thoughts not held in STM, e.g. descriptions and explanations. Retrospection is similar to thinking aloud, but more error prone in comparison to what the user actually did and saw.

Experimental research in usability testing

There is a lack of research literature reflecting on users experience with the TA. However, teaching graduate students TA test techniques, revealed a number of problems. They experienced that 1) they think faster than they can speak, 2) thought processes are much more complex than can be verbalised, 3) TA interferes with the interaction and the task and 4)TA does not come naturally. It seems there is a problem in assuming that performance measures have to rely on some kind of verbal data, and that a sentence is the verbal realisation of thought. Some performances are beyond words, but that does not mean that they cannot be observed, or even registered. Thoughts are not mainly verbal and directly accessible in oral speechb but are, to a large extent, tacit (13). Though the sentence that the user speak is a verbal realisation of a thought there is not a 1:1 relationship between the thoughts, the actions and the words spoken. Besides, the user is interacting with multi modal interfaces: colours, layout, sound, graphics, animations – and visualisations is the essential feature. This requires a mental interaction which is based in visual perception, and perception is the essence of knowledge (13). Knowing is not the same as verbalisation – it is much more than what we can verbalise, and comes into being through an act of sense giving (3). However, TA requires that attention shifts focus to constructing sentences or words and expressing them aloud, instead of

giving sense to that which is perceived and does not exist in verbal form. Perceptions and actions must be tranformed to talk, and even if the speech is immediate and run concurrently with the thoughts – users attention has to shift focus from understanding to verbalisation. As a consequence the process of understanding is interrupted because attention keeps changing object and TA may result in verbal overshadowing (14).

Visual perception is a sense giving process and verbalisation of thoughts has a disruptive effect on the interaction. When our students report that they think more than they can verbalise, that they think faster than they can vocalise – it may be because they sense these extremely complex mental process as almost instant mental processes. They do not describe the cognitive process taking place – but the way in which they experience it.

Testing visual interaction

The interface is visual and dynamic and the user´s interaction is based in visual perception, hence it seems obvious that any test of the interface should be able to capture the visual interaction. In our experimental approach we build on hand-eye/mouse-cursor coordination and the way the user´s eye follows the cursor movement. The theoretical underpinning for this is Polanyi´s(13) distinction between focal and subsidiary awareness as when a blind person uses a stick to feel her way through a space. Her focus is not on the stick – nor on the end of the stick, but on the meeting of the stick with objects or surfaces and the sense making of this meeting. This extension of the senses outwards away from oneself and into the world is assumed also to be the case in the interaction of pen and picture/hand and eye/mouse and cursor – hence the visual perception is the sense-making.

We started out by designing a pen and paper test and ask the students to let the pen follow their eyes roaming around in the picture. We then gradually elaborated the test design which was introduce the user in a stepwise learning process.

In the following the steps are specified and during the session all steps are followed up by interview.

- visual reading with pen following eyes on transparency on top of image (direct coordination eye-hand)
- visual reading on image projected on wall: hand and pen on transparency (semi-indirect coordination eye-hand)

- visual reading/interaction with computer interface and recording of cursor movement and screen (indirect coordination eye-hand)
- replay of recording and interviewing. The retrospective reporting is controlled by actual sequence recorded and not from memory

References

[1] Boren, M. T. & Ramey, J. (2000), "Thinking aloud: Reconciling theory and practice", *IEEE Transactions* 43, no. 3, pp. 261-278, 2000

[2] Branch, J. L. (2000), Investigating the information-seeking processes of adolescents, *Lib. & Inf. Science Research,* vol. 22,4, pp. 371-392.

[3] Bruner, Jerome (1990) Acts of Meaning, Harvard University Press, Cambridge, 1990

[4] Clemmensen, T. & Leisner, P., (2002), Community knowledge in an emerging online professional community, IRIS25 Denmark

[5] Dix, A., Finlay, J., Abowd, G. & Beale, R., *Human-Computer Interaction*, Prentice Hall, 1997

[6] Ericsson, K. A. & Simon, H. A.(1984), *Protocol Analysis. Verbal reports as data*, Cambridge, Massachusetts, 1984.

[7] Hackos, J. T. & Redish, J. C.(1998), *User and Task Analysis for interface Design*, Wiley, USA, 1998

[8] Karsenty, L. (2001), Adapting verbal protocol methods to investigate speech systems use, *Applied Ergonomics,* vol. 32, no. 1, pp. 15-22.

[10] Nielsen, J.(1994), "Estimating the Number of Subjects Needed for a Thinking Aloud Test", *Int. J. of Human-Computer Studies,* **41**, 3, pp. 385-397

[11] Nielsen Janni, Clemmensen T., Yssing C. (2002), Getting access to what goes on in people's heads? NordiCHI, proceedings. Denmark, p. 101-110

[12] Preece, J., Rogers, Y. & Sharp, H.(2002), *Interaction Design: Beyond Human-Computer Interaction*, John Wiley & Son, 2002.

[13] Polanyi, Michael (1967) Logic and Psychology*, American Psychologist 23*, p. 27-43

[14] Schooler Jonathan W., Stellan Uhlsson and Kevin Brooks (1993), Thoughts Beyond Words. *J, of Exp. Psychology*, 1993, Vol 122, 2, 166-183

A Model for Personas and Scenarios Creation

Lene Nielsen

Copenhagen Business School, Dept. of Informatics

Abstract

Personas and scenario writing is not an easy task. The construction seems to contain several obstacles; often the writing ends in description of stereotypes (Nielsen 2003) and the scenario seems not to be convincing. Some obstacles seem to be connected to the writing process others to the distinction between the Persona and the scenario.

In this paper I will take a look at the Persona and the scenario from a narrative point of view. The aim is to provide a model that can guide both the collection of field data and the creation of Personas and scenarios.

Elements for Understanding the Construction of Personas

Most writings on personas seem to focus on goals as part of what distinguish one persona from the other (Cooper 1999; Pruitt and Grudin 2003). But with a narrative point of view goals are part of what makes the persona act in a given situation. What differentiate personas are, as in real life, the personal traits the persona posses (age, background, psyche etc.).

Personas Construction

The persona as a rounded character (Nielsen 2002) can be characterised by the following elements:

- Body – body constitutes a human being. Sex, age, look helps the designer emphasise the Persona
- Psyche – to understand motivations for actions we need to understand what lies behind the motivation, the personality.
- Background – job position, family, education, social- and cultural positions explain motivations for actions.
- Emotional state – to know the emotional state furthers engagement in the Persona (Smith 1995). Inner needs and goals, ambitions and wishes create a foundation for the emotional state.

- Cacophony – two oppositional character traits (Horton 1999). The oppositional traits are what constitute the difference between a stereotype and a rounded character.

The Persona is static but becomes dynamic when inserted into the actions of the scenario. In the scenario the Persona will be in a context, in a specific situation, having a specific goal.

Elements for Understanding the Construction of Scenario

The scenario is a story that moves forward by the principle of causality.

Fabula

The creation of the fabula is an intersubjective process constructed by the reader from both the actual information in the written text and from the reader's presumptions and inference. (Bordwell 1997).

Content

The fabula contains a narrative logic and includes elements that seem to be present in most stories. These elements vary and the media influences the elements. A scenario is a special kind of media and some elements are crucial for the kind of drama a scenario is i.e. there will always be interaction with some sort of system, and the goal starts the story.

Events and Plot

Events in causation are essential to narratives. A narrative is made up of both constituent events, that are necessary for the story and supplementary events, that might not be essential but adds flavour and enrich the story (Abbott 2002). Plot is the linking of events that keeps the story moving (Cobley 2001).

Goals and Obstacles

The goal function as a starting point for the scenario as is the main driving force for the story. Obstacles can be part of the story and drive it forward.

In the scenario the character has needs that create goals. Carroll mentions that during the field studies one should look for obstacles (Carroll 2000).

Solution

Solution is part of the story elements and the dramaturgy. A story includes a character(s), setting(s), goal(s), plot and solution (Fields 1984)

Setting

In a scenario the setting is inevitable. It is the setting that pinpoint where the use takes place, the surroundings that may influence the use and time of day and other elements of context that might influence the use.

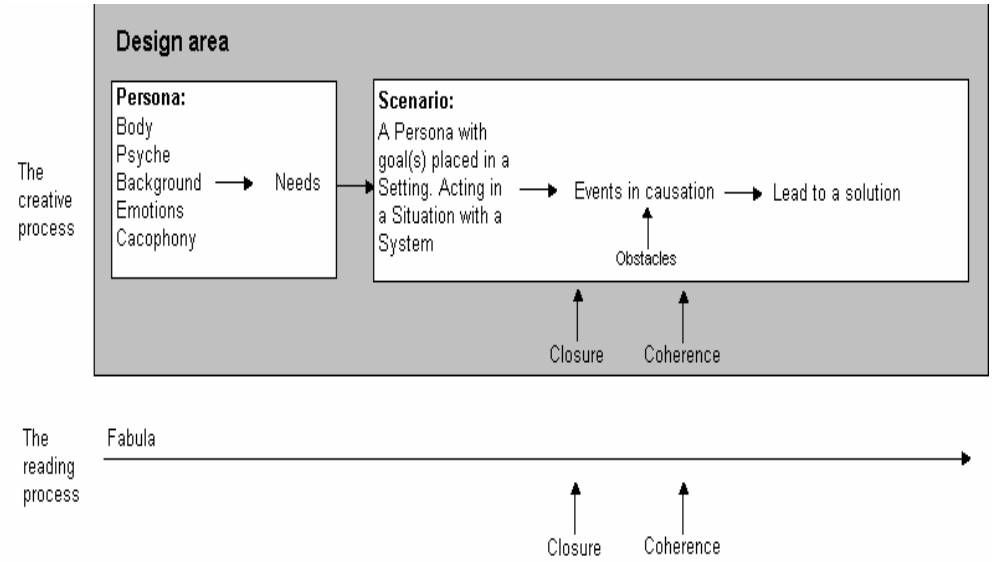
Closure, Resolution,

When a narrative resolves a conflict it achieves closure (Abbott 2002). Closure can be both for a single event and for the whole story. Resolution is one way of obtaining closure. When we read a story we want to have closure, to get answers to the questions and to see the end. (Brooks 1984).

Coherence

Coherence and continuity persuades us that the story is true. If it hangs together it is true (Abbott 2002). Coherence is extremely important for scenarios. It is very difficult to judge whether a scenario is true or not and coherence is the mean by which we judge. Coherence is not only valid for the story but also for the character, the setting and the actions.

A Model for Thoughts



The five areas of characteristics for the persona should be considered before writing. The characteristics reveal one or more needs when they are considered in the light of the design area. The needs undergo a transformation into goals when they are viewed in the light of the specific systems design. Each goal is the point of departure for the story and as such

the beginning of the scenario. The setting, the persona, the goals, and the situation is the motor the spins the story into a succession of events. Obstacles can disturb the events and spin the story in a new direction. At the end the story will reach a solution, either with a happy outcome or an unhappy one.

Closure and coherence should be considered in the creative process. Lack of coherence and closure disturb the story. It makes the reader infer actions that stems more from the reader's own imagination and area of knowledge than from a reference to field data.

Conclusion

With this model I hope to provide a guideline for the creative process of writing. But it should also be seen as a guide for what to look for in the field studies, what information we need about the users. In this model the users becomes much more than a vehicle to a system.

References

Abbott, H. P. (2002). The Cambridge Introduction to Narrative. Cambridge, The Cambridge University Press.

Bordwell, D. (1997). Narration in the Fiction Film. London, Routledge.

Brooks, P. (1984). Reading for the Plot - Design and Intention in Narrative. London, Harvard University Press.

Carroll, J. M. (2000). Making Use - scenario-based design of human-computer interactions. Cambridge, Mass, The MIT Press.

Cobley, P. (2001). Narrative. London, Routledge.

Cooper, A. (1999). The Inmates Are Running the Asylum. Indianapolis, SAMS.

Horton, A. (1999). Writing the Character-Centered Screenplay. L.A., University of California Press.

Nielsen, L. (2002). From User to Character. DIS2002, London.

Nielsen, L. (2003). Constructing the User. HCII2003, Crete, Lawrence Erlbaum Associates, Inc.

Pruitt, J. and J. Grudin (2003). Personas: Theory and Practice. **2003**.

Smith, M. (1995). Engaging Characters: fiction, emotion, and the cinema, Clarendon Press.

Ecological Cognitive Ergonomics

Rune Nørager

Institute of Psychology, University of Aarhus

Background.

Ecological Cognitive Ergonomics rests on two basic assumptions: 1) the human cognitive system has evolved to reflect physical reality in which we exist, hence the need for an ecological perspective. 2) the human cognitive system is optimized to deal with this reality, hence the need for an ergonomic perspective.

The physical reality is governed by natural laws which is also reflected in corresponding psychological cognitive laws and constancies that makes up the evolutionary foundation of human cognition. Research in infant cognition has clearly demonstrated how this foundation to some extent is hard-wired into the physiological makeup of the human brain (Spelke, 1998; Krøjgaard, 1999). The ability to deal with objects in four dimensional world of time and space makes up this basic cognitive foundation (Bærentsen, 2000). The brain is very efficient at this type of cognition. In contrast the resources for symbolic information processing and abstract logical thinking are very limited.

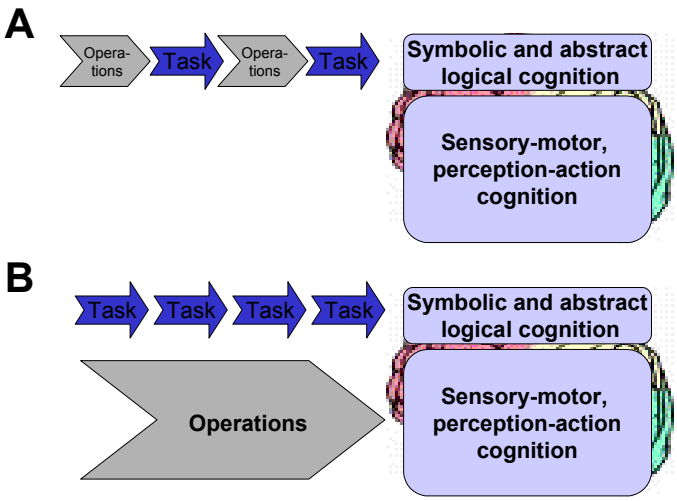
Much usability research is often deceived by the abstract logical problem solving capabilities that resides within our conscious focus. Cognitive capabilities within and outside the conscious focus are radically different (Spencer et. al. 1989, Hermer-Vazquez et. al., 1999). The premises and structure of the basic cognitive foundation is thus easily missed which creates a false foundation for the development of user interfaces.

The problem.

Programmed technology, i.e. technology that in one way or another contains software, represents a qualitative shift from other kinds of technology. With programmed technology a split between the physical object or tool and its logical functioning is separated. The user interface bridges this split.

Unlike other kinds of technology, *all aspects* of interaction between the logical functions of a machine and the user has to be created and dealt with explicitly in the user interface. The consequence is often 1) that aspects of

the interaction, which normally in ordinary technology is relegated to basic operational interaction styles, is represented in an abstract symbolical fashion. 2) The laws of the four dimensional world are not taken into account and hence not obeyed. Such situations are can be described as "magical" or "schizophrenic" (Mogensen, 1997). The implication for the user is that a large proportion of the user interaction is relegated to the rather limited recourses for abstract logical thinking. Basic trivial operations become the focus of our attention when they really should be supporting a more primary task (Figure A). Instead of a smooth interaction the interaction is broken up into sequences, where the user time and again has to figure out problems caused by what, in contrast to the dynamics of the four dimensional world, appears as magic.



Solution.

At the most general level the cognitive foundation of the four dimensional world is characterized by qualities like:

- Object permanence
- Causality
- Feedback
- Time
- Space
- Object identity.

User interfaces based on these characteristics will allow the user to utilize a larger proportion of the cognition resources available to him (Figure B).

Ecological Cognitive Ergonomics is centered around these characteristics and serves as a framework for the analysis of existing user interfaces and

provides very concrete guidelines for the creation of new ones. As a design tool it will provide a reference for what kind of information that must be communicated to the user, and how this can be done in a direct perceptible way that doesn't require symbolic or abstract logical thinking. As a design tool Ecological Cognitive Ergonomics will not limit or radically alter the design freedom of system and user interface developers. In stead it will suggest small and subtle but extremely essential changes or necessary additions to the interface.

Example.

In the Siemens SL45i mobile phone the listing of SMS messages in the inbox is controlled by rules and dynamics that are not transparent to the user i.e. is the message read or unread and time-stamp of message. The dynamics causes SMS messages to shift around according to multiple sorting mechanisms implemented in the software. The result are magical incidents where a trivial operational procedure becomes a challenge to the user unaware of the underlying dynamics. Laws of object permanence are compromised from the users point of view. From the Ecological Cognitive Ergonomic point of view the laws must either be obeyed or information about the controlling mechanisms conveyed to the user in a direct perceptible manner. This could have been achieved in several ways for example by 1) an animation of the resorting of SMS messages or by 2) adding distinctive object attributes in order to communicate an unique object identity.

Challenge.

With Ecological Cognitive Ergonomics it is not my intention to propose that user interfaces should be created in a one-one correspondence with the physical world such as contemporary real time shoot-em-up games are a good example of. The challenge is to uncover to what degree the governing laws can be abstracted and generalized into guidelines that can be implemented into user interfaces. The above mentioned characteristics of the four dimensional world are very general qualities, but the research in infant cognition has within the last 5-10 years managed to qualify these aspects with detail descriptions of their dynamics. The next step is to reformulate this work into an analytic framework and design tool. My own research focuses upon this task.

References

Bærentsen, K. B. (2000). Intuitive User Interfaces. *Scandinavian Journal of Information Systems.* Vol. 12, pp. 29-60.

Hermer-Vazquez, L., Spelke, E., Katsnelson, A.S.(1999). Sources of Flexibility in Human Cognition: Dual-Task Studies of Space and Language. *Cognitive Psychology, 39*, pp 3-36.

Krøjgaard, P. (1999). Spædbarnets erkendelse af objekters numeriske identitet. *Nordisk Psykologi, 51* (2), pp. 81-97.

Mogensen, J. (1997). Spædbarnet og den skizofrene. En verden til forskel. *Agrippa,* Vol. 18, pp. 22-35.

Spencer, C., Blades, M., Morsley, K. (1989). *The Child in the Physical Environment.* Bath Press, Ltd, Bath.

Spelke, E. S. (1998). Nativism, Empirism and the Origins of Knowledge. *Infant Behaviour & Development, 21,* (2), pp. 181-200.

Studying the integration of ICT infrastructures in problem-oriented project groups – a research proposal

Jens Kaaber Pors

Computer Science, Roskilde University

Introduction

The generic groupware application: BSCW is being made available to students as part of a major infrastructural development project to wire the campus-wide facilities at Roskilde University. An interdisciplinary group of local researcher has set out to follow and evaluate this development project and its repercussions. This paper describes a proposal for an empirical investigation of the integration of these ICT infrastructures with the work practices of students conducting problem-oriented work in project groups. The theoretical background and research questions of the research proposal are presented along with a discussion of methodological considerations.

An interdisciplinary research project entitled: 'RUC Online' running from 2003-2005 has been formed initially by researchers from the Institute of Communication, Journalism and Computer Science at Roskilde University (RUC). The purpose of this project is to follow, assess, and learn from a concerted, large-scale effort to provide comprehensive computer support for study activities at RUC. The facilities made available to the students include a campus-wide wireless network, a Web portal integrating institutional and personal links, and a generic CSCW system in form of the web-based groupware application BSCW for use in the students' projects. The RUC Online projects will investigate the introduction and adoption of these facilities as well as their social and study-related effects. The present paper describes a proposal for research to be conducted as part of of the overall research project.

Theoretical background

Within the HCI and CSCW research fields proximity and awareness through co-location have been identified as important circumstances for the establishment and maintenance of cooperative work e. g. (Belloti & Bly, 1996; Olson & Olson, 2000). The digital infrastructures currently being installed will allow students at Roskilde University to organise their work in

a different way resulting in new modes of employment related to the groupware. The study aims to uncover these locally achieved appropriations of the technology by studying them within a comprehensive perspective viewing to object of study as standardised packages comprising technological components coupled to modes of employment (Fujimura, 1987). The study is to analyse the disembedding of social relations and their rearticulation across different configuratons that takes place with the integration of groupware as an infrastructure for the work practices of the students in the project groups (Hayes, 2001).

Infrastructures for problem-oriented project group work

The education at Roskilde University is founded on an approach which regards problem-oriented project work as central (Olesen & Jensen, 1999). This kind of teaching and learning has been carried out with only modest support from ICT infrastructures such as word processors and e-mail. Only recently have so-called virtual project groups employing some kind of groupware technology have been organised as part of special courses and subjects, as reported in (Bjørn, 2003). This study and others conducted within the CSCW research field in corporate organisations (e. g. Pors & Simonsen, 2003) emphasise the importance of negotiation for the coordination of the activities of a group. The written word as the dominant form of communication mediated by groupware proves a serious challenge for this negotiation, since the immediate access to and feedback from co-located group members is an important resource for clarifying misunderstandings and coming to terms with the topic of the groups work i. e. agreeing on and creating a common interpretation of the formulation of the problem statement.

The system introduced to this practice called BSCW, which is an abbreviation of 'Basic Support for Cooperative Work' and is developed by the German research institute GMD (now Fraunhofer-Gesellschaft www.fraunhofer.de) as a research prototype employed among other places in the central administration located in both Bonn and Berlin after the reunion (Pipek & Wulf, 1999). Through several iterations and versions the groupware system developed into a web-based generic application (Bentley, Horstmann & Trevor, 1997). The application is available through the Internet (via bscw.gmd.de). Roskilde University has had an instantiation of the software running since the year 2000. Now as part of the efforts to wire the whole campus the groupware is made available to all students and faculty and packaged with the other initiatives, such as the web-portal that provided easy access to BSCW along with the resources of the library, etc.

The research question posed by this study: "How is generic groupware integrated in problem-oriented group work?" is answered by investigating the contents of the standardised packages by describing the relations of a specific technology and the practices of students carrying out problem-oriented project group work. The ensemble of technological and infrastructural components thus consist of several overlapping infrastructures, since the groupware technology is used alongside a host of other technologies employed to coordinate the activities in the projects of the students, such as e-mails, instant messaging, mobile phones, etc. The study aims to track how the employment of the specific technological ensembles unfolds and to what degree they involves groupware.

Methodological considerations

To avoid the much hyped euphoria over virtual universities and the like or the conservative insisting on the primacy of the face-to-face learning, the study has no taken for granted assumptions on the role of ICT for education. Instead an exploratory agenda is pursued to investigate and asses the relevant place for the kind of facilities that groupware technology provides and also follow the development activities related to the BSCW system within the centrally organised IT Operations responsible for the tailoring of the generic system to the particularities of a Danish university as well as the locally achieved work-arounds in the specific project groups. The study will combine and contrast qualitative and quantitative research methods and techniques. In collaboration with other researchers within the RUC Online project surveys will be conducted in the form of questionnaires regarding the pre-conditions and expectations of the students and analysis of log-files from the BSCW-server will render a 'big picture' of the actual use. For more detailed accounts of the actual use practices and the context of the employment of the groupware, fieldstudies based on participant observation in a selected project groups, interviews with project members and document analysis of the artefacts employed in project work (whether or not they are circulated via the groupware application) will be carried out. Experimenting with prototypes of design solutions is also under consideration as a way to generate experiences and ideas regarding different ways of integrating groupware as an ICT infrastructure in students project work.

Juxtaposing the result of both kinds of analysis will make the implementation of the groupware system and the evolving ways of employing it in practice available for enquires, that brings about an understanding of the place of groupware and other ICT infrastructures in the situated practices of problem-oriented group work.

References

Belloti, V., & Bly, S. (1996). "Walking Away from the Desktop Computer: Distributed Collaboration and Mobility in a Product Design Team" Paper presented at the CSCW'96.

Bentley, R., Horstmann, T., & Trevor, J. (1997). "The World Wide Web as enabling technology for CSCW: The case of BSCW" Computer Supported Cooperative Work (JCSCW) 6(2-3), 111-134.

Bjørn, P. (2003). "Re-Negotiating Protocols: A Way To Integrate GroupWare in Collaborative Learning Setting" Paper presented at the ECIS 2003.

Bowker, G. C., & Star, S. L. (1999). Sorting things out: Classification and its consequences. Cambridge: MIT Press.

Fujimura, J. (1987). "Constructing 'Do-able' Problems in Cancer Research: Articulating Alignment" Social Studies of Science 17, 257-293.

Hayes, N. (2001). "Boundless and bounded interactions in the knowledge work process: the role of groupware technologies" Information and Organization 11(1), 79–101.

Olesen, H. S., & Jensen, J. H. (Eds.). (1999). Project Studies – a late modern university reform? Roskilde University Press.

Olson, G., & Olson, J. S. (2000). "Distance Matters" Human-Computer Interaction 15, 139-178.

Pipek, V., & Wulf, V. (1999). "A Groupware's Life" Paper presented at the ECSCW´99.

Pors, J. K., & Simonsen, J. (2003). "Coordinating Work with Groupware. The Challenge of Integrating Protocol and Artefact" Paper presented at WG8.2 & WG9.4 Working Conference on Information Systems Perspectives and Challenges in the Context of Globalization.

Affective Computing used in an imaging interaction paradigm

Nette Schultz
CTI, Technical University of Denmark
Bldg. 371, DK-2800 Kgs. Lyngby, nette@cti.dtu.dk

Introduction

This paper combines affective computing with an imaging interaction paradigm. An imaging interaction paradigm means that human and computer communicates primarily by images. Images evoke emotions in humans, so the computer must be able to behave emotionally intelligent. An affective image selection agent developed within this paradigm is presented and evaluated.

Affective Computing

In different branches of computer science and related sciences, the word "emotions" begins to emerge. To model and use emotions may be beneficial when we are dealing with interaction between a human being and some kind of computer application/appliance. Some of the involved branches are pattern recognition, cognition and human-computer interaction, where researchers develop applications as for instance intelligent agents, personal digital assistants, wearable computers and retrieval of data from multimedia databases.

Why model emotions people ask! The answer is a question: What else do we know of, in terms of model theory, which may be able to behave intelligent? What is it that makes intelligence, and what is intelligence? Is intelligence rational? Why is it so, that emotional inhibited persons, for instance people which have been disconnected to some basic emotions caused by brain damage, can not behave rational and learn from the mistakes they make? To regard emotions and rationality as being opposite to one another is a very rough simplification. Emotions are a very important factor, when the rational room, our cognitive mind, is filled with decisions and rules. Rational behavior may be regarded as a multidimensional stochastic emotional model, where the training data are actions and events in life. So if we want an intelligent system, which behaves rational and predictable, we can start by developing and exploring emotional models.

In human-human communication emotions are a significant factor, therefore it is obvious, that human-computer communication is to some degree

inhibited, when the computer does not "know" about emotions. When a computer becomes able to perceive, operate with and express emotions, it can carry out more human related tasks than today's computers.

In affective computing emotional models are used for enabling the computer to perceive, "have" and express emotions (Picard, 1998). To model and use emotions in a computer is still a relatively new area, but it may be the way to go, if we want more user friendly and intelligent computer devices.

The imaging interaction paradigm

A human beings sight is a dominating sense among our five senses. Therefore it is interesting, to explore how images evoke emotions in people. An imaging interaction paradigm may be understood as a paradigm, where the interaction and communication is based on images. Images are used as communication language, where emotions and mood are embedded. Users and computers communicate emotions and moods through images. "A picture tells more than thousand words" as a saying goes. Images are already used today when people are sending pictures and emoticons by e-mail, and present themselves, companies or organizations through homepages using images. The dominating interaction modes (Preece et al, 2002) in this paradigm will probably be activities like conversing, exploring and browsing.

When dealing with digital intelligence, we have to use some kind of quantitative methodology to analyze and classify images. With inspiration from the content analysis method (Van Leeuwen and Jewitt, 2001) we can introduce categorical content variables describing the content of the images. Statistical image analysis can be used to get color, texture and object information from the images.

Case: An affective image selection agent

In Murillo (2003) statistical algorithms have been used to develop an affective image selection agent. The image selection agent gives the user an image, which is supposed to resemble the user's mood; furthermore the user can put new images into the agent's database.

The dataset, on which the algorithms are trained, consists of 400 images from the International Affective Picture System (IAPS) CSEA-NIMH, 1999, which have been rated under controlled experiments (Lang et al, 1999) in terms of the affective variables valence (pleasure), arousal (excitation) and dominance (attention).

The images have been categorized by a content variable. They look like the following examples:

Animals (75) Food (34) Landscapes (70)

Objects (69) People (98) Sports (51)

The goal is, to explore whether it is possible to develop an intelligent agent being able to classify and select images, in accordance to the emotions they evoke on users. Murillo (2003) has analyzed the data using several categorical content variables, color statistics, emotions and moods as variables. The statistical algorithms used have been principal component analysis, Bayesian discriminant analysis and neural networks. The neural network, a probabilistic neural network using radial basis functions (Matlab 6.5.0), has shown best performance. The data have randomly been divided into training and test set and the error rates are in the range 0-38%. This error rate seems reasonable for a first prototype.

Conclusions

Affective computing can be used within the imaging interaction paradigm in order to enhance human-computer interaction and computer mediated communication. Communication through images is highly emotional, and by using affective computing the human-computer interaction will be able to become emotionally intelligent.

In the case study, an affective image selection agent has been presented. The application is at an early prototype level, and can therefore not be expected

to perform optimal, but the present results in terms of error rates and application structure are promising.

Acknowledgments

Special thanks should go to my former student Ana Cristina Murillo Arnal for her work with the affective image-selection agent during her master thesis project.

References

Center for the Study of Emotion and Attention [CSEA-NIMH] (1999). International affective picture system: Digitized photographs. Gainesville, FL: The Center for Research in Psychophysiology, University of Florida.

Lang, P.J., Bradley, M.M. & Cuthbert, B.N. (1999). International affective picture system (IAPS): Instruction manual and affective ratings. Technical Report A-4, the Center for Research in Psychophysiology, University of Florida.

Van Leeuwen, T. and Jewitt, C. (ed.) (2001). Handbook of Visual Analysis. SAGE Publications.

Matlab 6.5.0 release 13. Documentation.

Murillo Arnal, A.C. (2003) Artificial intelligence using probabilistic models (Affective image-selection agent). Master thesis from CTI, Technical University of Denmark.

Picard, Rosalind (1998) *Affective Computing*. The MIT Press, Cambridge Massachusetts.

Preece, J., Rogers, Y. and Sharp, H. (2002) Interaction Design: Beyond Human-Computer Interaction. John Wiley & sons, Inc.

From Systems Design to CSCL?

Jesper Simonsen

Computer Science, Roskilde University, Denmark
simonsen@ruc.dk
www.ruc.dk/~simonsen

Introduction

My main research interest is the study of work practices of users and designers for the purpose of offering theories and methods for systems design in an organizational context. My research area is Information Systems (IS) including Human Computer Interaction (HCI), Computer Supported Cooperative Work (CSCW), and Participatory Design (PD). My research has been focused on interdisciplinary, empirically based studies, conducted by action research and case studies approaches in cooperation with industries including the Danish Film Board, the Danish Broadcasting Corporation, WM-data, Nordea, Bombardier. In this paper I describe my research experiences as well as current and future research activities.

MUST

A major part of my research has been devoted to the MUST research program, which I, in cooperation with Finn Kensing and Keld Bødker, conducted throughout a ten year period, 1991-2000, and which has resulted in a method for participatory design [2.3; 4.1; 5.1]. During the MUST program, we conducted 13 empirical projects all engaging an action research approach. The purpose of the MUST program was to develop theories of and approaches to what we define as IT design. An IT design project runs the course from the emergence of the first idea involving change in a company to the development of a cohesive vision for overall change. In my opinion, this is the most critical, complex, and challenging part of the systems development life cycle. It requires strong interdisciplinary skills, since it is completely dependent on the situation and organizational context and involves issues covering (and combining) the spectrum of IT development, organizational change, and qualifications related to human resources.

Within the MUST program I have been focused on PD/HCI approaches, including ethnographically inspired techniques [2.1; 2.4], strategic alignment [2.5], and large scale CSCW related initiatives [2.2].

Ethnographically inspired techniques were developed in cooperation with Lucy Suchman's research group at Xerox PARC, and approaches to strategic alignment was developed in cooperation with Kjeld Schmidt and Peter Carstensen, based on Kjeld Schmidt's work analyses.

DIWA

In parallel with ending the MUST program in 2000, I begun a three year interdisciplinary research program, the DIWA program (Design and use of Interactive Web-Applications) ending ultimo 2003. The participants in DIWA are a group of 8 Danish senior researchers and 8 Ph.D. students from Roskilde University (hosting 2 seniors and 5 PhD's), Copenhagen University, The Danish Technical University, and The IT University of Copenhagen working in cooperation with 6 companies.

The theme of the DIWA program is design, management, and use of interactive Web-applications in distributed work settings, i.e. as an IT platform for collaborative, distributed work inside an organization (intranet) or between organizations (extranet). The program is based on the assumption that the development of such interactive Web-applications introduces new managerial and technical challenges that most organizations and their IT departments have difficulties coping with.

DIWA researches a new area within systems development in an organizational context, since web-based applications opens up for new ways of communicating in organizations. The design, management, and configuration of the applications to a large degree are not handled by IT specialists, among others, due the generic character of these technologies. The structure and content of the information to a large degree is managed by the users of the application.

The research approach has mainly been a case study approach. The research methods applied have been a combination of qualitative and quantitative approaches including interviews, document analysis, surveying, and datamining of http log transactions. My empirical work has been concentrated on projects conducted in collaboration with Nordea, studying deployment and organizational implementation of groupware in the form of a generic web-based CSCW technology (Lotus QuickPlace) used in geographically distributed settings. Most of the results of this empirical work is still in progress and comprise the following:

- Eliciting general factors influencing the integration of groupware by using the theoretical CSCW framework of coordination mechanisms [3.11].

- Defining conditions for change and developing management strategies related to deployment of groupware in distributed organizations [3.13].

- Developing a general model explaining interdependent conditions for integrating generic groupware in collaborative practice within virtual teams [3.14].

- Investigating and evaluating using quantitative http log analysis as an approach to studying the use of groupware [4.4]

Future Research

The DIWA program has further broadened my research horizon within IS to include a deeper concern for CSCW and include related areas within KM and CSCL. I plan to continue this avenue within the final part of the DIWA program especially by working on the issues listed above.

Lately, I have been introduced to the RUC Online project (2003-2005). The purpose of this project is to follow, assess, and learn from a concerted, large-scale effort to provide comprehensive computer support for study activities at Roskilde University. The facilities made available to the students include a campus-wide wireless network, a Web portal integrating institutional and personal links, and a CSCW system for use in the students' coursework and projects. The RUC Online projects will investigate the introduction and adoption of these facilities as well as their social and study-related effects, thus empirically focusing on CSCL issues.

References

(Numbers refer to publication list on www.ruc.dk/~simonsen)

2.1 Simonsen, J. and F. Kensing (1997): "Using Ethnography in Contextual Design", *Communications of the ACM*, Vol. 40, No. 7, July, pp. 82-88.

2.2 Kensing, F., J. Simonsen, and K. Bødker (1998): "Participatory Design at a Radio Station", *Computer Supported Cooperative Work*, Vol. 7, No. 3-4, Kluwer Academic Publishers, pp. 243-271.

2.3 Kensing, F., J. Simonsen, and K. Bødker (1998): "MUST - a Method for Participatory Design", *Human-Computer Interaction*, Vol. 13, No. 2, Lawrence Erlbaum Associates, Inc., pp. 167-198.

2.4 Simonsen, J. and F. Kensing (1998): "Make Room for Ethnography in Design", *ACM-SIGDOC Journal of Computer Documentation*, Vol. 22, No. 1, February, pp. 20-30.

2.5 Simonsen, J. (1999): "How do we take Care of Strategic Alignment? Constructing a design approach", *Scandinavian Journal of Information Systems*, Vol. 11, pp. 51-72.

3.11 Pors, J.K. and J. Simonsen (2003): "Coordinating Work with Groupware: The Challenge of Integrating Protocol and Artefact", in M. Korpela, R. Montealegre, and A. Poulymenakou (Eds): *Organizational Information Systems in the Context of Globalization*, Kluwer Academic Publishers.

3.13 Simonsen J. and J. K. Pors (2003): "Conditions for Change Related to Groupware in a Distributed Organization – a Case Study", in C. Ciborra et al. (Eds.) *Proceedings of the 11th European Conference on Information Systems, ECIS'2003: New Paradigms in Organizations, Markets and Society*, 19.-21. June 2003, Naples, Italy.

3.14 Bjørn, P. and J. Simonsen (2003): "Teams of Practice: Interdependent Conditions for Integrating Groupware in Collaborative Practice within Virtual Teams", *Proceedings of the 26th Information Systems Research Seminar in Scandinavia, IRIS 26* - Scandinavian Approach to IS Research?, August 9-12, Haikko Manor, Finland.

4.1 Bødker, K., F. Kensing, and J. Simonsen (2004): *Participatory IT Design. Designing for Business and Workplace Realities*. MIT press.

4.4 K. Bøving and J. Simonsen (forthcoming): *http log analysis as an approach to studying use of IWAs*. Paper in progress.

5.1 Bødker, K., F. Kensing og J. Simonsen (2000): *Professionel IT-forundersøgelse - grundlaget for bæredygtige IT-anvendelser*. Samfundslitteratur.

Combining participant-observation and questionnaires to determine differences in cultural values between Denmark and the Philippines

Georg Strom

DIKU, University of Copenhagen, Universitetsparken 1, 2100 Cph. O.,
georg@diku.dk

Introduction

It is necessary to take differences in cultural values into account when software is exported or when development or information processing is out-sourced to an area with another culture.

I will demonstrate how it is possible to overcome limitations of some of the current investigations of cultural differences:

- Marcus et al (2003) have tried to deduct a number of cultural preferences of relevance for interface design from Hofstede's (2000) major study of five cultural characteristics. However, Marcus et al (2003) describe that their work until now has been unsuccessful.
- Singh and Kotze (2003) try to measure cultural values of interest for interaction design by asking to what extent their participants agreed with a number of statements. However, Nisbett (2003) notes that method may be unreliable, because the statements are interpreted according to the different cultural background of the participants.

Method

Hofstede (2001) recommends that any investigation of cultural characteristics employs provoked verbal responses, as for instance questionnaires or interviews, and at least one other type of measurements, for instance direct observations of peoples' behavior. Direct observations are subjective and open to interpretation, whereas provoked verbal responses do not always give a valid insight into the cultural values of the participants.

In 2003 I stayed 9 weeks near Dipolog, in the Southern Philippines. My stay made it possible as the unprovoked method to use participant-observation, i. e. "...spending a great deal of time with and participating in the everyday life of the natives (Nardi 1997). I identified three cultural aspects relevant for software design and with apparently significant differences between Danish and Philippine values.

Based on the participant-observation I designed a questionnaire that explored attitudes towards the identified cultural aspects. In order to make the interpretation of the questions as culturally independent as possible, the questionnaire described a number of specific situations and five possible reactions. Each participant was asked to select the reaction he or she would make in each situation. The questionnaire was answered by fourteen Filipino participants, thirteen students and one recent graduate, and by nineteen Danish students (after my return to Denmark).

Results

The participant-observation identified value differences on the following topics: Privacy, reliability and honesty. In this paper I will only describe the results as regards privacy in details.

During the participant-observation I observed that privacy was taken much less seriously in the Philippines than in Denmark, Some examples:

- At a Danish university student grades are not even displayed on a bulletin board. In contrast, Philippine newspapers published lists of students with their grades, even for those who barely passed the exam.
- In Philippine banks there were two chairs next to each bank clerk. The next customer sat down in the second chair where he or she easily could follow the transaction. In contrast, customers in a Danish bank wait where they cannot follow an ongoing transaction.

Type of situation ↓	Phil.	DK	Diff.	Expected from obs.
Friend passes on private information	2.6	3.3	-0.7	Phil < DK
Friend gets private information without permission	4.5	4.3	0.2	Phil < DK
Peers have access to personal e-mails	**3.1**	**4.5**	**-1.4**	Phil < DK
Boss have access to personal e-mails	4.0	3.5	0.5	Phil < DK
Publication of phone numbers and vital data	**1.5**	**3.5**	**-2.0**	Phil < DK
Police have access to text messages	**2.6**	**3.5**	**-0.8**	Phil < DK
Privacy total	**2.5**	**3.6**	**-1.1**	*Phil < DK*

Table 1: Privacy results from questionnaire. One is the most positive emotional reaction, five is the most negative. Statistically significant differences (>95 tested in normal distribution) are highlighted.

Expected from observation →	Negative difference		Positive difference	
Results in questionnaire ↓	All	Stat. Sign.	All	Stat. Sign.
Confirming observations	10	5	3	2
Contrary to observations	4	0	1	1

Table 2: Overview of all results (privacy, reliability and honesty). Stat. sign. indicate > 95 % tested in normal distribution.

Discussion

It is necessary to take into account that Philippines has large regional and income differences. The study was done with middle class students in a provincial area, and the results may for instance not be valid for upper-class students at a top university.

In situations where privacy is breached but with no description of direct negative consequences (situations 3, 5 and possibly 6) the responses in Philippines is significantly more positive than in Denmark. See table 1. However, the results also indicate that a breach of privacy that includes a breach of trust is regarded as negatively in Philippines as in Denmark (situations 1, 2, and possibly 4). That may be related to results indicating that Filipinos on a personal level react more negatively towards breaches of honesty than Danes.

The groups of participants in Denmark and Philippines were homogeneous and similar as regards age and level of education, and the participant-observation made it possible to design questions in English that were meaningful for participants in Philippines and in Denmark.

A test shows a > 90 % probability that none of the significant differences were generated by chance. Of the 8 significant differences, 7 confirmed the results of the participant-observation, a > 95 % confirmation of the results.

It is unlikely that the participants in one country had a tendency to choose more positive or polite reactions than participants in the other. There is no large discrepancy between the proportion of confirmed positive and confirmed negative differences, see table 2, and the averages of confirmed positive and negative observations are the same for Denmark and Philippines.

A comparison between the results of the questionnaire and the participant-observation indicates *possible error sources that shall be taken into account when studying cultural values through observation. The observer may:*

- Perceive differences because he or she is not doing the same things as at home, or because the observer is looking for differences.

- Observe actions without considering to what extent they are governed by external circumstances.
- Try to deduce values instead of observing people's actions. It is possibly that the reasoning of the observed person is different from the observers.

When comparing the results from the participant-observation and the questionnaire, all contradictory or not significant results on reliability and honesty can be attributed to these error sources.

Conclusion

The investigation shows that privacy in itself is much less important in Philippines than in Denmark. Danish precautions to protect private information may appear unnecessarily cumbersome in Philippines (even though they may be necessary), and when out-sourcing software development or information processing, it is necessary to take the different attitudes towards privacy into account.

The investigation identifies a number of possible sources of errors and ways of reducing their impact, and it demonstrates how it is possible to get a more reliable determination of cultural values by using a combination of participant-observation and questionnaires.

Acknowledgements

To Arlene Y. Cinco, Polanco, Philippines, for her assistance, and to Kasper Hornbæk, University of Copenhagen, for his comments to the paper.

References

Hofstede, Geert (2001): Culture's consequences, Sage Publications, London

Marcus, Aaron, Valentina-Johanna Baumgartner & Eugene Chen (2003): User Interface Design & culture, in Human-computer Interaction, Theory and Practice (Part II) Volume 2, ed. by constantine Stephanides & Julie Jacko, Lawrence Erlbaum Associates (proc. of HCII 2003)

Nardi, Bonnie A. (1997): The Use of Ethnographic Methods in Design and Evaluation, in Handbook of Human-Computer interaction, ed. by M. Helander, T. K. Landauer & P. Prabhu

Nisbett, Richard E. (2003): The geography of thought, Nicholas Brealey Publishing, London

User Interfaces for Automated Reasoning Systems

Jørgen Villadsen

Computer Science, Roskilde University, Denmark

The ease of use of automated reasoning systems is perhaps lower than for any other type of computing system available! In general, while anyone can use a word processor, almost no one but an expert can use a proof checker to check a difficult theorem. Perhaps this can be explained by the fact that the designers of such systems have had to put so much of their energies and attention into rigor, that they simply did not have enough energy left for good interface design.

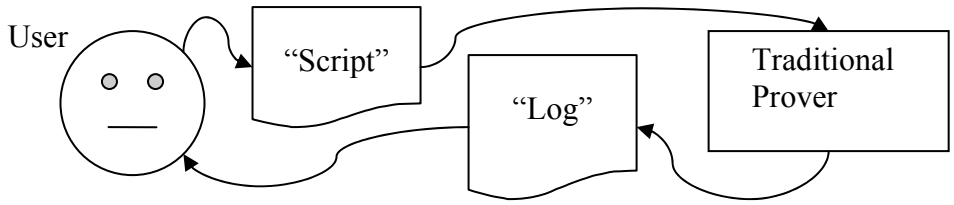
Anonymous (1994). *The QED Manifesto.* Springer LNCS 814: 238-251.

Introduction

The QED Manifesto as quoted above describes a future where much, if not all, of mathematics and (theoretical) computer science are formally verified by automated reasoning systems. Our aim is to survey the situation today and outline our views on the approaches to user interfaces for such systems.

The growing criticality and complexity of computer applications is well-known and for safety and/or security there is no substitute for formal proofs, cf. NASA's "Formal Methods Specification and Verification Guidebook" at http://eis.jpl.nasa.gov/quality/Formal_Methods. Hence we here focus on completely formal reasoning systems, or provers, thereby excluding simpler tools for type inferences, term manipulations, etc. According to e.g. Wiedijk (2003) there are about 15 mathematical provers in the world (plus variants). We emphasize that it is not the idea to automate the search for proofs as such - but once a proof is found, the prover must verify it automatically.

We illustrate below the usual situation 10-20 years ago: The user executes a script with goals, i.e. alleged theorems, and commands to guide the proof search. A common way to signal that the prover has verified the theorem is by printing "No subgoals left!" in the log. The user interface is very limited.



Today: Generic Declarative Interactive Provers

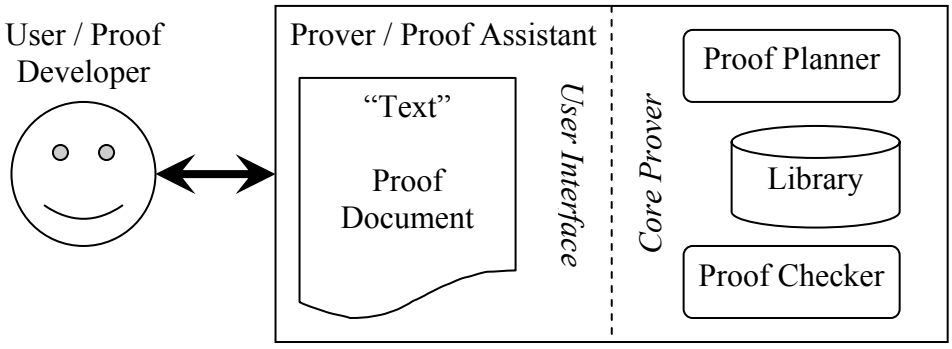
In order to support more difficult proofs we identify three improvements:

Generic. The first formal logics for mathematics were found 100 years ago. In computer science there are now many logical languages; even more choices than for programming languages, or word processor file formats. New logics are continuously invented since it is important for proof development to have a logic of the right power and ease of use. Since the construction of provers is hard, generic provers like Isabelle (Paulson 1989) that can handle multiple logics are most welcome. By default Isabelle has a higher order logic, which includes ordinary mathematics such that e.g. the floating point algorithms in Intel chips can be verified (Harrison 2000) while allowing for a simple semantics based on semiotics (Villadsen 2000).

Declarative. A shortcoming with the traditional "loop" situation mentioned in the introduction is that the proof cannot really be understood without executing the script and inspecting the log. In recent projects like Isar, "Intelligible Semi-Automated Reasoning" (Wenzel 1999), the scripts are more or less replaced by declarative proof documents, or texts. Isar is generic too since it can be adapted to multiple provers. The picture on the next page shows part of the Isabelle/Isar text in the "Group.thy" theory file.

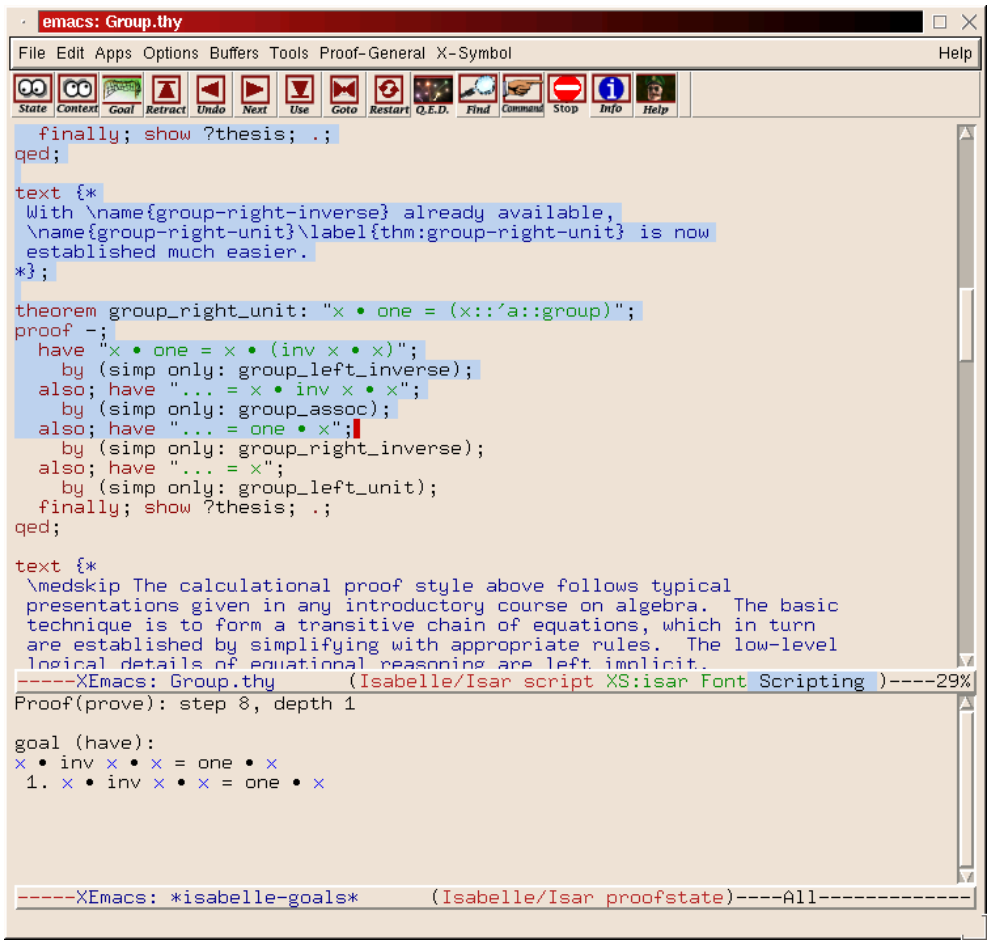
Interactive. The proof development with these declarative texts is best seen as an advanced kind of text editing. Nipkow (2001) verified a part of Java (the bytecode verifier), resulting in an Isabelle/Isar text of several thousands lines developed over long time. As a case study we shall in the following consider Proof General - a generic user interface for provers, based on the customizable text editor Emacs. It has been developed under that name since 1998 and is distributed under the GNU General Public License (GPL).

We illustrate below the architecture with some additional components, e.g. the library that may consists of more than one million lines (Wiedijk 2003).



Case Study: Proof General

The following snapshot from Aspinall (2000) shows the Isabelle/Isar text with the marked lines locked (constituting the script) and below that the proof state with the list of remaining subgoals (corresponding to the log). Integrated TeX document preparation instructions are also shown in the text.



The toolbar has 15 buttons with small icons for often-used user interactions:

State (eyes looking down) and *Context* (eyes looking up) provide further details about the proof state and context. *Goal* (soccer goal - perhaps not recognizable on the snapshot) allows new goals to be entered in the text.

Retract, *Undo*, *Next*, *Use*, *Goto*, and *Restart* (various arrow symbols like on a tape recorder) control the script management in smaller or larger steps. *Q.E.D.* (fireworks) abbreviates *Quod Erat Demonstrandum* (Latin “which was to be demonstrated”) and is used to finalize the proof.

Find (magnifying glass) and *Command* (pointing finger) assist the user in the proof development. *Stop* and *Info* (traffic signs) interrupt the proof search and provide various information, respectively. Finally *Help* (the official project logo: a military officer) offers general help. The use of color schemes and mathematical symbols like "•" makes it all more user friendly.

Conclusions

The overall impression from the case study of Proof General is that even this state-of-the-art interactive prover has a quite primitive user interface, mainly due to the Emacs setup. Generic provers like Isabelle that handle multiple logics have been used for a few decades, but generic user interfaces like Proof General are recent. The generic approach with declarative texts in Isar with high-level declarations rather than low-level commands - that must be executed by a prover to be intelligible - enable better user interfaces too.

These generic approaches are promising, both from a conceptual and a technical point of view, because often native user interfaces are extremely time-consuming to build and master. Although mathematical provers are surely not word processors, the *QED* future may not be far away with more research on improved user interfaces for automated reasoning systems.

Acknowledgements

This research was partly sponsored by the IT-University of Copenhagen.

References

Aspinall, D. (2000). *Proof General: A Generic Tool for Proof Development.* Springer LNCS 1785:.38-43.

Harrison, J. (2000). *Formal Verification of Floating Point Trigonometric Functions.* Springer LNCS 1954, pp. 217-233.

Nipkow, T. (2001). *Verified Bytecode Verifiers.* Springer LNCS 2030: 347-363.

Paulson, L. (1989). *The Foundation of a Generic Theorem Prover.* Journal of Automated Reasoning 5: 363-397.

Villadsen, J. (2000). *Logic based on Semiotics.* Congress of Nordic Association for Semiotic Studies, F. Stjernfelt et al. (Editors), University of Copenhagen, Denmark: 39-40.

Wenzel, M. (1999). *Isar - A Generic Interpretative Approach to Readable Formal Proof Documents.* Springer LNCS 1690: 167-184.

Wiedijk, F. (2003). *Comparing Mathematical Provers.* Springer LNCS 2594: 188-202.

Legibility of text meant to be read from a computer screen - a key factor in e-publishing

Niels Erik Wille

Dept. of Communication, Journalism and Computer Science
Roskilde University

The present development in computer mediated communication has to face a paradox: Items previously published in print are expected to migrate to electronic formats such as web-postings meant for online reading, and utilizing features such as hypertext, while both practical experience and the advice given by design gurus point to the fact that readers don't want to read longer texts from a computer screen, or as Jakob Nielsen succinctly puts it: "How Users Read on the Web. The Don't." (Nielsen, 1997)

The difficulties getting e-publishing beyond the point where it equals online distribution for local printing, are very narrowly linked with the issue of sustained reading from some sort of computer screen.

A survey of previous research shows that quite a lot of has been carried out in this area, and that most of it has been forgotten or ignored in actual design practice. One result though seems to have survived: That reading from a screen is 25 percent slower than reading the same text in printed form. And the corollary from this finding is that texts meant for online reading should be shorter that texts meant for print reading. Jakob Nielsen refers to this result several times, e.g. in (Nielsen, 2000, p. 101): "Research has shown that reading from computer screens is about 25 percent slower than reading from paper." No source is provided here, but in (Nielsen, 1995, p. 154-56) the research is referred in more detail. It turns out that it is based on a series of empirical tests reported in 1984 and 1987, and carried out by researchers affiliated with IBM and others (Gould & Grischkowky, 1984; Gould et al., 1987; Wilkinson & Robinshaw, 1987)

The dates of this research ought to have started off alarm bells. The Apple Macintosh was launched in 1985 and the first version of Windows in 1987. But it wasn't till version 3.1 of Windows that this GUI was working well and got a wider distribution. The graphical version of the first web browsers, Mosaic, was released in 1993. So the research referred to by Jakob Nielsen, was carried out with text based terminals (typically 12" screens) and not with modern PC's with GUI's and high resolution screens (size 15" to 17").

An important exception was Muter & Marutto (1991). They used a Macintosh IIX with and RGB monitor (resolution 640*480 and a refresh rate of 66,7 Hz). The screen was 23,5*17,6 cm (a 12" screen) and the actual page 20,5*13,5 cm (slighter smaller than an A5 page in landscape format). The line length was 82 characters, but each sentence was presented separately and separated with an empty line. The full text was 12 screens long. The printed text was 10 pages long with 41 lines á 60 characters (10 pts.) per page (10,5*17 cm). The experiment demonstrated no significant difference in reading time. This result has been supported by later research (e.g. Muter 1996. See also Tullis, Boynton & Hersh, 1995), but is ignored by Jakob Nielsen.

Andrew Dillon did a very valuable survey of previous research in (Dillon, 1994). His discussion, which includes (Muter & Marutto, 1991), opens up the possibility of further progress involving better design principles and software, as well as solutions to problems related to the hardware as such. And one conclusion is that existing research does not at all confirm that reading from a screen is necessarily slower or more tiring than reading printed matter.

On the other hand is seems an indisputable fact that users don't like sustained reading of longer texts online, that is from a computer screen. So explanations are to be sought in other areas. Andrew Dillon subtitled his study *Ergonomic Aspects of Human Information Usage*, thereby relating his work on usability factors to the field of ergonomics.

Studies of general ergonomic aspects of working with computers are obviously relevant. A series of technical studies led in the early 1990's to formulation of guidelines for computer based work places. In Denmark this was done by Arbejdstilsynet in regulations published in 1992, and supplemented in 2001. The guidelines are not aimed at sustained reading as such, but at work tasks such as text processing, proofreading, getting information from online databases etc. The guidelines address problems of working with texts in an environment where it is not possible nor suitable to print out the text and doing the reading from paper rather than from the screen.

A number of hazards are identified that are obviously important to the issue of possible fatigue or just lack of comfort associated with sustained reading from a screen: The symptoms are strain of the eyes, tensions and pain in muscles of the neck, shoulder and arm, pain in the back and legs etc. The factors identified are

- **Light** from windows and lamps, creating low contrast and reflexes.

Difference in light between screen and paper when the eyes moves between the two (relevant when keying in text and proofreading)

- **Distance** between eye and screen (including problems with glasses not adjusted to the special distances typical of screen reading). Fixation of the eyes at a particular line or area of the screen.
- **Reading position**. Relative position of chair, screen, keyboard, mouse, table etc. Strains on e.g. arms in activating and navigating the text.
- **Screen properties**: Size, Resolution, Light. Contrast. Flicker (refresh rate). Sharpness of lines.
- **Text properties**: Text style. Letter size (font size). Line length (in cm and number of characters). Space between lines ("leading"). Contrasts between letters and background.

The first three are of course of general relevance to the problem, while the last two are more specific.

The ergonomic guidelines are in accord with the extensive research carried out in the area of legibility of printed text. The core publication is (Tinker, 1963) but the results have been confirmed by others (cf. Reynolds & Simmonds, 1981; Hartley, 1994; Pedersen & Kidmose, 1993; Rubinstein, 1988; Horton & Lynch, 2001).

It is of course not possible to directly transfer the results from printed texts to computer screens, but it is possible to compensate for key differences such as differences in reading distances, screen format (typically landscape) versus paper formats (typically portrait), text size, colour, contrast and sharpness in the screen environment etc.

We are talking again about well established and research supported knowledge that is easy to adapt in preparing text for on-screen reading. Further research is probably needed to refine this, but first and foremost research seems to needed in order to demonstrate how this knowledge is systematically ignored in actual practice. And perhaps research may be needed in order to convince designers that we are talking about a serious problem that holds back a development that is actually wanted and supported for instance in the information policy adopted by the Danish government.

To take but a few examples:

Text size

Both Tinker's research and the guidelines adopted by Arbejdstilsynet point to the fact that text size is a crucial factor in legibility and the strain put on the eyes and visual perception in the reading process.

Tinker demonstrated that optimal text sizes where between 9 and 12 typographical points (as measured on the total height of the letters, including descenders and ascenders and normal leading). This applied to a typical reading distance of 25-35 cm. 9 typographical points equals 3,15 mm while 12 pts equals 4,2 mm.

The ergonomic guidelines demand a minimum text size of 4 mm measured as capital letter size, and preferably larger. In typographic measures this would be something like 17 pts. The size is meant for a reading distance of 50 - 70 cm. The result is supported among others by (Snyder, 1988) who actually recommends text sizes that are 40 - 50% larger than the minimum. Snyder measures capital letter size in terms of arc minutes, a measure suitable for calculating optimal letter sizes at different distances.

The fact that the greater reading distance imposed by the layout of a typical computer work place demands larger size letters, and that the relative blurriness of the computer type points to type on the large side rather than the absolute minimum, is consistently ignored in web presentations and similar online presentations of text. This fact may be verified by anyone surfing the Web.

It is even ignored in the very guidelines posted by people who ought to know better. The guidelines by Arbejdstilsynet are presented on the web with a capital letter height of 2 mm on a 15" flat screen (more or less equivalent to a 17" CRT) with a resolution of 1024*768. In 800*600 the capital letters are 3 mm high. The text is locked in such a way that it cannot be enlarged by a user using Internet Explorer version 6.

I blush to add that text heavy pages at the RUC web site suffer from the same problem, though the text is slightly larger: a capital letter height of almost 3 mm on a screen as above.

Line length

Typographical research has demonstrated that line length as measured in numbers of characters per line, is in combination with letter size a key factor i legibility (Tinker, 1983; Rubinstein, 1988; Pedersen & Kidsmose, 1993). It has been demonstrated that a line length of 55-65 characters (including spaces and punctuation marks) is optimal, and that reading speed declines rapidly with lines longer than 65 characters. This result seems to hold in the screen environment, though the optimal line length is probably shorter: 40-60 characters (Tullis, 1997).

Again this knowledge is consistently ignored in web design. And again that may be verified by a short surfing expedition on the web. There are

exceptions, and they are mostly found in the pages where they are least needed. The longer the texts the worse.

In the pages of the guidelines from Arbejdstilsynet the lines are 70-80 characters long. While RUC manage to put in 115 characters per line in text obviously meant to be read from the screen (resolution 1024*768).

Conclusion

As suggested above further research seems to be needed in order to break some well established bad habits in the world of online text presentation. Not to get new insights but to convince designers and design gurus that better typography and layout will be a decisive steps towards the vision of e-publishing taking over from print publishing, and getting the benefits of hypertext and multimedia in connection with long texts meant for sustained reading.

References

Arbejdstilsynets *bekendtgørelse* nr. 1108 af 15. december 1992 *om arbejde ved skærmterminaler.* <http://www.at.dk/sw4758.asp>

Arbejdstilsynet: *Arbejde ved skærme*. AT-vejledning D.2.3 Juli 2001. <http://www.at.dk/sw4544.asp>

Dillon, Andrew (1994): *Designing Usable Electronic Text. Ergonomic Aspects of Human Information Usage.* London: Taylor & Francis. 195 p. [New, revised ed. to be published in 2004]

Gould, J.D. & N. Grischkowsky (1984): "Doing the same work with hard copy and with cathode ray tube (CRT) computer terminals." *Human Factors* 26. 1984. p. 323-37.

Gould, J.D., L. Alfaro, R. Finn, B. Haupt, A. Minuto & J. Salun (1987): "Why reading was slower from CRT displays than from paper. *Proc. ACM CHI+GI'87* (Toronto, Canada, 5-9 April 1987). P. 7-11.

Hartley, James (1994): *Designing Instructional Text.* London: Kogan Page. 3rd. ed. 183 p. [Especially "Chap. 13. Designing Electronic Text." (p. 148 -162)]

Lynch, Patrick J. & Sarah Horton (2001): *Web Style Guide. Basic Design Principles for Creating Web Sites.* New Haven & London: Yale University Press. 2nd. ed. 223 p.

Muter, Paul (1996): "Interface Design and Optimization of Reading of Continous Text." I: H. van Ostentorp & S. de Mul (red.): *Cognitive Aspects of Electronic Text Processing.* Ablex Publ. 1996. <http://www.psych. utoronto.ca/~muter/pmuter1.htm>

Muter, Paul & Paula Maurutto (1991): “Reading and skimming from computer screens and books: the paperless office revisited?” *Behavior & Information Technology*. 1991. vol. 10, no 4. P. 257-66. <http://www.psych.utoronto. ca/~muter/pmuter2.htm>

Nielsen. Jakob (1995): *Multimedia and Hypertext. The Internet and Beyond.* Cambridge, Mass.: AP Professional. 480 s.

Nielsen, Jakob (1997): “How Users Read on the Web. They Don’t”. *Alertbox.* 1. Oct. 1997. <http://www.useit.com/alertbox/9710a.html>

Nielsen. Jakob (2000): *Designing Web Usability. The practice of Simplicity.* Indianapolis, Ind.: New Riders. 420 p.[Espcially p. 100 - 130]

Pedersen, Kim & Anders Kidmose (1993): *[sort på hvidt] en udviklingsrapport om typografi og læselighed.* København: Den Grafiske Højskole. [Parrallel text in Danish and English]

Reynolds, Linda & Doig Simmonds (1981): *Presentation of Data in Science. Publications, slides, posters, overhead projections, tape-slides and television. Principles and pratices for authors and teachers.* The Hage/Boston/London: Martinus Nijhof Publishers. 1981. 209 s. [Especially “The legibility of type” (p. 1 - 19) and “The presentation of text” (p. 20 - 31)]

Rubinstein, Richard (1988): *Digital Typography. An Introduction to Type and Composition for Computer System Design.* New York ... : Addison-Wesley. 340 p.

Snyder, Harry (1988): “Image Quality” In: M. Helander (red.): *Handbook of Human Computer Interaction.* Amsterdam: North Holland. P. 437 - 474.

Tinker, Miles A (1963).: *Legibility of Print.* Ames, Iowa: Iowa State University Press. 329 s.

Tullis, Thomas (1997): “Screen Design” In: Helander, Landauer & Prabhu (red.): *Handbook of Human-Computer Interaction.* Amsterdam: North-Holland. 2nd. compl. rev. ed. P. 503 - 531.

Tullis, Thomas, Jennifer L. Boynton & Harry Hersh (1995): “Readability of Fonts in the Windows Environment.” [1995] <http://www.acm.org/ sigchi/chi95/Electronic/documnts/intpost/tst_bdy.htm>

Wilkinson, R.T. & H.M. Robinshaw (1987): “Proof-reading. VDU and paper text compared for speed, accuracy and fatigue.” *Behaviour and Information Technology* 6, no. 2. P. 125-33.

The Dark Side of the Source Code: Games and HCI

Espen Aarseth

Department of Digital Aesthetics and Communication
IT University of Copenhagen
aarseth@itu.dk

Keynote abstract

There are few phenomena in the computing industry less studied than games. And yet, games are obviously among the most successful sectors, in terms of revenue, public interest, and innovation. Today, games are driving the IT evolution, and creating cultural and technological platforms that are then repurposed and made into tomorrow's social interfaces.

The lecture traces the hidden history of games computing, discusses the innovative aspects of games, and tries to promote a vision where game developers, HCI researchers, and academic game researchers all talk to each other and learn from each other.

www.dr.dk/kroeniken

Birgitte Bollerup Jacobsen

Danish Broadcasting Corporation

www.dr.dk/kroeniken

Together with our great commitment *Krøniken* [*The Chronicle*], a television narrative by Stig Thorsboe, a programme site will be launched at dr.dk/kroeniken.

The site will be structured in three parts: a fiction part directly connected to the series, a facts part offering a historical perspective on the period and finally a quiz and competition part.

1. The fiction part "The Chronicle" will primarily be oriented towards content with the ability to extend the viewer's experience in relation to the series. Here, the viewer will be able to satisfy his/her curiosity and come closer to the characters.
2. The facts part “The 1950s" will be oriented towards content offering background knowledge, learning and a broader perspective.
3. The third part of the site “Quiz" will contain entertainment in the shape of various games. Some will be based on the series and play with the viewers' knowledge of the fictive characters, whereas others will require actual historical knowledge

The reason why the site will be structured in three parts is to ensure that the viewer at all times knows whether the information on the site is related to the fictive universe of the television narrative, or whether the information is actually correct and related to the documentary and historical dimension of the site. This separation between fiction and facts is the basic idea behind the design of the site.

Whether the user visits dr.dk/kroeniken in order to extend his/her experience in relation to the series or in order to learn something and put the fictive

time image into perspective, the key word will be: **narratives**. Narratives of people, places and events.

The fiction part "The Chronicle"

In "The Chronicle" the user will have the following choices of content elements:

- Ida, Erik, Søs and Palle
- The Factory
- The Families
- Summary
- Extra
- About The Chronicle
- Credits

The fact part "The 1950s"

At the history part of the site it will be possible to select various approaches to meaningful persons, things and events from the period. The content is structured in a number of main themes each offering different perspectives on a given subject

- Danish politics
- Family life
- Consumption and business life
- From country to city
- The heroes of the time and (beginning) Americanization
- Fashion, design, hair and shoes
- Radio and television
- Spare time
- Transportation
- Standard of living

The idea is for each main theme to be presented by a picture or a clip and a short introduction as a teaser for the overall narrative of the given subject.

A main theme will be divided into 4-5 sub-categories (e.g. the subject Family life will have the sub-categories Working life, Home life, Sex, Children's life and Life in the institutions). Each sub-category will be displayed by a number of clips and a maximum of 3-4 pieces of text of each 815 figures (approximately 9 lines). In addition to this, the sub-categories may be supplemented by:

- Facts box with short lexical references
- Graphs of various figures
- Slideshows
- Humorous drawings
- Clip collections
- Time lines

Tasks

In connection with the historical material it will be possible to select a number of tasks and teacher's books. Both suggestions in relation to using the historical material in relation to basic school teaching as well as a number of tasks for the basic school students' own work with the historical clips will be included here.

Reviews

In addition to the historical main themes, the historical part of the site will also include a number of edited reviews of the individual years in the period of approximately 4 minutes. Each week, a new review of a year will be published. Together the number of reviews will constitute a time line for the period 1950-1959. The selection of the content of the reviews will be based on the content of DR's archives with an eye to the topical events in The Chronicle.

The quiz and competition part "Quiz"

The third part of the site is entertainment and games in the shape of various quizzes and competitions. Some will be based on the series and play with the viewers' knowledge of the fictive characters, whereas others will require actual historical knowledge and memory.