Proceedings of the

12th Danish Human Computer Interaction

Research Symposium

DHRS2012

Stephan Wensveen (editor)

Wednesday November 21, 2012
SPIRE, Mads Clausen Institute, University of Southern Denmark

The Sønderborg Participatory Innovation Research centre (SPIRE) is happy to announce that the 12th Danish HCI Research Symposium will be held at the University of Southern Denmark in Sønderborg on November 21, 2012.

DHRS has existed since 2001. The previous symposia have been hosted by University of Aarhus (2001, 2006, 2009), University of Copenhagen (2002), Roskilde University (2003, 2010), Aalborg University (2004, 2008), Copenhagen Business School (2005, 2011), and IT University of Copenhagen (2007).

The aim of the symposium is to stimulate Danish research in human-computer interaction by providing an overview of current activities and an opportunity for networking. To do this we adopt a broad definition of HCI research and encourage contributions that reflect the variety of topics, methods, theories, application domains and so forth involved in our research. Practitioners are encouraged to contribute reflections on industrial experiences with HCI work. The working language of the symposium is English.

These pre-proceedings are made as a service to the attendees of the 12th Danish HCI Research Symposium. The final version of the proceedings will be available after the symposium. Please do not cite or distribute as this is intended only for the symposium audience.

Kind regards,

the editor

Tuesday, November 20, 2012
Alsion 2, Sønderborg

PROGRAM Wednesday November 21, 2012

12th Danish Human Computer Interaction Research Symposium

Registration & Coffee
09:00 to 09:30

Welcome by Jacob Buur & Stephan Wensveen
09:30 to 09:45

ROUND 1: FIELD
Keynote Presentation: A 'Field' Approach to Interaction Design Research
Thomas Binder, The Royal Danish Academy of Fine Arts, School of Design
09:45 to 10:15

Paper presentation: User experience goals for interactive climate management systems in green houses
Torkil Clemmensen & Stephanie Barlow, Department of IT management, Copenhagen Business School
10:15 to 10:35
Paper presentation: Participatory Activities in Practice
Frederik Gottlieb & Vicki Sørensen, SPIRE Participatory Innovation Research Centre, University of Southern Denmark
10:35 to 10:55
Paper presentation: How Different Views of Communication Influence HCI Design: The Example of Shaping
Kerstin Fisher, Institute for Design and Communication, University of Southern Denmark
10:55 to 11:15

Discussion Round 1
11:15 to 11:45

Poster Lunch Break 11:45 to 13:00

ROUND 2: LAB
Keynote Presentation: A 'Lab' Approach to Interaction Design Research
Stephan Wensveen, SPIRE Participatory Innovation Research Centre, University of Southern Denmark
13:00 to 13:30

Paper presentation: The Effectiveness of Screen Captures in Instructions
Lars Christian Jensen, Institute for Design and Communication, University of Southern Denmark
13:30 to 13:50
Paper Presentation: Consider the details: A Study of the Reading Distance and Revision Time of Electronic over Dry-Erase Whiteboards
Rasmus Rasmussen & Morten Hertzum, Computer Science, Roskilde University
13:50 to 14:10

Discussion Round 2
14:10 to 14:40

Break
14:40 to 15:15

ROUND 3: SHOWROOM
Keynote Presentation: A ‘Showroom’ Approach to Interaction Design Research
Johan Redström, Umeå Institute of Design, Umeå University
15:15 to 15:45

Paper presentation: Provoking friendly encounters: social contraptions and collective appropriation
Robb Mitchell, SPIRE Participatory Innovation Research Centre, University of Southern Denmark
15:45 to 16:05

Paper presentation: Of Cars, Computers and Hell: User Unfriendliness of Personal Technologies
Anker Helms Jørgensen, IT University of Copenhagen
16:05 to 16:25

Discussion Round 3
16:25 to 16:55

Closure
16:55 to 17:30

User experience goals for interactive climate management systems in green houses

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ABSTRACT
This paper presents findings from interpretative phenomenological interviews about the UX of interactive climate management with six growers and crop consultants. A model of UX of interactive climate management is presented. The findings are reported in a UX target table, which can be the basis for future research on UX at work in this domain.

Keywords
Climate management, interpretative phenomenological analysis, usability, user experience,

1. INTRODUCTION
User experience (UX) researchers have mainly studied the positive emotions related to the voluntary use of computers in non-work contexts [7]. The focus has been on consumers' *initial* usage experiences of mobile phones, e.g. [10] and e-commerce websites, e.g. [12]. Frequently the method used to capture UX has been quantitative in the form of a survey or a scale, see e.g. [5]. In contrast, this empirical work-in-progress paper provides an example of how to capture UX in work contexts and with a qualitative methodology.

It is known that emotions may influence HCI at work [1, 11], that UX is relevant in work situations [6], and that the quality of HCI is also related to designing for positive emotions with interacting with complex systems. However, in addition to considering how emotions influence HCI in work contexts, we argue that the work place itself also restricts, shapes, influences, mediates, and relates to emotional UX At Work.

User experience is defined as a "person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service" [8], p. 9, which is influenced by user, system and context. To us, this definition appears to suggest that there is there a single measure „u" of usability, i.e. there is a single, unified concept of usability/user experience that can capture the relation between the human and the computer across the different social, cultural, technical and organizational contexts of an ICT system. However, we believe that this is a question that cannot be answered alone on theoretical grounds, but need to be answered also by empirical studies of user experience in different contexts.

In this paper we focus on what user experience is in a particular work context - that of growers doing climate management in green houses using climate control systems. One reason why this is a good choice for studying UX in work contexts is that there is much exact knowledge about how to control the climate in green houses using climate control computers. However, greenhouses are mostly open systems, plants may exhibit a kind of cognition [3], and green house production is important in many countries in the world [9]. Hence, what is described as growers experience of doing climate management with interactive systems may vary, depending of which of the professional perspectives or parts of the world, which the story is told from. Our aim in this short paper is to raise questions like

- Is there a single unifying meaning of the user experience of interactive climate management?
- What are peoples' (with expertise in the domain) user experience of climate management?
- What is a positive user experience of climate management systems?
- Is the UX of cliumate management similar across the world?

1.1 Related work
Textbooks in UX suggest the use of a UX target table, that is, a spreadsheet-like listing of work roles, user class, UX goal, UX measure and base and target levels [4]. In this paper we propose a research-based target table as the outcome of studying a single work context.

It is possible to view UX in work places as being mainly about positive emotions related to interacting with specialized software and hardware. Thus we assume that UX in interactive climate management depends on:

- Mandatory interaction with climate computer/other hardware
- Organizational culture rules for displaying emotions in grower companies
- Growers preferences for interaction (different versions of systems)

In this paper, we try to relate each individual's UX to these assumptions, and discuss in detail to what degree this is possible.

2. METHOD
To answer the research questions, we used an interpretative phenomenological analysis approach (IPA) [13]. With this idiographic mode of inquiry, the aim is to explore in detail how individuals perceive the particular situation they are facing. Interviews (11 in total) were conducted with greenhouse growers, consultants, researchers, software vendors and greenhouse assemblers ("montører"), all involved in climate management. This sample was carefully chosen to offer multiple perspectives on a shared experience for them, climate management in green houses. Thus climate management phenomena would be experiences of some personal significance to all of the interviewees. In this case the interviewees'

development of their involvement in climate management, how they experienced climate management, and how they made sense of climate management.

2.1.1 *Data collection*

The interviews were approached from a position of flexible and open-ended inquiry, and the interviewer (the first author) attempted to adopt a stance that was curious and facilitative (rather than, say, challenging and interrogative). IPA usually requires personally-salient accounts of some richness and depth, and so the research had to capture the interviewees' accounts in a way that permitted the researchers to work with a detailed verbatim transcript after the interview. The interviews were semi-structured in order to enter as far as possible into the world of the participant. Follow-up questions were posed, in order to validate the answers that the participants gave. The data were transcribed by a third-party, a native speaker of Danish, who was instructed to do a meaning transcription (leaving out hmms, oehmms, repeated words, etc).

2.1.2 *Data analysis*

After transcribing the data, the second author worked closely and intensively with the text, annotating it closely ('coding') for insights into the participants' experience and perspective on their world. The analysis of the data was conducted as IPA, supported by the use of Atlas.ti, a qualitative data analysis and research software. The analysis was at every step shared and discussed with the first author. By applying a collective IPA, the researchers attempted to grasp how the participants perceived and made sense of their own world, but at the same time the researchers were also trying to make sense of the participants trying to make sense of their world. Thus, we did in depth qualitative analysis, through careful examination of interview transcripts.

Each interview-transcript was read several times, before actual coding. Each was treated as a single case, as we are focusing on the individual experience of each participant. As the analysis developed, the researchers catalogued the emerging codes, and subsequently began to look for themes in the codes. Coding themes were chosen carefully, as the aim was to make sense of what the participants were saying, but at the same time constantly checking one's own sense-making, against what the person actually said. Themes were recurring patterns of meaning (ideas, thoughts, feelings) throughout the text. We aimed at finding themes that both identified aspects of climate management that mattered to the interviewees, and also carried something of the meaning of that climate management. Themes were eventually grouped under much broader superordinate themes, see figure 1. The final set of themes were then summarised for each individual participants and as a group. The aim was to capture the essence of interactive climate management, both for each group of participants, and across all participants. Thus the final part of the analysis was the narrative account of the meanings inherent in all the participants' experience, illustrating the findings. In this paper, we present only parts of our data, namely findings from interviews three growers and three consultants.

2.1.3 *Data reflection*

In our IPA, we tried to balance the descriptive phenomenology with some model-based insightful interpretation, in a way that anchored – through quotations - these interpretations in the participants' accounts. We held idiographic focus and considered each participant closely in order not to lose variations. We kept our focus on meaning, and only considered causal relations on the highest level of abstractions. Of course, we wanted to achieve transparency by giving contextual detail about our sample (see table 1), and a clear account of our process. We illustrated key points by verbatim quotes to allow readers to estimate the plausibility and transferability of our study. In later research we will cross validate with other studies of interactive climate management.

3. RESULTS/FINDINGS

The interview participants that we report findings for in this paper were three consultants and three growers, see table 1.

Table 1. Interview participants

Job position	Age	Gender	Years of education	Years of IT experience	Years of climate management experience
Consultant	54	M	17	33	30
Consultant	58	M	17	26	29
Consultant	54	F	17	30	20
Grower	48	M	15	24	24
Grower	53	M	17	34	31
Grower	49	M	16	13	25

3.1 Interactive climate management UX

On the highest level of abstraction, we see the user experience of interactive climate management as being influenced by workplace emotions, work processes and the worker's (user's) personal preference for interaction styles and functions, see figure 1.

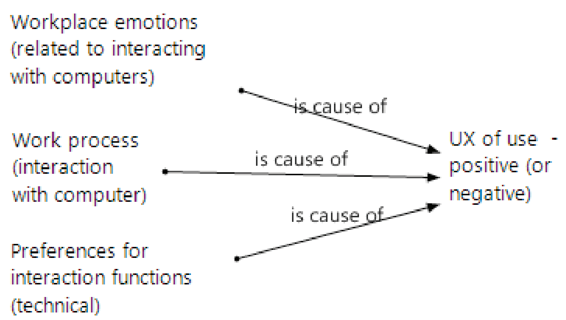

Figure 1. Model of UX of interactive climate management

3.2 Growers' UX

Grower A is a grower, and also sometimes a project leader. He is not so much in direct contact with the climate computer, but he will call some people who will type in the registrations that he is doing (the results of the climate management). Thus, he is collecting knowledge and distributing it to the people who are typing it into the actual climate computer. He will also give some advice on long-term strategies. He finds climate management quite interesting. He prefers to also be on the floor – out in the greenhouse – and is not interested in sitting in the office all day long doing climate management. He uses system

P, which runs on a single pc with windows, located in the administration building, and also Excel spreadsheets to the climate management.

In contrast, **grower B** uses system C, which is a dedicated computer located out in the green house. He talks about the old systems that he used a long time ago, and describes how well they were running. In general he is very optimistic around climate management/computers. He has been involved in some projects as a "guinea pig". He talks about what needs to be improved, e.g. a better dialogue between the developers/providers of the software, and the people who actually uses the system. He feels that some systems has been developed, because they thought it would benefit the growers, but he believes that an overall goal is missing, perhaps a forum could be created, such that the two parties could talk together. According to him, there is a lack of education in the branch, and many growers are not using all of the functions, in the system. Hence the design needs to be more user-centered and the end-users need to be more involved in the process. Many of the programmers/software developers have never sat their foot in a greenhouse. He does believe however, that the Danish developers could create a nice computer, but there is pressure from Dutch companies, because they are the frontrunners in climate computers. When asked whether or not he prefers the old '1200 system' or the new 'system C', he says that he would prefer the 1200. He would even consider to take out the 1200 from a warehouse and use it again in some cases, because it was easy for him to explain to the others, how to use it. It's simple, genius and with lots of functions. He does not care about the old fashion look in the 1200, because back then people had to learn it from scratch including the codes, everyone had to know all the processes in the 1200. Today, nobody knows what's behind e.g. an icon, they are afraid of pressing an icon, they don't know which code lies behind it. He'd rather just get to the point, instead of a lot of fancy graphics.

Grower C is a bit special because he is a grower without a climate computer, so he mainly explains why he does not own a climate computer and also brings forward a sort of "future" perspective, where he reflects on what he would find useful. He does not have a climate computer, thus he sometimes refers to why he does not use a climate computer in his work processes. He has some arguments as to why he has not invested in one, which he mainly sees as a nice complimentary tool, not an essential one. To him, work place emotions related to interaction with computers and his preferences for technical systems in his green houses are tightly interwoven. He is in general quite positive towards climate computers, but he is reluctant to invest in one, because he is turning 50 next year, thus is it worth the investment. He does not see a big enough need for one, because they are "too small". He distinguishes between "us and them", that is, he does compare himself as being smaller compared to the bigger greenhouse owners. However, he does describe several situations, where it would be nice to have one. It seems as though he has reflected upon the topic, because he can come up with specific scenarios where a computer would be useful.

He is skeptical towards a climate computer, as he states that he believes that plants need to be "eye-seen" and checked up on! He is not interested in giving up control 100% to the computer.

3.3 Crop consultant's UX

Crop consultant A is not just a consultant in the industry, but he also has a background in production planning where he does budgets, in relation to production plans. Sometimes the customer needs his "name" in order to get a loan in the bank to buy something for the greenhouses. The overall goal for climate management, according to him, is to save money. He finds climate management interesting – it is exiting to work with the opportunities that are involved. The combination of creating a nice climate for the plants, where they can save a lot of energy, that's a challenge in itself, that he finds fun.

Crop consultant B is focused on the plants. She is in general very positive towards climate computers, meaning that she thinks it is exciting, but most of all it's a very useful tool for climate management. She finds it exciting, interesting, useful, fun, challenging. She says that the young growers are especially interested in learning more about the use of the computer- they are interested and curious (asking questions themselves!). She prefers system P, the windows based system, over system S/C, the dedicated system. She is currently employed by one nursery, where she is allowed to log on to the climate computer from home, and makes adjustments. This is quite special since it is not so common, but it is because she used to be employed there directly. In other places, she would usually go in and look at the set points, graphs, and printouts, and then discuss in cooperation with the owner, if anything need to be adjusted. Usually they will make the changes themselves, unless they ask her to do it. She states, that she thinks that it should be more a more typical way of doing things i.e. that the consultant should have a more direct responsibility. She also says, that she is probably the only consultant who uses the climate computer a lot in her work. This is probably due to competencies, and that most crop consultants, view climate management as difficult, because they are scared of how different things might affect each other. She believes that as a crop consultant, it is not so important to know all the details and technicalities in the computer. It is rather a matter of using the climate computer to determine if the climate that she believes that a plant is thriving most optimally in, is what is being actually realized in the greenhouse. She explains that there are situations where she is walking around in the greenhouse with a grower and detects that e.g. the temperature is too low. The grower will then in some cases say, that it is "the boss" that is doing the adjustments. Thus, in some cases, there is a conflict that one person is doing the climate management, and that gives a set of different frameworks that they are allowed to work within. So the consultant's job is to try and work within those frames, but also to raise her opinion if she can see that e.g. heat savings are affecting the plants. She is also a bit skeptical towards the sensors, she states that you should only trust them to a certain degree, since they only tell you "part of the truth". She would like that the people "on the floor" would learn more about the climate computer and use it more actively. It does not make sense that it is the "boss" who is making the adjustments in the climate computer. She would also like that the interface would be more simple to utilize, because it is a matter of getting the right people "over to the climate computer". She believes that there is a change in the industry, meaning that climate management is not only restrained to a few trusted people. She feels there might be a change with the people she is working with, as more people are entrusted the responsibility. She is also quite positive towards mobile technology such as handheld devices.

Crop consultant C has been in the industry for 30 years and has been in consultancy for 24 years. He does not have many skills within IT, but he has the background knowledge in why certain things are adjusted the way they are – he does not have so much experience with that (he knows the principles behind it, but not in praxis). He is quite focused on the precise analysis of data, when dealing with climate management. He mostly uses the historical data from the climate computer, but does not do anything on the climate computer. It seems as though his focus is mainly directed towards quality, and what you can do in regards to climate management and production to reach a good quality. Quality is something they need to incorporate in their economic considerations. He would like that two settings were possible on the climate computer: one where you want to produce as much as possible, and one where you want to save as much as possible, with the cheapest resources possible (the economic perspective model-we are not in a hurry). With his background in mind, climate management takes place in the greenhouse. He makes use of some software (that the grower will never use), in order to make the analysis, and from that some things can be adjusted in the climate computer afterwards. He will also suggest some changes that the owner/grower can do, but stresses that in the end it is the greenhouse owner's responsibility-a lot of things can go wrong. He would like to have a more automatically operating system, where you could collect e.g. data from the previous year's production time and obtained quality (as standard), and then get the computer to act more automatically. However, some growers might feel that the computers will get all the power. He says that perhaps it can be a problem that the growers rely too much on "their green fingers", where it is compromising an appropriate climate management. He is very interested in finding key figures for climate managements.

4. DISCUSSION AND CONCLUSION

The interpretations of how growers and consultants experience interactive climate management can be summarized in a UX target table [4], see table 2. The common UX goal is that using interactive climate management systems should be interesting and useful. The growers need to feel like being on the floor of the green house, and that the interactions are easy to explain to colleagues. In contrast, the consultants focus on the plants and on saving money.

Table 2. UX target table

Work role	UX Goal	UX measure	Observed results
Grower(s) interacting with climate computers	Interesting, easy to explain to others, simple, with lots of functions, useful, safe, to the point, feeling of "being-on-the-floor"	Performance in specific scenarios Outcome over time meet company needs	?
Consultant(s) using the computer to analyze and give advice	Interesting, exciting, fun, useful, challenging, save money, focused on plants	Used by crop consultant in their work	?

This study has illustrated a phenomenological, grounded, descriptive approach to finding UX goals in complex work systems.

5. ACKNOWLEDGMENTS

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6. REFERENCES

1. Bedny, G.Z. and Harris, S.R. "Working sphere/engagement" and the concept of task in activity theory - Discussion. Interacting with Computers, 20 (2). 251-255.

2. Fallman, D., The new good: Exploring the potential of philosophy of technology to contribute to human-computer interaction. in, (Vancouver, BC, 2011), 1051-1060.

3. Garzón, F.C. The quest for cognition in plant neurobiology. Plant Signaling & Behavior, 2 (4). 208-211.

4. Hartson, R. and Pyla, P.S. The UX Book: Process and Guidelines for Ensuring a Quality User Experience. Morgan Kaufmann, 2012.

5. Hassenzahl, M. The Interplay of Beauty, Goodness, and Usability in Interactive Products. Human-Computer Interaction, 19 (4). 319.

6. Hassenzahl, M., Platz, A., Burmester, M. and Lehner, K. Hedonic and ergonomic quality aspects determine a software's appeal. in Proceedings of the CHI 2000 Conference on Human Factors in Computing Systems, ACM Press, New York, 2000, 201-208.

7. Hassenzahl, M. and Tractinsky, N. User experience - A research agenda. Behaviour & Information Technology, 25 (2). 91-97.

8. ISO 9241-210 Ergonomics of human system interaction-Part 210: Human-centred design for interactive systems (formerly known as 13407). International Organization for Standardization (ISO). Switzerland.

9. Kacira, M., SASE, S., Kacira, O., OKUSHIMA, L., ISHII, M., Kowata, H. and Moriyama, H. Status of greenhouse production in Turkey: Focusing on vegetable and floriculture production. 農業気象, 60 (2). 115-122.

10. Karapanos, E., Martens, J.B. and Hassenzahl, M. Accounting for Diversity in Subjective Judgments. Chi2009: Proceedings of the 27th Annual Chi Conference on Human Factors in Computing Systems, Vols 1-4. 639-648 - 2390.

11. Palen, L. and Bødker, S. Don't Get Emotional. Affect and Emotion in Human-Computer Interaction. 12-22.

12. Porat, T. and Tractinsky, N. It's a Pleasure Buying Here: The Effects of Web-Store Design on Consumers' Emotions and Attitudes. Human-Computer Interaction.

13. Smith, J.A., Flowers, P. and Larkin, M. Interpretative phenomenological analysis: Theory, method and research. Sage Publications Ltd, 2009.

Participatory Activities in Practice

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ABSTRACT

Through a series of participatory activities within a product development project, we analyse how these activities influence the design process and how new meaning is created through the interaction of crossing intentions (Larsen, 2010). By focusing on a specific theme in the project we reflect on how participatory activities are a key part in establishing important interactions between participants resulting in new design approaches. At other times participatory activities become a part of blurring these new approaches when performing new participatory activities towards developing new iterations of the concept in focus. We conclude that participatory activities can play a key part in the uptake of user knowledge but that a participatory innovation approach of establishing collaboration between crossing intentions can as well be considered provocative and as such, result in resistance and exclusion of potential project partners.

INTRODUCTION

This paper will focus on a Participatory Innovation project, the Strong Hand, in which a small startup company is developing a product. Through extensive funding, they have been able to outsource critical tasks to a range of external stakeholders.

The concept of the Strong Hand is to create an assistive device for the target group that can ease trivial tasks in the given context. The target group is arthritis patients who commonly experience pain and constrained use of their hands due to the disease. Throughout the project there has been a strong emphasis on the kitchen area as the main context of the strong hand.

We will investigate how the isolated theme of using a knife emerges, shifts and changes with the uptake of user knowledge, and the translation of participatory activities.

OUR ROLE

SPIRE has been involved in the project from the beginning. Our contributions to the project have mainly been facilitation of workshops and seminars as well as the planning, execution and mediation of user involvement in the development process.

LITERATURE REVIEW

In the field of participatory innovation, it is common to talk about creating meaning and exploring design possibilities by enabling diverse stakeholders to confront eachother through collaborative activities such as workshops and seminars (Buur, Matthews; 2010). Stacey (2003) talks about complex responsive processes as a key driver in innovation. He notes that meaning emerges in the local interactions between individuals and that innovation and development is not driven by an overall company structure as such, but is more likely to evolve as a result of the ongoing local interactions resulting in global patterns, which simply cannot be recognized before they emerge.

Buur and Larsen (2010) also notes that novelty emerges in the interaction of crossing intentions and relates to Fonseca, who says that innovation *is* the emergence of new meaning. Fonseca (2002, p. 116) further states that:

"Innovation does not start with a match between a rationally identified need and a set of competencies and tools, purposefully brought together in order to develop a solution. Rather, new meaning arises in ongoing conversations and it will be continually transformed until it is introduced into other conversational processes, namely those of their potential "users", only to be further and further transformed as people in different contexts use the innovation as a tool in their communicative interaction."

These notions of Participatory Innovation are reflected in our research, where we through participatory events discover how meaning emerges and themes for design are generated in the local interactions and collaborative activities where crossing intentions meet and often have immediate influence on the design process.

HOW TO USE A KNIFE

As a natural result of the deployment of the Strong Hand prototypes in users' homes, the perspectives for using the concept have developed; contexts such as garden use, grocery shopping and general household chores emerged. However, the kitchen as a use context has been dominant from the beginning of the design process: opening jars and food containers, unwrapping plastic packaging, cutting bread, holding, carrying and using pots and pans and handling kitchen cloths.

In this chapter we will focus on the knife as an isolated example of uptake of user knowledge and translation of design activities, which are co-influencing the design of a product in development.

In the following chapter we walk through the major findings, seen from a SPIRE perspective.

1. A Standard Tool for Arthritis Patients
In the early ethnographic studies, it was clear that a knife such as the ergonomically shaped knife in fig. 1 is a regular tool in the typical drawer of the targeted users.

Fig. 1 - typical ergonomic kitchen knife

This type of knife allows the user to use it without having to bend the wrist, as it is the case when using a regular kitchen knife.

2. An Important Daily Task
The concept portrayed in fig. 2 stands as an example of how the initial idea in the mind of the concept initiator has been more or less directly translated by an industrial designer.

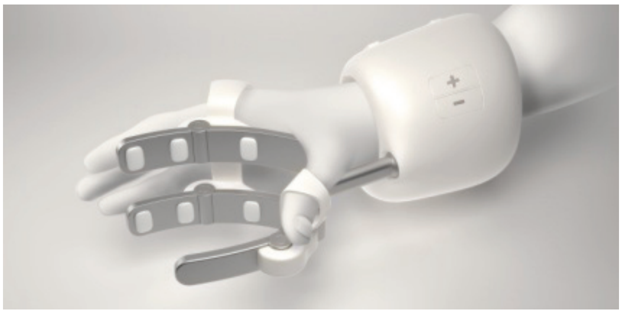

Fig. 2 – initial concept of the Strong Hand

In the first user workshop, this concept visualization was presented. Users and developers were brought together to develop key themes to pursue within the development of the Strong Hand.

One of the activities was a boundary game (Buur, 2011) where users and developers were evaluating a set of images picturing activities performed by the users, recorded during the preliminary ethnographic user studies (fig. 3).

Fig. 3 - Boundary Game

These activities helped the developers narrow down some functional themes such as “opening a jar of jam” and more general themes such as “kitchen labor”.

Through these activities, the notion of using a knife was rated as an important daily task where the targeted users would benefit from assistance. Using a knife thus started to emerge as a theme.

3. An Undiscovered Requirement

Mockup 1 was the first functional version of the concept. It was developed on the insights gained in the first workshop where the initial concept idea was presented to the focus group.

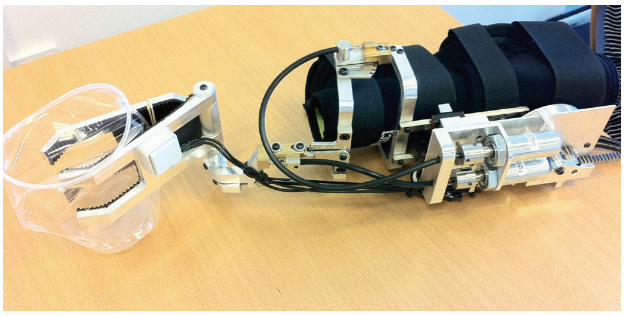

Fig. 4 – Mockup 1

With Mockup 1 ready, several interaction insights were gained based on user tests.

The first actual workshop established after Mockup 1 was ready, was focused on performing activities with combined actions. In this workshop, the two main developers were brought together with two occupational therapists. The agenda for the workshop was to allow the developers to expose their concept towards the therapists and thus to enhance their own insight in terms of matching their design with user needs.

Some insights were concrete such as moving from a dynamic connection between wrist piece and gripper towards a fixated connection (fig. 4). Others were more abstract, such as the theme “it (the device) should be easy ***not*** to use”, which emerged directly through this workshop (Gottlieb, 2012).

4. It Actually Works
In a following workshop seminar, users, project partners and therapists were brought together to experience how real users would be able to use the concept, in the form of Mockup 1. As an opening activity, everyone was watching as a user Anne, suffering from a rather severe condition of arthritis, was able to perform the activity of making a jam sandwich, including successfully cutting a slice of bread without much trouble.

Fig. 5 - Arthritis patients successfully using a kitchen knife

In the situation, this scenario made the use of a traditional kitchen knife seem possible as a part of the concepts overall performance.

5. Lost in Research
As a follow up on the before mentioned workshop, we performed a series of clarifying user visits to investigate whether the connection between gripper and wrist piece should remain dynamic or act more as a fixated extension of the underarm. These studies did not focus on combined activities, but relied on users immediate impression when fixating the gripper position. The knife was not a part of these studies, which focused more on simpler, less dynamic activities such as holding a bottle. On the results of these studies, it was decided to permanently fixate the gripper to the wrist piece.

6. A Major Concern
In the late stage of developing Mockup 2, there was a delay in the development, causing a postponing of the planned user studies with the device.

Fig. 6 - developer testing Mockup 2 gripper placement on kitchen knife

Among other issues, the delay was due to the developers struggling with making the gripper holding a knife properly (fig. 6).The knife now seemed a major concern in product requirements.

7. Users Are Not Satisfied
A key milestone in the project with Mockup 1 was for the device to successfully assist in opening a jar of jam. One of the recurring workshop activities was “making a jam sandwich” and thus expanded the isolated activity of opening the jar to the combined series of activities of preparing bread, cutting bread, opening the jar, spreading the jam, serving the sandwich on a plate. Though successfully accomplishing the task, through the combined activities, the developers seemed to rediscover the need for the device to be able to assist its user dynamically in activities and, among other isolated functions, being able to use a traditional kitchen knife (fig. 7).

Fig. 7 - Developer cutting bread with Mockup 1

When Mockup 2 was ready to be tested by the users, it was not clear, whether the developers had solved the issue of holding and using a knife, which had appeared to be a struggle during development. The focus of mockup 2 was on refining functionality based on the insights gained through studies with Mockup 1, as well as on wearability and deployment.

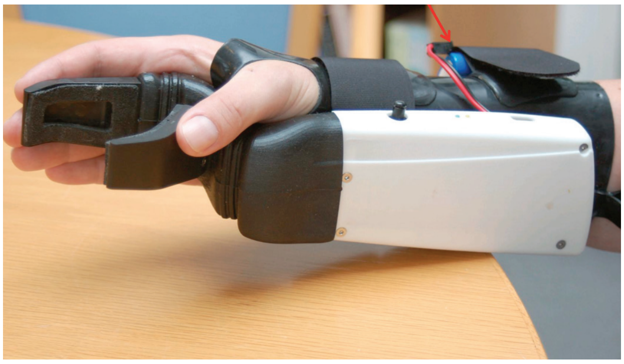

Fig. 8 – Mockup 2

A series of 10 identical devices (fig. 8) were produced and deployed in the homes of users who would individually use the device for a week. Based on the user studies with the 10 devices, a series of seminars and clarifying user workshops were established to analyze the material from the user studies and increase the focus towards developing the final version of the concept, a so called demonstrator.

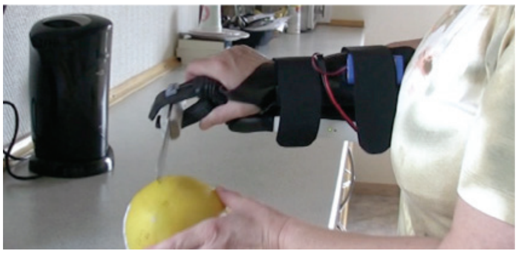

Fig. 9 – Birthe trying to cut a melon

The results where not overwhelmingly positive, considering the functional benefits of the device. Those of the participants who did try using the device with a kitchen knife were less successful and did not express excitement for the device as a helpful tool for this activity. As noted by the user Birthe when trying to cut a melon: "*You cannot apply enough force, however you hold the knife"* (fig. 9). However with some difficulty, she did accomplish to cut a slice of bread using the device.

The insights gained were, as with Mockup 1 concrete such as "the device needs to be lighter" and "the gripper is not able to hold a knife". More abstract was the theme of "becoming a robot" as several users were concerned that the device made them feel mechanical and exposed.

8. A Lot of Knives

The qualitative user studies with Mockup 2 were presented in a workshop where developers, therapists and a design consultancy were brought together to analyze and make sense of the pre-edited video material using a modified version of A- Frames (Halse, Clark; 2008)**.**

On the collaborative insight gained through the material, participants developed posters presenting their findings. Some were process-oriented mindmaps, others where more concrete in terms of a structured requirement specification

Fig. 10 - Requirement specification poster

In one of the groups, the discovery "a 'knife' is a lot of different knives" appeared (fig. 11).

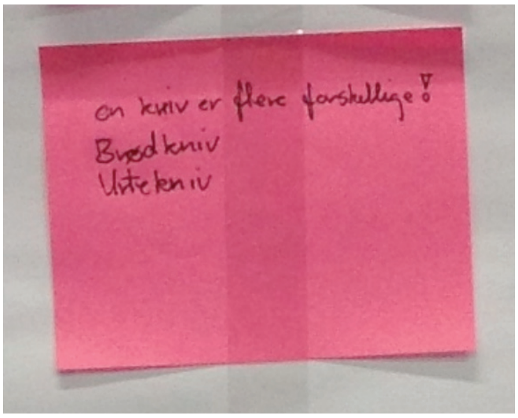

Fig.11 - "a 'knife' is a lot of different knives"

This discovery changed the perspectives of "using a knife", as it is now moving from a generalized object towards a group of different devices which should be equally considered when developing the product.

MOVING ON

The latest version of the concept is based on the concrete results from the studies with the previous models (fig. 2, 4, 8). Focus has been on decreasing the weight of the device as well as an option to "swing" the gripper aside to favor the requirement of the device being "easy ***not*** to use".

The more abstract themes such as "becoming a robot" has been translated to a more aesthetic design and has been handled by a professional industrial designer, whereas the previous model was designed with more focus on the functional requirements and less on the visual expression.

Fig. 12 – the Demonstrator

The rendering in fig. 12 shows the frozen concept of the demonstrator as it is supposed to look when ready. At the time of writing, the demonstrator model has not yet been built.

The presented overview shows how the concept has developed, and the legacy of the initial idea for the concept and the further iterations through the mockups is recognizable, e.g. the concept is at no time straying from the vision of a wrist borne gripping device. The changes made in each step are evolutionary and based on the concrete findings with the previous iteration.

However, other aspects in the development has been less developed throughout the process, e.g. exploring the notion of the knife theme, separated from the actual concept but with stronger relation to the user's experience, the use context and in this regard, existing solutions in a user's kitchen. Where we in this paper focus on this specific theme, this could also be reflected upon considering the general User Interface Design and interaction with the device, as well as the notion of User Experience Design. How do users actually like to use this device, what is a good kitchen experience?

In the following chapter we will reflect on the process from our perspective of using a kitchen knife to explore how Participatory Innovation activities are translated to specific requirements in development and how these requirements come to life in terms of product features and design choices.lace figures and tables at the top or bottom of the appropriate column or columns, on the same page as the relevant text (see Figure 1). A figure or table may extend across both columns to a maximum width of 17.78 cm (7 in.).

REFLECTION

As analyzed in the previous chapter, the theme of the knife:

1. Appears as an existing tool in users' homes
2. Emerges as a new theme among the members of the focus group
3. Is rediscovered as a different approach to product requirements
4. Becomes an accomplished requirement
5. Is neglected when it might have been most important
6. Becomes a major concern in concept development
7. Is noted by users as a less functional value
8. Evolves as a broader theme in considering the concept

Uptake of User Knowledge

As the theme emerges it is clear from early in the process that the users in the target group are commonly using an assistive tool, the ergonomically shaped knife, which is standard equipment in the kitchens of several users (1). In the first workshop involving users, the knife theme emerges as a part of kitchen activities where the users could benefit from assistance. However there seems to be a weak link between the observed use of specific tools such as the ergonomic knife and the definition of "using a knife" as a requirement for the concept (2). The requirement seems to stem from using a traditional knife, which is a more general problem, though in many cases solved by the ergonomically shaped knife. So the discovery of the knife theme as a requirement could be considered a symbol of the desire to create a product that mimics a well persons natural behavior, more than a functional requirement to actually help the members of the target group, that are in many cases already helped by existing solutions. In this respect, it is interesting to consider whether the emergence of themes was properly investigated in the early stages of development. This could have been done through many different approaches, such as designing for a rich experience, to explore the design space (Heape, 2007). However, the development was focused on synthesizing the developed themes from the early studies in the project into a standalone functional prototype.

While the knife theme is then less considered, during the development of Mockup 1, it emerges again in the discovery (3) that the device needs to support a broader range of functions to assist a user more dynamically. With developers and users the concept positively accomplishes to perform the knife activities as part of the established scenarios (4) and can thus be seen as meeting the previously emerged requirements of the device supporting combined activities rather than just isolated actions. But with the positive immediate impression of the device's overall performance, the theme seems to blend into the excitement that the device can actually perform activities of combined actions, which the knife theme itself is merely a part of.

Translation of Design Activities

As these activities are observed and evaluated by developers and researchers, a few questions arise, e.g. "should the gripper be dynamically connected or fixated to the wrist-piece"? This discovery is evaluated and tested with several users (5), but in these tests, the activity-based approach from the earlier sessions is less considered and the evaluation is relying on users' immediate impressions. The theme of using a knife in these studies is neglected and through a set of once again isolated actions performed by users, it is decided to fixate the gripper. Does this negligence of the activity-based approach established in the early studies relate to the overall excitement experienced in the activity-focused workshops? And does this indicate that an approach is less likely to be considered, if we no longer position ourselves as critical towards the?

In this light, the decision made on the discoveries in (5) is crucial towards the development of Mockup 2. Through conversations with developers it becomes clear, that the development of Mockup 2 is delayed as they are struggling to make the device *hold* a knife. Not to perform an *activity* with the knife, but *holding* a knife (6). As a possible consequence, the later deployment in a real use context with real users, uncovered the theme of using a knife as not being solved and not meeting the requirements of the targeted users (7). In the later stage, reviewing the performed studies with the developers, the knife theme reemerge as a broader theme, based on the discoveries that several users have problems using different knives (8) with the provided prototype, e.g. Mockup 2. The theme is once again proposed as a means of changing design approach and reconsidering the overall concept functionality by proposing a revised requirement specification. However, at this stage the main stakeholder, who is not willing to challenge the concept further by reconsidering e.g. product requirements, disregards the approach. As a consequence, the participant making this proposal is excluded from the project.

Whether there is a direct relation between the difficulties we discover in the concept development and the change in design approach, the determination by the developers to synthesize all the discoveries from the early workshops or other factors, provides us with a recognizable theme for reflection. What is interesting is how the focus in the development team and among several of the involved partners, seems to be often heavily influenced by small participatory events within the project:

- A key theme emerges from engaging users and developers in a participatory activity.
- The approach of the developers appears to shift by letting them expose their concept through a participatory workshop with other experts.
- As a general excitement appears among participants, developers, users, experts, researchers and partners, the activity approach blends into the excitement and is to some degree neglected in the following stage.
- As a theme reemerge as “fuel” to once again challenge the general approach at a late stage in development, the proposing participant becomes excluded from the process and the development continues unchanged towards the final product.

CONCLUSION

Through our studies, we have shown how participatory activities can assist in establishing a focus among participants and enable participants to change their approach through collaborative insight. In our reflection we discover how participatory activities can have a positive outcome but in some aspects also result in a negligence of focus on important themes to be considered in the studies of the concept in development. In the end we discover how the uptake of user knowledge at a late stage can be an accelerator of new ideas and approaches but if being too provocative towards the overall concept and common understanding among main stakeholders, can result in immediate exclusion of a participant.

REFERENCES

1. Buur, J., & Larsen, H. 2010. The quality of conversation in participatory innovation. CoDesign, 6(3): 121-138.
2. Buur, J., & Matthews, B. 2008. Participatory innovation. International Journal of Innovation Management, 12: 255-273.
3. Buur, J., & Oinonen, S. (2011). Video design hopscotch. Mads Clausen Institute, University of Southern Denmark.
4. Fonseca, J. (2002). Complexity and Innovation in Organizations. Routledge, London.
5. Halse, J. and Clark, B., 2008. Design rituals and performa- tive ethnography. In: Proceedings of the Ethnographic Praxis Industry Conference, 15–18 October 2008, Copenhagen, Denmark. Wiley-Blackwell, 128–145. DOI: 10.1111/j.1559-8918.2008.tb00101.x
6. Heape, C., 2007. The Design Space: the design process as the construction, exploration and axpansion of a conceptual space. Phd dissertation.
7. Stacey, R. D. (2003). The learning organization. Strategic Management and Organizational Dynamics: The Challenge of Complexity (2003) 4, 103-128.

How Different Views of Communication Influence HCI Design: The Example of Shaping

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ABSTRACT

In this paper, I argue that implicit views of communication can influence human-computer interaction design such that they may inspire radically different design approaches, with very different outcomes. Using the concept of shaping as an example, I show how the assumption of automatic processes in communication may lead to a restricted view of shaping by interactive alignment, whereas a collaborative view of communication allows a much broader range of strategies to be taken, which can enrich the designer's possibilities to shape users' behavior significantly.

Categories and Subject Descriptors

D.2.2 [**Design Tools and Techniques**]: User Interfaces

General Terms

Design, Human Factors

Keywords

Communication theory, HCI design, Alignment, Shaping

1. INTRODUCTION

The notion of 'shaping' was introduced into human-computer interaction (HCI) by Zoltan-Ford (1991) and describes users' convergence with the linguistic material presented to them. If people's behavior in HCI could be shaped in this way, this would facilitate automatic speech processing considerably and make the HCI designer's life much easier. The question is thus how shaping can be employed in HCI.

Shaping has been addressed from various points of view. While the term 'shaping' implicitly encodes the designer's perspective where human users are subtly guided into particular behaviors, there are also studies on shaping from psycholinguistic, sociological and psychological perspectives. In psycholinguistics, the phenomenon that speakers adjust to their communication partners has been investigated under the label of 'interactive alignment' (Pickering & Garrod 2004), whereas in sociology, especially in ethnomethodological conversation analysis, as well as in cognitive and social psychology, the phenomenon is rather viewed from the perspective of coordination.

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The ways in which the two views on shaping differ is the related to the amount of automaticity involved in communication; while in the first tradition basically a two-stage model is assumed in which there are first initial automatic, involuntary processes and only in a second step, people take their partners consciously into account, in the other position communication is seen as collaboration through and through. These two schools of thought hold radically different views of what shaping, i.e. the adaptation to the partner's behavior, is caused by. In this paper, I argue that which perspective is taken has considerable consequences for HCI design.

2. TWO VIEWS OF COMMUNICATION

In the two-stage model, communication happens in part based on automatic responses to the communication partner's behaviors. In the interactive alignment model, people are taken to pick up linguistic material from their communication partners' utterances as a result of automatic priming. Alignment on this view is assumed to be based on automatic and subconscious responses to the partner's utterances. Because alignment is taken to be automatic and subconscious, it does not require a model of the listener (Garrod & Pickering 2007: 444). Speakers thus do not take their listeners into consideration – unless there are problems or unless "the discrepancy between their knowledge and that of the speaker is made especially salient" (Garrod & Pickering 2007: 445). Explicit, as well as implicit, non-alignment is thus also possible, for instance when speakers try to conceal information, when they wish to disalign deliberately or when the previous representation was not understandable. Such strategies are however taken to be cognitively demanding and therefore to be rather exceptional.

The view that communication rests at least partly on automatic, involuntary processes concerns also other areas of communication, such as considering the communication partner's perspective and access to information in spatial perspective taking (e.g. von Stutterheim & Kohlmann 1998) or when referring to objects (e.g. Horton & Keysar 1996). In these approaches, speakers are assumed to make egocentric choices unless they have extra time or a particular reason to consider the partner's knowledge and perspective. Another approach that assumes automatic mechanisms is the computers-are-social-agents paradigm, which suggests that speakers transfer mindlessly from human communication to interactions with non-social communication partners, such as computers or robots (see Reeves & Nass 1996, Nass & Moon 2000, Nass 2004, for example).

In contrast, the collaborative view of communication holds interlocutors to be involved in constant implicit negotiation. In this view, communication is collaborative from the beginning (and orderly at all points, cf. Sacks 1984); thus, people will consider their communication partner already in early utterance planning processes (see Brown-Smith 2009). Correspondingly, in this view, people's mental models of their partners play a crucial role. Furthermore, linguistic labels are implicitly negotiated and collaboratively achieved (Clark & Wilkes-Gibbs 1981, Brennan & Clark 1996), perspective taking is carried out with addressees in mind (Schober 1995), and the addressees' knowledge and access to information are taken into account from the first moment of planning onward (Hannah et al. 2003).

Alignment in the collaborative view is accordingly a partner-oriented strategy rather than an automatic response. For instance, in the maze game studies reported on in Mills & Healey (2008: 49), the authors argue that alignment may be strategically employed in order to create a background against which an element to be corrected may be identifiable. They thus suggest alignment to constitute a resource for the participants rather than an automatic procedure. Similarly, Mills (2007: 128), who investigates the negotiation process of referential terms and strategies in dialog, argues that "alignment is actually the backdrop against which subtle, tacit changes are made in the process of developing abstract description types." These findings suggest that alignment is used strategically for particular communicative purposes and is thus not due to automatic responses (see also Schegloff 2004).

Alignment can indeed be related to strategic purposes; the studies carried out in the framework of Communication Accommodation Theory (Giles, Coupland & Coupland 1991) show that speakers' interactional goals and identity needs play a considerable role in speakers' decisions to re-use linguistic material from their partners. Furthermore, Fischer & Wilde (2005) argue that the speakers' partner models determine the limits to alignment. We investigated participants' willingness to align with a nonce word used by a robot in comparison with a spatial reference strategy that was completely opaque to the users and thus as uninterpretable to the participants as the nonce word. We found that speakers only aligned to linguistic material presented to them if it fit their concept of their addressee; in particular, they aligned with the spatial descriptions because they expected the robot to be competent in this area, but not with the lexical item, because they considered themselves more competent concerning natural language terms. This finding is in line with findings by Kraljic, Samuel & Brennan (2008) who find participants to align only with phonetic peculiarities of the communication partner when these constitute a characteristic trait of their communication partner, and not a contingent, accidental effect of the speaker's pronunciation. Thus, speakers may select to which linguistic features of the communication partner they align their utterances depending on their model of the communication partner, which speaks against automatic priming as the main causal factor.

To sum up, in the collaboration view, alignment is just one out of many strategies for cooperation, and shaping consists of guiding users subtly into appropriate representations of their artificial communication partner that help them choose behaviors that are adequate for the particular situation and its affordances. One way to do so may then be to present users with vocabulary or linguistic structures to pick up themselves, but in fact the scope of shaping is much broader in the collaborative view of communication.

3. CONSEQUENCES FOR HCI DESIGN

In the two views of communication, shaping would be approached quite differently.

3.1 Shaping in the automatic alignment view

In the interactive alignment model, shaping would be done by presenting linguistic features as clues that the communication partner is then intended to pick up automatically and subconsciously. Evaluation of successful shaping from the priming perspective then consists in counting the number of words and structures in which output by the system and input from the user are coordinated.

Several researchers have tried to shape users' linguistic behaviors by presenting them with linguistic material that the system can understand. The first study in this respect is Zoltan-Ford (1991); however, she finds alignment only for at most 51% of the system utterances, and in the conversational condition, in which the simulated computer produced complete natural language utterances, the amount of alignment found was only 35%.

Similarly, many of the studies on alignment show that not all speakers align. Assertions like "72-94% of the children showed positive accommodation on the different linguistic features examined'" (Oviatt, Darves & Coulston 2004: 16) do not only show that alignment occurs, but also that 6-28% of the children did not align with their (artificial) communication partner (and it is unclear how many linguistic features the children aligned with). If alignment occurs as an automatic priming effect, it remains open why only some and not all speakers align with their partners.

Furthermore, recent studies have identified a number of factors that influence the amount of alignment occurring; for instance, Branigan et al. (2007) show that people align to different degrees with their communication partners depending on their speaking roles (addressees versus overhearers), and Branigan et al. (2011) demonstrate that the amount of alignment depends on people's understanding of the capabilities of the communication partner: they align more if they believe the partner to be a non-native speaker and they align more with a basic than with an elaborate computer.

Thus, shaping from the perspective of automatic, priming-based alignment has to content itself with presenting linguistic material to the user, hoping that users will pick this material up and re-use it. Since Zoltan-Ford's (1991) initial study, however, no study has been able to report better numbers than hers (see Baber et al. 1997, Tomko & Rosenfeld 2006). Thus, there seem to be limits to the effectiveness of shaping from an automatic priming perspective.

3.2 Shaping in the collaborative view

Shaping from the collaborative perspective offers further possibilities than priming users with vocabulary and linguistic structures. In the collaborative view, participants will build up a partner model and take this into consideration throughout. From this perspective, the users' behavior can be shaped not only with respect to selected linguistic features, but with respect to their understanding of the task and their partner's strengths and weaknesses. Shaping thus concerns not only a careful selection of words for the user to pick up, but also choosing its behaviors, appearance and utterances in a way to allow the user to build up an appropriate mental model of the system. The methods available for shaping in the collaborative view are thus:

- presenting the user with linguistic material to make use of;
- presenting the user with linguistic material that matches the general competences of the system;

- presenting the user with other behavioral or visual cues that allow him or her to build up a coherent mental model of the system.

Thus, the collaborative view takes speakers' general need to build up a coherent model of their communication partner into account, which is particularly important in HCI since here people do not have a very accurate view of their communication partner (see Figure 1).

Figure 1: In HCI, the communication partner is literally a black box!

A measure for successful shaping in the collaborative view concerns, for instance, users' understanding of the task as measured by the number of out-of-domain vocabulary, the size and appropriateness of the vocabulary used, as well as users' judgments of the naturalness and fluency of the interactions.

4. A CASE STUDY

In this section, we explore shaping from a collaborative perspective. In order to study the impact of robot utterances on users' behavior, we compare interactions with a robotic wheelchair (Lankenau & Roefer 2001) in two conditions that differ regarding whether or not the robot produces verbal behavior; in both conditions, participants (nine native speakers of English in condition 1 and eleven in condition 2) had to carry out the same four tasks with a robotic wheelchair (see Fig. 2). The first task, which is the one reported on here, was to steer the robot around in order to 'train' it on the environment and to provide it with verbal explanations, in particular to familiarize the robot with locations in a room for handicapped people by driving it to particularly interesting locations and labeling them.

Figure 2: The robotic wheelchair 'Rolland'

Participants were free to move to as many locations as they considered relevant. There were no behavioral instructions. The robot was supposed to move autonomously only at the end of the instructions when it was meant to take the user to one of the locations it was previously trained on.

All verbal robot output in condition 2 was scripted and manipulated by a human 'wizard' hidden behind a flexible wall. Thus, for each location the respective participant steered the robot to, there was a set of robot utterances to be played in a particular order. For some utterances, the wizard had different choices depending on the label the participant had used, for instance, *sofa* versus *couch*, *fridge* versus *refrigerator*, *stove* versus *hot plate*. While this procedure may seem unnatural, the resulting dialogs are in fact quite fluent, and participants were found to find the interactions to be very enjoyable (cf. Andonova 2006).

Scripting the robot output does not only render all robot output identical and thus the dialogs comparable across persons and conditions, providing a unique methodological opportunity to study the influence of isolated variables, it is also computationally the cheapest method possible. Thus, it should be impossible to discard the results of this study on the basis of the assumption that the dialogs used in this study necessitate unrealistically sophisticated speech technology.

The robot utterances were designed in order to subtly guide users into appropriate understandings of the task and the capabilities of the robot. We applied the following four criteria: 1) we used everyday vocabulary, in order to prevent people from thinking that they have to talk in extra-ordinary ways to the robot. 2) We made sure that the robot used the terms consistently (cf. Zoltan-Ford 1991). 3) We provided implicit cues to the task; in particular, we had the robot announce its 'readiness' after the greeting by saying 'you can take us now to a place you want to name'. Furthermore, if the participant was driving the wheelchair without talking, the robot would ask 'where are we going to'. These two utterances serve as implicit clues to the task to label relevant locations in the room for the robot. 4) Since in conversation between humans explicit signs of understanding are very rare (see Heritage 10984), we provided only implicit feedback in the form of 'relevant next contributions' (Sacks et al. 1974, Clark & Schaefer 1989), in particular in the form of clarification questions designed to elicit further information relevant for the task given.

All interactions were recorded and transcribed. The transcripts were analyzed semi-automatically (using simple shell scripts).

The results, first of all, concern the users' linguistic behaviors in the baseline condition, against which the shaping condition can be compared. In this condition, we can observe considerable linguistic variability, for instance with respect to the labels used (e.g. *dinner table, dining table, supper table, eating table, table, table with plates, my table, table with the fern*), but also with respect to the instructional strategy employed, for example: imperative (*drive to the desk*); declarative with a first person singular (*I'm driving to the coffee table*) and first person plural personal pronoun (*we are driving right now to the TV set*); modal verbs (*now we can go to the table*); or no verb at all (*from the desk to the computer table one meter back*).

The high variability observed is also reflected quantitatively in the number of different words used in this condition. While the number of different words in this condition ranges between 41 and 206 for the different speakers, the list of different words for the nine speakers combined is 255, illustrating that the participants understood the task and interaction situation slightly differently. The type/token ration in this condition is 0.37, while in condition 2, it is only 0.14. Thus, participants in the shaping condition used fewer different words, even though they communicated almost five times more (in terms of number of words) with the robot.

Condition 1 is furthermore characterized by considerable amounts of out-of domain vocabulary, for instance:

American English, boy, brown, car, cars, case, coffee, comfortable, confuse, direction, drunk, eat, else, evening, fern, forget, glasses, good, green, heading, hitting, homework, important, insulted, interesting, just, kept, know, lamp, laughing, learning, life, like, little, maybe, news, nice, online, pick, pot, probably, properly, really, round, see, sharp, shopping, smashed, supposed, very, wanna, watch, wheels, wobbling, work

These findings suggest that users in the baseline condition were not very focused on what the robot could possibly understand, while in condition 2, participants generally exhibited a much better understanding of he task.[1]

The following example illustrates how a participant gradually revises his mental model of the robot and produces increasingly appropriate instructions, and in fact it is him who has learned a lot in the end:

Rolland: You can take us now to a place you want to name.
RD043: (2) do you see the <attrib=prominent">plant</attrib> on the <attrib=prominent">left</attrib> forty five degrees, (1) a green plant, (2)
Rolland: I'm sorry?
RD043: -- that's what I thought, (laughter) -- um -- move forward, (1) (...)
Rolland: Where are we going to?
RD043: we are going to see the plant, do you see the plant, --
Rolland: The plant?
RD043: -- green plant,
Rolland: (2) Is it the object in the corner?
RD043: yes, (1)
Rolland: Okay, thank you.
RD043: - okay,
Rolland: Okay, where are we going to next?
R043: this is the refrigerator. (2) - do you see the refrigerator? --
Rolland: Is this where you want to be to open it?
R043: - no (2) move forward, (3) this where I want to be - to open it, -- more or <par>less</par>
Rolland: <par>Okay,</par> thank you.
RD043: 'kay,
Rolland: Okay, <par >where are</par> we going to next?
RD043: <par>this is</par>- this is the stove, (3)
Rolland: Is this part of the kitchen?
RD043: -- this is part of the kitchen. (1) (to experimenter:) he's learned a lot!

5. DESIGN IMPLICATIONS

The current study has shown that the view of communication implicitly embraced may have a considerable impact on the HCI design approach taken; depending on the model of communication assumed, the designer has more or fewer strategies for shaping the users' behavior at his or her disposal. In the current study, we have seen that the collaborative view of communication provides the designer with a bundle of possibilities, several of which turned out to be highly successful for shaping users' linguistic behavior. Especially providing users with implicit clues to task understanding turned out to be highly effective. In contrast, alignment based on automatic priming was found to be as limited in effect as reported on in previous studies (e.g. Zoltan-Ford 1991, Baber et al. 1997, Tomko & Rosenfeld 2006). Thus, with respect to shaping, the collaborative view of communication produces better results.

[1] See also Fischer (2011) for an analysis of users' behavior in the third task: Here, users were found to employ almost five times more different words (306) in the baseline condition than in condition 2 (68). While in the second condition no out-of-domain vocabulary was used, at least 57 words were completely out-of-domain in the first condition.

6. ACKNOWLEDGMENTS

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7. REFERENCES

[1] Andonova, E. 2006. On Changing Mental Models of a Wheelchair Robot. *Proceedings of the Workshop on 'How People Talk to Computers, Robots, and Other Artificial Communication Partners'*, Hansewissenschaftskolleg, Delmenhorst, April 21-23, 2006, pp. 131-139.

[2] Baber C., Johnson, G.I. and Cleaver, D. 1997. Factors Affecting Users' Choice of Words in Speech-based Interaction with Public Technology. *International Journal of Speech Technology* 2: 45-59.

[3] Branigan, H., Pickering, M., McLean, J. and Cleland, A. 2007. Syntactic Alignment and Participant Role in Dialogue. *Cognition* 104: 163-197.

[4] Branigan, H. Pickering, M., Pearson, J., McLean, J. and Brown, A. 2011. The role of beliefs in lexical alignment: Evidence from dialogs with humans and computers. *Cognition* 121: 41–57.

[5] Brennan, S. & Clark, H.H. 1996. Conceptual pacts and lexical choice in conversation. *Journal of Experimental Psychology: Learning, Memory and Cognition* 22: 1482-1493.

[6] Brown-Schmidt, S. 2009. Partner-Specific Interpretation of Maintained Referential Precedents during Interactive Dialog. Journal of Memory and Language 61: 171-190.

[7] Clark, H.H. & Wilkes-Gibbs, D. 1986. Referring as a collaborative process. *Cognition* 22: 1-39.

[8] Clark, H. H. and Schaefer, E. F. 1989. Contributing to discourse. *Cognitive Science* 13, 259-294.

[9] Fischer, K. 2011. How people talk with robots – Designing Dialog to Reduce User Uncertainty. *AI Magazine,* 32(4):31-38.

[10] Fischer, K. and Wilde, R. 2005. Methoden zur Analyse interaktiver Bedeutungskonstitution. In: Solte-Gresser, C., Struwe, K. and Ueckmann, N. (eds.): Von der Wirklichkeit zur Wissenschaft. Aktuelle Forschungsmethoden in den Sprach-, Literatur- und Kulturwissenschaften, pp. 163-174. Hamburg: LIT-Verlag.

[11] Garrod, S. and Pickering, M. 2007. Alignment in Dialogue. In: *The Oxford Handbook of Psycholiguistics*, pp. 443-451. New York: Oxford University Press.

[12] Giles, H., Coupland, J. and Coupland, N. (1991), *Contexts of Accomodation. Developments in Applied Sociolinguistics*. Cambridge: Cambridge University Press.

[13] Hanna, J.E., Tanenhaus, M.K. and Trueswell, J.C. 2003. The effects of common ground and perspective on domains of referential interpretation. *Journal of Memory and Language* 49, 43-61.

[14] Heritage, J. 1984. A change-of-state token and aspects of its sequential placement. In: Atkinson, J. & Heritage, J. (eds.): *Structure of Social Action: Studies in Conversation Analysis*. Cambridge: Cambridge University Press.

[15] Horton, B. and Keysar, B. 1996. When Do Speakers Take into Account Common Ground? *Cognition* 59, 91-117.

[16] Kraljic, T. and Brennan, S.E. 2005. Prosodic Disambiguation of Syntactic Structure: For the Speaker or for the Addressee? *Cognitive Psychology* 50: 194-231.

[17] Lankenau, A. and Roefer, Thomas 2001. A Safe and Versatile Mobility Assistant. *IEEE Robotics and Automation Magazine* 7: 29-37.

[18] Nass, C 2004. Etiquette Equality: Exhibitions and Expectations of Computer Politeness. *Communications of the ACM* 47, 4: 35-37.

[19] Nass, C. & Moon, Y. 2000. Machines and mindlessness: Social responses to computers. *Journal of Social Issues* 56, 1, 81-103.

[20] Oviatt, S.L., Darves, C. and Coulston, R. 2004. Toward Adaptive Conversational Interfaces: Modeling Speech Convergence with Animated Personas. *ACM Transactions on Computer-Human Interaction (TOCHI)*.

[21] Pickering, M. & Garrod, S. 2004. Towards a Mechanistic Psychology of Dialogue. *Behavioral and Brain Sciences* 27: 169-225.

[22] Reeves, B. and Nass, C. 1996. *The Media Equation.* Stanford: CSLI and Cambridge: Cambridge University Press.

[23] Sacks, H. 1984. Notes on Methodology. In: Atkinson, J. & Heritage, J. (eds.): *Structure of Social Action: Studies in Conversation Analysis*. Cambridge: Cambridge University Press.

[24] Sacks, H., Schegloff, E.A. & Jefferson, G. (1974). A Simplest Systematics for the Organization of Turn Taking for Conversation. *Language* 50: 696–735.

[25] Schegloff, E.A. 2004. Putting the Interaction Back into Dialogue. (Commentary on Pickering & Garrod). *Behavioral and Brain Sciences* 27: 207-208.

[26] Schober, M. 1995. Speakers, addressees, and frames of reference: Whose effort is minimized in conversations about location? *Discourse Processes* 20, 2: 219-247.

[27] Tomko, S. & Rosenfeld, R. (2006). Shaping user input in Speech Graffiti: A first pass. *Proceedings of the ACM Conference on Human Factors in Computing Systems*.

[28] von Stutterheim, C. and Kohlmann, U. 1998. Selective Hearer Adaptation. *Linguistics* 36, 3: 517-549.

[29] Zoltan-Ford, E. 1991. How to Get People to Say and Type what Computers Can Understand. *International Journal of Man-Machine Studies* 34: 527-647.

The Effectiveness of Screen Captures in Instructions

[Extended Abstract]

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ABSTRACT

Screen captures are found in almost any software manual [3], but what is their function, and do they contribute to users' task completion? Research has of yet not found any unequivocal evidence that screen captures contribute positively to users' task completion, nor under which circumstances they do so. This is what this paper aims to uncover. The paper is based on the approach developed by Lucy Suchman in which Constructive Interaction is used in conjunction with Conversation Analysis in Human-Computer Interaction (HCI). The data for this study was collected by conducting a usability test of the Western Digital Media Player. Twelve people participated and worked in pairs to complete a series of tasks on the device with the help of the manual. The study shows that the relationship between a screen capture and the textual instruction affects how efficient a screen capture is in relation to task completion. The paper is rounded off by discussing how designers of software manuals can benefit from these findings.

Categories and Subject Descriptors

J.4 [**Computer Applications**]: Social and Behavioural Sciences

General Terms

Human Factors

Keywords

HCI, screen captures, constructive interaction, conversation analysis, design, manual, instruction

1. INTRODUCTION

Images and other visuals are used extensively in instruction manuals. Instruction manuals comprised exclusively of text are becoming increasingly rare, especially with regard to software manuals [6]. Furthermore, research indicates that screen captures are present in nearly three out of four manuals [3]. The commonplace that "a picture is worth a thousand words" [7] does seem to apply to instruction manuals. Images in instruction manuals have been much researched over the past two decades. Research has found that images used with text may improve readers' comprehension of the subject matter [7], [3]. However, images in software instruction manuals are typically restricted to either icons/buttons or screen captures [3]. Screen captures are rather large images that take up much space in a manual. Therefore, a usability test of the Western Digital Media Player (and it's manual) was conducted. The goal of the study was to find out if, how and under which circumstances screen captures in the manual contribute to task completion.

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2. METHOD AND DATA

2.1 Data Collection

The usability test in this study was conducted with the method known as constructive interaction, which involves having two or more people to work together on problem-solving tasks. Constructive interaction attempts to elicit information from participants, paired in dyads, in a natural setting. They explain in a natural way to each other not only what problems they perceive, but also possible solutions [5, 8].

2.2 Procedure

Dyads were given a list of tasks to perform and an instruction manual. Dyads were separated in two conditions: three of the dyads were given the original manual (complete with screen captures) and three were given a textual manual (an edited manual without any screen captures). A camera was placed in a fixed location and facing the dyads, which means that any results and conclusion presented in this paper are based on the interaction within each dyad.

2.3 Data Analysis

The data was first analyzed by measuring the time taken to complete each task. This gave an overview of any differences in performance between dyads given a textual manual and dyads given the original manual. The second step was to select those tasks that differed in performance for transcription and analysis. This analysis is qualitative in nature and was done by using conversation analysis (CA). CA is the study of talk, or talk-in-interaction, as many practitioners of CA call it [1], and is carried out by transcribing spoken interactions. One concern of CA is repair, which is especially

Table 1: Analytical Framework

Line	Speaker	Utterance	Nonverbal Action
1	F:	naviger til menulinjen home startskærmen	F reads out loud from the manual

interesting in relation to this study since repair in interaction indicates a problem in the communication between the speaking partners. CA can help to determine what the problem is and whether speaking partners are able to resolve the problem. For this reason CA is often used to solve problems in Human Computer Interaction (HCI) which was demonstrated by Lucy Suchman in her study of the interactions between a photo copying machine and its users [8]. Suchman found that the users' actions were for the most part not visible to the machine, which in some cases lead to complete communicate breakdowns, which are identified by repetitions and restarts. These breakdowns are categorized as either false alarms or garden paths. False alarms occur when users assume something has gone wrong and tries to initiate repair, although nothing has gone wrong at all [8]. Garden paths occur when users don't realize that something has gone wrong, although something in fact has gone wrong [8]. Suchman's use of constructive interaction and conversation analysis is the basis of the methodology used in this paper. The analytical framework shown in table 1 is inspired by the framework developed by Suchman [8]. However, the framework used in this paper focuses on the interaction between participants, whereas Suchman's framework focuses on the interaction between user and machine, which means that some alterations to the framework were made.

Speakers in each dyad are identified by either F (for female) or M (for male) for the sole purpose of being able to identify each participant in a dyad, as each dyad consists of one male and one female. The last column to the right shows contextual information such as nonverbal actions that makes it easier to understand what is going on.

2.4 Transcription Conventions

The transcription conventions used in this paper are based on Dansk Standard for Registrering af Talesprog [4]. Following conventions are used:

- Talk is orthographically transcribed in concordance with Retskrivningsordbogen [2]
- Words in transcriptions appear in same order as they are uttered
- (p) is used for pauses of any length
- (uf) is used for utterances that are incomprehensible
- (t) is used for all kinds of hesitation
- (afbryder) is used for interruptions with both the interrupted as well as the interrupter
- Numbers are spelled out
- (latter) is used for laughter

This set of transcription conventions were selected for two reasons. Firstly, talk in the video recordings is in Danish. Secondly, eight of the twelve participants speak the regional dialect of Southern Denmark, "Sønderjysk", which can be very difficult for non-native speakers of "Sønderjysk" to understand. This of course makes an orthographic transcription relevant.

2.5 Test object

The object being tested is a device that can be connected to a TV and enables users to play media content in many different file formats. It plays virtually any music and video

Sequence I: Finding HOME (Dyad A)

Line	Speaker	Utterance	Nonverbal Action
1	F:	naviger til menulinjen home tror du ikke man skal trykke på den der home knap (afbryd)	F reads out loud from the manual
2	M:	(afbryd) jo det kan vi godt prøve (afbryd)	
3	F:	(afbryd) jamen jeg kan også bare prøve piletast	
4	M:	der må være en der hedder home her	
5	F:	video (p) internet (afbryd)	F scrolls through home screen
6	M:	(afbryd) nej du kan (uf) (afbryd)	
7	F:	jeg prøver at trykke home	F presses button
8	M:	nej tror nemlig det du har gang i her er home	
9	F:	tror du det home det her	

file stored on either a USB harddrive or a USB stick. In addition, the media player can also stream media over a local area network and access certain internet services such as YouTube, Netflix and Facebook.

2.6 Participants

Twelve participants were invited to participate in this usability test. The participants were all first-time users and were selected because research show that troubles encountered by first-time users of a system provide more valuable feedback than feedback gathered from experienced users [8]. This is most likely related to the fact that users accustomed with a system know how it works and are less likely to make the same mistakes as an inexperienced user. Participants in each dyad know their partner intimately.

3. RESULTS

3.1 Screen captures that contribute to faster task completion

In general, dyads given the original manual completed tasks faster, sometimes several minutes faster than dyads given a textual manual. In addition, several of the dyads given a textual manual failed to understand some key concepts of the user interface. For example, two of the three dyads given a textual manual did not to full understand the concept of the "Home" screen. The "Home" screen can be described as a main menu from where users can access the system's five major functions; music, video, photo, internet media and settings. Users who don't understand the concept of "Home" take longer time performing tasks as demonstrated by Dyad A in sequence I. The participants in Dyad A are given the task to return to the "Home" screen, but they are not really sure what the manual refers to as the "Home" screen. This is seen in line 4, 7 and 8. The dyads given the original manual do not have this problem since a screen capture of the "Home" screen is displayed in the manual.

Another problem encountered by the dyads given a textual manuals was to understand the feedback given to them from the user interface. This problem is well-demonstrated by Dyad D in sequence II. Dyad D have prior to sequence II physically connected an ethernet cable to the system, in order to enable a working internet connection. Dyad D then

Sequence II: Test Connection (Dyad D)

Line	Speaker	Utterance	Nonverbal Action
1	M:	enter (p) hvad skriver den	M presses button on remote
2	F:	passed	F reads output from TV out loud
3	M:	er det godt eller skidt	M and F reads in manual
4	F:	du skal lige trykke ok	
5	M:	check connection (p) så er vi tilbage igen	M and F reads in manual
6	F:	(t)	
7	M:	hvad så hvis den tager næste side (p) hvis vi går check connection der (p) network connection (p) check passed	M reads output from TV out loud, F leafs through manual
8	F:	er den så mon i orden	
9	M:	ja det er godt nok et godt spørgsmål	F reads in manual

navigates to the "settings" menu to confirm that they have an active working internet connection. This confirmation is given in line 2, but both participants fail to realize this, which is seen in line 3. The failure to understand the feedback from the system results in a false alarm [8] causing Dyad D to repeat this step. Ultimately Dyad D moves on to the next task, but do so without knowing whether they solved the task. The entire sequence lasts 5 minutes and 31 seconds. Dyad C, who were also given a textual manual had similar difficulties, but took "only" 3 minutes and 25 seconds to complete the task. The dyads given the original manual had no difficulties with this step and took on average 2 minutes and 24 seconds to complete this step.

3.2 Screen captures that don't contribute to faster task completion

The analyses of sequence I and II indicate that screen captures help users to understand concepts in the user interface and help users make sense of the feedback they get from the system. However, not all screen captures were shown to benefit the users. One such screen capture is seen in figure 1. The figure shows the instruction and screen capture related to the use of an on-screen keyboard, which is used when searching for a video on Youtube. Dyads were given the task to search for and play a specific video on Youtube. Interestingly, the dyad who were able to complete this task the fastest were Dyad C, who were given a textual manual. The dyads given the original manual were on average faster than dyads given a textual manual. However, Dyad E, who were given the original manual took nearly 3 minutes to complete a task that Dyad C, who were given a textual manual only took 40 seconds to complete. The cause of this can be found by reviewing sequence III. Dyad E successfully spell the keyword using the on-screen keyboard before line 1 and then look for a way to initiate the search. However, they find no "search" button. In line 1 participant F suggests to hit the "enter" button, but to no avail. She then suggests to hit the "backspace" button and says that this is what usually is done. This causes the system to delete the last entered character, as seen in lines 6 and 7. The suggestions and comments made by participant F indicates that she has experience using YouTube on a regular PC. She then tries to apply this knowledge to the task they are faced with here. This can be inferred by her suggestion to hit the "enter" key, which is one way of initiating a search

Figure 1: Screen Capture w/Instructions: On-Screen Keyboard

Sequence III: Using the On-Screen Keyboard (Dyad E)

Line	Speaker	Utterance	Nonverbal Action
1	F:	ja oppe på pil jo (p) kan du ikke bare trykke enter da	
2	M:	nej vi (uf) bare	
3	F:	kan du ikke bare trykke på pilen da (p) det er da det man plejer at gøre	
4	M:	det er den der	
5	F:	ja	
6	M:	hov der mangler da et t (p) (uf) (p) hvor har vi t henne da	
7	F:	nu sletter du det t igen jo(afbryd)	
8	M:	hvorfor gør jeg det da	F leafs through manual

on YouTube.com on the World Wide Web. Her suggestion of hitting the "backspace" key also makes sense. The key is located on the right side of the search field, which makes users notice this key before any other because they are used to reading from left to right. In addition, the key is given special prominence because of its size, making it the single largest symbol on the on-screen keyboard. All dyads, except Dyad C had similar problems to those experienced by Dyad E.

Another screen capture seemingly not contributing to users' task completion is shown in figure 3. This screen captures relates to the task of playing a video file. It is one of the tasks in which dyads given a textual generally completed the tasks faster. In addition, two of the dyads given the original manual could not make sense of the instructions, but did manage to complete the task. They did so however, without knowing how they did it making it unlikely that they would be able to repeat the task. This scenario is demonstrated by Dyad E in sequence IV.

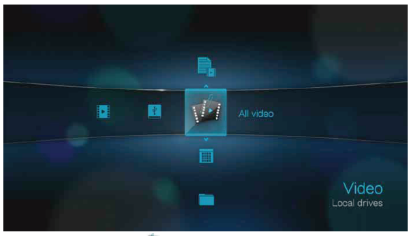
4. DESIGN IMPLICATIONS

The manual contains more than 160 screen captures. However, it was found that not all screen captures contributed positively to dyads' task completion. How come some screen captures contribute positively to task completion and some do not? Previous research indicates that the effectiveness of screen captures is influenced by the readers, the complexity of the task, the length of the task and the type of manual used [3]. Yet, are there any elements in the screen captures that influence how effective a screen capture is? The answer to this question may be found by comparing screen captures present in the manual with Karen Schriver's ways of integrating prose with graphics [7]. Schriver proposes two

Figure 2: Screen Capture: Video

Sådan afspilles en video:

1. Gennemse til video- kategorien.



2. Marker All video (Alle videoer), og tryk derefter på **ENTER**.

   ELLER

   Hvis mediebibliotet er aktiveret kan du vælge at navigere vha. en filterindstilling (**All Video** (alle videoer), **Date** (dato), **Folders** (mapper), **Recent** (seneste) ellerr **Playlist** (afspilningsliste)) ved at vælge ikonet for video og derefter bruge fjernbetjeningens venstre og højre piletaster til at rulle gennem indstillingerne på listen.

Sequence IV: Playing Video (Dyad D)

Line	Speaker	Utterance	Nonverbal Action
1	M:	så skriver den bare local drivers (p) har det noget med det her at gøre (p) hvad gør vi forkert da	M turns his gaze toward the manual
2	F:	(t) jamen vi har sprunget over(uf)	
3	M:	er der ikke en back her(afbryd)	
4	F:	der står der folder (p) det stod der noget om her	F points to TV
5	M:	ja (p) folders og hvad så (p) skal jeg trykke enter	M turns his gaze toward the manual, F reads the manual
6	F:	(uf) naviger ved hjælp af rings (p) det gør vi så (p) prøv en gang at vælge ikon for vid(t)	
7	M:	på hvad	
8	F:	vælge ikon for video og så derefter bruge	
9	M:	der det var den der	M presses button on remote
10	F:	nu må vi kunne gå op og ned (p) kan du ikke det (p) prøv og tryk enter (p) sådan der (uf)	
11	M:	der kom det da (p) en ud af fem eller hvad p	

text-image relationships to be used with instructions:

- **Redundant** - Presentation of the same idea visually and verbally. This way of integrating image and text is reported to be especially effective for topics that are difficult for readers to understand [7].
- **Supplementary** - Presentation of main ideas in one dominating mode, while the other mode provides additional details. Schriver points out that supplementary relationships are good for procedural instructions and can often help to clarify main ideas [7].

The relationship between the screen capture and text in figure 1 seems redundant in nature. The instruction is both verbalized and visualized. The instruction to use arrows to write a keyword is shown in the image by the presence of text in the search field, the selection of a letter ("e") on the keyboard and by showing a marker in the form of an underscore character right after the keywords ("wd tv liv" in the text field. However, the second part of the instruction ("Vælg Submit...") does not seem to represented in the screen capture at all. In other words, there is no relationship between this part of the instruction and the screen capture. When this happens, users don't benefit from the screen captures because text and screen captures are merely placed in proximity of each other, seemingly without any thought as to what their purpose are. An integration of screen capture and instruction could have been achieved by marking the "submit" button in order to make users pay attention to it. This example serves the purpose to show that ill-designed relationships between screen captures and instructions can be a contributing factor to why some screen captures don't seem to speed up task completion.

5. CONCLUSION

The aim of this study was to find out how screen captures in a manual contribute to task completion in manuals. Findings suggest that screen captures enable users to complete tasks faster than without screen captures. However, this is only true when screen captures relate to the accompanying instructions. Conversely, users were shown to misunderstand instructions when screen captures do not relate to the textual instructions in the manual. These findings encourage designers to acknowledge that screen captures are not self-explanatory but need to be integrated with the textual instructions. Further research in this field should concentrate on validating the claims made in this paper. Particularly, that the relations between screen captures and instructions are a contributing factor to how well a screen capture contributes to faster task completion. Another topic for further research is how one can best create meaningful relationships between textual instructions and screen captures. Karen Schriver has done some work in this direction already (1997). However, her work applies to all kinds of prose and graphics, whereas methods relating specifically to screen captures in software manuals could prove a useful tool to document designers working in HCI.

6. REFERENCES

[1] D. Cameron. *Working With Spoken Discourse*. Sage Publications, 2nd edition, 2007.

[2] Dansk Sprognævn. *Retskrivningsordbogen*. Alinea - Aschehoug Dansk Forlag A/S, 2001.

[3] M. Gellevij. *Visuals in Instruction*. PhD thesis, University of Twente, 2002.

[4] K. Gregersen. *DANSK STANDARD for UDSKRIFTER og REGISTRERING af TALESPROG*. Duplika, 1987.

[5] N. Miyake. Constructive interaction and the iterative process of understanding. *Cognitive Science*, 10(2):151–177, April-June 1986.

[6] D. Roy. Using spatial representations in designing english software manuals for non-native speakers: A preliminary study. In *Professional Communication Conference*, pages 1–18. IEEE International, 2007.

[7] K. Schriver. *Dynamics in Document Design*. Wiley Computer Publishing, 1997.

[8] L. A. Suchman. *Human-Machine Reconfigurations - Plans and Situated Actions*. Cambridge University Press, 2007.

Consider the details: A Study of the Reading Distance and Revision Time of Electronic over Dry-Erase Whiteboards

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ABSTRACT

Electronic whiteboards are replacing dry-erase whiteboards in many contexts. In this study we compare electronic and dry-erase whiteboards in emergency departments (EDs) with respect to reading distance and revision time. We find inferior reading accuracy for the electronic whiteboard at all three levels of distance in our study. For revision time, the electronic whiteboard is slower on one subtask but there is no difference on another subtask. Participants prefer the electronic whiteboard. Given the font size of the electronic whiteboard, the inferior reading accuracy is unsurprising but the reduced possibilities for acquiring information at a glance when clinicians pass the whiteboard may adversely affect their overview. Conversely, the similar revision times for one subtask show that logon may be done quickly. We discuss how details such as font size and logon may impact the high-level benefits of electronic ED whiteboards.

Author Keywords

Electronic whiteboard, usability, efficiency, font size, logon

ACM Classification Keywords

H.5.2 [User Interfaces]: Interaction styles; Screen design.

General Terms

Design; Experimentation; Human Factors

INTRODUCTION

The benefits that motivate the introduction of many new technologies in workplaces are high-level, yet when the benefits remain unattained the reasons are often apparently mundane details. For example, systems for increasing the capacity of air-traffic control have failed because the affordances of paper flight strips were under-recognized [3], systems for asthma self-management have failed because asthmatics did not want to continually think of themselves as ill [5], and systems for facilitating collaborative planning among mutually present people have failed because the screen size was sufficient for individual use only [8].

The background for the study presented in this paper is the high-level benefits that motivate the introduction of electronic whiteboards in emergency departments (EDs) combined with our observations of some potentially influential details that appear to have entered almost unnoticed into the design of the electronic ED whiteboards in Region Zealand, one of the five healthcare regions in Denmark. Historically, dry-erase whiteboards have been used for coordinating patient care and facilitating communication among ED clinicians and have proven to be quintessential for the smooth and safe operation of EDs [7]. The motivations for replacing these whiteboards with electronic whiteboards typically include: more efficient information management, access to whiteboard information from distributed locations, integration with other electronic records, ED capacity monitoring, extraction of statistical performance data, and real-time patient tracking [4]. However, during our involvement in the implementation and evaluation of electronic ED whiteboards in Region Zealand, we observed some design details that might threaten the attainment of these high-level benefits by degrading the usability of the electronic whiteboards.

One such design detail is the font size of the textual information on the electronic whiteboards. The font size is noticeably smaller than the font size of the handwritten information on the previously used dry-erase whiteboards. Informal observation suggests that this makes the displayed information harder to read at a distance and forces the clinicians to move closer to the electronic whiteboard when retrieving information, thus slowing their work pace. Another design detail is the mechanisms for interacting with the electronic whiteboard. Compared to the ease of writing and erasing information with a marker on a dry-erase whiteboard, the process of logging on to the electronic whiteboard and then altering information using either touch screen or mouse and keyboard appears time consuming and complicated. Informal observation suggests that this process may sometimes slow down or disrupt the clinicians and possibly cause frustration. Despite these apparent drawbacks the electronic whiteboards afford the clinicians with a number of possibilities and advantages not afforded by the dry-erase whiteboard. These include standardization of the otherwise often difficult to read hand written information as well as traceability due to login requirements. We decided to compare experimentally the previously used dry-erase whiteboards with the electronic whiteboards actually used now to uncover the effect of these two design details.

WHITEBOARD DESCRIPTION

The graphical layouts of the two whiteboards are similar. Both consist of a matrix-like structure with rows and columns displaying patient related information, see Figures 1 and 2. Each row represents a patient and contains patient information such as name, age, medical problem, triage level, attending nurse, and attending physician.

The dry-erase whiteboard measured 118×146 cm. The height of each row of patient information was 8 cm. Information on this whiteboard was handwritten using dry-erase markers and augmented with colour-coded cardboard squares used for indicating triage levels. The division of the whiteboard into rows and columns was permanently marked on the whiteboard.

The electronic whiteboard is a wall-mounted 52´´ touch-sensitive monitor displaying a web application. The monitor measures 65×115 cm and has a row height of 3 cm. Information on this whiteboard is entered via the touch-screen interface or via mouse and keyboard. Clinicians log on to the electronic whiteboard by briefly holding a personal token onto a sensor. Log off is done by tapping an on-screen button.

METHOD

We conducted a within-subjects study in which participants used the electronic and dry-erase whiteboards to solve a reading task and a revision task. The healthcare region and the management of the ED approved the study prior to it being conducted.

Participants

The 18 participants (17 females, 1 male) were clinicians on duty the day the study was conducted at the ED. The participants comprised physicians, nurses, and auxiliary nurses with an average age of 49.9 years (SD = 7.7). They had an average ED seniority of 8.2 years (SD = 9.7) and rated the frequency of their use of the electronic whiteboard at an average of 20 (SD = 26.78) on a NASA TLX-like scale from 0 (often) to 100 (never). Thus, participants were experienced users of the electronic whiteboard, which had been in use at the ED for 21 months. All participants had normal or corrected-to-normal eyesight.

Whiteboards

In the study we compared the actual electronic whiteboard in use with the previously used dry-erase whiteboard. During the study the electronic whiteboard and the dry-erase whiteboard were placed in the same room away from the command room of the ED. Interaction with the electronic whiteboard was restricted to the touch-screen interface.

Tasks

The study involved two tasks: a reading task and a revision task. For the *reading task*, participants were asked to read out loud the contents of three of the whiteboard rows. The three rows were read at decreasing distances to the whiteboard, first 5, then 3.5, and finally 2 meters. The rows contained 30 to 62 characters of realistic data.

Figure 1: The dry-erase whiteboard.

Figure 2: The electronic whiteboard.

The *revision task* consisted of two subtasks: changing the triage code for a specified patient and entering transfer-to-ward information for another patient. On the electronic whiteboard, the first subtask involved logging on with the participant's personal token, changing the patient's triage code using a drop-down menu, and logging off. On the dry-erase whiteboard the same subtask consisted of changing the patient's triage code by replacing a coloured cardboard square with a square in another colour. Solving the second subtask on the electronic whiteboard involved logging on with the personal token, selecting the transfer-to-ward information from a drop-down menu, and logging off. On the dry-erase whiteboard the same subtask consisted of clearing the cell of any previous contents and writing the transfer-to-ward information with a dry-erase marker. The transfer-to-ward information was 3-4 characters in length.

We included the logon process in the use of the electronic whiteboard because actual whiteboard use at the ED consists mainly of logons to make one or two changes.

Procedure

The study was conducted at the ED in a quiet room. Participants were first welcomed, explained the procedure, and asked a few questions about their background. Then, participants solved the reading task and next the revision task. Both tasks were first solved using the electronic whiteboard, then the dry-erase whiteboard. Finally, participants rated the ease of use of each whiteboard on a scale with the anchors 'easy' (0) and 'difficult' (100) and ranked the whiteboards in order of preference. Participants were asked orally about the reasons for their preference. Each session lasted approximately 5 minutes.

Data Collection and Coding

The sessions were audio recorded to capture the data from the reading task and the reasons for participants' preference. Both authors individually coded the accuracy of the reading-task data by comparing these data to the actual whiteboard content. Accuracy was rated on a four-point scale from 1 (unable to read but may be able to discern colour codings) to 4 (fluent, error-free reading). The data from two participants were used for training, after which the authors discussed their coding. The Kappa value of the agreement between the authors' coding of the remaining participants' reading-task data was 0.80 indicating substantial agreement [2]. All disagreements between the authors were discussed and a consensus was reached.

For the revision task, the completion time for each subtask was recorded with a digital stopwatch.

RESULTS

Below we analyse the obtained data using analyses of variance (ANOVA). For the analysis of the reading task, the independent variables were the type of whiteboard and the distance whilst the accuracy rating was the dependent variable. Due to a clerical error one reading task was not audio recorded, leaving 17 participants for this analysis. For the analysis of the revision task, the independent variable was the type of whiteboard while completion time was the dependent variable. All 18 participants were included in this analysis and in the ease-of-use and preference analyses.

Distance	**Electronic**		**Dry-erase**	
	Mean	***SD***	***Mean***	***SD***
5 meters	1.71	0.92	3.65	0.49
3.5 meters	3.06	0.83	4.00	0.00
2 meters	3.76	0.44	4.00	0.00

Table 1. Accuracy (1-4) for reading task, $N = 17$

Table 1 shows the results for the reading task. There was a significant difference in accuracy between the two whiteboards, $F(1, 16) = 73.92$, $p < 0.001$, with better reading accuracy for the dry-erase whiteboard. There was also a significant difference in accuracy between the three distances, $F(2, 15) = 43.89$, $p < 0.001$. Bonferroni-adjusted pair-wise comparisons indicated that reading accuracy decreased significantly for each increase in distance. A significant interaction between whiteboard and distance on accuracy, $F(2, 15) = 30.70$, $p < 0.001$, indicated that the decreased reading accuracy at longer distances was mainly due to the electronic whiteboard.

Individual comparisons between the two whiteboards at each distance showed a significant difference in accuracy at 5, 3.5, as well as 2 meters, Fs(1, 16) = 58.86, 22.02, 4.92, respectively (all ps < 0.05). At all three distances accuracy was better with the dry-erase whiteboard. Notably, accuracy with the electronic whiteboard was not better than with the dry-erase whiteboard for any participant at any distance.

Table 2 shows the results for the revision task. For the first subtask we found a significant difference in completion time between the two whiteboards, $F(1, 17) = 12.28$, $p < 0.01$, indicating that the dry-erase whiteboard was faster than the electronic whiteboard. For the second subtask there was no difference in completion time between the two whiteboards, $F(1, 17) = 0.20$, n.s.

Subtask	**Electronic**		**Dry-erase**	
	Mean	***SD***	***Mean***	***SD***
Subtask 1	26.52	9.58	19.66	4.09
Subtask 2	25.94	11.29	24.57	4.37

Table 2. Completion time (seconds) for revision task, $N = 18$

Participants rated the ease of use of the electronic whiteboard at an average of 13.89 (SD = 17.54) and the dry-erase whiteboard at an average of 6.94 (SD = 5.18). For both whiteboards the rating is closer to the "easy" (0) than the "difficult" (100) end of the scale. There was no difference in ease-of-use rating between the two whiteboards, $F(1, 17) = 2.36$, n.s.

In terms of preference, 13 participants preferred the electronic whiteboard, 2 preferred the dry-erase whiteboard, and 3 had no preference. A Friedman test of the preference data showed a significant preference in favour of the electronic whiteboard as a whole, $\chi^2(1, N{=}18) = 8.07$, $p < 0.01$.

The participants gave several reasons for preferring the electronic whiteboard. Generally, the participants preferred the electronic whiteboard as a whole because it was easy to use, because it was a smarter system than the dry-erase whiteboard, because it provided more information than the dry-erase whiteboard, and because the text displayed is independent of personal handwriting styles and thus always legible. The most frequent reason stated in favour of the dry-erase whiteboard was that it was very reliable because it had no down time.

DISCUSSION

Given the design of the electronic whiteboard it is unsurprising that the dry-erase whiteboard can be read accurately at greater distance and revised at least as quickly. What is surprising is that the importance of being able to read and revise the whiteboard information accurately and rapidly seems to have been down prioritized compared to other design considerations e.g. showing more information.

The ED clinicians often glance at the electronic whiteboard in passing, as opposed to stand in front of it scrutinizing its contents. Similarly, the ability to gain an overview by simply glancing at the display is an important feature of other systems [6]. The possibility of retrieving information “at a glance” seems particularly important and useful in situations of fast pace and high workload. While such situations are common in EDs, this study shows that the electronic whiteboard has reduced the clinicians’ ability to read the whiteboard information accurately, especially at longer distances. This may impair the clinicians’ ability to quickly gain an overview of the ED status, in turn slowing down their work pace. An advantage of the electronic whiteboards is, however, that this system provides more and better information, which to some extent seems to negate the disadvantages of not being able to retrieve information “at a glance”.

The time required to revise the electronic whiteboard is longer for one subtask and the same for the other subtask, compared to the dry-erase whiteboard. While the slower performance on the triage subtask is important because triage codes are set and changed 100+ times a day, the similar performance on the transfer-to-ward subtask is the more surprising because the use of the electronic whiteboard involves logon. A candidate explanation for the similar performance on the transfer-to-ward subtask is that the physical token carried by the clinicians provides for an efficient logon procedure. The logon procedure is particularly important in hospital environments because work in these environments is nomadic, frequently interrupted, and characterized by brief periods of use [1]. Thus, clinicians perform the logon procedure many times a day. Bardram [1] identifies logon as one of the reasons why electronic systems often cause more frustration amongst clinicians than their manual counterparts. The participants’ preference for the electronic whiteboard and the absence of a difference in their ease-of-use ratings suggest that the logon procedure is considered quick and simple. The difference in revision time for the triage subtask, which also involved logon, shows however that the interaction mechanisms, including logon, of electronic whiteboards still need to be improved to compare with making simple changes on dry-erase whiteboards. A further challenge in devising these interaction mechanisms is that during real ED work clinicians often manipulate the whiteboard while having a phone in one hand and some papers in the other.

In order to avoid that important details go unnoticed in design processes and thus end up hampering system use, we recommend that systems be evaluated in the field before their design is finalized. Such pilot implementation under realistic conditions appear more likely to lead to the identification of mundane details, such as the importance of accurate reading at a glance, than more fieldwork prior to the design phase or more reflection during the design phase.

CONCLUSION

This study shows that design details that may seem mundane and trivial can impact the usability of electronic whiteboards. The smaller font size of the electronic whiteboard reduces participants’ ability to read whiteboard content accurately; this may reduce ED clinicians’ ability to retrieve information at a glance and slow them down. The participants perform some whiteboard revisions slower with the electronic whiteboard and others equally fast with the two whiteboards. The similar performance on some revision tasks shows that logon does not necessarily consume extra time. The logon procedure seems to be efficient and fit well to ED work. In sum, apparently mundane details may have a substantial impact on the usability of a system. To tease out such details before a system is taken into operational use we recommend evaluation in the field.

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REFERENCES

1. Bardram, J.E. 2005. The trouble with login: On usability and computer security in ubiquitous computing. Personal and Ubiquitous Computing, 9, 6 (2005), 357-367.
2. Landis, J.R. and Koch, G. G. 1977. The measurement of observer agreement for categorical data. Biometrics, 33, 1 (1977), 159-174
3. Mackay, W.E. 1999. Is paper safer? The role of paper flight strips in air traffic control. ACM Transactions on Computer-Human Interaction, 6, 4 (1999), 311-340.
4. Rasmussen, R. Electronic whiteboards in emergency medicine: A systematic review. Proceedings of the 2012 International Health IT Symposium. ACM Press, New York, 483-492.
5. Sassene, M.J. and Hertzum, M. 2009. Incompatible images: Asthmatics' non-use of an e-health system for asthma self-management. In *Patient-Centered E-Health,* E.V. Wilson, Ed. IGI Global, Hershey, PA, 186-200.
6. Tan, D.S., Smith, G., Lee, B., Robertson, G.G. 2007. AdapativiTree: Adaptive tree visualization for tournament-style brackets. IEEE Transactions on visualization and computer graphics, 13, 6 (2006), 1113 - 1120.
7. Wears, R.L. and Perry, S.J. 2007. Status boards in accident emergency departments: Support for shared cognition. Theoretical Issues in Ergonomics Science, 8, 5 (2007), 371-380.
8. Whittaker, S., and Schwarz, H. 1999. Meetings of the board: The impact of scheduling medium on long term group coordination in software development. Computer Supported Cooperative Work, 8, 3 (1999), 175-205.

Provoking friendly encounters: social contraptions and collective appropriation

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ABSTRACT
This paper argues for an interactive physical installation based approach to making public spaces more friendly. How the private nature of personal networked devices add to this challenge is outlined. By contrast, new dynamic materials offer great potential for influencing the sociability of public spaces. However how novel forms of interactivity may influence interpersonal interaction is poorly understood. Social contraptions is proposed as a means to address this challenge of informing the design of physical social catalysts. These design interventions explored how unusually positive behaviour, particularly in relation to the boundaries between people, might be provoked. How observed responses to the deployment of one social contraption can stretch and extend a prominent conceptual framework for social interaction design is presented as evidence for the value of this approach.

Author Keywords
social contraptions, design for social interaction, design research, interactive arts.

ACM Classification Keywords
H5.m. Information interfaces and presentation : Miscellaneous.

General Terms
Design, Economics, Experimentation, Human Factors,

DO WE NEED SMILES BETWEEN STRANGERS?
Big cities can be unfriendly places, and perhaps the more densely populated they are, the less friendly they seem, as the sociology pioneer Simmel wrote:

"*one nowhere feels as lonely and lost as in the metropolitan crowd"* [28].

Organisations that manage and/or promote urban areas would like to make them seem more sociable as this can increase at least perceptions that their cities are friendlier, safer and more fun. Ilja goes so far to suggest important economic effects:

"*where trust and social networks flourish, individuals, firms, neighbourhoods, and even nations prosper economically*" [12]

Fostering interactions between strangers has commercial applications at a more micro-level too, for instance businesses want to understand and exploit customer to customer interaction [1] [22]. Other difficulties in commencing interaction can also apply in social events ostensibly designed for people to meet. For instance, when mingling in crowds new arrivals can find it hard to break the ice and become part of a group.

Personal devices - solution or problem?
A number of attempts have been made to develop systems for mobile phones and portable computers to address these challenges such as attempting to "extend the familiar stranger relationship" [23] and sparking conversations through photo sharing [14] and mutual address book contacts [15] amongst ad hoc groups of people.

Bespoke systems intended for ice-breaking purposes also include electronic conference badges systems [3] and handheld devices for the public, yet anonymous sharing of emotion in a shared location [11].

However mobile computing solutions to address this problem space can be counterproductive. Mobile applications whether worn or handheld cannot address population divisions concerning access to devices and/or bandwidth particularly along lines of age, income, local versus international visitor etc. Also mobile phones have the potential to be "used extensively as a private antisocial device" [7] and their applications have been called "attempts to limit or even close down opportunities for encounters with difference"[3].

Crawford draws attention to how devices can become not bridges but barriers to interaction:

"Communication technologies, like physical spaces, create structures which include and exclude participants, and in

so doing they can create social boundaries equivalent to the walls and windows in physical space" [29].

Users of today's smartphones are also only a screen tap away from a whole host of other applications, media and services. This can lead to anti-social distraction in that operating hand held devices can result in less attention paid to surrounding people. Such absence of what has been called by developers of social learning experiences a "Heads up experience" [2] makes co-located interaction more difficult whatever the context of use.

EXPLOITING OUR MULTI-PURPOSE BODIES

Interactive environments offer potential to avoid the distributed and private nature of personal device based systems. Futhermore, Physical installations afford and sometimes require physical actions. When successful they can be also be very multifunctional. For example, Hansen et al claim for "Pendaphonics", a tangible-physical sonic environment, not just two purposes but a whole range of potential applications:
"an element of urban revitalization...a compositional tool; an educational exhibit and classroom manipulative; and as interface that facilitates playful interaction, exploration, discover and creativity" [9]

The variety of uses claimed for Pendaphonics might be partly explained through references to embodied approaches in psychology. If people are using their bodies to do something, then the range and multiplicity of what they are doing, and how others may interpret this can be very wide. As Lindbolm and Ziemke argue, even within social interaction alone, there are at least four fundamental purposes of the body:

"1)the body as a means and end in communication and social interaction
2) the body as a social resonance mechanism
3) embodied action and gesture as a helping hand in shaping , expressing and sharing thoughts
4) the body as a representational device" [16]

Increasing Physicality

Physical environments themselves may also begin to take on such a mix of purposes if they become more responsive, and dynamic as proponents of interactive architecture such as Bullivant [4] foretell. Boundaries might literally turn into bridges. We may be at the dawn of a new era of flexibility and malleability of physical materials. If visions of responsive and transformable materials such as Ishii's Radical Atoms [13] come to pass, then physical spaces have the potential to undertake all four of the social interaction purposes listed above [15]. This may be in complement to, or opposition to the actions of one or people in a space. Or perhaps open up entirely new means for people to interact.

Cutting edge technology however, is not a prerequisite for increasing the complexity of situations, particularly in relation to human-human interaction. As social media exponent Clay Shirky put it:
"*Communications tools don't get socially interesting until they get technologically boring*" [27]

Shirky's espousal of finding value in situations involving simpler technologies can also be used to summarising the benefits of the design research approach we call social contraptions.

MOCKING UP TOMORROW'S INTERDEPENDENCIES

Social Contraptions is an umbrella term for a variety of experimentation in social situations. The aim of a social contraption is to engage nontechnical or mixed audiences in a natural setting with an interactive intervention *and* their fellow participants, particularly those with whom they were previously unacquainted. How people individually or collectively respond to, avoid or exploit

Social contraptions are intended to have an effect upon social situations. They aim to move a situation towards qualities of novelty, instability, indeterminacy and interdependence. This has previously been argued to be of value to designers concerned with exploring how to understanding embodied interaction [6] dynamic contexts [21] and also open up possible new design research approache such as "critical co-design" [20].

What is a "contraption" and how are they "social"?

The word *contraption* is used to refer to the interventions because it hints at complication and elaborateness rather than simple effectiveness. Something labelled *contraption* has the implication of being a slightly ungainly, but nevertheless effective contrivance, rather than an elegant device. A *social contraption* can be considered as positioned halfway along an imaginary continuum between *social mechanism* and *facilitation*. That is to say, a contraption is neither wholly deterministic, nor a wholly personality driven, subjective process.

The word *contraption* also has associations with the fantastical inventions depicted in the cartoons of Rube Goldberg [30] Storm P [25] or Heath Robinson [9] and thus connotes a certain unpredictability and liability to malfunction without warning. Also, similar to these cartoonists how the contraption functions, although elaborate, is not intended to be completely obscure. Furthermore, these contraptions may also be labelled *social* because participants in encountering them, are to varying degrees, *part of the contraption* for other participants. The social is both the ingredients of, and the aim behind the contraptions.

Positive breaching environments

This approach differs from Garfinkel's [8] original notion of breaching experiments that explored responses to deliberate violations of social norms. Here the design interventions can be said to offer an invitation, encouragement or provocation for participants to behave in unusual ways towards *each other*. Thus social contraptions can be seen as a participatory breaching experiment or in a sense; the situation could be described as a breaching *environment* [19] that is co-created by the responses of participants.

Physical social contraptions

A variety of mechanical contraptions have been developed [18] . An example of one physical social contraption is described below in order to allow a disccussion of how social contraptions may challenge a respected conceptual model for understanding social interaction.

Blender: mixing people up with giant revolving blades

'Blender' was a social contraption which consisted of a configuration of moveable walls rotating about a central column in a room. This interactive installation could be likened to a large revolving door or a giant four bladed human powered propeller. 'Blender' was positioned at the centre of a fixed circle of chairs. The four revolving door wooden panels or "blades" were shaped and sized so that they would pass closely over the knees of guests seated on the chairs. Despite its considerable weight, it was easy to push the panels from any point except very close to the column. The circle of chairs filled the width of the room and so in order to progress through the gallery, guests needed to revolve the barrier by pushing and/or move in the same rotational direction as and when another guest pushed the doors.

Through this arrangement, it was intended to create a continuously circulating social situation, which might spark interactions between seated and standing guests. An aim of this contraption was thus to create a social situation in which being a stationary "wall flower" was impossible since the edge of the circular space contained the fastest moving part of the contraption.

REVIEWING STAGES OF SOCIAL INTERACTION

Ludvigsen [17] argues that in order to develop installations to bring strangers together, designers should think in terms of how people can be induced to progress through four different phases of co-located experience from an initial level of *distributed attention*. If an intervention can transform the character of the *distributed attention* phase to that of the *shared focu*s level, then it may be possible for the *shared focu*s phase to allow progression to the level of dialogue which might lead to what he calls the most memorable and social level, that of *collective action* [17]. Observations of participant responses to the *Blender* strongly suggest that size, dynamism and novelty of the Blender make it very much an object of shared focus.

Blender a shortcut to collective action?

If pushing the panels of the Blender in the same direction is considered a collective action, then participants can be seen to very readily reach a state of collective action without requiring passing through a phase of dialogue. Many gallery visitors seemed initially reluctant to touch the panels. However, seeing one of their fellow participants push or pull a blade seemed to convey that it was permitted and/or desirable that they do the same.

Once the Blender was revolving, by far the majority of people pushing or pulling it, would not attempt to change the direction of its revolution. Instead, most people manipulated the panels so that the artefact rotated at approximately the same speed and in the same direction as the artefacts most recent movement prior to their action. This appeared equally true irrespective of whether participants manipulated the panel whilst it was in motion i.e. pushing/pulling so that it continued to revolve, or whether people waited for the motion to cease, before manipulating the artefact so that the previous motion recommenced.

Confrontation or collective appropriation

An exception to this tendency of politely sedate collective action was the over exuberant and boisterous panel pushing of some of the younger adult male gallery visitors. On several occasions there were instances of participants developing what could be said to be games with these barriers including trying to spin the blades as fast as possible. Then when the structure was moving fast, trying to leave it until the last fraction of a second before jumping out of its way. Such exuberant individualism, if and when it was appreciated or echoed by other participants might be considered more social than the more harmonious polite form of collective action even though these game like actions might appear more confrontational.

An alternative reading is to consider such play as a particular kind of collective action: appropriation. Participants playing boisterously with the Blender, by turning it into a game of their own devising, can be seen as creating their own meaning and use for the situation. This suggests that they could be said to be much more fully engaged with the artefact, the situation, and their fellow participants than those pushing politely. Thus it is proposed to add a fifth layer to Ludvigsen's four stage model: collective appropriation. When participants are not only acting together, but coming together to collaboratively explore new possibilities, then they could be said to be behaving significantly more socially than when performing relatively simpler routines of pushing doors for each other.

Appropriation has been previously been identified as being crucial to successful design [26] but perhaps creative collaborative appropriation is worthy of more attention.

FURTHER WORK

The author has begun to examine if, and how a number of other design frameworks pertinent to social interaction can be tested and stretched through holding up participant responses to social contraptions. Completion of this theoretical investigation alongside further iterative empirical deployments is hoped to enable better understanding of the potential for physical social catalysts and what contribution these interactive artefacts can make to their development.

CONCLUSION

This paper has argued that novel, low tech interactive artefacts can challenge and inform understandings of social interaction. Such social contraptions explorations can be seen as very early stage exploration into understanding the social and anti-social potential of kinectic and responsive environments.

REFERENCES

1. Baron, S., A. Patterson, K. Harris, and J.Hodgson. "Strangers in the Night:Speed dating, CCI and Service Businesses." Service Business 1, no. 3 (2007): 211–232.
2. Benford, S. et al., 2004. " Savannah": designing a location-based game simulating lion behaviour. In *International Conference on Advances in Computer Entertainment Technology*.
3. Borovoy, R., F. Martin, M. Resnick, and B.Silverman. "GroupWear: Nametags That Tell About Relationships." *CHI 98*, 329–330, 1998.
4. Bullivant, L. (2006). *Responsive environments*. London: V & A.
5. Crawford, A. "Taking Social Software to the Streets: Mobile Cocooning and the (an-) Erotic City." Journal of Urban Technology 15, no. 3 (2008): 79–97.
6. Donovan, J. & Mitchell, R.. Social contraptions and embodied interaction. *ACM UBICOMP adjunct papers* (2010) pp. 403–404
7. Eriksson, E., T. R. Hansen, and A. Lykke-Olesen. "Reclaiming Public Space:Designing for Public Interaction with Private Devices."*TEI '07*, 31–38, 2007.
8. Garfinkel, H. (1964). Studies of the Routine Grounds of Everyday Activities *Social Problems*, Vol. 11, No. 3 (Winter, 1964), pp. 225-250
9. Hamilton, J., & Robinson, W. H. (1995). *William Heath Robinson*. Brighton:Pavilion.
10. Hansen, A. M.S, D. Overholt, W. Burleson, and C. N Jensen. "Pendaphonics: a Tangible Pendulum-based Sonic Interaction Experience." *TEI '09* 153–160, 2009.
11. Hansson, R., and T. Skog. "The LoveBomb: Encouraging the Communication of Emotions in Public Spaces." In CHI'01 Extended Abstracts on Human Factors in Computing Systems, 433–434, 2001.
12. Ijla, A. M. "Does Public Space Create Social Capital?" International Journal of Sociology and Anthropology 4, no. 2 (2012): 48–53.
13. Ishii, H., D. Lakatos, L. Bonanni, and J. B.Labrune. "Radical Atoms: Beyond Tangible Bits, Toward Transformable Materials." Interactions 19, no. 1 (2012): 38–51.
14. Kohno, M., and J. Rekimoto. "Searching Common Experience: a Social Communication Tool Based on Mobile Ad-hoc Networking." Conference on Human Computer Interaction with Mobile Devices & Services, 15–22, 2005.
15. Kostakos, V., E. O'neill, and A. Shahi. "Building Common Ground for Face to Face Interactions by Sharing Mobile Device Context." Location-and Context-Awareness(2006): 222–238.
16. Lindblom, J., and T. Ziemke. "Interacting Socially Through Embodied Action"In F.Morganti, A. Carassa and G. Riva (eds) *Enacting Intersubjectivity: A Cognitive and Social Perspective on the Study of Interactions.* IOS Press Amsterdam (2008).
17. Ludvigsen, M. "Designing for Social Interaction". Doctoral thesis. Aarhus School of Architecture, 2007.
18. Mitchell, R. "Physical contraptions as social interaction catalysts" The Third Workshop on Physicality – a British HCI workshop, Cambridge, UK, 2009
19. Mitchell, R. "Social Contraptions as Breaching Environments." *TEI'12*, 393–394, 2012.
20. Mitchell, R. Physical social contraptions sparking inspiration for understanding interaction in and with dynamic contexts. CHI Sparks (2011).
21. Mitchell, R., A. Gillespie, and B. O'Neill. "Cyranic Contraptions: Using Personality Surrogates to Explore Ontologically and Socially Dynamic Contexts." In Proceedings of the Second Conference on Creativity and Innovation in Design, 199–210, 2011.
22. Nicholls, R. "New Directions for Customer-to-customer Interaction Research." Journal of Services Marketing 24, no. 1 (2010): 87–97.
23. Paulos, E., and E. Goodman. "The Familiar Stranger: Anxiety, Comfort, and Play in Public Places." *CHI '04*, 223–230, 2004.
24. Peters, K. "Being Together in Urban Parks:Connecting Public Space, Leisure, and Diversity." Leisure Sciences 32, no. 5 (2010): 418–433.
25. Petersen, R. S. (1995). *Storm P.* Copenhagen: Borgen.
26. Salovaara, A., Hook, K., Cheverst, K., Twidale, M., Chalmers, M. and Sas, C. (2011) "Appropriation and Creative Use: Linking User Studies" *CHI '11.*
27. Shirky, C. (2008). Here comes everybody: The power of organizing without organizations. NY, NY: Penguin
28. Simmel, G. The Sociology of Georg Simmel: Translated by Kurt H. Wolff. Free Press, 1950.
29. Willis, K. S, K. Chorianopoulos, M. Struppek,and G. Roussos. "Shared Encounters." CHI'07 Extended Abstracts 2881–2884, 2007.
30. Wolfe, M. F., & Goldberg, R. (2000). *Rube Goldberg*. New York, NY: Simon& Schuster.

Of Cars, Computers and Hell: A Historical Perspective on User Unfriendliness of Personal Technologies

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ABSTRACT
In today's fascination by sleek and powerful computing technology it is tempting to forget the origin of the technology. Highly relevant to HCI in this regard is a recent book by historian of technology Joseph Corn "User Unfriendly: Consumer Struggles with Personal Technologies, from Clocks and Sewing Machines to Cars and Computers". Corn analyses the user unfriendliness for early adopters of a range of personal technologies, primarily clocks, sewing machines, cars and computers as these are archetypical examples of personal technologies. His main claim is that none of these technologies subjected consumers to the hell like cars and computers. Based on a thorough analysis of contemporary accounts by early adopters, Corn convincingly drives home his point. This paper presents and discusses Corn's book and main line of argument. The purpose of the paper is to sensitize the HCI community to the historical perspective.

Keywords
History of personal technology, user unfriendliness, technology consumption, technology obsolescence.

INTRODUCTION

In the interaction between humans and computers, enormous developments have taken place since the early seeds of the area HCI in the 1970s, when the term *user friendliness* was key, see for example Norman's *The Trouble with UNIX* [4].

Today we routinely use sleek and powerful computing technology no one imagined a few decades ago. It is tempting to focus on the fascination and technological opportunities and forget the origins of the technology, let alone connections to earlier exemplars of similar technologies. Highly relevant to HCI in this regard is a recent book by historian of technology Joseph Corn of Stanford University "*User Unfriendly: Consumer Struggles with Personal Technologies, from Clocks and Sewing Machines to Cars and Computers*" [1].

Corn analyses the *user unfriendliness* of a range of personal technologies covering several centuries, focussing on early adopters. Indicated by the title his primarily addresses clocks, sewing machines, cars, and computers as these are archetypical examples of *personal technologies*. His main claim is "*None of these ... subjected consumers to the hell cars and computers did.*"

The starting point for Corn's book was his struggles with computers in the early 1980s at Stanford University. Hence he *"began looking for earlier examples of machines that were also maddening challenging but had also become popular consumer products."* (7) As a historian, he thought that computers could not have been the first technology that put early adopters through such hell. Corn's numerous sources are early adopters' writings about their experience: *"These writings constitute a treasure trove for historians wishing to peer over their shoulders ..."* (9)

The primary merit of Corn's book is the provision of a historical grounding of the concept *user-friendly*. The book can be seen as a socio-historical account of the usability of personal technologies. To the best of my knowledge no other similar works exist on the history of user unfriendliness. The book is an important contribution to fundamental works on historical, social and psychological aspects of technology like Norman's *The Psychology of Everyday Things* [5], Rose's *User Error: resisting computer culture* [6], Ihde's (1993) *Philosophy of Technology* [2], and Misa's *Leonardo to the Internet: Technology & Culture from the Renaissance to the Present* [3].

The organization of the present paper mirrors closely the organization of the book. After the Introduction, where key concepts are introduced, the three technologies clock, sewing machine, and cars are presented. The next chapter addresses personal computers and compares them to cars, while the epilogue describes consequences of the spread of digitization in personal technologies. I will present a brief discussion of the book, conclusion and perspectives. Throughout the paper I quote many fine points from the book. I have taken the liberty to refer to specific pages like this "(68)" instead of the traditional "[1, 68]".

The purpose of the paper is to sensitize the HCI community to the historical perspective by drawing parallels between major types of personal technologies, in particular the car and the computer.

OUR MARVELLOUS AND MADDENING MACHINES

In this chapter, Corn introduces the two key concepts: *technology consumption* and *technology obsolescence.*

Technological consumption is described as follows: *"Buyers of leather or cloth pants might lose a button or tar a seam, and shoppers might not exactly know how to prepare their chicken, but everybody grows up with at least a general awareness of the uses for, and the management and care of, clothes and foodstuffs. And if they lack such knowledge they know where to turn; they can ask a friend or relative, or ... consult a cookbook. And they also can readily describe their problem or need. ... Technology consumption, however, faces greater challenges. Learning to use their new machine might demand considerable study and practice, and if the machine fails to work or perform as expected, consumers often neither can describe the problem nor know what to do to rectify it".* (12)

Corn then introduces a central point: *"Unlike foodstuffs ... machines endure and must be nourished and maintained, like domesticated animals.*" (13)

Technological obsolesecence is described as follows: *"Becoming accustomed to using machines and often dependent on them, consumers soon discovered the modern phenomenon of technological obsolesecence. Devices bought a few years earlier might still work but had become less desirable than and often decidedly inferior to the latest versions of this technology. Or old machines that wanted a single replacement part could no longer be repaired because the manufacturer no longer produced that item, thereby forcing sustomers to costly upgrades. The age of personal technologies had arrived!"* (18) For further details on technological obsolescence see the book *"Made to break: technology and obsolescence in America".* [7].

THE THREE PRE-COMPUTER TECHNOLOGIES

This section presents *selected* facets of the four technologies in question as space does not allow a more thorough account. The backdrop is hundreds of years of use of devices such as spinning wheels, hay rakes, harnesses, harpsichords, sundials, and scythes. These remained largely unchanged; in short, before 1800 material novelty was largely restricted to art and fashion (17); consumption was *traditional. "A brand new ... ceramic pot, ax, musket, or pair of eyeglasses in 1800 differed little from one made in 1750 or even 1700."* (17)

Clocks

The first personal technology to enter peoples homes was the mechanical clock, made possible by mass production. Before then people had relied on simple means as position of the sun, length of shade, or sundials. The clocks did come with instructions affixed to the back or indside of the clock's wooden case, filled with technical jargon. Never before had printed instructions been neccessary for household devices so users had virtually no experience in following printed instructions.

Learning to wind a spring-powered clock caused trouble as winding too much caused the spring to break and too little made the clock loose accuracy. The instructions were not clear: *"The anonymous authors ... had a lot to learn about what made for a clear instructional text."* (25) In addition, many people did not have experience with locks and keys so winding a spring-driven clock by inserting the key or crank was not obvious. *" ... the directions anticipate that the process might be new and begin by explaining how to insert the key or crank into the clock's face."* (27)

Even with these simple devices, tinkering was neccessary and problematic: *"... apply one drop of good oil to the verge and crown wheel"*. However, oil was not a common commodity, difficult to come by and expensive. (26)

Sewing Machines

In the middle of the 19th century, workable sewing machines appeared, intended for use in factories. But due to their versatility - and in spite of their high price and their complexity - these machines soon became common in homes. They were used by women who *"initially were sceptical, wondering how a machine could sew and produce seams with stitches as regular and durable as those they could make by hand."* (30)

Due to their complexity, sewing machines came with multi-page booklets and users became readers by neccessity. *"Titles like 'The Howe Sewing Machine Instructor' suggest how the industry considered the manual a surrogate for the human tutor."* (41) The manuals visualized use for the customers: *"... depicting a pair of hands working with the machine. This gave the illustration greater instructional and psychological power.*" (41)

Women also had to tinker with sewing machines as they wanted the machine to stay "healthy". *"Anthropomorphizing a sewing machine as it were able and capable of fits, speels, or willful behavior, women revealed what would become a familiar consumer response to complicated consumer technologies. Their comments expressed both the unavoidable intimacy users developed with the working of their machines as well as the value they placed in a machine's 'good behavior'."* (35) Contrasting sewing by hand, *"... sewing mechanically required that women frequently stop to manipulate the machine's controls or make adjustments."* (43) In addition, the women were *"... often required to use the tools that sewing machine manufacturers provided them, usually a screwdriver, wrench, and oil can."* (43) Such tools were not common in households by then.

Mastering the thread tension was tricky: *"Operators learned that numerous factors might affect thread tension: the type of thread itself; the nature of the fabric; the number of layers; the length of the stitch; and even the humidity. Automatic thread tension was introduced on later machines."* (43).

Cars

The backdrop for early adoption of cars in the late 19'th and early 20'th century was horse drawn carriages for rapid, personal travel. Note that cars initially were called "horseless carriages". Cars were indeed alien and strange, by some even considered a passing fad. *"To men and women, who had never run a device more complicated than a bicycle, lawn mover, or sewing machine, getting into the driver's seat of an automobile could produce ... dizzying confusion"* (88). Many facets are relevant, here

I'll focus on starting, steering, reliability, tinkering, instruction manuals, and tools.

Before the advent of the electric starter around 1910, gasoline driven cars were started by cranking. This was not only taking place outside where the driver was exposed to wind and rain, but it was hard, difficult, and errror prone. Injuries to arms, wrists and hands caused by engine backfiring were common. A novel diagnosis "chaffeur's fracture" appeared: a peculiar and complicated fracture of the bones of the forearm. (94)

Steering the car itself by operating the tiller and to keep the car off the road shoulder and the ditch was not a simple task on narrow dirt roads. Hence " *... early motorists often practiced [steering] separately from operating the vehicle itself, sitting in a non-moving car whose wheels were jacked up off the ground."* (98)

The cars were not that robust and reliable. Not rarely cars lost parts while underway; busy streets were strewn with car parts. *"Trouble was part ... of motoring: springs and axles 'broke', gears were 'stripped', and connecting rods were 'thrown' etc."* (126) Emergencies repairs on the road were common, sometimes enabling the driver to limp home; sometimes not, so the driver *"had to 'get a horse', submitting to the ignominy of being towed by an obliging farmer."* (126)

Tinkering was neccessary - daily or weekly - in order to maintain the car, get to know it and thereby be able to handle a breakdown on the road. *"Nothing was so embarassing to take a friend for a ride and don't know what to do in case of breakdown."* (120) With the 1924 Nash it was recommended that owners spent 20-30 min once a week and *"your chassis will be kept thoroughly lubricated."* (131)

As with sewing machines, cars came with printed instruction manuals. *"Representing a machine in words, diagrams, and illustrations, an owner's manual created a simulacra of the technology itself."* (147) As a consequence, a market of independent guides and manuals emerged. Hence, the 1915 book *The Model T Ford Car* sold nearly a million copies in its first 8 years. (149)

Early automakers had little incentive to improve the manuals, as they were able to sell virtually every car they built. *"In the 1910s, however, as competition increased and sales mushroomed, the auto industry became more aware of the almost universal ignorance buyers had about the new technology and began to improve the manuals."* (157) In spite of the succcessful instruction manuals for sewing machines some decades earlier, *"it took ... nearly twenty years to figure out how to write comprehensibly ... for novices."* (151)

By the 1930s cars were no longer exotic and strange. *"The car had become an inseparable part of people's lives"* (119). Greater reliability and innovations were contributing to the success, among these electric starters, synchromesh transmissions, all steel bodies, and advances in rubber fabrication. (142) Consequently, *"drivers now ran their cars almost exclusively from ... the driver's seat."* (117)

COMPUTERS

Corn describes the backdrop for use of personal computers as follows: *"When the personal computer entered the market, people were too young to remember early automobiles and motoring. In the meantime people have adopted a huge range of mechanic and electric devices such as stoves, refrigerators, power drills, TV, and radio."* (177) *"In general ... the new technologies ... caused consumers little struggle and frustration. In the late 1970s and early 1980s, the relatively idyllic relationship consumers had with new machines ended abruptly, shattered by the arrival of personal computers and the digital era."* (181)

In this chapter Corn focusses on the personal computer era. The starting point was kits like the Altair 8800 that came in the mid-1970s without software and input/output devices. Contacts and lamps on the front panel connected to the registers constituted the interface. (182)

Next Corn addresses the first truly personal computers on which video gaming was a key application: Tandy, Commodore PET, TRS-80, IBM-PC, and Apple II; the latter has been called the first "real consumer product" of the infant industry. (182) Users of these personal computers also had their share of struggles, for example with non-forgiving DOS command syntax and alienating language such as *"Abort, Retry, Ignore?"* (190). *"To many people the purpose and function of the new technology beyond typing seemed opaque and hard to fathom."* (184)

The facet is well known from HCI: *"What made computers intimidating to adults was their abstractness. The opaque exteriors of these "black box" technologies revealed nothing about how they worked or what they did."* (186) *"This aspect [tangible vs. symbolic] of using early computers had no parallel with the work of early automobilists had to do with their new machines. While the language of "Motor" included much strange vocabulary like carburetor, spark plug, or vibrators, those words all stood for tangible things, components that operators could see and touch, making them easier to learn and remember."* (193)

Two killer applications helped overcome this obstacle in the mid-1980s: word processing and VisiCalc as their functionality was readily graspable. PCs entered homes and small businesses in much larger numbers. But numerous features were unfriendly, among these print codes for italics and bold. Bins at Stanford University were often filled with loads of discarded paper after the computer had run amok, italicizing page after page. (193)

This strict syntax of command languages contrasts operating early cars. *"The first generation of automobiles permitted users to be somewhat sloppy, starting their engines without retarding the spark, say, or moving out from a dead stop in second or even third gear; the vehicle might react noisily and roughly, but it usually responded. ... Personal computers, however, forgave no such imprecision or errors of 'syntax'."* (190)

As reliability was an issue, backing up documents was neccessary. This facet contrasts earlier writing technologies: *"When the pen's ink ran out, the pencil's point broke, or when the typewriter jammed, what was already done was still there on paper."* (195)

Corn focusses on early adopters and therefore does not address further developments, but notes *"meanwhile, personal computers continued to evolve at a rapid clip, making the Apple IIs, Commodore PETs, and TRS-80s ... seem like relics from the Stone Age. ... Besides their speed and power, modern personal computers have incorporated many other improvements and innovations that have dramatically altered what we do with them and their importance in our lives."* (199)

In the final chapter Corn addresses the consequences of the spread of digitization in personal technologies. Starting with a vivid account of a new digitized thermostat in Corn's home, he looks at cameras, wristwatches, and VCRs, and argues that digitization has supported the user-unfriendliness of the devices.

OF CARS, COMPUTERS, AND HELL

This section presents Corn's main points regarding on cars and computers. *"Unlike automobiles ... which became user-friendly after 30 or so years of improvement, personal computers have still not reached that point - and it is not clear that they ever will. Today's computers are definitely more reliable and easier to use than those of the 1980s or 1990s, but we can still go through hell with these machines, their remarkable technical progress notwithstanding. ... The worst thing is that its hard drive can crash, the ... equivalent of Armageddon."* (200)

Corn argues why: *"It is the frequent lesser computer troubles, the glitches, bugs, incompatibilities, and virusses, that prevent the technology from attaining the user-friendlines of an automobile."* (201). In addition, *"We muddle on: First: try again; next: quit program and restart it; third: switch off computer and reboot. "Mysteriously, this ploy often succeeds ... we do not have the slightest idea what went wrong."* (201)

Finally, an interesting observation: *"Computer users still have nothing quite like the neighborhood service stations that once adjusted and repaired automobiles."* (202)

In spite of the enormous advances in user-friendliness of cars, Corn also remarks that things can go the wrong way with once user-friendly technologies. After WW2 *"when car climate controls, security and alarm systems, and entertainment and information systems became newly complicated and user unfriendly, forcing owners to read in order to understand their machines."* (162)

One of Corn's main points is: this trend is strongly supported by digitization*: "Computerization is spreading, infiltrating other household devices by giving them digital interfaces and enhanced functionality while at the same time changing once user-friendly and easily learned machines into newly challenging technologies."* (202) Hence, regarding the future, in the Epilogue Corn " ... *looks at how digital computing technology has spread spread into ever more machines and devices, continuing to stymie consumers and ensure that user unfriendly remains in our vocabulary*." (19)

DISCUSSION, CONCLUSIONS, AND PERSPECTIVES

This paper is strongly one-sided being based exclusively on one source - a format not usually acceptable in academia. However, As Corn's singular book is the first work of its kind it is hard to include other sources to sharpen and contrast the line of argument. Relating the *user unfriendliness* of a broad range of personal technologies is in my view a laudable endavour - and Corn has succeeded very well. The account is finely organized, the sources are numerous, valid, and broadly based. In sum, Corn's book presents a thorough and valid account of the history of the user unfriendliness of personal technologies and a convincing line of argument regarding the main point: None of the other technologies subjected consumers to the hell like cars and computers did.

The book has made me even more aware of user-unfriendly technology. Especially the comment on *" ... the frequent lesser computer troubles, the glitches, bugs, incompatibilities, and virusses"* (201) has made me reflect on the bumps that we take for granted in using personal computers and other technologies. As an example on the spread of digitization, at the IT University of Copenhagen, all electric switches and sockets are programmable. This is a new layer of "advanced" technology and, inevitably, it comes with novel types of errors: lights switching on and off and sockets providing electricity arbitrarily. Amen?

REFERENCES

[1] Corn, Joseph (2011): User Unfriendly: Consumer Struggles with Personal Technologies, from Clocks and Sewing Machines to Cars and Computers. Johns Hopkins University Press.

[2] Ihde, Don (1993): Philosophy of Technology. New York: Paragon House.

[3] Misa, Thomas J. (2004): Leonardo to the Internet: Technology & Culture from the Renaissance to the Present. Baltimore: Johns Hopkins University Press.

[4] Norman, D. A. (1981). The Trouble with UNIX. Datamation, November 1981, 139-150.

[5] Norman, D A: The Psychology of Everyday Things. Basic Books, 1988.

[6] Rose, Ellen (2003) User Error: Resisting Computer Culture. Toronto, Ontario: Between the Lines.

[7] Slade, Giles (2006): Made to break: technology and obsolescence in America. Cambridge, MA: Harvard University Press.