The Interaction Character of Computers in Co-located Collaboration

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An INTERACTION CHARACTER refers to a coherent set of qualities of the actions that an application mediates. Examples of such characters include the 'computer as a tool' and the 'computer as a medium'. This paper investigates INTERACTION CHARACTERS of applications used in co-located collaboration. Three qualitative cases have been investigated: consultation at banks, interaction design studio work, and interactive television usage. Interviews, observations, and workshops, as well as prototype design and testing, were conducted as part of the case studies. The results show that the INTERACTION CHARACTER may change swiftly in the middle of usage, which means that people are using the systems quite differently from one moment to the next. One way to increase the flexibility of a system is to facilitate those shifts between different INTERACTION CHARACTERS, by for instance letting people use the system as a tool one minute, and as a medium or a resource the next.

Keywords: interaction character, use quality, co-located collaboration, flexibility, interaction design, interactive television, bank consultation.

1 Introduction

Interaction designers and researchers need a wide variety of concepts that they can use to describe and analyse the use of the products that they are designing or studying. Too few concepts may make researchers and designers of human-computer interaction (HCI) insensitive to the nuances of the situation and the uniqueness of every design case. Some language of interaction design is indeed necessary, and commonly used concepts like usability, learnability, effectiveness, efficiency, user satisfaction, and consistency are part of that. They help in making

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different qualities of systems-in-use visible and allow us to compare products by discussing their properties, but other aspects of systems-in-use are also important and need to be highlighted. [E.g. Löwgren & Stolterman 1998; Bratteteig & Stolterman 1997; Levén & Stolterman 1995; Cross 1995; Stolterman 1991; Lawson 1980]

This article presents a qualitative collective case study where the concept INTERACTION CHARACTER is applied in the study of three quite different settings of co-located computer usage. In short, INTERACTION CHARACTER describes the kind of actions a system is designed to allow, support, and afford. The settings are customer meetings at banks, an interaction design studio at a university, and interactive television usage in living rooms. The purpose is to further refine the concept originally coined by Löwgren and Stolterman [1998], who in their turn based it on an article by Kammersgaard [1988] on perspectives of human-computer interaction. Co-located usage is very interesting in relation to INTERACTION CHARACTER since the concept has been developed with the premise of a single user operating a single computer connected to a network. The applicability and limits of the concept are therefore put to test by looking at co-located collaborative usage of computers. This paper describes the INTERACTION CHARACTERS for applications in co-located collaboration.

2 Theoretical Background

The work presented in this paper falls within a tradition of action-theoretic positions in human-computer interaction. It is closely related to activity theory [e.g. Leontiev 1978; Nardi 1996a, Wertsch 1998], and distributed cognition [e.g. Hutchins 1995]. In activity theory, the basic unit of analysis is a mediated activity where human action is performed by means of artifacts. The three cornerstones of an activity are the subject who performs actions; the mediating artifact; and the object that action is directed towards. The activity is also driven by motives in order to reach some outcomes. This is, however, not the entire picture. It is worth noting that activities are not stable; they change in an almost fluid way over time, and one consequence of that is that the object in one activity may be a mediating artifact in the next. Since every action is situated in an organisational context, other agents, their work, and motives are also affecting the action. In addition, procedures, norms, and artifacts, which have evolved within the history of an institution, explain why an activity is performed in a certain way. A more thorough description is provided by for example Wertsch [1998] and Nardi [1996a].

In distributed cognition, actions are seen as part of a system where cognitive work is distributed over individuals and artifacts, and also distributed over time. Culture precedes cognition, since cognitive behaviour is not only a property of the individual, but also an emergent property of the joint human-artifact ensemble. The artifacts themselves are, furthermore, physical embodiments of culture and history. Culture therefore provides the structural resources for action. Distributed cognition places the goals of a cognitive system as a whole in focus, while activity theory has the objectives and actions of the conscious individual as point of departure [Nardi, 1996b]. That makes them two sides of the same coin; activity theory is more

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interactional while distributed cognition is more oriented towards the structural foundations of cognition and action.

2.1 Use Qualities

A computer system that mediates the users' actions as part of a larger cognitive system or organisation, can be said to have many different qualities, or properties, in its usage. Some of the qualities are objective and others are not. Some are social and yet other qualities are subjective. Another aspect of use qualities of an artifact is their level of abstraction. They can be at a high level, functioning almost as dimensions of use. Examples include, the SCOPE OF ACTIVITY that can be performed by means of the system; the CHANGEABILITY in terms of freedom to change the form, structure, or functionality of the system; and the INTERACTION CHARACTER in terms of what kinds of actions the system is designed to allow, support, and afford. Others are more specific descriptions of how the system is, or how it should be. These specific 'use qualities' can be expressed in the form of adjectives or short phrases like AFFORDABILITY, EFFECTIVENESS, ELEGANCE or INTEGRATION. All of these statements about how a computer system is or should be in its use can be utilized for specifying and assessing design solutions. Use qualities in the form of design objectives can for example, be ordered in a dependency hierarchy using the objectives tree method [Cross 2000; Arvola 2003]. Howard [2002] argues that abstract non-quantified objectives help in retaining the focus on overall aspects of use qualities, before details cloud the picture.

Some final words about how multi-faceted use qualities are: Every action or even the entire activity of using a system has practical, social, and aesthetic aspects. Some actions are more easily described as being practical, social or aesthetic, while other actions are more complex and can be described from any of these three perspectives. Therefore when a user, designer, or other stakeholder of a computer system argue that the system ought to be, for example, 'reliable', its RELIABILITY should be assessed from a practical, a social, and an aesthetic perspective. Other perspectives such as affective values, construction or ethics may (and should!) also be applied to the usage of any artifact. [E.g. Ehn & Löwgren 1997; Howard 2002; Holmlid 2002; Arvola 2003]

2.2 Interaction Character

One of the higher order use qualities that a system can be said to have is its INTERACTION CHARACTER. A character is a coherent set of specific qualities, as Janlert and Stolterman [1997] defines it. They argue that designing a computer system with consistent character, regarding behaviour and appearance, provides support for anticipation, interpretation, and interaction. When an application changes its behaviour temporarily it can be said to change mood. INTERACTION CHARACTER is here defined as a coherent and relatively stable set of qualities of the actions that an artifact mediates. Actions, in turn, consist of a purposeful subject who induces change in an object by means of a mediating artifact.

Löwgren and Stolterman [1998] elaborate Kammersgaard's [1988] ideas about perspectives on human-computer interaction, by coining the concept of

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INTERACTION CHARACTER (‘handlingskaraktär’ in Swedish). Kammersgaard views them as perspectives that a designer or user may apply to a system-in-use in order to highlight certain aspects of it. Each application or component can, at any given point in time, be seen as a system component, a dialogue partner, a tool, a medium, or as an arena. This list of characters is not seen as exclusive, but rather provides a starting point for discussions about INTERACTION CHARACTERS.

The first character that they describe is that of the application as a *system component*. In the systems perspective, both users and applications are part of a larger system (for example a business) that tries to accomplish something. Standardised tasks can be allocated between human and human, as well between human and machine for optimal performance. The organisation is the agent who is performing actions by means of people and technology, and the activity is directed towards business objectives.

The second character is that of the application as a *dialogue partner*. In this perspective, a dialogue is held between the application and the user. The dialogue is preferably conducted on the user’s terms and human-human communicative behaviour is therefore used as a benchmark [Qvarfordt 2003]. Written and spoken natural language is the primary form of interaction, and feedback that allows meta-communication is important. Quite often the dialogue partner can be represented as an agent of some kind. The actions of a user are directed towards an objectified application by means of natural language. The application then performs the actions that the user has requested.

The third character is that of the application as a *tool*. Given this perspective there must be a material to which the user can apply the tool, in order to produce a result. The relation between artifact and user is highly asymmetrical and control is an important use quality. It is preferred if the tool can become almost invisible to the user so that he or she only sees the activity. For example, a carpenter does not use a hammer, but is rather hammering. The hammer is invisible until there is some kind of breakdown in the activity, for instance if the carpenter hits a finger or if the shaft breaks. The artifact itself then comes into focus and moves from being the mediating artifact into being the object. Transparency of the interface then becomes important so that the user can understand what went wrong, recover from the error, and return to the activity of production. Most production-oriented applications can today be seen as tools.

The fourth character is that of the application as a *medium*. This perspective on a computer application has spread with the growth of the Internet. An application with the character of a medium promotes and allows human-human communication, either in the form of one-to-one communication such as e-mail or in the form of one-to-many as in online newspapers. Another distinction relevant to media is whether they are synchronous or asynchronous. The difference between a tool and a medium is that the object of the activity is not a material but rather one or several other people.

In the light of the changes that came with the Internet, Löwgren and Stolterman added one character to Kammersgaard’s original quartet. They call the fifth character *the arena*: a computer-generated stage where actors are represented by avatars and act in relation to other actors. Immersion is important and a rich set of ways to interact with each other is sought. The arena can be described as a stage

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for social action, where the avatars are like puppets to the users, and they may have varying degrees of autonomy.

3 Method

The three cases, consultation at the bank, interaction design studio work, and interactive television (iTV) usage, were chosen because they represent quite different situations of use with quite different computer systems. They are, however, all situations where several users collaborate whilst being co-located. Due to their dissimilarity, common features are more likely to represent a more general condition. Within the cases, a collection of methods has been used. Workshops, observations, interviews, and questionnaires have been utilized, as well as prototype design and testing. The overarching research method is however a qualitative collective case study [Stake 1994] where three settings of co-located collaboration are compared: consultation at the bank, an interaction design studio, and interactive television usage. The empirical work in these three settings includes around 115 hours of interviews and observations, and about 35 hours of workshops, with 49 informants all in all.

3.1 Procedure in the Bank Case

The focus of the studies conducted at the bank was identification of use quality requirements for a teller system [Holmlid 2002]. In total, 40 hours of workshops, and 30 hours of observation and situated interviews were conducted. Initially the use of the teller system was modelled in 14 *workshops* with learning developers at the bank. Several tentative models of use quality were developed, and a new course in using the teller system was designed within the bank organisation. The participants were two active researchers functioning as usability experts and interaction designers, a project leader at the bank, a bank employee who had developed a previous online course for the teller system, and a developer who had implemented the course. In addition, five clerks at four branches were tracked on two occasions for half a day. The researcher took part of their work, took notes, and asked questions. In total, 30 hours of *observation* let us learn more about their work and allowed us to ask probing questions about episodes that took place. Finally, a project team at the bank analyzed the transcribed field notes from the interviews and the observations during three 3-hour *workshops*. The team consisted of three learning developers and three in-house system developers that all had experience of bank work. One researcher facilitated the workshops while another researcher took notes and manned the video camera. Our own analysis was also informed by the interpretations made in these workshops.

3.2 Procedure in the Studio Case

A field study in an interaction design studio at a university was conducted. The specific research focus was on events where students used resources individually and then jointly, before returning to individual use. In an e-mail *questionnaire*, the students in the design studio were asked to describe events where the work in the

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studio was fun and events where it was tiresome and boring. The reason for using this questionnaire was to get an idea about what the students cared about when they were in the studio. This set the frame for further observations. Five out of six students answered the questionnaire. During the course of one design assignment, a researcher worked in the studio by a desk, and did *situated interviews* as well as *observation*. Interviews were conducted as the opportunity arose in the observation and they were triggered by events that took place. A total amount of 20 hours was spent on observing the work of the six students and the two teachers, and field notes were continuously taken.

3.3 Procedure in the Interactive Television Case

Two interactive television prototype systems were developed, in order to study properties of such systems-in-use [Arvola & Holmlid 2000; Arvola, 2003; Rimbark, 2002]. As part of that work, interviews were conducted, both situated in peoples homes and in simulated home environments after trials of the prototypes. Situated interviews conducted in people's homes were made as *technology tours* [Baille et al. fourthcoming], where people were asked to show and tell what technology they have and how they use, or do not use, it. In total, 56 hours of technology tours were made in eight homes. None of these homes had interactive television at this date. Field notes were taken during all interviews and most of them were audio recorded (some informants did not want to be recorded). 3-hour long situated interviews have been conducted with five informants. Two of them were male and three were female. Two informants were academics of age 28, and three of them were middle-aged with children who had left home. One of these interviews was conducted as a group interview with a married couple. In addition, interviews have been conducted with four elderly people about the technology that they had in their homes. Two were women and two were men. The elderly got disposable cameras, which they could use to document technology that they encountered. The researcher met with the four elderly in their homes on three occasions, and each informant was interviewed for ten to twelve hours in total.

During *prototype testing*, 21 users were observed during usage, and interviewed afterwards about their experiences. In total, 7–8 hours of observations and semi-structured interviews were made during these tests. The ages of the participants ranged between 21 and 30 years, and half of them were male and half were female. All of them were considered to be early adopters, with a high degree of computer experience. The tests took place in environments that looked like somebody's home but evidently were not. The first prototype was a quiz game, and eight users tested it in pairs. They were interviewed afterwards one by one. The second prototype was a news on-demand service, and it utilized two remote controls for simultaneous input. Five pairs of users tested it, and they were interviewed in pairs after the session. One initial session was also held with three participants that surfed online news with one remote control. Field notes were taken during all observations and interviews, and six of the ten sessions were audio or video recorded. The test sessions, including interviews, lasted from 30 minutes up to one hour.

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4 Case Setting I: Consultation at the Bank

In customer meetings at the bank that was under study, a consulting clerk and one or two customers met together in the clerk's personal office. The clerk used a PC with the screen turned away from the customers, and both customer and clerk utilized pen and paper. Their objectives were to get the customers' economy in order and perhaps make some changes. The clerk also wanted to keep a good relationship going with the customer and make profit for the bank.

In the offices that were observed, the clerk sat so that he or she could meet the customers when they arrived at the doorway. On the desk they placed the documents that they were to go through during the meeting and the clerk often turned to the PC in order to get the latest information about interests and similar figures. If the meeting was about a loan the clerk would have to do extensive input to the system and was during this time turned partly away from the customers. The back of the office was for papers and files that the clerk used in his or her individual work.

A meeting was usually prepared in advance so that the clerk could guess what it would be about if he or she had not been told. Then the clerk printed out the forms, the information, and the documents that it would probably be necessary to go through together with the customer. Quite often they asked the customer to read or prepare something from one meeting to the next. The collaboration was to a high degree controlled by the clerk, but questions from the customer usually led their cooperative activity in unanticipated directions. The customer could see all the documents and forms that were lying on the table and by that draw conclusions about what they had to go through during the meeting. The clerk and the customers also cooperated by helping each other to keep face. Clerks were concerned that the customers felt at ease with confiding in them and felt that their economic situation is quite common; the customer must not be embarrassed. The clerk often had to ignore the customer when there was much input into the system or when he or she had to go to the printer. The clerk would then frequently ask the customer to forgive the non-attention and the customer usually made it clear that he or she completely understood: "After all, we've all had to work with computers, haven't we."

5 Case Setting II: Interaction Design Studio

In the interaction design studio that was studied, six to eight students worked together. They had their own PCs and their own desks were covered with sketches and personal items. Two design teachers sat in private offices in the same corridor, and they could, if they wished, see the students through the large windows between the corridor and the studio. Within the studio the students could see and overhear each other and cooperate at the whiteboard or the shared large table, or at someone's desk. The whiteboard was also used for projection from the shared PC, which had extra accessories such as CD-writer, drawing tablet, and scanner. Near the whiteboard and the shared table were also bookshelves with books on design and HCI. The students considered themselves to be there to do design and deliver before the deadline, and also to learn to do design by reflection and discussion.

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They also wanted to have fun and enjoy each other's company, while experiencing a flow of creativity in the group. Sometimes the students considered the studio to be too noisy with people that just fooled around and were not inspired to work. The teachers' objectives were to see every student and his or her abilities and skill in order to find ways to strengthen the student, as well as facilitating a good, creative, and friendly atmosphere in the studio. The teachers also had other courses to teach and other things to do.

The students and the teachers could easily see what others were working on by glancing at the sketches and the printed screen shots that the students had on their desks. The possibility to see what the others were working on provided a ground for unplanned interaction and chat about their work. This created an opportunity to be helpful as well as to get help from other students. Talking to others about their work was also an inspiration for the individual student. After these shorter periods of group work it went back to individual work again (see also Bellotti & Bly [1996] and Geisler et al. [1999] for similar observations).

Students often talked across the room from desk to desk and others that were in the room were free to join the conversation. Sometimes they stood next to someone working on-screen, and if the collaboration was tighter they had the opportunity to go to the shared table in the middle of the room in order to discuss and make joint sketches. Students also presented their work for each other and for the teachers more formally at the end of each design assignment. They usually did that by using the projector to show their demo or prototype, while the others sat around the shared table. During these "critique and focus sessions" the teachers and students probed the rationale for the design products as well as the process, and the objective of the sessions was peer learning.

6 Case Setting III: Interactive Television

While watching television (at least in Sweden), people are usually seated in the couch in the living room, unless they simply have it turned on in the background while they do other things. Television is often viewed in the company of others, either with friends or family. During working days, 75% of the time in front of the television is spent together with others. That figure is almost 80% during weekends [Ellegård 2001]. The family include children, parents, partners, grandparents, and so on. The exact constellation of the household may vary from single person households, to large families, or friends sharing an apartment, or perhaps elderly with visiting children and grandchildren.

It was observed during the tests of the iTV-prototypes that the television screen was a natural focus of attention. A single remote control was used for interacting with the television set and the set-top box, but in the technology tours it was noticed that that there usually were other remote controls lying on the table. Viewers reported that they often conducted other activities in front of the television screen; for instance chatting, eating, drinking, knitting, reading, or even surfing the Internet on a laptop. Users of iTV basically had three joint motives when they were lying or sitting on the couch: taking it easy, being together, and/or being entertained. They may also have had individual motives as suggested by the different side activities.

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The activity in front of the television set was represented in the constellation of things in the living room. If there were cookies and tea on the table the people present were probably eating and drinking. If someone had the remote control then everybody could see that that person was in charge of the viewing experience. The way a blanket was lying on the couch indicated the degree of relaxation and so on. These things were open for interpretation by anyone who entered the room, and that person could then adjust his or her own private agendas so that individual activities did not come into conflict.

In the technology tours it was observed that the television usually was in front of a wall. There was a table a couple of meters away from the television screen, and on the other side of that table there was commonly a couch. On one or both sides of the couch there could be room for an armchair. The remote control was lying on the table where it was accessible for everybody, near a person in the couch, or in the hand of a person. Some larger living rooms had different parts for different kinds of activities, for instance a large dinner table, a small coffee table, or perhaps a desk or a bureau. In smaller apartments there was a bed or a sleeping alcove in the same room. The exact arrangement of the living room depends on the architecture of the home, on the activities that are undertaken in the room, and also on the generation that the residents belong to.

While testing the iTV-prototypes it was noted that the remote control owner often spoke out aloud about what he or she was doing. If he or she did not, the other people in the couch had trouble following the interaction. The others often lost interest in what was going on on the screen. The remote owner sometimes excused him or herself for extensive surfing. Occasionally the others in the couch told the remote owner what to do. When the remote owner felt that he or she could not decide what to do, the remote was usually handed over to another person. Sometimes the other person also asked for the remote control. When the remote was lying on the table it was considered to be free for anyone to access and manipulate, but only if that person was equal in the home: a guest in a household may hesitate to reach for the remote if not invited. In the design of iTV-prototypes it was assumed that that two remote controls was better than one, in order to facilitate the shifts of control and hence distribute control. The drawback was that it was not easy to see who was in charge of the shared screen and that tended to create screen wars and users that are annoyed with each other [Rimbark 2002; Arvola 2003].

7 Results

A common INTERACTION CHARACTER in all three settings was that of the *application as a tool*. The interaction with the application was in focus, and the interaction between people became secondary. In the case of iTV that meant that the person who did not have the remote control lost interest. In the interaction design studio students often worked by themselves and the applications were then in tool usage. The system as a tool was also an INTERACTION CHARACTER that appeared at the bank. During the extensive time spans of data input into the system, or when there was a breakdown, the clerk was forced to ignore the customer. The customer then started to look into the roof and the clerk excused him or herself for

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ignoring the customer, in order to help the customer regain face. The computer was then objectified and thereby entered as a topic into the conversation. When the computer is used as a tool during the meeting, the customer becomes a distraction for the advisor. This is a problem when the use of the computer is in this character for too long. The application as tool is for this reason the least wanted INTERACTION CHARACTER during a customer meeting.

During the customer meeting, the most preferred INTERACTION CHARACTER is instead the *application as a resource,* which is a variant of the tool. The social interaction is in focus when using an application as a resource, while the software interaction is secondary. For the tool it is the other way around. When an application is a resource rather than a tool, the clerk can attend to the customer rather than the system. A resource is only backing up the user in his or her main work. In this case the main work is to listen to the customer, in order to end the meeting with a signature on a contract.

Another INTERACTION CHARACTER that was observed in all three settings was a variant of the medium: the *application as a common resource*. When an application is a common resource, the interplay between the participants is in focus while the application feeds that interaction. The difference between a common resource and a medium is that the former inputs something to a dialogue, while the latter mediates or acts as an intermediary in a dialogue. Just as with the resource, it is the social interaction that is in focus, but in contrast to the resource the common resource is available and controlled by all participants and not only by one. They are also using it with joint or overlapping motives. At the bank, the printouts from the systems worked as common resources and occasionally the clerks turned their screens towards the customer in order to explain or show something. In the interaction design studio students often showed something to another student in order to get comments. They view it, point, and discuss in order to coordinate their work and give feedback. During critique and focus sessions they sat together using a projector to show a prototype. They also made printouts and sat by the shared table to sketch and discuss. During all these episodes the applications were used as common resources. When users of iTV played a game on the television screen or when they surfed news together, the applications were used also as common resources for conversations and the content of the applications fed the dialogue with topics. This is also an example of the application as a common resource.

While remaining within one INTERACTION CHARACTER, an application sometimes changed *mood of control*. Applications could sometimes be in *turn-taking control*; one of the participants controlled the interaction at one time but could later on turn over the control to another participant. Sometimes that individual asked for the control and at other times the control-owner simply turned it over. If the joint use of an application continued for some time a practice of turn-taking usually developed. This was particularly clear in the case of interactive television where there usually is only one remote control. This only happened with printouts from applications at the bank, and not with the applications themselves, due to the expert-client relationship. In the interaction design studio, applications could be in turn-taking use when two students sat together in front of one screen. At some times, especially when applications and printouts were used as common resources they were also seen to be in *parallel control* by all users. More

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commonly they were "backseat driven" in *mediated control*; other participants told the control-owner what to do. Sometimes the clerks turned the screen towards the customer to show something or explain. The clerk then distributed control to the customer, and invited him or her to be a backseat driver while the clerk took on a supporting role. That meant that a number of design considerations of bank secrecy and the tension between private and public became important. Occasionally in the interaction design studio, a student stood behind another student while he or she was working, and commented on what the primary user was doing. Sometimes the bystander told the primary user what to do. For instance: "What if you write it like this…" The application is then used as a tool with mediated control, or backseat driving. For users of interactive television backseat driving was also common. For example, one user told the other what news article to choose.

Applications were often used in many different ways. The INTERACTION CHARACTERS were not stable. The iTV-appliances sometimes changed rapidly from being a medium with content in focus, to a common resource that fed the social interaction of the users and was used with equal control. In addition, people in front of an iTV-appliance will enter and leave the activity (for example to make coffee), and the subgoals of the activity may vary as the activity goes on. The iTV-appliances could also be a tool for carrying out an action without concern of others. They were switching between turn-taking control, parallel control (when that was made possible by means of two remote controls), and mediated use. At the bank, applications were seen to switch between common resource, resource, and tool. A clerk talked to a client using the application as a resource by glancing at some figures, and only moments later it was a tool for entering information. When the clerk turned the screen or made printouts it became a common resource. In the studio, students worked with their applications in many different ways in a pattern similar to the bank clerks' usage.

8 Discussion

The results show that there are variants of the medium and the tool, which play a role in co-located use of applications. It is different to use a system while being co-located with others, and to use a system in solitude. The results also showed that the shared control over an application could change between different users in three different ways: turn-taking control, parallel control, and mediated control. The systems studied in this paper did, however, not support very fluent and swift changes between different INTERACTION CHARACTERS and different moods of control. It was cumbersome for users to use a system in different ways. A number of workarounds and insufficient strategies were used: printouts, turning screens with the risk of exposing things, using a system as tool and ignoring other people, and so on.

More field studies are needed in order to evaluate how applications work for people outside the laboratory. In real life, goals and motives shift constantly and the environment of the interaction also changes. For instance, people enter and leave activities, which means that software changes between being in joint use and individual use. This transforms the activity in a fundamental way and the INTERACTION CHARACTER changes. If the application does not support a certain

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kind of character or control mood, it is likely to hamper the naturalness of people's social interaction as well as the practical usage of the application. Janlert and Stolterman [1997] argue that a consistent character is important for users' interpretation, anticipatation, and interaction with an application. That consistency should apply to every action across all INTERACTION CHARACTERS that the application may have in its usage. If the entire system is to be SNAPPY, every action that is performed must be SNAPPY. One could, however, claim that an application should belong mainly to one INTERACTION CHARACTER, but the results in these studies indicates that it is more rewarding to view each component of an application as being able have different INTERACTION CHARACTERS. This is in accordance with Kammersgaard's [1988] argumentation. It is the job of the designers to decide which ones should be supported and afforded in different situations of use.

8.1 Designing Flexible Applications

A consequence for design is that changes in INTERACTION CHARACTER may be a means for reaching flexibility in computer usage. A design problem that was encountered in the bank setting was that of designing systems that do not force the clerk to be rude and ignore the customer. A solution is to allow users to change INTERACTION CHARACTER. A clerk who can decide whether a system should be a common resource with parallel control, a tool with individual control, or a passive resource, can adapt to the current needs of the social situation. A user interface that is distributed over multiple display surfaces with different input and output units may solve this. If the applications at the bank were flexible in this manner the need for printouts would probably decrease, and therefore the bank would save time not only for the clerks but also for the customers. In addition, the clerk would not have to ignore the customer and then apologise.

In the case of iTV it was observed that users who did not interact with the application lost interest. In order to solve that, two remote controls were introduced, but that only led to interference. If users could choose which INTERACTION CHARACTER to use at any given time this problem would be solved. Again, multiple screens are part of the solution. If there are displays where users may individually pursue their own goals whilst being physically close to each other, their goals of entertainment, laidback interaction, relaxation, and togetherness can be met. They would also have the opportunity to move information objects between all screens, both public and private.

The students in the interaction design studio would also benefit from a system where they could display information anywhere. In such a system they could instantly move their objects of work from their own screen to another student's screen, to the common table, or to the whiteboard.

It does seem reasonable that supporting fluent changes of INTERACTION CHARACTERS and changes between control moods would increase flexibility and allow users to reach temporary goals that suddenly appear in co-located collaborative activities.

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8.2 Future Research

The next step for this research is to implement and field-test computer systems with interfaces that are distributed over many different devices, and where information can be "thrown" between the multiple displays. The idea is to allow users to switch INTERACTION CHARACTERS at will depending on present individual or joint goals. The system will consist of personal devices as well as shared devices and it will be tested in several situations of use, including the interaction design studio and consultation meetings.

8.3 Conclusions

This paper has described how systems used in co-located collaboration were used as tools, resources and common resources. They were also used with different moods of control: turn-taking control, parallel control, and mediated control. The system as a common resource and the system as a resource can be seen as variations of media and tools respectively. The design decision of which INTERACTION CHARACTERS to support and afford in different situations of use will to a large degree decide the entire scope of actions that a system can be used for. The systems studied in this paper did not support fluent changes in INTERACTION CHARACTER. It was cumbersome for users to use a system in different ways. A number of workarounds and insufficient strategies were used: printouts, turning screens with the risk of exposing things, using a system as tool and ignoring other people, and so on. One way to build flexible systems for co-located collaboration is to allow users to fluently switch between different INTERACTION CHARACTERS. Future research on field studies of such flexible systems is welcome, in order to determine their value and the design considerations involved.

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