

# Regulating Prominence: A Design Pattern for Co-located Collaboration

Mattias ARVOLA and Anders LARSSON

Dept. of Computer and Information Science, Linköping University

SE-581 83 Linköping, Sweden

{matar, andla} @ida.liu.se

**Abstract.** Co-located people do things individually while participating in collaboration. It is, however, difficult for designers to foresee what they will do individually and what they will do jointly. Participants therefore need to be able to move any information object between private and public states, but that is cumbersome to do with objects confined to a traditional PC-based workstation. This paper describes a design pattern, which addresses the problem. Designers can resolve it by making a platform where users can regulate how prominent they want to make information for themselves and others. The pattern is based on field studies and design work in three different settings where desirable use qualities were identified, categorized and translated into forces in a design pattern. Conflicts between forces were noted as problems, and solutions were sought to establish a pattern. A multiple-device platform was finally derived from the pattern to provide an example of how it can be realized. It is concluded that use qualities from a qualitative analysis of technology usage can provide the empirical basis for a design pattern. This fits well with several traditions within HCI and CSCW such as ethnographically informed design, scenario-based design, and design space analysis.

**Keywords:** Design Patterns, Use Qualities, Co-located Collaboration, CSCW

## 1. Introduction

Users of technology need to move fluently between working in their individual ways and working collaboratively according to their communicative practices, but doing so may not be straightforward [1]. An example of one such situation is consultation meetings where clerks explain something and swivel their screen towards their customers [2, 3]. In human-computer interaction (HCI) and computer-supported cooperative work (CSCW), there has been a limited amount of research that has focused on systems that are *both* individually and jointly used [e.g. 2, 3, 4, 5]. This paper presents a design pattern for systems that are used within small face-to-face groups and often switch between individual and joint use. Not all individuals in such situations can be considered to be primary users all the time, but the presence of others influence the primary user's usage and the others are influenced in return.

There are several approaches to designing software for use in face-to-face situations. There are electronic meeting room systems that assist co-located collaboration. Examples

include different kinds of electronic whiteboards [6], large shared displays [7, 8], and entire meeting rooms [4, 9, 10, 11]. There are also Single Display Groupwares, which enable shoulder-to-shoulder collaboration by means of simultaneous parallel input to a single shared display [12]. Most of the systems designed to support co-located groups have focused on joint use alone. With multiple-display solutions people have, however, the opportunity to work individually as well as jointly with the system. Such systems enable co-located users to work privately on an individual screen, such as a handheld computer, and they also allow them to share information on a public screen, and choose what to do on the big shared screen and what to do on the small private screen [13]. Interfaces for such software are distributed over several devices have been called distributed interfaces within the field of ubiquitous computing [14]. One such distributed interface is Sharednotes, which is designed by Greenberg, Boyle and LaBerge [15]. They enforced a strict difference between public and private, where notes could be either completely private for individual use or completely public for joint use but nothing in between. It did not work very well and instead they recommend a design that allows users to fluidly shift between private and public work, including the many gradations in between. They ask for more research into the issue and the aim of this article is to make a clear statement of the important dimensions of the problem to allow designers to assess the impact on their specific design situation. This is achieved by presenting the results in the form of a design pattern for co-located cooperative systems. An additional aim is to illustrate how design patterns can be used for documenting design knowledge, hence contributing to a growing body of design patterns within CSCW [16, 17, 18]. This is accomplished by moving from studies of cooperative activities to actual design of a computer system through a design pattern.

## 2. Theoretical Background

During the seventies Alexander and his colleagues [19, 20] developed the concept of design patterns as a reaction against the kind of architecture that had been built within the modernist tradition. He felt that many of the immeasurable qualities of architecture had been lost. The Alexandrian patterns strive for making architecture come alive, and this, Alexander argues, happens when all the conflicts between different forces—wants, needs, and fears—that exist in a specific design situation are resolved. In this paper, forces are seen as potentially conflicting, but still desirable qualities in the usage of an artefact. These use qualities can be expressed in the form of adverbs, adjectives or descriptively used nouns like ‘effectiveness’, ‘elegance’ or ‘integration’ [21, 22, 23]. Each design solution can then be assessed in relation to these use qualities, for example as claims in scenario-based design [24].

Every design pattern describes a re-occurring problem, its context, the forces that are at play in the situation and a generic solution to the problem. The feature that solves the problem is written in a generic but concrete way, so that it can be designed in an infinite number of ways, but still is readily identifiable. Anyone should be able to see if a design solution has a particular feature or not. In a well-written pattern, every reader should also readily recognize the problem.

All patterns can be seen as working hypotheses; a pattern represents the current understanding of what the best arrangement is for solving a particular problem. For this reason, it is important that the pattern is clear, sharable, and debatable. Alexander and his team used

an asterisk after the pattern name to indicate the degree of faith they had in the pattern. No asterisk meant that it was a tentative formulation of a pattern; one asterisk was that it was fairly stable; and two asterisks meant that it was very well supported.

Within HCI, a number of different formats for writing patterns have been suggested [e.g. 25, 26, 27], but we have, like Junstrand et al. [16], chosen to present the pattern in Alexander's original style, since his patterns are more alive and concrete than other patterns. We have, however, chosen to label the different parts of the pattern for clarity of reading. A more formal style would have provided more overview and ideally one would write patterns in two versions: one comprehensive for inspiration and evidence and one formal for overview and connection to other patterns. A comprehensive version is presented in this paper. The descriptive form of patterns that Martin et al. [17, 18] advocate in their PoInter patterns, include vignettes that are real examples from their own and other's ethnographic fieldwork. We have instead chosen to extend the description of empirical material behind the identified the forces. The PoInter patterns do not provide the concrete solutions to concrete problems that interaction designers often seek for.

### 3. Method

The overarching research method is a qualitative collective case study [28] where three settings of co-present use of computers are compared: a professional setting (customer meetings at banks), an educational setting (interaction design education in a studio), and a leisure setting (home entertainment and information). The empirical work in these cases includes meeting all in all 49 informants during 41 observation and semi-structured interview sessions ranging from one to four hours, and 14 half-day workshops. The written up and transcribed field-notes were read and re-read by several researchers and expressions describing how it was or should be to use an artefact in that situation were marked (i.e. adjectives, adverbs and descriptive noun phrases). Descriptive qualities were transformed into prescriptive qualities (e.g. 'difficult to go between systems' turns into 'seamless tool integration'). The qualities were then categorized, and thematically organized into more abstract use qualities. Finally they were anchored in the empirical material to make sure that nothing had been lost in the abstraction. Conflicts between desirable use qualities were especially noted since they form a basis for the problem statement in design patterns in terms of conflicting forces. Finally, we tried to identify features of situations where the use qualities were not in conflict in order to find a solution to the problem. Two prototypes were built within the leisure case to elaborate the use qualities and patterns in interpretative iterations.

#### 3.1 Procedure in the Professional Setting

The main focus of the studies conducted at the bank was to identify use quality requirements for a teller system, and to model and develop an online course in using the teller system (see [21] and [23] for other accounts of this study). In total, 35 to 40 hours of workshops, and 30 hours of observation and situated interviews were conducted.

The use of the teller system was modeled in 14 workshops at the bank. Several tentative models of use quality were developed and a new course in using the teller system was de-

signed. The participants included 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 that course. In addition, five clerks at four branches were tracked during two half-days at work. 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, interpretative workshops were conducted. A project team at the bank analyzed the transcribed field notes from the interviews and the observations during three 3-hour workshops. They were three learning developers and three in-house system developers that all had experience from bank work. One researcher facilitated the workshops while another researcher took notes and handled the video camera. Our own analysis was also informed by the interpretations made in these workshops.

### 3.2 Procedure in the Educational Setting

A focused field study in an interaction design studio at a Swedish university was conducted. The specific research focus was on events where students used resources individually and then jointly, and then back again to individual use. In an e-mail questionnaire, the students in the design studio were asked to answer when the work in the studio was most fun and when it was most tiresome and boring. The reason for 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. The researcher investigating the studio had also taken classes in a similar studio a few years earlier and had also teaching experience from courses based on studio work.

### 3.3 Procedure in the Leisure Setting

Two interactive television (iTV) prototype systems have been developed (see [29, 30] for further details), and as part of that work, interviews have been conducted, both situated in actual homes and in simulated home environments after trials of the prototypes.

The situated interviews conducted in homes were made as technology tours [31], where people were asked to show and tell what technology they have and how they use it, or do not use it. In total, 56 hours of technology tours were made in eight homes. Field notes were taken during all interviews and most of them were audio recorded (some informants did not want to be recorded). Two informants were academics in their late twenties, three of them were middle aged with children who had left home, and four were elderly.

During tests of prototypes, 21 users were observed and interviewed afterwards about their experiences. All users were in their twenties. In total, 7–8 hours of observations and semi-structured interviews were made during these tests. They took place in environments that looked like somebody's home but apparently were not, since they were located in an office

building. The first prototype was a quiz game and the second was an on-demand news service, which utilized two remote controls for simultaneous input. 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 sessions lasted 30 minutes up to one hour.

#### **4. The Professional Setting: Customer Meetings at Banks**

In customer meetings at the bank, 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 customer's finances in order and perhaps make changes. The clerk also wanted to keep a good relation to the customer and make profit for the bank. A meeting was usually prepared in advance so that the clerk could guess what it would be about. The clerk printed out the forms, the information and the documents that probably would be necessary to go through together with the customer and placed them on the desk in full view for the customer. He or she often turned to the PC in order to get the latest information about interests and similar figures and sometimes the clerk would have to do extensive input to the system. The collaboration was to a high degree controlled by the clerk, but questions and requests from the customer usually led their cooperative activity in unanticipated directions. In order to be efficient and not keeping other customers waiting, the clerks often had parallel customers on-screen; preparing one customer while waiting for another. During meetings, clerks switched rapidly between different systems and tools.

#### **5. The Educational Setting: Interaction Design Education in a Studio**

Six to eight students worked together in the interaction design studio. They had their own PCs and their own desks, which were covered with sketches and personal items. Two design teachers were occasionally in the studio. The students could see and overhear each other and cooperate at the whiteboard, at the table, or at someone's desk. The whiteboard was also used for projection from a shared PC.

The students were there to design, deliver before the deadline and learn design by doing, reflecting and discussing. They also wanted to have fun and enjoy one another's company, while experiencing a flow of creativity in the group. Sometimes the students considered the studio to be too noisy. The teachers wanted to see every student's abilities and skill to find ways to strengthen the student, as well as facilitating a creative and friendly atmosphere. Both students and 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. This provided a ground for unplanned interaction (see also [32] and [4]). Students also presented their work for each other and for the teachers more formally at the end of each design assignment. During these "critique and focus sessions" the teachers and the students probed the rationale for the solution as well as the process. The objective of the sessions was peer learning.

## 6. The Leisure Setting: Home Entertainment and Information

People usually watched television seated on the couch in the living room, unless they only had it turned on in the background while doing other things. In general, 75–80% of the time in front of the television is spent together with others [33].

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 there usually were other remote controls lying on the table. Informants 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. They had three overarching motives for spending time on the couch: taking it easy, being together, and/or getting entertainment and information. In the technology tours, it was observed that the television usually was placed in front of a wall. There was a table a couple of metres away from the television screen and on the other side of that table there was usually 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 someone's hand. 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 depended on the architecture of the home, on the activities that were undertaken in the room and on the generation that the residents belonged 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 regularly lost interest in what was going on the screen, and 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 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 an equal participant: a guest in a household could hesitate to reach for the remote if not invited.

## 7. Design Pattern: Regulating Prominence \*

The analysis of the three case settings revealed four use qualities as desirable for all three settings: participation, autonomy, extemporaneity and politeness. Conflicts between the qualities were also identified, and this formed the basis for the forces and the problem statement. The solution statement is based on analysis of situations where the forces are not in conflict, trying to find some feature that resolves the potential conflict.

### 7.1 Introduction to the Pattern

People in COLLABORATION IN SMALL GROUPS [17] work jointly, but also individually. It is therefore important for in such situations to be able to control the objects of work and flu-

ently move them between private and public states, including gradations between [15], but so far no pattern has shown how to do so. This pattern can be used to figure out the digital details of work places provided by Alexander et al [19] in INTIMACY GRADIENT (127), SMALL WORK GROUPS (148), HALF-PRIVATE OFFICE (152), and ALCOVES (179). The pattern also complements the PRIVATE AND PUBLIC DIGITAL SPACES (127b) [18].

## 7.2 Problem Statement

People in small groups do things individually while participating in collaboration. Hindering people to do so or excluding them from the joint activity can be quite impolite. In addition, it is rather difficult to foresee what objects participants will use for individual actions and what objects they will use for joint actions. Therefore, people need to be able to move objects between private states and public states, including gradations between, but this is cumbersome to do with information objects confined to traditional PC-based workstation.

## 7.3 Problem body

Users of personal technologies often meet and co-use their devices [34] and occasionally there is some form of public display available that can be used for joint purposes (such as a television screen or a monitor swiveled towards a customer). Collaboration would be of better quality if users could then easily move information objects between their personal technologies as well as to the public screen and back again. In the home, all devices such as stereos, televisions, PCs, tablet computers, etc. could be interconnected, and whenever a conflict between personal interests arises the information object could be moved to another device. Consider a scenario where someone wants to watch a show on the television screen while someone else is in the living room listening to music, the music could be moved to the stereo in the bedroom and the other person could go there and listen instead, or perhaps they, by a simple operation, could move it to the personal handheld music device instead. Alternatively, if someone watches a movie on a small screen in a bedroom it could easily be moved to the large screen in the living room if anyone else also wants to watch. Four forces in this situation (participation, autonomy, extemporaneity and politeness) are described below by a short theoretical statement, which then is exemplified from the fieldwork.

*Participation.* People who are co-present in a situation of use have some projects that they do together. Sometimes the projects are small, like a greeting for instance, and sometimes they are bigger, like watching television together. The feeling of participation is also important for the individual participants and it is one strong incentive to participate. Below follows an excerpt from field-notes illustrating participation in the leisure case where two informants played a quiz game on the television screen.

- Isabelle: Let's go for that category again. It was good.  
Lisa: Yeah, *right!*  
Isabelle: It's two or three. Let's say the window-sill. ((Gives incorrect answer. Hands over the remote control.))

Lisa: ((Hits the dice by pressing the OK-button, moves and gets a question.)) Oops, this is embarrassing. ((Gives incorrect answer.)) *No!* ((Hands over the remote control.))

Lisa pretended to be bitter when she said: “Yeah, right!” The participants playing the quiz game were involved in a joint pretence [35]. Throughout the game, players pretended to be angry and said insulting things to the other player, who recognized that it was not serious and played along. However, the design of the quiz game sometimes made it unnecessarily cumbersome for the players to create this joint pretence. Since they sat side-by-side their attention was directed towards the screen three meters away, rather than towards each other. This meant that it took more effort for them to attend the other person. If the players did not keep the attention partly directed towards each other they could not see when the other invited to a joint pretence. This was suggested not only by what was being said, but also what was being done in terms of posture, gestures, and facial expressions.

One important thing for the participants in the leisure case was to spend meaningful time together. In the bank case the participative aspects of using interactive artefacts in the customer meetings were disclosed in several different ways. Firstly, many of the activities that took place before an actual meeting aimed at creating common ground and a structure for coordination in order to have a smoothly running meeting in the end. Secondly, participative actions were directed at shared and public objects in the meeting. Thirdly, an awareness of the progress of the meeting as a whole was maintained by having the physical layout of documents on the desk in the peripheral.

In the interaction design studio, participation included getting help, inspiration, and serendipitous input from others. For doing so students needed to share objects and coordinate their activities. Awareness of what others were doing was obviously important for coordination purposes. It was maintained by having others’ objects of work in peripheral vision and by overhearing.

Joint projects have joint goals, shared objects and shared representations. In order to work on these shared objects, participants need to establish common ground and to maintain coordination [36]. This means that they have a shared view on what they mean by different terms, what they want to achieve and how to achieve it. For that to work, they need to devote some of their attention to the other participants and what they do. The usage of an interactive artefact is participative when the actions performed by means of it are oriented towards shared objects for a joint goal. In Heideggerian terms, whenever there are co-participants around even the most seemingly individual and practical action is partly oriented towards the others as part of being-with them.

*Autonomy.* Here follows an excerpt from the field-notes in the studio case where Jack and John worked on a group assignment:

Jack rolls with his office chair to his desk when they have divided the work. Then they work in silence. After a while Jack leans back and stares up into the roof. He changes position, and continues to write.

Jack: How is it going? I’m like done now.

He walks over to John and they discuss.

Jack: Ehm, we’ll do it like this then?



John: Yeah.  
Jack: Should they do that exactly?  
John: Ehm, But... I've changed some minor things.

In this episode Jack and John worked autonomously when they needed concentration and focus. They divided the work and when the different parts were completed they worked jointly again. Before this episode they sat by the shared table, sketching together on a large piece of paper and before that they worked individually, trying to figure out how to approach the problem. Their group assignment had large portions of autonomous work.

In the leisure case, the autonomous parts of the co-present setting showed themselves in many ways. The interests of one person in the living room could be completely different from another person, but they still wanted to spend time together. This meant that one person could surf on the Internet or play computer games while the partner was watching television. If there was no room for autonomous actions they had to take turns, otherwise the passive participant could leave the room to do something else. This is also probably why people excused themselves for extensive surfing; they did something not very interesting to the other participants.

In the customer meetings at the bank, clerks had many autonomous activities running in parallel with the joint activity that they had together with the customer. For instance they constantly kept track of what consequences changes in the customer's financial behaviour could have for the profitability of the customer. They did this by keeping an eye on their computer screen. Occasionally they instead devoted all their attention to the computer and minimal attention to the customer. At these moments they excused themselves and blamed the computer and the routines for their inattention to the customer.

In more general terms, participants in the co-present setting have private agendas and activities as well as joint goals and activities [35]. They want to perform autonomous actions unimpeded. Individual work is performed in parallel with joint work and it is either stemming from a personal interest, from using objects as tools for one's own mind, or from private agendas. Attention must, however, still be partly oriented towards others individual work so that they are not disturbed. In addition, actions that normally would be characterized as participatory, often serve individual ends as well.

*Extemporaneity.* At the bank we could observe how extemporaneity affected the use of the computer systems. Take, for example, the following excerpt from an interview:

"It should flow between the systems. You often have to get information from many different places, and suddenly you think: 'Where the hell do I find that information?' That cannot happen in the meeting with the customer. [...] It's about trust!" (Clerk)

To avoid this from happening clerks worked autonomously preparing the next meeting and finishing the last, at the same time as a new customer entered the office. The clerk needed to show and explain things to come to an agreement with the customer during the meeting. The clerk hesitated, however, to use the clerk's private screen as a shared reference, since it was full of confusing figures and codes, it showed secret information about the previous customer and it displayed the profitability of the current customer. The clerks regularly handled this by printing out information that could be shared, jointly accessed, and jointly manipulated in the meeting. This solution was, however, inefficient since unanticipated in-

formation could be needed. To share the new information with the customer they could choose between turning the screen to the customer, telling the customer what the information was, or making a new printout. Turning the screen led to the problem described above. Using only words to tell the customer and not being able to show was difficult. Making a printout took too much time, and again, if the clerks did not attend the customer they were impolite.

In the home we could observe how the appliances sometimes switched rapidly between being a media with content in focus, a tool for carrying out an autonomous action without concern of other participants, and a common resource that fed topics into the social interaction. The co-present activity could take any turn and the usage of the technology changed according to that (see also [23]).

In the design studio the extemporaneity disclosed itself in the following way. The students and the teachers could easily see what others were working on by glancing at the sketches and the printed screen shots on the 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 for help and inspiration. After these shorter periods of group work it went back to individual work again as noted above under autonomy.

Whenever people meet in dialogue the outcome is somewhat unpredictable and spontaneous [35]. What previously was private may therefore, in a serendipitous interaction suddenly be needed for joint actions. Since individual and joint activities run in parallel and feed into each other an impulse that change the activity can come from any direction or source. A joint activity can spur an individual trail of thought and action, and what someone else does individually can also do so. In addition, what someone does for him- or herself can feed into a joint activity.

*Politeness.* At the bank, one of the most important goals for the clerk in a customer meeting was to manage the customer relationship. As noted earlier: It is about trust. The clerks wanted to be trustworthy, they did not want to lose face and they did not want the customer to lose face either:

“The customer must never feel that their situation is abnormal, that would make the customer uncomfortable.” (Clerk)

Sometimes, however, the systems at the bank made it more difficult for the clerk to create a good relation to the customer, since they sometimes drove the clerk to more or less ignore the customer, which was regarded as quite impolite. The clerk had to make excuses and apologize in order to keep the equity in the meeting.

Similar things could happen in front of the television. For example when someone monopolized an appliance, he or she occasionally apologized for doing so. Some users were very keen to make sure that the others got to see or read what they thought was interesting. Another way that politeness was shown was that guests in the household would not take control over an application if not invited.

Politeness in the studio included not looking in other students’ drawers and not touching others’ belongings. One should also state critique in a nice way, while also being able to take critique. Other things that reflect politeness was helping someone who asked for help, respecting others’ concentration, and not peeking over someone’s shoulder if not invited to do so. It is important not to build computer environments that disrupt these norms.

In theoretical terms, the participants in a co-present setting have a mutual wish to maintain each other's face [37, 38]. Every participant has a claim to autonomy and do not want his or her individual actions to be impeded by others. The co-participants recognize this autonomy and do not want to impede on it. They also respect and want respect for their self-image and self-worth. Not doing so would be impolite and face threatening. When the participants set up a joint project they have to make a commitment to get some work done. Any act taken within that commitment will affect not only the public perception of the actor's self-worth and autonomy, but also that of the co-participants'.

*Summary.* People do things autonomously while participating in collaboration. They also have others in mind while performing individual actions. Some of these are publicly displayed so that other participants can monitor the actions peripherally and through that create an awareness of what is going on. Hindering people to do their own things or shutting them out from a joint activity can be quite impolite. It is quite difficult to foresee what objects participants will use for individual actions and what objects they will use for joint actions because of the extemporaneity of face-to-face conversation.

In everyday life, our focus is constantly shifting between different objects while other objects are kept in the background. When working on physical objects it is easy to manage the shifts by for instance moving a piece of paper 20 cm or by swiveling our chair [39]. Managing a constantly shifting focus in the stream of everyday activities is hard to do on virtual information objects with our current technology, since they are confined to a rather small, stationary and inflexible physical surface.

Therefore:

#### 7.4 Pattern Solution

As shown in Figure 1, provide participants with a platform where they can work in parallel on private information objects that are prominent only to them and also work together on joint objects that are prominent to others. Create a mechanism for easily making objects more and less prominent for oneself as well as for every other participant so that an object can be prominent for one person while peripheral to others.

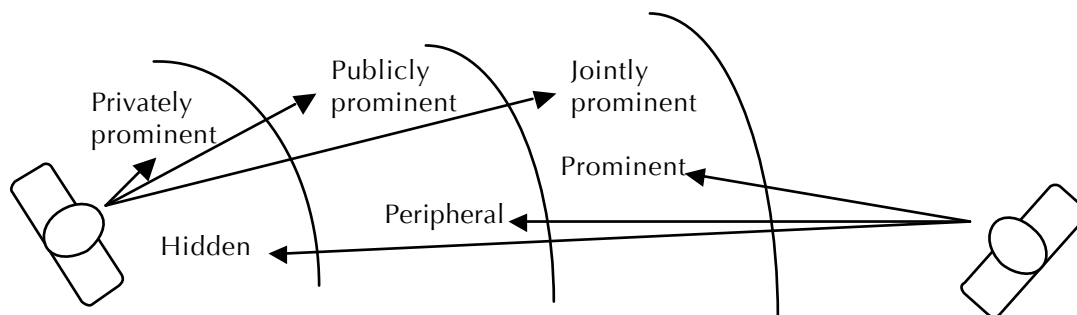


Figure 1. REGULATING PROMINENCE from the perspective of the left participant.

## 7.5 Connections to Lower Level Patterns

It is likely that it takes several screens for the participants to run private activities in parallel. If privacy that is not necessary then a single big shared screen might work, but it would have to have a public area where all participants can work jointly on a prominent public artifact [17], as well as a public area where they can work individually on objects that are prominent to them but peripheral to others, as with an artifact as audit trail [17]. Such a division of the large screen can be made using tiled working surfaces [26]. A private surface on a otherwise shared screen would have to be hidden, for example behind tabs or a “hide-button” utilizing a stack of working surfaces [26], but that would not be a very elegant solution since a user have to turn the screen away, or ask the others to look away, in order to access that surface privately. This can be perceived as impolite to other participants.

## 8. Example of a Design Derived from the Pattern

REGULATING PROMINENCE can be realized in many different ways, but we wish to illustrate one way it can be implemented in a design. The LOCOMOTION system is a multimedia home platform derived directly from the pattern. It is based on two interconnected tablet computers and a PC with a large plasma screen, but other devices like mobile phones, handheld computers, personal video recorders and home-PCs can easily be integrated into the network. Users can move objects between the displays by a simple drag and drop. A user can tilt the tablet and make it peripherally public to the other in order not to interrupt the other’s activities. An object can be dropped on the drop-area for the plasma screen if a user wants to make an object prominent to the other. If one would want to make it really prominent to the other and also interrupt the others activity one can drop it on the other’s tablet. Finally, if a user want to keep something hidden, the tablet can be tilted so that others cannot see the screen. In order to provide this, the system is built around a distributed event manager that allows the drop events to be transferred between different devices (see Figure 2).



Figure 2: The current version of LOCOMOTION consists of two tablet computers and a PC with a plasma screen connected over the network.

LOCOMOTION is a distributed system consisting of two major sub-components; (1) a distributed event manager that allows system events to be transferred between devices over the network, and (2) a graphical system for representing the different devices connected together.

It is built as a peer-to-peer system with no central server and this makes it easily adaptable to an ad-hoc network. It is implemented using the JAVA programming language, and the event manager uses a small protocol on top of TCP/IP. This approach allows the system to be language-independent in the graphical system, which in turn means that it is open to additional clients located on other types of device, such as PDA's or cell phones that do not support JAVA or high-level protocols.

## 9. Discussion

Locomotion is an illustrative example of how one can implement a design solution based on the pattern regulating prominence. During the last five years several experimental systems have implicitly implemented, or have a potential to implement, the design pattern presented in this paper. One of them is the i-LAND environment, where different kinds of roomwares like the DynaWall, the CommChair, and the InteracTable have been tested [11]. Another project which implements the pattern is the BlueSpace workspace [40], which provides users with a number of different screens and display surfaces, including an Everywhere Display projector, which allow users to display graphics on any surface of their choice. The Design Conference Room, Collaborative Classroom and Reconfigurable Collaboration Network [4] can also easily implement regulating prominence. Another way to implement it is to use occlusion on a digital table (see [41] for further discussion about digital tables). If the table knows where people are around it and where physical objects are on the table, it can display information so that one user can see it and not the other. One can also display information so that only people who know what to look for can see it [42].

There are, around us in our everyday life, different cooperative settings that implement this pattern to varying degrees. The counter in a shop is one such place where some parts of the desk belong to the shop assistant and some parts belong to the customer. The spatial properties of the desk provide natural surfaces for private, peripherally public and jointly public actions. We do, however, seldom meet computerized systems that work according to the pattern presented here. The ones that work include physical objects of work and not digital information objects. However, professional practices have overcome this limitation in cooperative process management like the underground line control [8, 43], and rescue management [44]. In these settings, the technical systems provide representations on both private and public work surfaces, and in order to make activities peripherally public the workers speak aloud and overhear each other.

The problem of information visibility and its control depicted in regulating prominence is applicable also to geographically distributed and partly to asynchronous collaboration, but the solution is not. Some kind of workspace is probably useful when trying to find a solution to the problem in distributed collaboration. In asynchronous work it would be advantageous to be able to leave information objects where you know others would find them, but since there is no immediate dialogue in such situations there is no extemporaneity and hence not the same need for fluid and seamless movement of objects.

Regarding the design methodology of design patterns, regulating prominence demonstrates that traditional qualitative analysis into categories of qualities-in-use of an artefact, can provide an empirical basis for forces in a CSCW or HCI design pattern. In the case of regulating prominence the forces are participation, autonomy, extemporaneity and politeness and

these qualities have been grounded in empirical material. Conflicts between the use qualities were highlighted in a problem statement, and further analysis of situations that did not have the conflicts provided grounds for the solution statement of the pattern. This approach to documenting design knowledge fits well with current traditions in ethnographically informed design [45]. Use qualities as competing forces is not an entirely a new idea. One can trace it in the claims analysis of scenario-based design [24] as well as in the questions-options-criteria notation of design space analysis [46]. However, no previous research has made the explicit connection between desirable use qualities and design patterns.

A problem when generalizing over three very different cases to create a generic design pattern such as regulating prominence is that there is a risk to create a vague pattern since it becomes unspecific due to loss of detail. Design situations are unique situations and patterns should therefore be used with some care in a design process, contextual factors may have a very large impact on which design solutions that are appropriate. One should therefore read patterns as inspiration and reminders rather than as rules. Inexperienced designers will probably find them more rewarding to use than experienced designers will.

Several issues remain for future research. There is a large potential for scenarios to be used when describing forces in a design pattern to make the pattern and especially the conflicting forces come alive for a design team. In addition, it seems appropriate to relate the claims analysis in scenario-based design to the desirable use qualities in the situation, and hence to the forces in a design pattern. This is however only a working hypothesis at this time and future research on the issue is indeed welcome. Another direction for future research is to look into the efficacy of CSCW design patterns on actual design work in both educational and professional settings. One property of a well-written design pattern is that it is communicable and debatable and to be that it must be clearly stated. This should be empirically tested in practice.

## 9.1 Conclusions

The design pattern REGULATING PROMINENCE have demonstrated that the four forces participation, autonomy, politeness and extemporaneity can be in conflict with each other in co-located collaboration. The problem is that users need manage this conflict by moving objects between private states and public states, including gradations between. This can, however, be cumbersome to do with information objects confined to a traditional PC-based workstation. The solution is to provide users with a platform where they can regulate how prominent they want to make information for themselves and others. LOCOMOTION is one example among other systems that can implement this design pattern. A design methodological conclusion of this paper is that use qualities from a qualitative analysis of technology usage can provide the empirical basis for a design pattern. This fits well with several traditions within HCI and CSCW such as ethnographically informed design, scenario-based design, and design space analysis. Further research on exactly how to make the connection with scenario-based design is advocated.

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