Designing new workspaces to provide physical and social affordances for successful interaction

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ABSTRACT

Our research is concerned with the physical and social orchestration of group collaboration that emerges in shared information spaces. In particular, we are interested in how the physical and social affordances of different kinds and combinations of shared displays can be designed to engender improved ways of communicating and interacting with shared informational resources. Our findings from a series of experimental and ethnographic studies show how configuring the orientation, number and size of shared displays, together with presenting dyna-linked information across multiple displays can significantly improve group interactions, moving them towards more equitable and comfortable ways of collaborating.

INTRODUCTION

The default mode of interacting with a computer is via a monitor sitting in front of a desk. Such a set up is fine for doing individually-based work or collaborating with others remotely. However, whenever someone wants to work with others in their physical workspace - for example, to show them something on his screen - requires him to 'make room' for the others to join him. Typically, this ends up as a make-shift arrangement, where the others either bring up a chair and huddle around that person's PC monitor, or stand behind him peering over his shoulder. Alternatively, they may sit on the other side of that person's desk, leaning over it awkwardly, while the other person attempts to bring them into their workspace by swivelling their monitor towards them. Either way the invitees can find it difficult to communicate about what is being presented.

A particular kind of workspace that suffers from this kind of single-display, shared viewing problem is in public spaces, like museums, shops, surgeries, where interactions take place between an authoritative person (e.g. sales agent, receptionist, doctor) and a recipient (e.g. customers, patients, visitors). An all too familiar situation is one where the agent sits behind one side of a desk, retrieving and displaying information on their PC, with the other party marooned on the other side, staring at the back of the computer (Figure 1). The arrangement has the effect of restricting access to information primarily to the agent and in so doing making it difficult for the 'customer' to become engaged in the collaboration, even if both parties are willing (Scaife et al 2002). Hence, in such contexts, having single desktop monitors primarily geared to the agent's use acts as a physical and social barrier, typically making the interaction between the two parties awkward and asymmetrical. Having control of the computer means, too, that the agent tends to end up driving the conversation, with the customer largely taking on the role of a passive recipient, peering at the screen of information only when the agent indicates that it is acceptable for them to do so. Once, this pattern has been established, it becomes difficult for the customer to take control of the conversation again and it is certainly unacceptable for them to interact with information on the computer.

Figure 1. Typical PC set-up between an agent and customer

Such appropriations of the single user-based PC to meet the ad hoc demands of two-party collaborations are clearly sub-optimal, often resulting in an invasion of the other's work and personal space, making it uncomfortable and difficult for both parties to work together. So, how might we design different kinds of workspaces that will allow individuals to interact with their computer-based and paper-based information resources while allowing others to join them in a more equitable way?

To help think about how to design applications that support people working together at the same time and as a co-located group Stewart, Bederson and Druin (1999) have promoted the notion of Single Display Groupware (SDG). They suggest providing a large enough display, with various entry points that will allow more than one person to join in (e.g. use of multiple mice or shared pointers with a shared drawing tool). Luff and Jirotka (1998) suggest a number of design implications for future technologies based on their ethnographic studies of how groups, that are co-located, use everyday *interactional resources* to coordinate their collaborative and social activities. Others have begun creating quite different kinds of displays and devices and combining them in novel ways, intended to allow multiple people in the same place to interact with information (Ishii et al, 1997, Guimbretiere et al, 2001; Rekimoto, 1998). With the recent advent of wireless and pervasive computing, there has also been a move towards designing environments and spaces that are embedded with various assortments of interconnected displays and computational devices (e.g. Dietz and Leigh, 2002; Streitz et al, 2002).

A problem that arises when designing new arrangements of technologies for a workspace, especially when setting up new forms of shared displays, is that it can potentially be very confusing for the people entering and sharing that space, especially knowing where and what to look at any given time. For example, it is often difficult to work out who is controlling what when using multiple cursors on a public shared display; the outcome of which is to disrupt the flow of a collaborative activity. Another problem is the extent to which the new arrangements contravene existing norms of social acceptability, comfort and physicality. For example, studies of interactive whiteboards in use (Rogers et al, 2002) have shown how awkward it is for groups to stand in a line, side by side when viewing and interacting with the information on the display.

A key concern when designing more flexible shared workspaces to support different combinations of people (i.e. individuals, dyads and other groupings), therefore, is determining how to constrain the location and orientation of the shared displays and devices such that the right kind of physical affordances are created to promote the right kind of social setting to support the collaborative activities in question. These should be of a form that make it obvious to the various people how they can join in and interact with the *shared information spaces* in the physical space they have entered. For example, the space should be designed to show them on first entering, where to sit or stand, that will enable them to interact with each other comfortably and to feel they have equal access the displayed information.

DESIGNING SHARED INFORMATION SPACES

In the Espace project we have been investigating the physical, social and computational design of shared information spaces. In particular, we are concerned with how to present information on *multiple* interlinked

displays that can be interacted with in different ways by different social groupings. Our focus has been on exploring the spatio-temporal aspects of how best to display co-linked representations on multiple displays such that the individuals can follow the flow of information that is being presented and also know intuitively how to interact with the information presented on different displays. In particular, we are interested in how individuals in different groupings know which display (or part of) to look at and find and interact with the information they need (or which someone else is referring to) for a given task or stage of an activity.

We have carried out a number of experimental and ethnographic studies (Rodden et al, 2002; Rogers et al, 2002) that have shown how orientation and positioning of different kinds of interactive displays can have profound effects on the nature of the coordination and collaboration that unfolds. Specifically, we are interested in trying to design new workspaces that allow two-party groupings to view displayed information together at the same time and to work shoulder-to-shoulder, to be able to attend to the same thing, or to gesture at items on display. We took as our starting point the development of an arrangement we called the eTable shown in Figure 2. This was originally designed as a single back-projected horizontal display surface, that allowed two or three people to view and work with the display. People could sit or lean on/stand at it, and the display location allowed an area for placing and working on things such as paper/brochures. Interaction with the display surface was pen-based, using an inexpensive mimio unit.

Studies using this initial configuration showed it improved collaboration between small groups markedly, compared with the same groups trying to collaborate when huddling around a single workstation. However, there were a number of problems. These included difficulty of establishing eye contact, handing over the mimio pen between each other and focussing attention on a single screen. In particular, it was difficult for the group members to keep track of the relationships between what was being displayed in the different windows. For example, information changing in two windows simultaneously, whose relations were important, was hard to perceive because this information could alter in placement and size, or even be overlapped.

Figure 2. Back projected eTable, using mimio-pen as input

In our next study we designed an interactive console-based table which consisted of multiple linked displays, each of which presented a certain type of information, and whose relations with each other were designed to be explicit. The use of multiple monitors has been found to be an effective strategy by users for coordinating information (Grudin, 2001). In our set-up, we embedded three integrated large flat 21-inch displays set (two horizontal and one vertical), in an oval table 1.5m long and 1m wide (see Figure 3a).

Figure 3(a). The design of our physical layout of multiple screens and dynalinked representations and 3(b) in use at the trade show

The console was designed to allow different groupings of customers and an agent to sit or stand in front of it, allowing them to see each other and make eye contact, without having a table or a vertically hanging whiteboard acting as a barrier between them. Sufficient surface space was also provided as part of the console for a wireless mouse and keyboard together with room for placing other materials.

The software that was designed to present information on the different screens that were contextually 'dynalinked' with each other. For example, an itinerary planner was presented on one screen and the effects of making certain choices in this were shown on another screen. The agent and customers can refer to both and make changes to one which will cause further changes in the other (see Scaife et al, 2002, for details).

Our rationale behind the design of this particular set-up was to enable people to work together on a more equal basis by removing the sense of an interview or consultation, and reducing social awkwardness. When placed in a real life setting at a large travel trade show, located at the front of the stand of a travel agent, we discovered a 'honeypot' effect. People were drawn towards the console, where upon an agent would invite a particular grouping to sit or stand next to it and them. All manner of groupings 'dropped in' to this space and planned together a round the world trip, using the various online resources and interactive planning tools we had developed for this application. A main observation of the way the two parties worked together was that the customers and agents focused much more on the information in front of them, while maintaining eye contact. The effect was a much more relaxed and less formal set-up than the single display on the desktop commonly found in travel agents. We also observed much more evidence of continuous rather than interrupted interaction and where both parties played a more equal role. Hence, this kind of physical set up, together with the interlinked information displays, created a different kind of interaction, where social awkwardness particularly on first contact with the agent, was much reduced. As well as making the customers feel more comfortable, it also improved mood and rapport between the two parties as the transaction between them progressed.

CONCLUSIONS

In sum, our research points to how the physical design of shared displays and the way information is presented on them and made accessible to people can have quite significant effects on the way groups and in particular, two-party ones, conduct their collaborative activities. A key concern is determining how to design shared information spaces that provide the right set of physical affordances that will allow people to feel comfortable and know how to interact in the space, which in turn will support the flow of attention across multiple representations and the necessary coordination when collaborating.

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