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Ethical issues in interaction design

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Abstract. When we design information technology we risk building specific metaphors and models of human activities into the technology itself and into the embodied activities, work practices, organisational cultures and social identities of those who use it. This paper is motivated by the recognition that the assumptions about human activity used to guide the design of particular technology are made active, in use, by the interaction design of that technology. A fragment of shared design work is used to ground an exploration of different solutions to one of the technical problems that arise when technology is used to support similar work over distance. The argument is made that some solutions to design problems are better than others because they enable human interaction in different ways. Some solutions enhance the possibilities for human agency, others diminish it. This means that there can be a moral basis for choosing between alternative interaction design decisions that might otherwise be considered equivalent in terms of the functionality and usability of the technology.

Key words: Computer-Supported Cooperative Work, human-computer interaction, shared drawing applications, technology design practices, usability

Introduction

> But now what matters most is not to perpetuate or bring about a particular image of man (sic), but first of all act to keep open the horizon of *possibilities*
>
> Hans Jonas (1984) *The Imperative of Responsibility*. p. 140. Original emphasis
>
> I wasn't thinking about the social representations I was creating as constitutive of the world in which I would have to live.
>
> Gibson-Graham, J. K. (1996) *The End Of Capitalism (as we knew it)*. p. ix

Any technology designed for use in human activities incorporates assumptions about how it will be used. These assumptions, whether explicitly represented in the design process or not, are essential resources that designers exploit to shape their developing designs into specific products. Here, my interest is in the ways that assumptions about human activities are represented in the practices of information and communications technology (ICT) design, where those assumptions come from and how they shape the options for future use of the technology. This interest stems from the insight that our ability to think about any design problem, and the quality of our thinking, depend to a large extent on the appropriateness of the representational resources that we can use in our thinking (Suchman 1994, p. 1).

In the working environments of technology design the term *interaction design* names an emerging area of research and practice. The authors of a major text in the field explain its focus as: "designing interactive products to support people in their everyday and working lives. In particular, it is about creating user experiences that enhance and extend the way people work, communicate and interact" (Preece et al. 2002, p. 6). I am using interaction design in this context to refer to the design of the actions, and the ways these can be combined with other actions, that are potentially available to people when they are using ICTs to support, mediate and/or enable their activities in some way. Some relevant design issues include: the constraints that shape people's actions in relation to the technology they use, how these actions can be achieved in practice, how they fit into and structure the ongoing interaction, what overheads and benefits can specific actions contribute to the overall interaction and what effects can be produced.

The technology that especially interests me here has been made possible by the use of communications technology to link computer systems to support, enable or otherwise mediate cooperative activities between a group of people who may or may not be working in a shared physical space. In technology design environments this kind of technology is qualified by the acronym CSCW (Computer Supported Cooperative Work). CSCW technology enables people in different places to share the same computer files, either at the same time or at different times, and to exchange any other kind of information that can be represented digitally including audio and visual information. Electronic mail has so far been the most successful application of CSCW technology. But there are many others including teleconferencing and chat groups, virtual worlds, systems designed to control workflow within groups and a range of applications that use audio and video channels to support basic social browsing of distant workplaces. Central to this paper are those that provide a shared workspace where some of the actions of individual participants and the developing work of the group can be represented. More recently, the rapid growth of the world wide web means that interactive web applications are becoming available that offer different kinds of services to participants in cooperative activities that are no longer just work defined. Some of these cooperative technologies have been analysed by those concerned with ethical issues such as surveillance and privacy (e.g., Kling 1996; Spinello 2000; Introna 2001; Clarke 2001), and, particularly relevant for my concerns here, the role that specific technologies play in the production and shaping of social identities (e.g., Suchman 1993; Cocking and Matthews 2000; Cerqui 2002).

This paper is motivated by the recognition that the assumptions about human activity used to guide the design of particular technology are made active, in use, by the interaction design of that technology. When we design information technology we risk building specific metaphors and models of human activities into the technology itself and into the embodied activities, work practices, organisational cultures and social identities of those who use it. In turn, when people are required to act according to the prescribed behaviour of particular representations of human activity then there are questions to ask about whether some of these representations and their associated options for action are better or worse than others. Since ethics is concerned with action, these are ethical questions. These are important questions because how they are answered determines what actions specific technology can, or can not, support in practice. They are urgent questions because as ICTs are increasingly designed and used to mediate the behaviour of particular people, then the technologies themselves increasingly assume ethical significance because of the role they play in shaping how it is possible for people to be when they use technology, and the agency they can create use, both in their work and their interactions with others.

This paper is written from within human-centred technology design traditions where it is an established practice to insist that technology design is informed by an understanding of the practices of those who might use the new technology. By the term human-centred design I describe a commitment to technology design research, methods and approaches that prioritises the agency and quality of experience of those who use the technology. Human-centred approaches are motivated by a commitment to the usability and usefulness of technology on the one hand and user-participation in technology design and implementation on the other. They offer another perspective to technology design than the more dominant technology-driven or management-driven perspectives. Human-centred design has a long history in technology design through areas of design practice such as Participatory Design (Greenbaum and Kyng 1991), Socio-technical Systems Design, Human-Computer Interaction (Preece et al. 2002), Social Informatics, Computer-Supported Cooperative Work and even Agile Development methods such as Extreme Programming (Rittenbruch et al. 2002). Specific techniques include various kinds of user and usage field studies (e.g., Blomberg et al. 1993; Plowman et al. 1995; Plowman 2003), the development (from these studies) and ongoing use of user scenarios and personas to drive the design and evaluation process (e.g., Cooper 1999; Bødker 2000; Carroll 2000; Grudin and Pruitt 2002), rapid and frequent prototyping coupled with ongoing evaluation using a range of usability evaluation methods (e.g., Preece et al. 2002) and the development and application of a range of design principles and heuristics (e.g., Preece et al. 2002). This set of techniques has been developed over the last two decades and is well-researched, understood and tested (Robertson et al. 2004).

The focus of this paper is a single technical issue – managing input from multiple users into a shared workspace application – in the design of a particular kind of CSCW technology that is now commonly available – shared drawing applications. Working from human-centred technology design traditions, I begin by grounding the discussion of technology design in this paper in a fragment of genuine cooperative design work in a shared physical work space. The fragment of actual work serves here as an example of multiple input from more than one user into a shared workspace; that is as an example of the kind of work that shared drawing applications have been developed to support. From there I consider some of the solutions to managing multiple inputs that were proposed in the research literature when shared drawing applications were in their early stage of development. My purpose here is the disclosure of the normative effects of a particular kind of technology (Brey 2000; Tavani 2001) that result from the assumptions about, and representations of, human activities in technology design practices. My interests are, on the one hand, to make available to those who are not working within technology design some understanding of how a particular range of little black boxes, in this case shared drawing applications, came to be the way they are (Latour 1987; Foucault 1994). On the other, my concern is to establish some moral basis for those designing technology to choose between alternative interaction design decisions that might otherwise be considered equivalent in terms of the functionality and usability of the technology.

Managing "multiple inputs" in shared physical work spaces

Figures 1 to 6 and the dialogue that follows them are taken from 45 s of video footage from an field study of shared design work (interested readers can find detailed accounts of this study and its findings in Robertson 1996; 2000). The participants were designing a computer-based learning application. The focus of my interest in this fragment of interaction is the drawing pad the designers are using, especially its role in, and contribution to, the interaction itself. The shared drawing applications that are central to the remainder of this paper could act as a substitute, of sorts, for this shared drawing pad when the designers are working in different places. This is one of many possible examples of shared use of a drawing pad from the study. It was chosen to use here because it is small enough to include in this current context while still enabling the following discussions to be grounded in actual human practice.

In this fragment, two designers are sitting working together at a table during their final design meeting before the initial prototype of the application was built. Each designer has notes from previous meetings on the table in front of her. On the table, between them, is the drawing pad with some roughly sketched screen designs and explanatory notes that have been made earlier in the meeting. The designer on the left, Dorothy, has made the notes and sketches on the drawing pad and, as this fragment starts, the pad is oriented towards her.

The designer on the right, Susan, is offering a suggested solution to a crucial design issue that has remained unresolved and problematic throughout the whole process. As she begins to speak she draws a computer screen in the air (Figure 1). She continues to describe how her possible solution could work, making gestures within the imaginary screen space she has drawn and looking to see that Dorothy is following her (Figure 2). In shared physical space, Dorothy is easily able to see Susan's gestures and their contribution to the developing conversation. By Figure 3, drawing in the air is no longer sufficient and Susan has picked up the pen in front of her and is looking around for something draw on. Dorothy moves the drawing pad with the shared meeting notes towards her, while inviting her to draw on the pad (Figure 4) and Susan begins to draw within the screen outline, that Dorothy had drawn earlier in the meeting, on this shared pad (Figure 5). In the final Figure both designers are writing or drawing on the same screen sketch; that is, they are both using the shared drawing pad at the same time. The dialogue

Figure 1.

Figure 2.

that accompanies the figures is provided to give the reader some sense of the context for each of these inputs into the shared physical workspace, and to demonstrate how they flow easily from the ongoing conversation at the same time as they enable that ongoing conversation.

Susan. Up, I guess, pops (Figure 1, draws a screen in the air and then gestures to adds bits to it) for this place. So ... it's the building itself, and some details (Figure 2, looks at Dorothy who is watching her drawing in the air)

Dorothy. You know a little, perhaps a, um... (Figure 3, picks up pen and turns to table behind her looking for something to draw on)

Dorothy. (Figure 4, sees that Susan is looking for something to draw on, turns the drawing pad so it is equally facing both of them, then pushes the pad towards Susan) You're allowed to draw on here. Keep it all on this and then I'll just have one lot of notes to worry about. I mean.

Susan. OK. Yeah. All right. (Figure 5, starts filling in details within the screen outline that Dorothy has drawn earlier) OK. So maybe the ... they've popped on that building and here's the little symbol of it. And perhaps there's a , there's like a window and, and maybe there's ... I don't know ... the others that were involved in this place etc. (writing and drawing on screen representation) The, um ...

Dorothy. People.

Susan. people themselves. (writing)

Figure 4.

Dorothy. Newspaper clippings. (Figure 6, leaning forward and highlighting the place on the screen where these could be)

Susan. Yeah the clippings, and the stuff. (writing 'clippings' in place Dorothy had indicated) Um ... What else?

There is nothing particularly remarkable about the designers' smooth negotiation of access to (or input into) the shared drawing pad. There are many examples of such skilled negotiation in the data from this study and from other studies of shared design work (e.g., Tang 1989; Minneman and Bly 1991; Plowman et al. 1995). But it becomes much more remarkable when viewed from the perspective of designing technology that might support such shared

Figure 3.

Figure 5.

Figure 6.

use of a workspace and drawing pad when the designers are in different places. Each use of the drawing pad by the designers, including each gesture in relation to it, contributes to shaping the interaction, between the participants, that creates the shared activity. Current technology provides very reduced resources to capture and represent the actions of the designers in their use of the shared drawing pad even within this fragment of interaction.

In the following section I consider some of the options for designing just one of these resources from the technology design research literature when such systems were first proposed. My purpose in grounding this discussion of technology design in an actual example of human work practice is to highlight the genuine social issues inherent in technology-mediated interaction and to separate these from the genuine technology design issues inherent in enabling that mediation. The latter are then more able to be addressed on the basis of their effects on the agency of those using the technology to design their own interactions and their own work practices.

Managing multiple inputs in shared drawing applications

Shared drawing applications can provide a shared workspace for those who make and use sketches and other kinds of images in their work and who are working in different places. They exploit the metaphor of a shared drawing surface such as a whiteboard or a drawing pad, like the one used in the example of shared work discussed above. Participants using these applications can draw or write on their own computer screen and whatever they draw or write is visible on the screens of all the other participants. All participants see the same images on their screen and each of them can change and/or highlight some aspect of what they see. This makes it possible for people who are in different physical spaces to both see and change the same thing at the same time and to ground their ongoing work within whatever is represented in this shared workspace. On a technical level, shared drawing applications need to accept input, generally some part of or change to a drawing – such as an equivalent to pointing, annotating, changing or generating a drawing on the shared writing pad used in the fragment of interaction presented in the last section – from each of the participants in the shared work, wherever they are physically located, and then make this input available to all the participants with access to the shard workspace, again wherever they are physically located.

Some of the participants' gestures can be represented in the shared workspace by the use of telepointers. These are cursors, visible to all the participants, that identify the individual controlling each one by different symbols or labels. The cursors indicate which parts of the screen each participant is working on and can be used to represent indexing gestures. For example, when one participant says "that red circle needs to go there", they can use their cursors to indicate which red circle and where "there" is. Participants can use voice channels, video links and/or telephones to enable their conversation.

The technical problems involved in maintaining a shared file between a number of different places are considerable and their solutions are not trivial. The technology needs to be able to detect a change made on one screen and ensure that this change is made on all screens. There can be synchronisation problems if there are a number of inputs from different participants because, in distributed systems, there is always a time delay associated with the use of shared files. Digital information always takes time to be encoded and decoded, and to get from one place to another. A range of technical issues can affect the time delay for input from different participants including the local connection speed as well as wider network quality of service factors such as speed and load. This technical problem of synchronising multiple, distributed inputs into a shared file is called concurrency control and there has been a number of solutions developed for it. In the remainder of this section I consider three of them.

The "problem" of floor control

In shared drawing applications, one solution to the synchronisation of input from different people is the implementation of access control protocols. Floor control is one such protocol that enforces various kinds of turn-taking by exploiting the metaphor of an individual 'having the floor' in a meeting environment. Only one individual at any one time can make changes to the shared space and there are specific interactions with the software application, as well as with the other participants, required of each individual to manage their access to the shared space and the resources it provides. By controlling the various kinds of access to the shared space, any simultaneous input from different people is prevented, by design, and so cannot scramble the system or undermine the integrity of the shared workspace.

The following passage begins an early paper from a conference on Computer Supported Cooperative Work (CSCW) that presented an access control model based on floor control for use in shared workspace applications.

> Access control is an indispensable part of any information sharing system. However there has been relatively little work done in controlling access to the collaboration. Most collaborative systems give all collaborators the same rights to all objects and expect access to be controlled by social protocol.[1] *Thus, they do not provide computer support for preventing mistakes, conflicting themes or unauthorised access* (Shen and Dewan 1992, p. 51, my emphasis).

There are a number of unquestioned assumptions about human activities that involve the use of shared information systems underlying this statement. One is the assumption that software applications that do not enforce participant behaviour in a collaborative process are somehow lacking – in the sense that they can not be fully successful as technology for human use. Another is that the technological control of what is essentially a social process is both natural and unquestionably desirable. A third is that social protocols are not able to successfully enable collaboration that uses an information sharing system and therefore the mechanisms to control this collaboration need to be built into the software itself. But the main point I want to make here is that these assumptions rely on the presentation of access control mechanisms as a solution to social "problems", such as avoiding mistakes or ensuring a group of people work on a common theme, that can not otherwise be resolved. Yet there is neither justification nor evidence, in the paper or elsewhere, that such problems exist in the first place, let alone that social protocols can not be used to negotiate a solution to them.

In another example from the CSCW literature, different assumptions about human activities are used to ground the discussion of different floor control algorithms.

> If care is not taken, a distributed groupware system can suffer concurrency control problems due to events arriving out of order, leading to inconsistencies in the image, the underlying document, and the group's mental model of what is actually going on (Greenberg and Marwood 1994, p. 207).

In this example the effects of time delays are inconsistencies; but the authors do not differentiate between inconsistencies in the objects within a shared information system, the images or the files, and inconsistencies in some assumed yet unexplained property of the group of people involved, their shared "mental model". Mental models are a problematic and contested term used, in the Human Computer Interaction and Interaction Design literatures, to refer to an individual's existing understanding of some artefact or process (see for example, Preece et al., pp. 92–95). They are problematic because of the cognitivist metaphor for human memory and action that they embody and their very existence is contested by situated approaches that share a greater attention to particular people as an embodiment of experience rather than a symbol processing machine (e.g., Suchman 1987; Hutchins 1995; Clancey 1997). In this instance, I understand that the authors are using the "the group's mental model" to refer to the participants' shared understanding of "what is actually going on". The important point here is the assumptions about human cognition that can enable the unquestioned existence and status of such a model in a form where it could ever be consistent, so that its inconsistencies can be grouped, without differentiation, with those of the technology and then used as an explanation and justification of need for floor control in shared applications. Yet later in the same paper the authors noted that their own shared drawing prototype ignored concurrency control altogether (p. 210). They found that not only were there no complaints from users, but apparently no one noticed any resulting inconsistencies, if indeed there were any. The authors explained:

[1]For readers from other disciplines, "object" in computer science and related fields has a technical meaning. It is used to refer to entities, *within a software application*, that have a distinct and defined boundary that enables them to exist independently within the context of the software. Examples include lines and shapes in a drawing program, the specific drawing tools that make them, a drawing made of up lines and objects, the file that stores the drawing (hence object-oriented design, object-oriented programming languages etc)

> The point is that, in many groupware applications, concurrency conflicts may be rare because people mediate interactions themselves. When conflicts do occur and slight inconsistencies appear, they may not be problematic in practice. Finally, if people do notice conflicts and problems, they are quite capable of repairing their negative effects *and consider it part of the natural dialogue* (p. 211, my emphasis).

Floor control mechanisms resolve technical problems, namely the synchronising of conflicting input from multiple, distributed sources, by embedding social metaphors such as meetings and their related protocols in the shared workspace software itself. The specific issue I want to highlight here is the slippage that follows when technical problems are recast as social ones when these social problems do not appear to exist prior to, and outside of, their use as justification for solutions to these technical problems. The existence of these social problems owes more to their constant citation to justify certain technologically-driven design decisions, in this case the implementation of floor control protocols, than to any basis in real human experience. In the fragment of shared work discussed above the inputs into the system, that is the various uses made of the drawing pad in the interaction, were both sequenced by, and explained by, the designer's conversation. This was the case even when the designers were using the same screen sketch on the drawing pad, at the same time, as the basis for that conversation. It was the case in every similar example in the study and a finding common to a range of similar studies of shared workspace activity (e.g.,Tang 1989; Minneman and Bly 1991; Plowman et al. 1995).

The "problem" of idea ownership

A quite different approach to the management of multiple inputs was explored in an experimental shared drawing application called CaveDraw (Lu and Mantei 1991). In this application, multiple inputs were not managed by ordering input through floor control protocols but by isolating the parts of, or objects within, the shared workspace that could be affected by any particular individual's input into the system. CaveDraw was developed to explore idea ownership in shared drawing applications: "Ideas have creators and thus, owners. Any time a sketch is modified by other participants in the group, ownership preservation becomes an issue" (p. 107). An individual user of CaveDraw could specify that he or she owned a particular drawn object by choosing to draw the object with a particular drawing tool, a "coloured marker" set to a colour that none of the other participants could use. That individual could also choose not to own an object by drawing it in a different drawing tool, a "pencil" that drew black lines no matter which participant was using it. The resulting drawn object could be used by any of the participants.

The researchers based their design decision on a single example from a number of studies of shared drawing activity. On that occasion, a dominant participant was observed to erase another's sketches without negotiation or permission. This action, quite understandably, undermined the success of the collaboration (*Ibid.*). Implementing ownership of drawings and parts of drawings was intended to prevent such behaviour by using the technology to enforce a particular social protocol. But the authors observed: "although CaveDraw supports design ownership, its support has some drawbacks. Designers can 'sign' their work but the decision to make a particular design private needs to be made at tool selection time" (p. 108). In other words, before something got drawn, choices needed to be made about its future use and these choices determined its future use; when using this system people needed to decide before they acted whether the result of that action is to be publicly available within the ongoing cooperative process. This added decision altered "the flow" of the design process itself. In addition, the authors noted that idea ownership also meant that a particular drawing could not be taken up, changed and used in different ways according to how the design process unfolded. Nor could particular drawings be removed from the shared workspace if their owners left the shared activity for any reason (*Ibid.*). In the example of genuine shared design work discussed above, the entire interaction involved the flexible use of the shared drawing pad where access to it depended on what was happening in the design conversation and where drawings made at previous meetings were constantly and opportunistically reused for different purposes in different ways by different people. This example could not have happened if it was subject to the constraints implemented in CaveDraw without a massive shift of control over the interaction itself from the designers to the technology. This shift occurs because of the social protocols enforced by the software itself.

Idea ownership is a complementary rather than an alternative strategy to floor control protocols for managing multiple inputs to a shared workspace. In floor control, a social protocol is embedded in the technology as a solution to technical problems that have been recast as social problems. These, in turn, gain their legitimacy by their citation as the justification for particular technology design decisions. In idea ownership a perceived social problem is solved by designing a rigid social protocol that is also embedded in the technology itself. As a side effect, potential synchronisation problems are also resolved. But both these "problems" are resolved because the social situations from which they may or may not result are prevented from occurring at all by the design of the technology. In each case the participants' agency, and their responsibilities, to successfully manage a cooperative process, including the maintenance and expression of socially appropriate protocols, are rendered irrelevant to the interaction by the interaction design of the technology.

The "problem" of managing multiple inputs

A third approach to the "problem" of managing multiple inputs is to recognise and treat it for what it is; it is a technical problem that rarely has any impact on the use of the technology should it actually occur. If and when it might genuinely affect the participants' interaction then, and only then, is technical support provided for the negotiation of a social solution by the participants involved in the process. In practice this means the software application processes all input as it arrives. Even if there is a clash, or if any input arrives out of sequence for any reason, then the participants need only deal with if it they notice it at all, and then only if it matters to the interaction. Instead of implementing any concurrency control procedures to control the interaction between participants, the system can, if indeed it does anything, enhance the perceptual resources available to the participants when clashes occur.

An example of this approach is the prototype shared whiteboard application, Tivoli (Moran et al. 1995). In a paper explaining their decisions the designers wrote:

> While the system resolves concurrent actions to preserve data consistency (according to the system's definition of consistency), the intentions of the users may be in conflict. There is no way the system can know about user intentions or how to resolve conflicting intentions, *but it can make it easier for users themselves to manage the conflicts....* Further actual conflicts seem to be fairly rare events which can be limited to minor consequences if treated correctly (p. 31, my emphasis).

On occasions when changes were made to the same shared object at the same time Tivoli generated as many copies of the original object as required to support the different inputs. Participants could immediately perceive that there has been a conflict and resolve it by negotiation. The approach of the designers of this system was that the role of the technology is to alert the users to conflicting inputs, not to shape their behaviour so that conflicting inputs do not occur in the first place. In this way the rare conflicts that may occur can be used to make the design conversation more robust by demonstrating that more than one participant is focused on a particular aspect of the shared workspace. The interaction design enhances the participants' agency to design their own interaction and work practice rather than forcing this interaction to fit within predefined and inappropriate protocols embedded in the technology.

Discussion

Studies of cooperative work have repeatedly shown that people are perfectly capable of managing their interactions themselves. In the fragment of interaction presented in this paper, and in every single one of the many occasions where an artefact was shared throughout that entire design process, issues of access and ownership were smoothly negotiated by the designers. Negotiating access to objects "owned" by another was essentially polite social behaviour. None of the participants appeared to have the slightest problem in performing or interpreting such behaviour. Access was not assumed, but always offered. The fragment of interaction demonstrates how social negotiation around object use was constitutive of the cooperative process and contributed to a jointly accomplished solution. In contrast the discussion of solutions to concurrency control issues demonstrated how this social negotiation around object use was compromised when technical problems were resolved and/or avoided by embedding social protocols within the technology itself.

Greenberg and Marwood (1994) concluded their discussion of concurrency control issues by giving each of their considered options the same status, leaving it to technology designers "to choose a concurrency scheme that fits the nuances of their application" (p. 215). But I have long felt dissatisfied with conclusions that different solutions to the support and mediation of human interaction are equal and that selection between them depends only on the particular circumstances of their immediate application. Shared drawing systems, that impose protocols or restrictions on any aspect of shared object use, compromise the agency of those using the system to manage, themselves, the social protocols that enable the cooperative process.

There are moral choices to be made in the selection of concurrency control protocols, indeed in interaction design decisions in general, for the simple reason that some solutions are better than others when they enable people to act and interact with others in ways that enhance their agency, and responsibility, in shaping those interactions. If we accept that human identities are shaped by our interaction with others over time, then we need to ask what kinds of identities particular mediating technology produces. We need also ask what kinds of powers and capacities to act that specific people, whose identities are shaped through their use of particular technologies, will actually have in practice. Or, put more simply, what kinds of human agency are being produced.

Agency is produced when any person acts and when any technology is used. It may even be the case that different combinations of different people, different technologies and different cultural protocols can, when viewed from a purely functional perspective, perform identical actions and so appear to have produced identical agency. But the agency of these combinations, in total, can be produced within them in different ways, in different places and can be of fundamentally different kinds. Moreover, those people whose actions enable the successful functioning of these combinations will experience and evaluate the situation quite differently from those who observe and/or benefit from the work done. As agency is about the capacity to act and ethics is about action, then how human agency is produced, distributed and experienced within environments where technology is used is a central ethical issue in the design of technology and the design of the activities that technology is used for.

We know that information technology is continually used for purposes, and within contexts, that were not foreseen by those who designed it. Once the design decisions are made however, and the boundaries drawn and the objects defined, they are implemented in software products that by various marketing exercises become established solutions in the marketplace. Designing systems reduces to a shopping problem – the best fit solution to a particular situation of use is selected from available packaged solutions and then integrated into the existing technology infrastructure.

Shared drawing applications that embed the various protocols for managing multiple inputs that I have discussed here, as well as variations of them, are no longer research prototypes but commonplace applications. Interested readers will find examples of each of them available within off-the-shelf technology available for use in supporting remote collaboration. Any decisions that might have been made about concurrency control in the early days of development of these applications, and the rationale behind them, are now long forgotten and their resulting protocols for use fixed and unexamined. Moreover, the design and use of shared drawing applications is no longer an area of researchers' attention, the focus having moved on to new kinds of still developing technology (e.g., Robertson et al. 2004). Studies of informal shared drawing activity have become less common in the literature since 1993. By that time a range of prototype drawing tools were available and routinely incorporated into groupware applications and commercial products that were being released into the market as packaged solutions to the problems of working over distance. They have become little black boxes that "seem to move even without people. More fantastic, it seems they would have existed even without people at all" (Latour 1987, p. 133).

Jonas (1984) argued that the rapid development of modern technology had changed the making of technology from a response to human necessity to the essential purpose of human effort (p. 32). The success of the technology that has resulted from the linking of communications technology and computer systems means that more and more attention and resources have been devoted to its continued growth. The future direction of the development of this technology assumes ethical significance not just because of the interaction issues that emerge from its use but also because of the central place such technology now occupies in development efforts and an increasing number of work places. There has been little place or time in this process of constant redevelopment and rapid technological change for reflection on that growth, where it might be directed or even if it ought to continue at all. The result is a process of change that appears to drive itself and a technological determinism that provides no time for its own self-correction or regulation and that "in whatever time is left the corrections will become more and more difficult and the freedom to make them more and more restricted" (*Ibid.*).

Yet Jonas also saw the acceptance of such determinism as an ethical failure. He wrote:

> Not you or I: it is the aggregate, not the individual doer or deed that matters here; and the indefinite future, rather than the contemporary context of the action, constitutes the relevant horizon of responsibility. This requires imperatives of a new sort. If the realm of making has invaded the space of essential action, then morality must invade the realm of making, from which it had formerly stayed aloof ... (1984, p. 9).

Designing technology is an activity within the realm of making. In the management of multiple inputs into shared drawing systems, morality remains aloof when each of the different concurrency control solutions is given the same status. These solutions are, in the overall scheme of things, solutions to very small problems. But interaction design can be defined by the constant need to find solutions to great numbers of such very small problems whose cumulative effects can wield huge influence. Solutions to each of them can be judged by the same human-centred design principles: avoid using technology to enforce social protocols and choose solutions that enhance the possibilities for human agency over those that clearly diminish it.

At its heart, my concern with moral choices in interaction design stems from a Foucauldian-informed recognition that shared drawing applications, in common with other kinds of technology intended to enable, support or mediate human interaction, operate in that space where technologies of power intersect with technologies of the self (e.g., Foucault 1994) to produce the particular kind of docile bodies that particular societies and particular work places require: "not only in the sense of acquiring certain skills but also in the sense of acquiring certain attitudes" (p. 225). In this paper I have tried to show how the recasting of the technical problems of concurrency control as social problems of access control can function as a mechanism that opens and crosses this space where technologies of power intersect.

But Foucault also recognised our capacities to seek out ways to resist the normalising effects of disciplinary power. It is these capacities that I understand to underlie his consideration of ethics as "the relationship you have to yourself when you act" (p. 131). This could suggest the possibility of a range of strategies, beyond the development of human-centred design principles, that can range from education to resistance and that can be used by those outside of technology design environments to continually problematise and undermine the naturalness, necessity and inevitability of the specific kinds of recoding of our behaviour that the use of communication technologies asks of us.

Particular people are formed not just by their own physical characteristics and dispositions but as much by the contexts within which they have lived their lives. Who particular individuals can be in the future depends very much on their present contexts and the options for action within them. In a discussion of human embodiment and ethics, Gatens (1996) argued "we are accountable for the present in that we are responsible for those present possibilities that become actual through our actions" (p. 105). The crucial point for interaction design is that as present possibilities become what actually 'is', the assumptions that have shaped them become embedded, over time not just in the technology itself and the social and organisational protocols surrounding its use, but in the specific embodied histories, capacities and social identities of particular people.

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