Modelling Computer-related Disengagement from Collaboration in Meetings

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ABSTRACT
We have noted that participants in meetings disengage from the conversation when they perform tasks with information resources such as laptop computers or pen and paper. A detailed study of five meetings has revealed a preference among participants to limit their disengagements to ten seconds. The preference is particularly evident when tasks are performed with pen and paper; also evident is the incidence of short disengagements punctuating long tasks. On the basis of these two features, we have outlined a model of paper-based task performance during meetings. We have then looked at how well participants are able to adhere to the model when performing tasks with computers, and find some areas of non-compliance. We discuss what this means for those setting requirements for technologies to be used in meetings.

1. INTRODUCTION
A fundamental concern of HCI has always been to improve the support that people gain directly from computer technologies. This concern motivated the pioneering work of Card, Moran and Newell (Card, Moran et al. 1983), and also that of Suchman (Suchman 1987). Suchman's work is especially relevant to this workshop, for it was instrumental in drawing attention to people's collaboration and the need to support it better. This in turn led to establishing the field of CSCW.

However, the improvement of support has not been the only concern of HCI researchers: another has been to track the emerging technologies of interaction and learn how they can be applied successfully to meeting users' needs. This kind of research can help reduce the risk of serious system failures, which can in turn have disastrous effects on collaboration (U.S.Congress 1988; LAS 1993; Scott, Rundall et al. 2005).

In this paper we discuss the negative impact of the laptop computer, a technology that is being used increasingly in meetings and other collaborative settings. In this instance there has been no lack of attention paid to improving support to users. But a guiding principle of laptop design has, from its inception, been to provide the full capabilities and tools of the desktop computer on an easily portable hardware platform; this is a major source of the laptop's wide appeal. The problem lies in designers' assumptions that these users would be working on their own and interacting solely with their laptops, rather than collaborating and interacting with other people face-to-face.

There is extensive evidence, most of it anecdotal, that laptop use interferes with collaboration during meetings. Our own studies of meetings, while not aimed at describing these effects at the macro level, have provided many examples of them, e.g.:

> difficulty in resuming full participation in a meeting after a long interaction with a laptop;
>
> insistence on conducting a laptop-based web search to answer a question after being told it doesn't matter;
>
> conducting a 'filler' conversation on an irrelevant topic (e.g., child care problems) while using a laptop, thus preventing the main conversation from continuing;
>
> breaking into an ongoing discussion to announce the results of a lengthy web search, now no longer relevant.

Our overall interest lies in these types of interference with collaboration, and in how to reduce them. We believe this is best done by following the lead of HCI pioneers, and seeking to make incremental improvements, in this instance to the support that laptops currently provide in meetings. Our adoption of this approach has led us to focus on two particular research goals. The first is how to measure improvements to meetings support, without which it becomes hard to track progress. The second is how to model the behaviour that is being supported, so as to guide the design of improvements. We report here on recent progress we have made in these two areas.

2. THE STUDIES
The primary focus of our research has been on small workplace meetings of up to a dozen people, and on their use of paper-based and computer-based information resources. We report here on a study conducted during the first half of 2005, in which a number of meetings were videotaped and analysed. This study was strongly influenced by an earlier study of medical consultations, and we therefore start by summarizing that study's results.

2.1 Prior study of medical consultations
In 1998-9 a study was undertaken by Xerox Research Centre, Cambridge UK, of consultations in two primary healthcare centres in London. At that time, computer use was already widespread in primary healthcare, but doctors were still using paper records extensively. The data thus support some interesting comparisons of the two types of resource, which might not be feasible in today's heavily computerized health centres.

In this study we noted that the use of information resources of either kind typically led to a pause in conversation, and that this pause rarely lasted longer than 10 seconds (Newman and Taylor 1999). Further analysis of the video data indicated that this feature of consultations was particularly pronounced when doctors used pen and paper (see Figure 1). When they used computers the effect was less apparent. Also, more than three times as many pauses exceeded 10 seconds when computers were used.

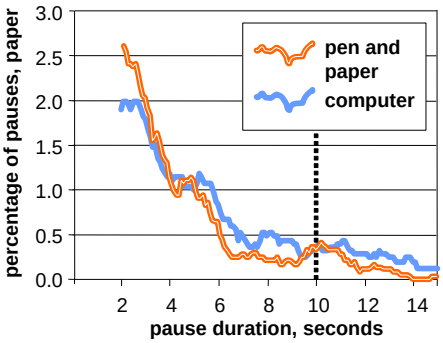

Figure 1. Distribution of pause durations in medical consultations when information resources were used. Moving averages of durations, measured to the nearest 0.1 seconds.

2.2 Recording and analysis of meetings

The study of medical consultations motivated us to collect video recordings of meetings, as a means of understanding the effects of laptop use in these settings. It also suggested a line of study and analysis. We hypothesized that, if there were temporal constraints on the use of documents in two-person conversations, there might be similar constraints in larger meetings. Also, there might again be differences between the effects of using paper and of using computers.

We therefore videotaped eight meetings, 35 to 75 minutes each in duration, in several different organizations. From these we selected five meetings, representing roughly equal participation by paper and computer users overall. These are shown in Table 1.

What interested us in these meetings was not silences, of which there were very few, but *disengagements* from the conversation when participants used paper or computer resources. Staying engaged is an important aspect of face-to-face collaboration: as Goodwin points out, a display of engagement "treats someone who is physically present as also relevantly present, and a locus for joint collaborative activity" (Goodwin 1981). Conversely, displaying disengagement may be regarded as an indication of unavailability for collaboration.

We therefore measured the durations of every detectable display of disengagement in the five meetings, of which there were nearly six hundred. Typically the start of each such display was marked by a turn of attention to an information resource or, if the person was speaking while turning, by an end to their conversational turn. The end of the disengagement display was indicated by turning attention to another attendee, or rejoining the conversation before turning. This method corresponds closely to that suggested by Stiefelhagen, with its reliance on head orientation (Stiefelhagen 2002).

Table 1. Data on the five meetings recorded. The *mins* column shows the videotape duration; *participants*, how many (male and female) took part; *info tools*, the number of users of pen and paper (*P*), laptops (*L*) and Tablet PCs (*T*).

	description	*mins*	*participants*			*info tools*		
			m	*f*	*tot*	*P*	*L*	*T*
A	sales team verbal presentations	58	3	3	6	1	4	1
B	tech support team weekly status	35	4	0	4	4	0	0
C	researchers' information exchange	35	0	3	3	0	3	0
D	student charity monthly status	57	4	3	7	7	0	0
E	software design	56	5	1	6	1	3	0
	Totals	**241**	**16**	**10**	**26**	**13**	**10**	**1**

Figure 2 shows how the frequency of disengagements varied as their duration increased, for both pen-and-paper and computer users. Disengagements by pen-and-paper users form a marked peak at around 9 seconds' duration. Where computers are used there is a less pronounced peak at around 10 seconds.

2.3 Brief reengagements

In our study of medical consultations we had noted doctors' use, during lengthy tasks, of brief reengagements with the patient in the form of *intermediate remarks*. These were usually neutral remarks whose effect was "reset the clock" for the doctor's next pause, thus allowing the current task to proceed in silence for up to another 10 seconds:

Doctor: You're ask, you're saying [*picks up letters*] about the results from what's been happening in the hospital?
Patient: Yes, they discharged me from there.
[*D starts reading letter*]
(6.6 seconds' silence)
D: Right.
(3.2)
D: They really pass the buck don't they?
P: [*laughing*] Heh heh.

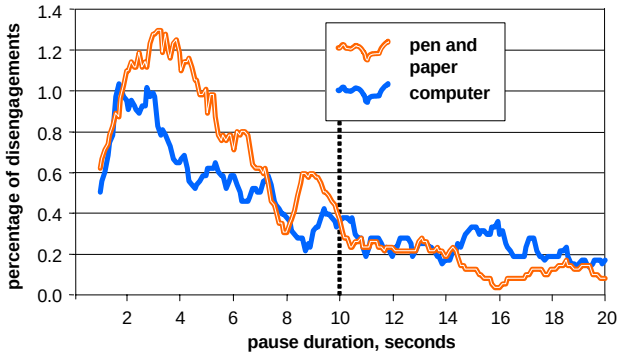

Figure 2. Durations of disengagements during meetings, when tasks are performed with pen and paper and with computers.

(2.7)

D: [*looking up at P*] So this is regarding getting some IVF treatment?

In the meetings we have studied there are also brief reengagement displays, lasting around 2 seconds, that appear to achieve a similar purpose. The disengaged person rarely speaks during the reengagement, instead typically lifting their gaze briefly to the current speaker and then returning to the information resource. Again, the purpose of these displays appears to be linked to performing a lengthy task. During some of these tasks, a whole series of brief reengagements may take place. For example, we have seen ten successive reengagement displays, each of 2 seconds or less, during the performance of a 55-second computer task; none of the intervening disengagements lasted longer than 9 seconds.

3. TASK PERFORMANCE IN MEETINGS

We are beginning to perceive a structure to the outwardly simple action of withdrawing from conversation to interact with an information resource. We are not yet in a position to define this structure with confidence, but we can sketch out its form and suggest how it can inform the design of technologies for collaboration. On this basis, we can propose a *model of task performance in meetings*.

The current version of the model is based on our analyses of tasks involving pen and paper. This is not to say that computer-based tasks conflict with the model, for they are largely in agreement. Rather, we believe the data on pen-and-paper tasks on their own provide strong enough evidence of the features we have described above. A model based on this evidence can, we suggest, support comparisons between task performance with pen-and-paper and with computers.

The main feature of our model is the strong preference, shown whenever pen and paper are used, to keep disengagements to 10 seconds or less. There is clear evidence of this in the data from medical consultations, in which both patients and doctors are seen to act so as to resume suspended conversations at or before the 10-second point. In the meetings data we see a similar preference by those who disengage, but we rarely see other participants take action to draw the person back into the meeting. It is harder, therefore, to demonstrate that they, too, prefer this to happen within 10 seconds. The strongest evidence we have found of this lies in the reduced attention that a participant will receive from others if they remain disengaged beyond the 10-second point. An example of this can be found in (Newman and Smith 2006).

3.1 The Model

The model can be stated in terms of the *tasks* that participants perform with information resources, and of the *disengagements* that accompany these tasks, as follows:

A. Participants who perform tasks normally display disengagement for their full duration, but with some exceptions, see C below;

B. Participants prefer that their own disengagements should last no more than 10 seconds;

C. A participant whose task is tending to exceed 10 seconds will make a brief display of engagement before the 10-second point is reached.

It may be possible to add further features to this model, but we are not yet in a position to do this confidently. We would like, for example, to be able to include in B the preference of others for sub-10-second disengagements, mentioned in section 2.3. We would also like our model to be more precise, in C, about when brief engagement displays are made during longer tasks. Our data suggest that they usually occur within 6 seconds of disengagement during paper-based tasks, and this may account for the minor peaks visible at around this point in Figures 1 and 2.

As it stands, the model offers a basis for analysing variations in how the use of information resources affects face-to-face conversation. Our data suggest that, as a resource, pen and paper enables people to conform quite closely to the model while performing tasks. Users of computers appear to be less successful, however. To understand why this is, and what could be done about it, we have looked at how well our data on computer-based tasks comfirms to the model.

3.2 Modelling computer-based tasks

As we pointed out earlier, computer users showed less evidence than paper users of a preference for disengagements of 10 seconds or less, and in this respect they complied less closely with part B of the model. The clearest evidence of this was the greater proportion of disengagements exceeding the 10-second time-frame: 46% of computer users' disengagements overran, compared with 31% of those using pen and paper. We believe such overruns must be apparent to others present, and that they are likely to hinder collaboration.

We see a second difference in people's compliance with part C of the model, the brief display of engagement before reaching the 10-second point. As yet we have only preliminary data on this, which we show in Figure 3; it shows durations of disengagements that occur during lengthy tasks, and that are followed by a brief reengagement. The chart suggests that these reengagements, too, are sometimes occurring too late when computers are used. The same is true of paper users' brief reengagement displays, but to a much lesser degree. It is also evident that computer users have greater difficulty in reengaging early, i.e., at or before the 6-second point we mention above.

Thus when computers are used there is less conformance with the model of disengagement, in ways that are likely to reduce attention to the meeting, or at the very least to be seen by others as lack of attention. We conclude with some thoughts on what is

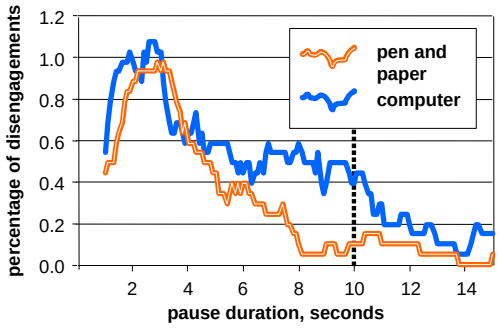

Figure 3. Durations of disengagements during lengthy tasks in meetings, occuring immediately prior to brief reengagements.

required of collaborative tools to ensure better conformance and shorter disengagements.

4. DISCUSSION

We are suggesting here that there is a common time-frame of 10 seconds to which people in meetings orient when they disengage in order to use information resources. In other words, attendees at meetings do not simply prefer to use these resources as quickly as possible; they also prefer to limit each such use to 10 seconds, and they prefer that others do the same.

We are finding that computer use in meetings hinders people from attaining these preferred outcomes, in ways that use of pen and paper does not. Of course, pen and paper cannot match computers for functionality; this is a case of balancing trade-offs. The question we would pose is whether the incidence of lengthy disengagements can be reduced without depriving users of the functonality they need.

In approaching this question ourselves, we kept in view the ways paper is used in meetings, and have found this helpful in two ways. First, paper has been used in meetings for centuries, and its survival for so long suggests that it may be appropriate to use it as a *baseline* for measuring the effectiveness of other technologies. Second, paper has *affordances* that contribute to its versatility, and a better understanding of these affordances may help us improve computer tools (Sellen and Harper 1997).

As a baseline, use of paper achieves a high degree of compliance with our model of task performance. We suggest to designers that a medium-term goal might be to adapt laptop tools so that they reach a similar level of compliance. We would expect this to result in less disruption. An obvious area in which to focus attention is the checking of email. Here it seems likely that filtering messages on the basis of their length could be helpful, for a participant could then choose to display only short messages in his or her inbox, and might be able to examine individual messages in under 10 seconds.

As a design resource, the affordances of laptops may point to ways in which a range of tasks can be performed in units of 10 seconds or less. The challenge here is to provide the user with resources for *designing* the method for performing the task. Instances of this design can be seen in paper use, e.g., when a quick handwritten note is taken by abbreviating its contents. Examples of recent designs that provide such affordances include the *Stuff I've Seen* and *Phlat* systems of Dumais, Cutrell et al. (Dumais, Cutrell et al. 2003; Cutrell, Robbins et al. 2006).

We are exploring technical strategies such as these, and plan to test whether they make a positive difference to users' ability to conform to our model of task performance. Meanwhile we hope to conduct further studies with a view to extending the model and dealing with some of its weaknesses. As mobile devices become increasingly common, we expect they will cause increasing numbers of disengagements from conversations, not just in meetings but in all kinds of social interaction. Consequently research in this area will, we believe, become increasingly important.

5. ACKNOWLEDGMENTS

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