Disruption of Meetings by Laptop Use: Is There a 10-Second Solution?

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CHI 2006, April 22–27, 2006, Montréal, Québec, Canada.
ACM 1-59593-298-4/06/0004.

Abstract
We have conducted a study of meetings to gain an understanding of the sources of disruption when laptops are present. We videotaped five workplace meetings in which over 600 *information tasks* were performed by participants using paper or laptops. We saw evidence that people preferred task durations not to exceed approximately 10 seconds. Tasks performed by laptop users were more likely to exceed this limit, and this could contribute to disruptions. We suggest that laptop software may need to assist users in keeping tasks within 10 seconds' duration.

Keywords
Meetings, laptop, conversation, disruption, affordances.

ACM Classification Keywords
H5.m. Information interfaces (e.g., HCI):

Introduction
As mobile digital devices proliferate, people are relying less on fixed artifacts and services, and more on ubiquitous alternatives. Telephone calls can now be made from the tops of mountains, hi-fi stereo music enjoyed while riding a bicycle, and breaking news watched on the beach. For the user, this growing freedom to use any technology anywhere is hard to

resist; but for those others who happen to be in close proximity there are downsides, such as noise pollution and collisions with TV-watching pedestrians. We see little evidence that this social interference is being addressed through the redesign of mobile technologies. Instead, legislation and policies are being introduced to restrict the technologies' use.

Through the development of the laptop, the personal computer has become a major player in this social milieu, with a similar mix of results. In this mobile guise it offers much the same computing power as a desktop computer, runs the same software and, with wireless networking widely available, has the same connectivity. It has thus gained two capabilities of the mobile phone and the personal music player: it can be taken into virtually any social setting, and it can then interfere with the social interactions taking place there.

This work-in-progress report presents results from a study of how the increased use of laptops is affecting the social dynamics of workplace meetings. There is informal evidence that laptops are disruptive here. Their users may, for example, mishear information through lack of attention, ask for it to be repeated, and perhaps even want it re-discussed. Our study has not attempted to confirm this evidence systematically, even though this would be desirable. Instead we have investigated how laptop usage affects the essential displays of *conversational engagement* in meetings. These are the verbal and non-verbal displays that, in Goodwin's words, treat someone who is physically present as also *relevantly present*, and *a locus for joint collaborative activity* [2]. We have taken this line of research with a view to identifying generic design criteria for devices likely to be used in meetings.

We have been guided in our research by the workplace studies of Goodwin and others, in which they relied primarily on a conversation-analytic approach [2,3]. We have also taken note of broad quantitative studies of meetings with and without computer support, such as those of Olson et al. [7]. Conversational analyses by Heath, Greatbatch and others of medical interaction are especially relevant, because they observed both computers and paper in use for taking notes [4,5].

The study we report here owes much to the work of Heath and of Greatbatch et al. They inspired a 1998 study of doctors and patients involving the first author [6], which focused on the suspensions of conversation occurring when the doctor consulted the patient's records or wrote a note. People in these two-person conversations displayed a strong preference for keeping the suspensions to 10 seconds or less. Thus doctors who initiated a suspension tended to conclude it, and resume the conversation, after about 10 seconds; patients who witnessed a suspension tended to break the silence within 10 seconds or less. One way or another, talk was likely to resume at this point.

The study: Data gathering

Our initial objective for this study was to compare how laptop users and non-users participated in meetings. We therefore videotaped five face-to-face meetings for periods ranging from 35 to 58 minutes (Table 1). We had no strict criteria for selecting meetings, other than to avoid large gatherings that would be difficult to record and analyse. We tried, however, to ensure a mix of genders, of computer and non-computer users, of meeting types, and of UK and US settings. We gave participants no instructions, and explained our purpose merely by stating the above initial objective.

	description	minutes		participants			info tools		
		rec	used	m	f	tot	P	L	T
A	sales team verbal presentations	58	58	3	3	6	1	4	1
B	tech support team weekly status	35	30	4	0	4	4	0	0
C	researchers' information exchange	35	14	0	3	3	0	3	0
D	student charity monthly status	57	30	4	3	7	7	0	0
E	software design	56	56	5	1	6	1	3	0
	Totals	**241**	**188**	**16**	**10**	**26**	**13**	**10**	**1**

Table 1. Data on the five meetings. The ***minutes*** columns show the lengths of the segments of videotape ***recorded*** and ***used***; the ***participants*** columns show how many (male and female) took part; the ***info tools*** columns show the number of users of pen and paper (***P***), laptops (***L***) and Tablet PCs (***T***).

Non-computer users were in the majority in the data we gathered. To avoid bias, therefore, we selected just 30 minutes' data from each of the two paper-only meetings, while retaining all of the usable footage from the other meetings. This ensured that the numbers of person-minutes analysed were closely similar (444 vs. 442) for laptop and non-laptop users. One participant used a Tablet PC, and was excluded from the analysis.

Analysis of the study data

Our analysis of the study data has been strongly influenced by the results of the previous study of medical consultations [6]. In view of its findings, we chose to explore whether people in meetings exhibited similar behaviours. We did not expect to observe many 10-second silences in meetings, and indeed we found none. We did hypothesize, however, that people might show the same preference as doctors towards concluding, within 10 seconds, those activities that disengaged them from the conversation.

We studied the tasks that people performed using the information resources they brought with them, such as laptops, notebooks, pens and paper. We defined as an *information task* any uninterrupted period of engagement with information resources, and consequent disengagement from the meeting's conversation. A simple instance might be a glance at the screen of a laptop, as if to check the topics of incoming mail. A more complex information task might involve reading handwritten notes, adding to them, turning pages and reading further. Table 2 shows, in the "initial" columns, the numbers of information tasks identified in this way, and their average durations.

Results from initial analysis

Figure 1 shows the initial graphs we obtained by plotting durations of information tasks in the two conditions of Table 2. In each condition the majority of tasks were completed in 10 seconds or less, with paper users achieving 67% and laptop users 60%.

resource	person-minutes	initial		adjusted	
		N	avg dur	N	avg dur
pen and paper	444	343	10.4	333	10.7
laptop	442	264	13.3	186	20.7
All	**886**	**607**	**11.7**	**519**	**14.3**

Table 2. Data on information tasks. The initial values include the number of tasks identified, ***N***, and their average durations. Corresponding values are also shown after adjusting for partial reengagements.

Our initial results thus support the hypothesis that people in meetings prefer to complete information tasks within 10 seconds. We were surprised, however, that Figure 1's distributions of of durations were so similar. We could see no obvious explanation, in these two distributions, for the kinds of disruptions we observed during the meetings, which included:

- participants' occasional difficulties in rejoining a conversation after completing tasks; these showed up as inability to gain others' attention, or reduced contribution to a discussion in which they had previously been participating actively;
- embarking on information searches that extended far beyond the point at which the information could have been of use in the meeting;
- breaking into the conversation, after completing such a search, in order to share the retrieved but no longer relevant information.

These types of disruption appeared to occur only with use of laptops, and not with pen and paper. We have insufficient data to confirm this, however.

We made one other observation in the early stages of our analysis, concerning the shared use of information spaces such as computer screens, to which Bannon has drawn attention [1]. In the meetings we studied, laptops and paper were typically treated as private resources and were not shared with others. An exception to this occurred in Meeting C when, after 14 minutes, the three participants switched to sharing their laptops in order to show each other online information. From this point onwards their conversation tended to run concurrently with performing information tasks, rather than alternately.

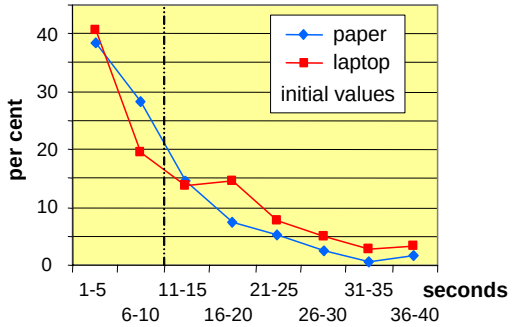

Figure 1: Durations of tasks performed on paper and laptops.

Shared use of laptops is of course constrained by their small screens, and we never observed it between more than three people. In these smaller groups, however, it appears to change the joint activity from purely conversational to one that draws on shared information, as described by Goodwin and Goodwin [3], and as seen when doctors share screens with patients [6]. We recognize the need to incorporate these more complex activities into our analysis, but we have not yet found a way to do so. It is for this reason that we used only the first 14 minutes of the Meeting C data.

Analysis of reengagement displays

In our initial analysis we assumed that the completion of each task was always followed immediately by a full reengagement in the conversation. The results shown in Figure 1 led us to question this assumption, however, and to examine participants' displays of engagement between tasks. We noticed that the displays following completion of laptop tasks were often quite brief and muted, involving only a quick nod, a glance or a one-word utterance. Equally, the recipients of these *partial displays* often made little or no acknowledgement of them.

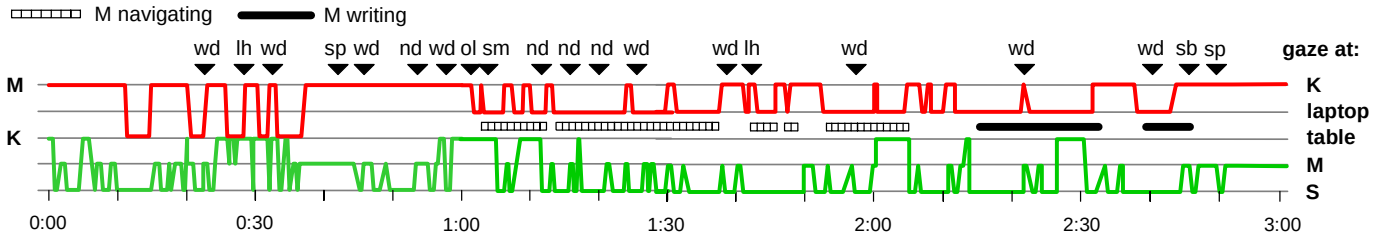

Figure 2. Chart of gaze directions of two participants, M and K, in a three-person meeting, showing the effect of M using her laptop, which begins at 1:03 minutes and ends at 2:45 minutes. The third participant, S, remains silent throughout, listening to K. M's trace is labelled with her non-gaze actions: one-word utterance (wd), longer utterance (sp), laugh (lh), nod (nd) open laptop (ol), sit back (sb).

Examples of partial engagement displays occur in Figure 2, which is based on a three-minute sequence from Meeting C. Here one participant (M) engages in a series of laptop tasks over a period of 1 minute 42 seconds. The chart shows the gaze directions of M and of a second participant (K) who speaks almost uninterruptedly during the entire three minutes. The third participant, S, attends to K in silence during this period. Two interesting behaviours emerge:

- M's gaze has been mainly on K until 1:03 minutes, when she opens her laptop. From this point onwards she gazes almost continuously at her laptop. She still makes brief glances at K, however, at intervals that never exceed 10 seconds.
- K's gaze begins to dwell mainly on S after M transfers her attention to her laptop. Her gaze periodically returns to M, typically just after M has glanced at her, but quickly shifts back to S.

Thus M continues to show preference for limiting the durations of her disengagements to 10 seconds; she does so through the periodic but partial displays of engagement she makes towards K. But M's glances and nods are not enough to retain the attention of K, who appears to regard her as having disengaged.

We have analysed the incidence of partial engagement displays in the video data. Wherever participants paused between two information tasks, we have classified their displays of engagement as either full or partial, i.e., either adequate or inadequate to support resumption of conversation [3]. Where we have found only a partial display we have joined the two tasks into one. The effect of these adjustments is shown in Figure 3, in which the two distributions are significantly different ($p<0.01$). The proportion of laptop tasks completed in 10 seconds, previously 60%, is now only 43%. The remaining tasks appear to form a separate distribution that peaks at around 18 seconds Paper-based tasks remain distributed much as in Figure 1, with 66% (previously 67%) taking 10 seconds or less.

Discussion and future work

We are finding that interaction with computers often leads people to disengage from conversation for periods beyond 10 seconds, and that this is unacceptable both to them and to others. We see important implications

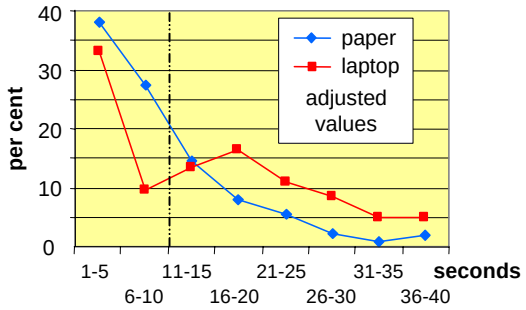

Figure 3: Durations of tasks, adjusted for partial displays.

for the design of mobile technologies, and for further research to support this design. One implication is that knowledge workers' tools, until now designed exclusively for use in isolation, may indeed be causing disruptions when used on laptops in meetings. This hypothesis is supported by our observations of lengthy laptop tasks and their interference with participation in conversation. An important next step, however, is to gather more data on meetings and gain a better understanding, both of the source of disruptions and of the offsetting benefits that accrue from laptop use.

In the meantime, we believe a case can be made for adapting the software tools used in meetings so that users can more easily keep their tasks within the 10-second threshold. This poses a significant design challenge. We believe a solution strategy may lie in augmenting the *affordances* that laptop software offers for organizing tasks to fit within desired durations. By studying the relevant affordances of paper [8], and how they enable users of pen and paper to keep their tasks short, we hope to discover ways to provide laptop users with tools that can be used in meetings with less risk of causing disruption.

Acknowledgements

We are grateful for advice offered by Jonathan Grudin, Tracey Lovejoy, Abi Sellen, Gayna Williams and other colleagues. We also wish to thank our 26 participants for allowing us to videotape their meetings.

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