"I'd Be Overwhelmed, But It's Just One More Thing to Do:" Availability and Interruption in Research Management

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ABSTRACT
Many CSCW projects dealing with individual availability and interruption filtering achieve only limited success. Perhaps this is because designers of such systems have limited evidence to draw upon; most data on interruption management is at least a decade old. This study uses an empirical sampling method and qualitative interviews to examine attitudes toward availability and interruption. Specifically, we analyze how corporate research managers spend their time and look at how their attitudes toward interruption relate to their various activities. Attitudes toward interruption are marked by a complex tension between wanting to avoid interruption and appreciating its usefulness. We conclude by discussing the implications of these findings for design, suggesting that the notion of socially translucent systems may be a fruitful approach.

Keywords
CSCW, availability, interruption, time management, attention economy, managers, social translucence

INTRODUCTION
In recent years, there has been increased discussion of the "attention economy" and "information overload." Essentially, these discussions suggest that the important commodity in the current economy is no longer money or other physical resources. Rather, it is an individual's time and attention. Due to limited time, attention is a limited resource. Those who succeed will be those who best gain others' attention, or who most effectively deploy and manage their own [7]. While these ideas are certainly not new (e.g., [8]), technology seems to have exacerbated the problem. Technology has allowed more and more information and people to reach us than ever before. More and more, individuals feel overwhelmed.

If technology is one of the leading causes of this problem, it makes sense that technology could also be a solution. While researchers have explored some approaches to ameliorating the attentional demands of communication technologies, however, they have met with limited success. For example, Rodenstein, Abowd, and Catrambone [19] designed a system prototype that allowed an individual to filter interruptions in a lightweight fashion. Studies of this prototype, however, revealed no significant performance gains for those using the system. This is consistent with later research showing that notification of an incoming message, even when the message is ignored, is disruptive to task performance [6]. In a somewhat more complex approach, Milewski and Smith [15] built a telephone system that allowed a caller to preview a callee's self-declared state before placing a call. Unfortunately, Milewski and Smith weren't able to test the usefulness of their availability states. Instead, they discovered that users of the system never seemed to remember to change their availability state, rendering the preview ineffective.

One conclusion that might be drawn from this previous work is that the strategy of requiring an overloaded, attention-limited person to devote time to managing these demands may not be the best approach. What is the alternative? Instead of placing the burden on the overloaded individual, the system could take on the management of incoming demands for attention. Perhaps a system could automatically filter interruptions for users; or, perhaps, it could reveal the callee's state to a potential caller without requiring the callee to declare this information.

Regardless of the strategy pursued, it seems clear to us that more information is needed. While there is a considerable literature in this area, it is rather surprising to note that most of the work is at least a decade old, and, clearly, the technological terrain has changed quite significantly in that time. Thus, in this study, we take a strongly empirical approach and begin asking how it is that people really spend their time, and how they view demands upon it.

Our study examines a group of managers in a corporate research laboratory. While, in some regards, this group does not fit typical management demographics (e.g., the majority have doctorates), they still have the demands on their attention and the frequent interruptions that characterize management more generally. Thus, as we

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proceed, we will show where our findings replicate earlier literature with different populations.

ON MANAGEMENT

A great deal is known about management – management styles, management theories, techniques, leadership qualities. Far less is known about how managers really spend their time and how they cope with the numerous forces competing for their attention.

Sproull [20] provides an early empirical study of interruption. Sproull shadowed seven managers for 3-6 days each, taking notes on what they did. She found that a manager's day is dominated by brief, oral communication (80%) and many short activities (an average of 58 activities with a duration of 9 minutes). Activities were interrupted 21% of the time, but interestingly, managers spontaneously interrupted themselves as often as others interrupted them. Sproull's data paint a picture of continuously multitasking managers and she concludes, "The difficulty in distinguishing between interrupted and interrupting activity suggests that it may be misleading to think about managerial attention in terms of tasks and interruptions" [20, pg. 23]. This view accords with the results presented here that show a simple view of interruption and availability to be inadequate.

A decade ago, Panko [18] reviewed the available literature on how managers spend their time. He found, not surprisingly, that availability patterns varied by the manager's position in the corporate hierarchy; the higher a manager was, the more time s/he spent in meetings of one form or another. He found that managers spent approximately 25-60% of their time engaged in some form of communication. Half of the manager's day is spent in the manager's own office. An additional ten percent of the day is spent in the manager's own department. Finally, he found that the majority of meetings managers have are dyadic face-to-face encounters.

Panko's review has two limitations. First, it is a decade old, and, as we've noted, communication technologies have changed a lot in that time. Second, while it describes how managers spend their time, it offers little insight into how managers deal with interruption. Thus, while Panko acknowledges that management is interruption driven, he does not explore how this is manifested in the experience of the manager or in managerial work practices. Some recent research has pointed to the disruptiveness of interruption. (e.g., [2, 3, 14]); however, there are also claims that interruption can be beneficial (e.g., [4]), though, with the exception of [16], no research is available. In our view, a more thorough understanding of how people manage their time and deal with interruptions, as well as the drawbacks and benefits of interruptions, would be valuable in informing the design of new communication technologies.

METHOD

The goal of this study was to understand how managers spend their time and how their attitudes toward interruption vary in relation to their activities. We used an adaptation of

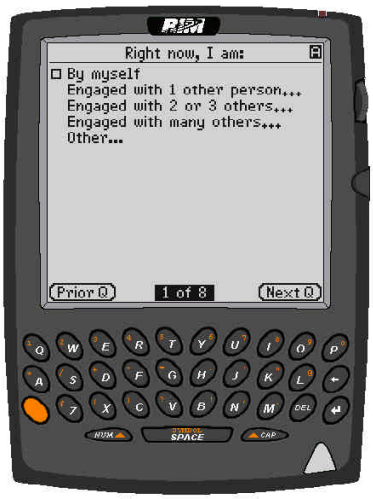

Figure 1. For the pager study, each manager carried a RIM Blackberry™ for the period of a week.

Kubey and Csikszentmihalyi's Experience Sampling Method (ESM) [12], in which we randomly interrupted managers with a survey delivered via a wireless pager.

Twelve managers in IBM Research were outfitted with a RIM Blackberry™ for one week. Figure 1 shows the device. At random intervals each day, the device interrupted the participant (via a silent vibrating alarm), and presented him or her with a brief survey. The interruptions were constrained to be no less than thirty minutes and no more than two hours apart. The survey consisted of eight questions that could be answered by an experienced participant in less than thirty seconds. Essentially, the survey asked participants: "What are you doing right now? Are you alone or with others? How would you feel about someone interrupting you right now?" The eight questions were designed to give us fine-grained answers about these questions. The first four questions, which are most relevant for this paper, are illustrated in Table 1. Our participants informally reported the probes to be annoying, but curiosity about the results encouraged sustained involvement.

When giving subjects the device, we conducted a short training session to teach them how to use the device. The study lasted for a week, and most subjects wore the paging device from 8:00AM until 9:00PM. If participants did not want to participate during personal hours, we modified the times to page them only during normal business hours. Once the participant completed the ESM portion of the study, we conducted a follow-up interview that lasted approximately thirty minutes. During the interview, we asked questions aimed at determining unique constraints on each individual, the individual's attitude toward availability and interruption, and the challenges they faced. The interviews provided valuable insights into the responses given to the ESM probes.

During the week of observations, the pager was programmed to administer the survey ten times a day, but it was possible for a participant to complete fewer probes. If

1. Right now, I am:
- By Myself
- Engaged with 1 other person…
  - This is a planned event.
  - This is an unplanned event.
- Engaged with 2 or 3 others…
  - This is a planned event.
  - This is an unplanned event.
- Engaged with many others…
  - This is a planned event.
  - This is an unplanned event.

2. I was engaged in:
- Deep concentration
- Reading / Writing
- Watching / Listening
- Interaction / Communication…
  - Face-to-face
  - Telephone
  - Email
  - Chat / I.M.
  - Other…
- Eating
- Traveling
- Other…

3. This activity is:
- Business
- Personal
- Other

4. How much time would you have for an interruption?
- It would be awkward to be interrupted.
- I would prefer not to be interrupted.
- I could be available for a few seconds to a minute.
- I could be available for minutes or longer.

Table 1. Questions 1 through 4 of our survey illustrate how it was designed to provide detailed information about a manager's state and attitudes.

there was no response to a probe, it would time out after five minutes and the survey would be replaced with a question that asked why the subject did not respond. Because of these missed probes, the number of data points for each individual varies. Subjects completed the survey 71% of the time overall and 80% of the probes during business hours. In total, this provided 295 completed surveys, 190 (64%) of which occurred when the subject was engaged in a business activity. Of the missed probes during business hours, slightly over half were because the subject was too busy to respond. For the remaining missed probes either the subjects did not have the paging device with them or they did not notice the probe.

SUBJECTS

At IBM Research, there are three levels of management between standard employees and the corporate vice president (first-line, second-line, and third-line managers, respectively). We solicited participants from all levels, resulting in seven first-line managers, four second-line managers, and one third-line manager. Two potential subjects declined to participate because they did not want to wear a pager or be interrupted.

With the exception of one first-line manager, all subjects were male. Two managers (one first-line and one second-line) were of European background. The remaining subjects were of North American background. While there are some suggestions that communication patterns vary along gender [21, 23] and cultural lines [22], these issues could not be examined here without broader participant demographics.

RESULTS AND DISCUSSION

Our results generally replicated earlier results in the amount of time managers spend alone (42% in our data) and in how much time they spent in communication with others (46%). However, the combination of ESM and interview data also revealed new results, particularly for the understanding of managers' attitudes towards interruption. We found a fundamental tension between the disruptiveness of interruption and its potential benefits. Also prominent in our data was the importance to managers of maintaining a sense of control over interruptions. The data also revealed relatively consistent daily rhythms in attitudes toward interruption. In this section, we explore these findings in more detail.

Time Distribution

Of 190 probes in which the subject said that the current activity was business-related, 43% of the time the subjects were alone. The next largest activity was spontaneous, unplanned dyadic meetings. This category accounted for 14% of the reported activities. In order of frequency, the remaining activities were large planned meetings (12%), planned meetings with 2 or 3 other people (9%), planned meetings with one person (6%), and spontaneous meetings with 2 or 3 people (4%).

Meetings that can occur through serendipitous encounters seem to do so. As greater numbers of people are involved, there appears to be a steep drop off in how easily an unplanned meeting can occur. In these cases, it becomes necessary to plan meetings in order to ensure that all can be present. Therefore, dyadic communication favors spontaneity while larger meetings require planning.

When managers are alone, most of the time is spent reading and writing. Of 73 responses in this category, 68% of the time the manager was involved in either reading or writing[1]. "Deep concentration" (our term) was another important activity, taking 45% of the manager's alone time. (Managers indicated being involved in both deep concentration and reading/writing 34% of the time.) Other important activities included traveling (10%), doing email (10%), and organizing (3%). While these numbers suggest a surprisingly small amount of time devoted to email, it is likely that some email activity was reported as "reading/writing."

The type of communication channel(s) used for meetings varied as a function of number of participants and whether the meeting was planned or spontaneous. For two people, all planned meetings were face-to-face, whereas impromptu meetings took place via telephone 14% of the time. Research has suggested (e.g., [17]) that physical proximity is an important factor in successful collaboration. As

[1] The survey allowed multiple answers to this question. Therefore, the percentages do not sum to one hundred percent.

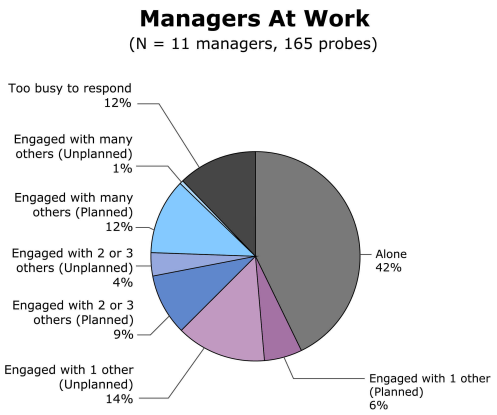

Figure 2. During business hours, managers spend a significant amount of their time alone. Nearly half of their day, however, is taken up with meetings and other informal conversations.

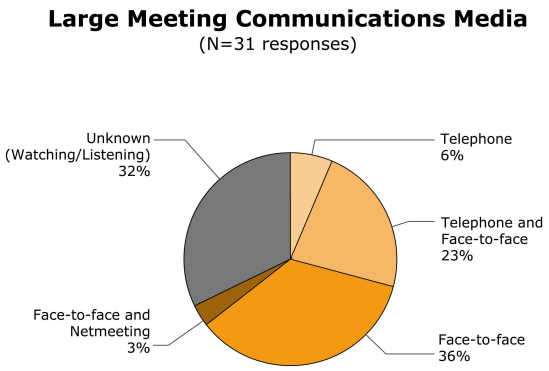

Figure 3. Many large group meetings involve some form of mixed modality among face-to-face, telephone, and eMeeting participation. When managers reported "passively attending" meetings, it was not possible to tell which modalities were used.

meeting size increases, however, there is less reliance on face-to-face communication. With three to four people, 14% of the planned meetings are telephone conferences. Of eight spontaneous meetings this size, only one was a telephone conference. Meetings with more than four people often involved multiple media. Survey data indicated that large face-to-face meetings involved telephone interaction 23% of the time. Large telephone conferences, on the other hand, involved a face-to-face component 75% of the time. In approximately one third of the cases, managers indicated for question one that they were engaged with many other people. For question two, however, they indicated that they were "watching/listening" rather than engaged in some form of communication. For these cases when managers passively attended meetings, we were unable to determine which modalities were in use (Figure 3).

Levels of Management

Panko [18] suggests that higher-level managers spend more time in meetings than their lower-level counterparts. While our sample size at each level is too small to draw strong conclusions, we did find this pattern in the likelihood that managers were by themselves when probed. The ratio of planned to spontaneous meetings in our data also seems to increase as the level of management increases. Since this pattern has not been previously reported, it warrants further investigation.

Availability and Time

While there are no straightforward rules to specify a manager's attitude toward interruption when s/he is alone, some general patterns do emerge. Each time the probe occurred, we asked managers to identify how much time they had for an interruption (Table 1, Question 4). The possible responses were that it would be awkward to be interrupted, that the manager would prefer not to be interrupted, that the manager could spare a few seconds to a minute, and that the manager could be available for minutes or longer. When managers were alone, their openness to interruption seemed to vary regularly based on the time of the probe. Mapping the time of a probe to the manager's response to this question yielded strong clustering patterns (Figure 4).

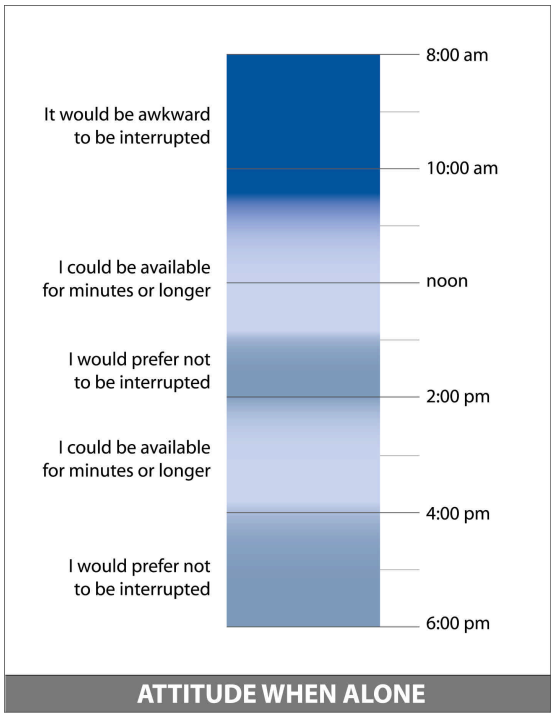

Figure 4. A summary of managers' attitudes toward interruption when alone. The exact pattern for any individual might differ from that shown here (lighter shading indicates greater openness toward interruption).

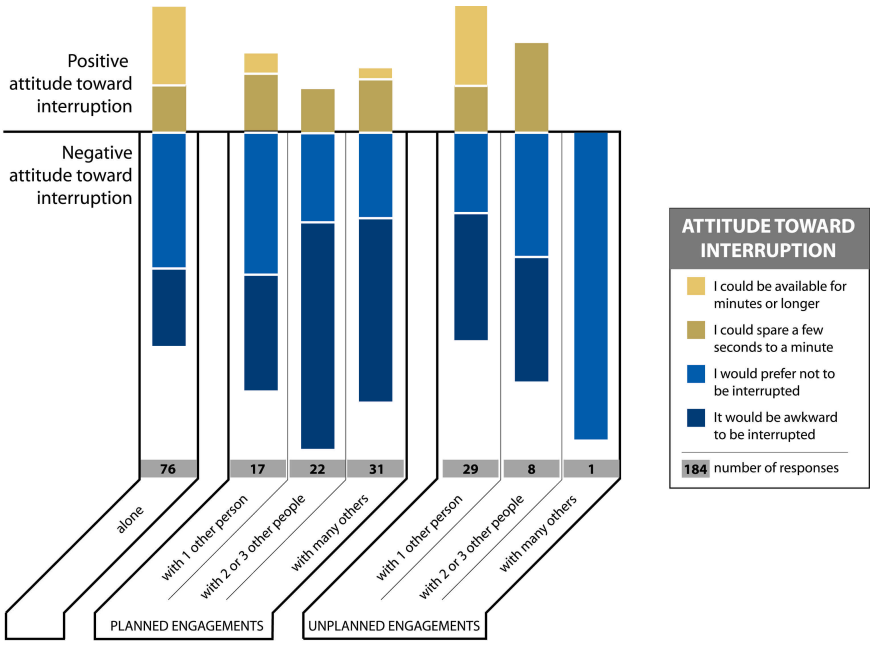

Figure 5. Attitudes toward interruption vary based on the activity in which managers are engaged. Each bar indicates proportions of responses for each state. Bars represent 100% of the responses rather than absolute numbers. Note that there was only one recorded occurrence of an unplanned large group meeting (far right).

At least within IBM Research, managers tend to arrive at work between 8:00AM and 9:00AM and leave between 5:00PM and 6:00PM. In the morning, until about 10:30AM or 11:00AM, it is typically awkward to deal with interruption. Then, there is a lull during which the manager could be available for minutes or longer that lasts until about 1:00PM. Between 1:00PM and 2:00PM, managers prefer not to be interrupted. From 2:00PM to 4:00PM, managers once more become available for interruption. Between 4:00PM and 5:30PM, managers again prefer not to be interrupted. After 5:30PM, attitudes vary, but tend toward availability if the manager reports still being engaged in business activities.

Relation between Activity and Availability

While attitudes toward availability vary throughout the day, some general patterns are also visible based on the activity in which the manager is engaged. Figure 5 shows a consolidated view of managers' attitudes towards availability in various states. If an event is planned, interruption is generally more awkward than if it is unplanned. The data suggest a correlation between the size of the meeting and attitude, but larger meetings were too rare to determine significance. While there is not much difference between meetings with two or three other people and meetings with more people in the awkwardness of interruption, there were a few cases in the larger meetings in which managers reported being available for minutes or longer.

Interruption Driven

Despite what seems to be a general aversion to interruption, managers commonly spoke of themselves as being "interruption driven." One manager described himself as needing interruption:

> I have sort of come to rely on interrupts. If I'm not being interrupted, I don't know what to do. I have to generate an internal interrupt of some sort to get me going.

While this manager might be an extreme case, many others echoed a more conservative version of the same theme. For example, one manager claimed interruption as a memory aid:

> One [benefit of interruption] is so that I don't have such a short-term memory load. I can deal with something now and not have to deal with it later.

More importantly, however, managers view interruption as part of their job description. As one manager said, "I guess I see handling interrupts as part of what I do." While managers do talk of learning to deal with interruptions, they have uniformly come to see them as an important part of what they do. All managers viewed interruption as a necessary part of their job. Beyond simply being part of the job description, however, managers often reported deriving benefits from interruptions.

In the interviews, managers suggested that benefits from interruption arise in two ways. First, openness to interruption allows the manager to deal flexibly with problems before they become overwhelming. One manager summarized this saying:

> Being flexible enough to respond and respond quickly to certain kinds of interruption, I find to be useful in getting things done.

Second, the interruptions themselves often carry useful information. This information assists other projects serendipitously.

> [It's] useful to be open to interruption to – in an informal way – pick up information or be able to make a connection that you wouldn't have otherwise. Often [the] more relaxed or offhand way… can be more effective than setting up an appointment.

Previous research has also suggested possible benefits to being interrupted [16]. Our results provide additional support for the notion of beneficial interruptions. Some interruptions, however, can be significantly more disruptive than others. From a manager's point of view, the most disruptive interruptions are ones that do not come soon enough. These are the interruptions that occur when something has become a crisis; they are the interruptions that occur late because the interrupter could not or declined to reach the manager earlier.

Managing Interruption

Despite a desire to remain open to interruption, there are times that managers feel they must have uninterrupted time to accomplish their tasks. Therefore, we investigated ways that managers seek to handle their incoming interruptions. Since different communication technologies interrupt in different ways, we were interested in how managers use and deal with different communication media.

For face-to-face interruptions, managers use a variety of social strategies. Most managers, when working alone, work in a private office. While in the office, they often use the door as a social signal regarding their availability. Some managers tend to use the door in a binary mode:

> Either my door is open, in which case I'm available, or it's closed, in which case I'm not there.

For others, however, the door is a continuum that is readily interpretable by others:

> I can't tell you how many degrees of door openness or closeness there are, but there are many degrees. And people generally interpret those fairly well.

With social cues like this, however, managers sometimes feel that they miss information. When they allow others to make decisions about when interruptions are appropriate, they lose control over handling the interruptions. This can mean that the manager misses information. One manager expressed this problem:

> If someone decides not to bug me [not only] will I not know that in most cases, but I might disagree with their decision. In fact, I *know* this. I know that there are times when people did not tell me about this thing or the other thing because they said, "Well, your door was closed. I didn't want to interrupt you." And, I very strongly disagreed and was unhappy about that decision.

Social cues based on physical artifacts such as doors do work, but they may require discussion of the norms surrounding them in order to be effective cues [11]. As such, they are not predefined artifacts (or categories of availability), but rather have culturally constructed meaning [10]. Meanings tend to be specific to institutions and individuals. Understanding these meanings requires a process of enculturation into a community of practice [13].

Telephone and email are generally handled differently than face-to-face interruption. With the advent of voice mail, both telephone and email can be dealt with whenever the manager chooses. Therefore, when managers are attempting to work without interruptions, they will frequently attempt to ignore potential incoming interruptions, such as telephone calls and email messages. Some managers find this easy to do, but others find that they need to change their physical location, whether by moving within the office or leaving it altogether. One manager talked about the irresistible pull of incoming email or a ringing telephone:

> It's like reaching for the chocolate or potato chips you're not supposed to have. I just don't have enough willpower to stop myself from reaching for [the email] and seeing what it is.

Whether one considers this a matter of personal willpower, as this manager expresses, or a common effect of our powerful and ever-present communication technologies, if the manager wants uninterrupted time, the temptation to respond must be removed. In fact, this manager discovered that by simply moving across the office to another desk physically separated from email and the telephone, it was easier to ignore interruptions and focus on the task at hand.

Managers also reported using a number of other tactics to avoid interruption. Some managers block off time in their own calendar so that it cannot be scheduled with other things. Some simply lock themselves in their office and ignore most types of interruption. Others stay home where they can better control incoming interruptions. Whatever technique they prefer, most managers only employ it for part of the day. That way, they remain available on a daily basis, but still find time to work without interruption.

Work/Life Balance

In a recent, three day online global summit among IBM employees, discussants described two distinct approaches to balancing work and personal life so that neither overwhelms the other. One strategy involves drawing a hard line. During work time, personal issues should not interfere. During personal time, work issues should remain behind. Only in cases of emergency does this line blur. The other strategy emphasizes flexibility. Personal issues are dealt with on work time and work issues can be dealt with at home. Most individuals seem to feel that they align better with one or the other of these approaches. Our data, however, suggest a more complex picture for those who favor a flexible approach. It seems that these individuals only do so when they can control the flexibility. For

example, when work begins to encroach on home life, they prefer to choose when to fit it in rather than automatically accepting an interruption.

In response to the probe study, most individuals indicated that on personal time, business interruptions should be either critical to the manager or critical to the interrupter. The interviews, however, told a different story. A number of individuals stated that they try to remain flexible. As one manager put it, "I guess I would want to be seen as reachable." Several managers, even those who draw a hard line between work and home life, echoed the theme of difficulties that arise when others cannot reach them:

> I guess I would hate to think that there is work that isn't being done because people can't reach me or they feel stuck or in a quandary or upset or whatever because they can't reach me. … I guess it would be good if I were more easily reached for that time that I'm not sitting by my work computer.

During personal time, managers want to be accessible to those who need their attention. At the same time, however, they wish to maintain control over these interruptions. They do not mind doing work at home, but they want it to fit into the holes in their personal schedule rather than disrupting it. One manager summarized this feeling by discussing the type of connection that he would like to have to his professional activities:

> I would not mind being connected all the time, but more on the email side than on the phone mail side. … It's probably more in a pull-mode connected than in a push-mode connected. I would be perfectly happy to have web access all the time and no incoming inbox.

IMPLICATIONS FOR CSCW SYSTEMS

Many computer systems designed to alleviate the problems of interruption and limited availability fail because the intuitive notions of designers may not match the realities of the problem. While the word *interruption* typically carries negative connotations, we have seen that managers experience an internal tension in their attitude toward interruption. On one hand, there is little doubt that interruption can be disruptive to the task currently occupying the manager's attention. On the other hand, the interruption may bring news related to something else that the manager views as important. Managers need uninterrupted time to accomplish certain tasks, but view interruptions as important to accomplishing certain higher level goals. As one manager put it:

> I'm not sure that having fewer interruptions would really achieve a lot because part of being a senior manager is dealing with all of the stuff that doesn't work as planned. It's just a matter of life. It's part of my job to deal with large amounts of interruption. … If it could be planned, then it would just work [out].

Therefore, managers struggle with finding the balance between entertaining useful interruptions and avoiding distracting ones. Achieving such a balance is inherently problematic.

CSCW software has traditionally supported a binary notion of availability rather than the continuum in which managers typically work. Users of these CSCW systems must declare their attitudes toward interruption in advance. These settings are then used to filter potential interruptions. While this method can produce uninterrupted time, it does a poor job of supporting the potential benefits of being interrupted. Our findings suggest that designers of CSCW systems should focus on making interruptions more effective rather than on decreasing them.

How to make interruptions more effective, however, is a challenge. This study offers a number of suggestions for how CSCW systems can be designed to do this. First, there is rarely a state during which an interruption would be ideal. By their nature, interruptions will disrupt something. This implies that systems should not be designed to queue possible interruptions until the ideal time. Rather, interruption should occur at the best relative time. As this study suggests, there are periods of lull during the day and certain states during which interruption is better received than other times or states. While the details of this study cannot be applied to all populations, the suggestion of regular patterns of acceptable interruption times should be explored for other CSCW audiences.

Another interesting implication of this study is that technology has not significantly changed a manager's daily life. The discourse surrounding the concept of information overload suggests that technology is exacerbating the problem. This study, however, suggests that managers still follow the same communication patterns that were documented ten [18], twenty [20], or even thirty years ago [5]. While changing technology certainly has effects on society, it is not clear that technology is causing all of the challenges that critics predict.

The complexities surrounding availability imply that the acceptability of interruption is a socially constructed phenomenon. Because of this tension between benefits and disruptiveness, certain interruptions receive a higher priority than other ones. More importantly, the priority of an interruption relative to the current task varies. Regardless of state or time, availability is handled differently depending on the nature of the interruption.

Technological systems are rarely able to independently deal with this sort of social construction [1]. Therefore, social processes need to be designed into any system designed to ease the challenge of limited attention. We believe the notion of socially translucent systems [9] can provide one way to approach this challenge. Creating awareness and accountability through making behavior more visible – the definition of a socially translucent system – can allow social mechanisms to play more effective roles in technology-mediated interruptions. For example, by

making information such as current activity, location, historical patterns of activity, etc., visible in a way that does *not* require vigilance and active maintenance on the part of the recipient, potential interrupters can make better-informed decisions about whether to interrupt. Of course, as the managers in our study report, relying on social mechanisms to manage interruption is not infallible and does not always accord with their wishes. But, when they fail, it tends to result in negotiation – that is, further social interaction can be used to repair or gloss over problems. On the other hand, when computer filtering fails, only anger and sometimes a sense of helplessness results. Information and attention are complex social processes that would seem to require social solutions. Designing socially translucent systems to manage interruption can help embed these processes in the technologically-mediated systems through which we interact.

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