
Time Management with Adaptive Reminders: Two Studies and Their Design Implications

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Abstract

Effective time management is fundamental for office workers with crowded calendars and numerous constraints and demands on their time. Design of tools to assist such users must account for varying preferences over the type and amount of support desired. We describe efforts to elicit these preferences as part of the iterative design process of an AI-based mixed-initiative calendaring tool. We (1) establish the specific types of assistance in which target users expressed interest, and (2) highlight our findings regarding the scheduling practices and reminding preferences of these users that in turn motivate the redesign and enhancement of our system.

Keywords

Iterative design, preferences, reminding, scheduling, time management, user study

ACM Classification Keywords

H5.2. User Interfaces: Evaluation/methodology, User-centered design.

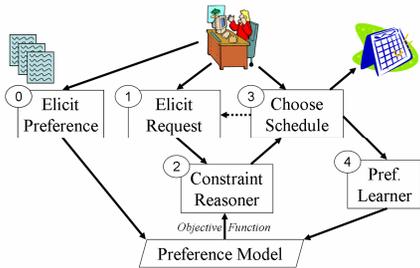


Figure 1: Scheduling process in PTIME. The system employs AI reasoning and learning, to present likely preferred schedule options for a meeting request [1].

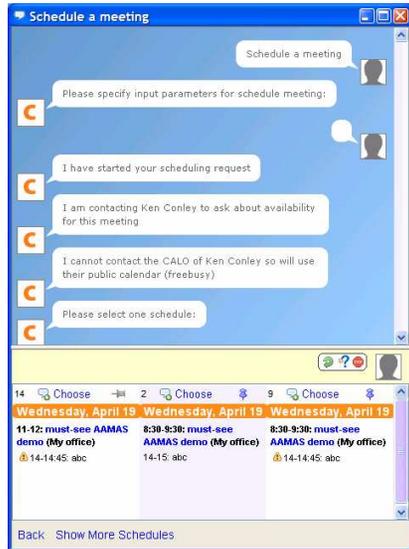


Figure 2: Schedule option presentation in the initial design of PTIME. The options are presented in the lower half of the screen, as part of user-system dialogue seen in the upper half.

Introduction

Our work is focused on assisting in the process of time management. We are working within the infrastructure of a general-purpose, computerized office assistant named CALO [6]. We work with a component of CALO called PTIME (Fig 1), an intelligent, adaptive scheduling assistant that manages a CALO user's calendar and scheduling requests in a mixed-initiative manner [1].

Our research contributions include: (1) highlights from a case study in iterative design in the domain of time management, (2) results of two user studies that motivated the various stages of development of the system, and (3) design implications of these studies, both on the system itself and more broadly.

Efforts to build semi-automated calendaring tools are plentiful [4, 5, 8]. Among other studies of user scheduling habits and calendaring tools, Palen [7], notably, examined the use in situ of group calendaring software at Sun Microsystems. Studies report reluctance to invest in accurately and fully informing a scheduling system of preferences (to the extent that an individual can articulate them) unless either (1) the process is not burdensome and people are persuaded of the benefit, or (2) they are mandated to do so [8]. Other studies emphasize that, even when confident in the behavior of a (semi-)automated system, people seek transparency into its reasoning [2, 7].

First User Study

Good practice in designing for usability begins with understanding the user population and the nature of the work expected to be accomplished [3]. Due to external factors, the first design of PTIME was driven by technology. Upon our entry to the project, we

conducted a mixed-method study to understand the calendaring practices of our target user group of busy knowledge workers. The specific insights we sought to gain through this effort were (1) what do you do and what is difficult about it? and (2) what would you like to do, and where might you appreciate assistance?

The study consisted of two parts: an in-situ diarying by the subjects, and a post-hoc evaluation of the diary combined with a semi-structured interview. Our study had eleven participants, with various office- and research-based roles. We asked participants to keep a diary over one week's scheduling activities, keeping track of how meetings were scheduled, what decisions were made and why. The fivefold foci of the study, along with a synopsis of our findings, are as follows:

- **Event characteristics:** people perceive three dimensions to the meetings on their calendars: (1) *one-on-one vs. group*; (2) *mandatory vs. optional attendance*; and (3) *fixed vs. floating*.
- **Scheduling processes:** people schedule events in a variety of ways, including: (1) *walk-in*; (2) *constraint satisfaction* (group meeting participants' preferences are elicited until a mutually acceptable meeting time is found); and (3) *iterated refinement* (a back-and-forth process of finding a mutually acceptable meeting time).
- **Decision factors:** (1) meeting importance; (2) urgency and/or criticality; (3) interest; (4) relationships (e.g., to host, other participants [8]); (5) perturbation (effect on other meetings); (6) stability (i.e., the number of times the meeting has been rescheduled); and (7) preferences (of the individual and of others).
- **Preferences:** there were four categories of schedule preferences: (1) meeting-specific (e.g., time

of day); (2) calendar-wide (e.g., fragmentation, number of events per day); (3) related to relaxation of meeting request constraints (e.g., proximity to specified time); and (4) related to relaxing calendar-wide constraints (e.g., no overlaps).

- **Scheduling needs:** common suggestions for creating a system to meet its users' needs included: (1) coordinating meetings between a group of busy people; (2) intelligent reminders; (3) transparency into assisted scheduling decisions; and (4) greater control over scheduling processes (e.g., accepting requests or not).

Summarizing our findings and those of earlier studies, we divide scheduling tasks into three broad areas:

- 1. Calendar Input:** we distinguish (a) the easy case of simply adding an entry to the calendar from (b) the hard case of scheduling and/or negotiating a meeting or event. In case **1a**, the user has the precise entry in mind, and simply adds it, whereas in case **1b** the precise entry may be yet unformulated (“I’d like it on Monday”), or may be constrained such that it cannot be entered ideally (e.g., “Bob cannot meet on Tuesday”).

- 2. Calendar Viewing:** examination and management of one or more calendars. Here the user seeks to understand her schedule and allocate her time.

- 3. Event Attendance:** acting based on calendar entries. Here a user employs the calendar and related artifacts to ensure she acts to meet her objectives, e.g., departing on time to attend a meeting.

Second User Study

The purpose of our second user study was to evaluate the then current system and provide further insights into our target users' general reminding preferences and scheduling practices. This study was undertaken

with a greater number of subjects (31 compared to 11), seeking quantitative data rather than qualitative insights, and developing breadth in questions over scheduling and reminding preferences rather than depth about scheduling practices alone. The questions we developed were in part motivated by the latent intention to develop a reminding component within PTIME, as well as the desire to improve on earlier designs of the system, i.e., further target scheduling task **1b** (handling difficult scheduling problems) as well as task **3** (facilitating event attendance).

Scheduling Our study had a strong focus on understanding participants' scheduling practices and preferences. Questions varied from asking about general calendar management practices (e.g., which type(s) of calendars—electronic, paper, mental, etc.—are preferred; how many meetings per week tend to be listed in the calendar) to preferred methods for providing feedback to an automated calendar assistant (e.g., willingness to rank a set of toy and/or true scheduling options; willingness to provide the system with an overall satisfaction rating). Results reinforced the understanding of the space of scheduling practices garnered in our initial user study. This was especially useful due to the larger number of participants; hence, we can be more comfortable generalizing the results on scheduling practices laid out in the preceding section.

Reminding To address scheduling task 3, namely the facilitation of event attendance, we began to develop an adaptive reminding component of PTIME. This component, not included in the first iteration of the design, provides reminders tailored to user preferences in accordance with a learned model of the user.

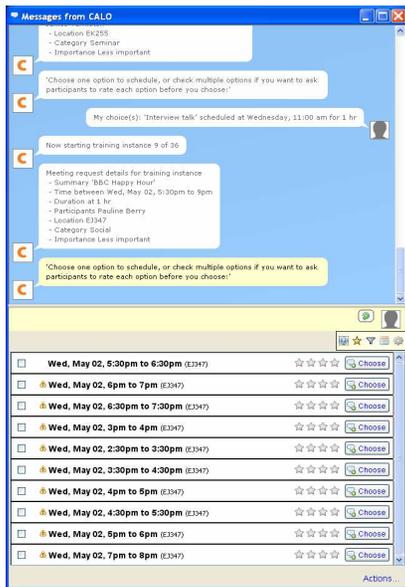


Figure 3: Schedule option presentation in a later iteration of PTIME design. Star ratings permit (optional) user feedback; options are presented in context of a calendar display (not shown).



Figure 4: Two of the eight visual reminders: one displayed on the desktop sidebar and another on a mobile phone.

Acknowledgments

Thanks to our colleagues on the CALO project, especially the PTIME team. This material is based upon work supported by the Defense Advanced Research Projects Agency (DARPA) under Contract No. NBCHD030010. Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the DARPA or the Department of Interior-National Business Center (DOI-NBC).

Our study, conducted prior to developing the reminding component, focused on understanding how people prefer to be reminded and whether there are detectable patterns among user preferences that may be useful for both targeting and expediting the preference learning process. We measured and compared preferences both with and in the absence of explicit contextual information. We presented participants with a set of screenshots representing eight different visual reminders (see Fig 4), most appearing on a computer screen and one displayed on a mobile phone. We found that in the absence of explicit contextual information, preferences for visual reminders are quite similar: the same types of visual reminders are considered more or less annoying, or intrusive, when no other information is provided. When people were asked to consider context, preferences became more diverse: e.g., some people prefer more intrusive reminders in some instances and not others, and other people prefer a certain type of reminder much more exclusively.

We have performed some preliminary data mining to gain insights about the relationship between people's reminding preferences and scheduling practices. Some interesting correlations exhibited in our dataset include that only a small percentage of people who rely on paper calendars tend to use reminding tools, and that people who use a mobile phone to manage their schedules (perhaps in addition to other means) tend to be most enthusiastic about the prospect of reminder systems to aid their time management.

Summary and Future Work

We described two user studies that led to a deeper understanding of the scheduling practices and reminding preferences of busy knowledge workers.

These studies are in the context of the iterative design of a mixed-initiative, adaptive scheduling system.

Prior to each study, the evolving system was tested, and after each study we performed new design iterations accounting for the feedback received from study participants. Our first design iteration addressed the hard case **1b** of the calendar input task, and the primary focus of our second design iteration was also on **1b** as well as task **3** via adaptive reminding. Screenshots of some examples of the PTIME interface over time are depicted in Figures 2 and 3. Future work includes further evaluation and a third design generation with a strong focus on adaptation.

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