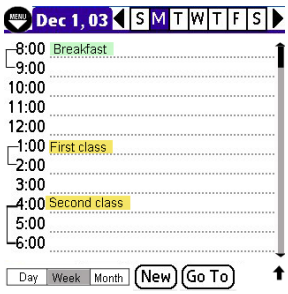
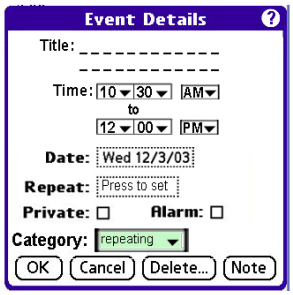
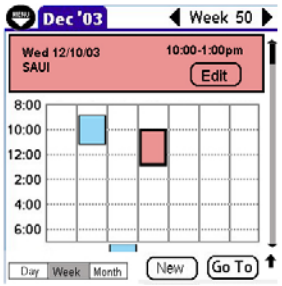
Consistency Matters:
A Palm OS Redesign







Group 10

Carnegie Mellon University
Human-Computer Interaction Institute
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Executive Summary

The Palm Pilot is the world's most popular personal digital assistant. Yet the Palm Pilot suffers from a number of design flaws that severely impair the Palm owner's user experience. We are an interdisciplinary team of designers, engineers, and computer scientists brought together to improve the Palm OS. Through extensive user testing and system analysis using the latest Human-Computer Interaction methodologies (including contextual inquiry and design, heuristic evaluation, cognitive walkthrough, and think-aloud), we discovered a host of problems with the Palm interface. Chief among these problems are an inefficient calendar application, a confusing search system, and inconsistent affordance and feedback. In this report, we propose an exciting and innovative redesign that evolves the current Palm Pilot into a personal information manager that is efficient for experienced users yet remains easy for novice users to learn. We accomplish this goal by implementing standards-based UI affordances and consistent feedback mechanisms. Read on to learn more about why *Consistency Matters*.

Use-Case Scenario

Background

Jack and Jill are both faculty members in separate departments at Carnegie Mellon University (CMU). Jill is the department chair of the Human Computer Interaction Institute (HCII), while Jack is a teacher in the Design department. Due to school regulations, each faculty member is required to use a scheduling application known as Corporate Time.

Jill has been at CMU for approximately ten years; therefore she has an extensive amount of experience using Corporate Time, but is only familiar with the basic functions such as setting up a meeting and changing the properties of a meeting. Jill has also been using a Palm Pilot in conjunction with Corporate Time. Due to the large number of activities and obligations that Jill is involved with, she is generally running around campus during the day, and uses the Palm Pilot to remind her of appointments. At night she syncs her Palm Pilot and Corporate Time to include any meetings that have been added to one but not the other.

Jack has only been at Carnegie Mellon for about one month. Although he has not completely mastered Corporate Time, he has mastered another scheduling application, Microsoft Outlook. Jack tends to not be a very busy person and is generally not in his office. He is accustomed to a routine schedule, so anything that he does not do everyday he will generally forget unless something reminds him. Jack is not a very technical person and has never used a Palm Pilot before.

Carnegie Mellon University recently received a new budget that provided each faculty and staff member with the new G10 Palm Pilot. Jill is very excited. Although she uses her Palm Pilot regularly, there are features and applications that she felt could be improved. Jack is also excited. Although he is not very technical, he enjoys learning how to operate new technology.

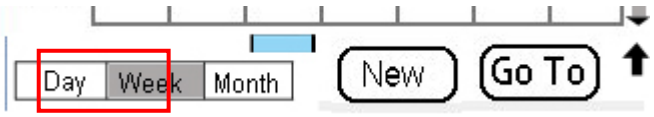
Scenario

The HCII department has several seminars that it has scheduled to occur every week. They are on Wednesday from 4:00 pm – 5:30 pm starting on October 01, 2003 and continuing for eight weeks. Since

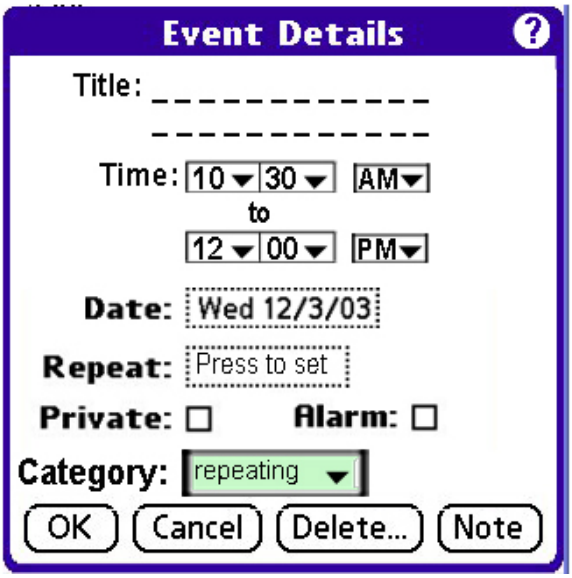
Jill is so busy, she enters the meeting immediately into her Palm Pilot. Given that Human Computer Interaction is so closely related to design, Jack decides to enter these repeating meetings into his new Palm Pilot along with the contact information for Jill and other faculty members, friends and family.

Jill's Experience

Jill begins by pressing the Date Book hard button to turn the Palm on and go directly to the needed application. Jill is surprised to notice the change, but is glad that it occurred. The day view of today's current date, August 25, 2003 appears. Jill notices an immediate change in the use of space and with the use of button labels and screen resolution. She is interested in getting to the week view so she taps on the week button, and progresses forward to the desired week.



She taps on the "New" button, assuming that the "Set Time" dialog would appear. After tapping on the button an "Event Details" dialog box appears that allows Jill to enter the title, the time, the date, repeating, privacy, alarm and category. She proceeds to fill in the desired information.

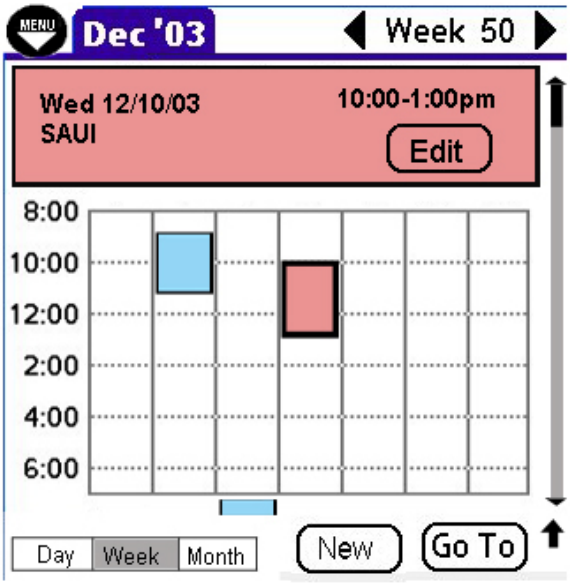


After completing the task of making the meeting repeating, Jill notices the Category option and the color associated with it. She taps on the pull-down menu and it shows a list of categories and various colors for each category. Jill is satisfied with this meeting being filed under the "Repeating" category, so she taps "OK".

Upon clicking "OK", the week view is displayed again and the meeting is displayed in the category color chosen, which is just as Jill expected because of her knowledge of Corporate Time. Jill is comfortable that the task is completed properly due to the high level of visual feedback from the system.

Jack's Experience

Jack turns the Palm Pilot on using the power button. A list of possible applications appears on the screen and he looks for the one that gives off the most scent for entering in a repeating meeting. The Date Book application seems to correlate the most with his previous experiences, so that is what he taps on. The application opens in the day view for the current date, August 25, 2003. He is interested in the week view, so he taps on "Week". Despite the fact that Jack has no experience with the Palm OS, he completes the task similarly to how Jill did. After tapping "OK", he realizes that he set the wrong date for the first meeting. Unsure of how to edit the information, Jack taps on the event, and a dialog containing an "Edit" button appears.



After tapping “Edit”, the “Event Details” dialog appears and he is then able to change the date. Jack also feels that he has successfully completed his task, because the system’s visual feedback shows that the meeting has been moved.

Jack was so intrigued by his experience that he continued to use the palm as an organizational tool. Many times he was scheduling meetings with other faculty members, but he also entered in their contact information along with family and friends. During a meeting, a faculty member announces that he has a new phone number. Unsure of what the person’s last name was, Jack uses “Find” to locate all places on the palm where the person’s first name is associated. Once the Jack located the faculty member in the Address Book, he is able to identify the person and change his phone number.

Date Book Application

Although the Palm OS can be used for general computing tasks, its design is specialized for organizing personal data. The most prominent application is the Date Book, which is used to manage a personal appointment calendar. Most of our analyses were focused on the use of this application. This paper will discuss proposed design changes that were inspired and supported by user data and analytical methods. References to supporting Usability Aspect Reports are provided where appropriate. Please consult the appendices for more detailed discussions of individual aspects.

Day View

Several methods revealed a recurring problem with the Day view of the Date Book application: important functions are not immediately apparent to the user. We believe that this is due to a lack of proper labeling or visual guidance. Several subtle changes will allow this view to retain the basic visual appearance expected by current Palm users, while providing more guidance, a better fit to user expectations, and fewer opportunities for error. See Figure 1 for a mockup of the new Day view.

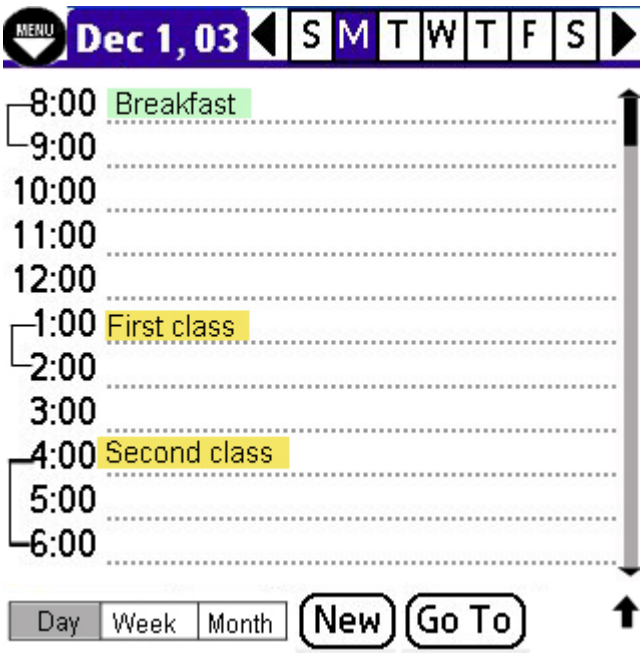


Figure 1: Redesigned Day View

First, our design replaces the icon representations of the day, week, and month calendar views with a similar control using text labels. Think Aloud (TA) data corroborated the predictions of confusion made via Cognitive Walkthrough (CW) and Heuristic Evaluation (HE) analyses (pjc-TA-01, g10-CW-02, bpg-HE-01). Although the new control will consume more space on the interface, other changes we propose will make that space available without sacrificing functionality.

A subtle issue was revealed by HE regarding the navigation controls (shown in the upper-right corner of Figure 1). Although the arrow buttons are placed near a display which shows a single highlighted day, pressing the buttons in fact navigates by week. For example, a user who is currently viewing December 1 and taps the forward arrow would be shown the appointments of December 8 (bpg-HE-03, pjc-HE-05). This parallels a problem revealed in Contextual Inquiry (U1-Artifact [153]). This is also inconsistent with the use of the hardware navigation buttons, which advance by individual days (pjc-HE-09, pjc-HE-10). Since similar controls in the same location on other Date Book views advance by the currently displayed time increment (week or month), we propose that these navigation buttons should be consistent with that behavior. Although this change might cause a user to perform more button presses to advance the view by weeklong increments, we feel that this tradeoff is reasonable to prevent user confusion – especially considering that other navigation methods are available.

Related to this issue, we propose a change to the current scrolling mechanism in this view. In the current Day view, if more appointments are set on a particular day than can be displayed simultaneously, two vertically oriented arrow buttons appear in the lower-right corner of the screen. These buttons are small and close together, making them error-prone. They are aligned on the same axis as the hardware arrow buttons, which could lead a user to expect that these controls share a common function (pjc-HE-09, pjc-HE-10). They are also inconsistent with some other Palm OS applications that display lists of items. Our design utilizes the same scrollbar control that appears in the Memo Pad application. This scrollbar can benefit from the affordance of the plastic edge surrounding the device's screen to guide the stylus. Although this control occupies the space of approximately two characters of text, it does not need to be

shown in the common case when all of a day's appointments can be displayed on screen. We also propose that the hardware buttons perform a "wrapping scroll" behavior, which first scrolls the current view before moving to the next day in the chosen direction.

Consolidated Event Details

Our TA participant showed great difficulty in recognizing the distinction between tapping the time heading next to an appointment, which opens a "Set Time" dialog, and tapping on the appointment title, which enables use of the "Details" button. The user failed to infer the meaning of "selecting a record", as he was instructed by an error message (pjc-TA-02). A similar problem was predicted by g10-CW-03. The user also showed great difficulty in finding the "Repeat" function necessary for his sample task (g10-CW-04, bpg-TA-02, abm-TA-02, amj-TA-02, jh-TA-02), and repeatedly lost data because of inadvertent taps outside of the title text entry area (bpg-TA-03). Finally, HE identified a potential problem in finding the "Delete" function (jh-HE-14, abm-HE-09, amj-HE-01). We believe that all of these problems are related to the separation between an appointment title and its detailed settings.

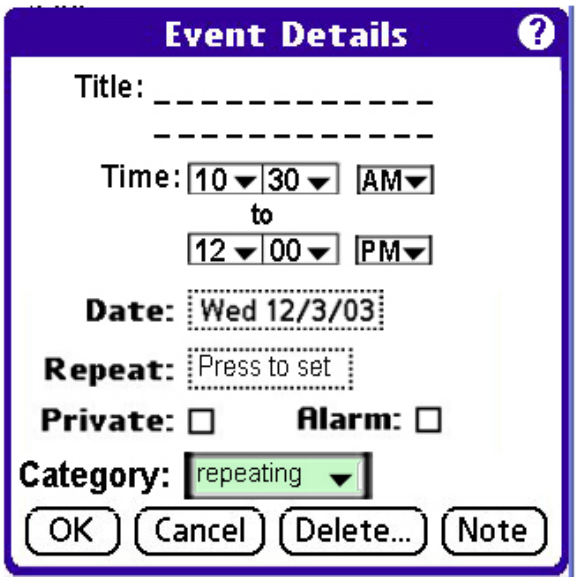


Figure 2: Event Details Dialog

We propose that all settings should be consolidated into a single "Event Details" dialog. Any tap made within the horizontal space of an appointment, including taps on the title text, the white space after

the title, or the time header, would open this dialog. All editing operations would occur in this single view. Because all operations involving an appointment bring the user to this single dialog, all related functions will be presented to the user without requiring special indicators on the Day view. This allowed us to remove the problematic Details button entirely. Note that most of the efficiency of the previous design can be retained by pre-selecting items within the Event Details dialog according to the tap-location that triggered it. For example, if a user taps within the title text, the text cursor should be placed at the position tapped, ready for input.

The consolidated Event Details dialog is designed to resolve several problems with the Set Time dialog discovered during our TA. The user did not notice that his start time was set to PM rather than AM. This interacted with the error-prevention logic in the dialog in an extremely frustrating way (bpg-TA-01, amj-TA-03, jh-TA-03). Our Event Details dialog includes the function of the Set Time dialog via a set of pop-up menus. The visual layout of the pop-up menus is in accordance with the most common way of writing time intervals in text, so the user will naturally encounter the appropriate data in reading order. The current error-prevention logic will be active in the pop-ups by disabling times that would produce impossible time intervals. This visual indication prior to the click should prevent the user confusion exhibited in the TA because of shifting selections.

Categorization

Finally, Contextual Inquiry revealed that the user could benefit from being able to label events with categories and associate these categories with colors (U1-Sequence, U1-Artifact [86], U1-Flow [33]). Appointments that have been categorized are displayed with a colored background (though a user can set a white background for a category to disable these highlights). In order to incorporate this into the Date Book, we have placed a category option in the Event Details screen. This pop-up menu displays all of the current categories with the appropriate color highlights.

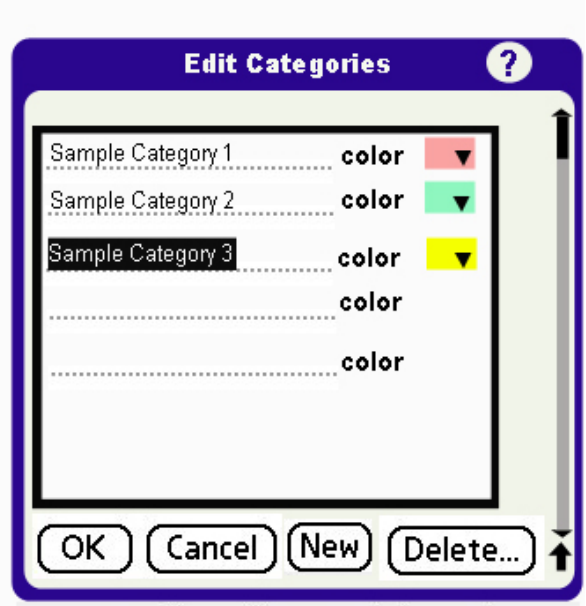


Figure 3: Edit Categories Dialog

The Edit Categories dialog for the Date Book is accessible via the last item in any category selection pop-up menu or via the application menus. We have modified it to be consistent with other Palm OS dialogs in button placement. (This is described in more detail in the Dialog Cancel Buttons section.) We have also consolidated the title editing function into the main dialog view, eliminating an unnecessary set of clicks. A category can be associated with a color here. Note that the color options would be restricted to a fixed set of low-saturation pastels, chosen to maximize the legibility of black text overlaid upon them.

Week View

The final area of the Date Book application that we will address is the Week view. The changes to this view are primarily to maintain consistency with the changes made to the Day view. Figures 4 and 5 show that the changes regarding the scroll bar, category-based coloration, and button placement are analogous to those described above. Two unique changes are worth noting. First, the column headers have been outlined to show that they are active buttons. This addresses a similar problem to the difficulty with the Day view time headings mentioned earlier (g10-CW-03). Second, an “Edit” button has been added to

the preview box that appears when a user taps on an appointment. The intention is for all of the data areas of the box to be active tapping targets that take the user to the appropriate field in the Event Details dialog. However, users may not recognize that they can perform this action, and it is infeasible to outline all of the text as clickable. The Edit button serves as a cue for new users who may not otherwise know about this feature. Finally, we note that an existing feature of the Week view addresses a breakdown in our CI Artifact Model (282). The small color blocks below a day column indicate that an appointment is present off screen, so that the user will not assume that their evenings are completely free. This feature should be maintained and extended to support category-based colorization.

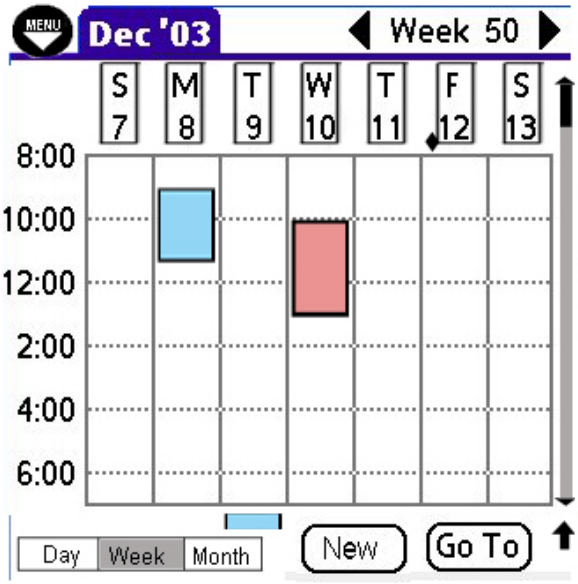


Figure 4a: Week View

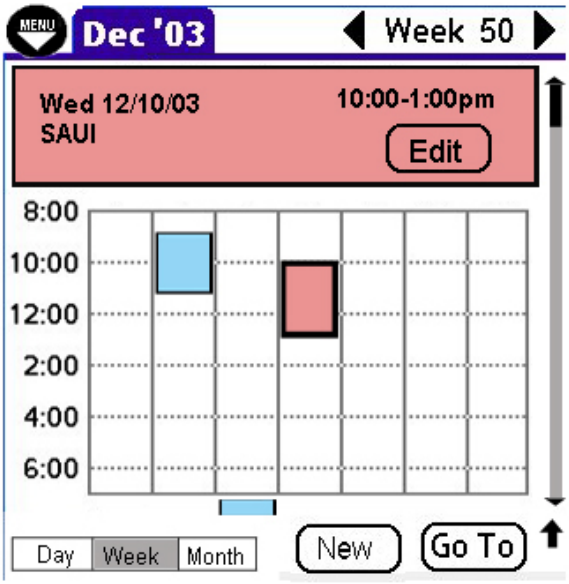


Figure 4b: Week View with Event Popup

Find and Search Results Dialogs

Several related problems were revealed in the Find and Search Results dialogs by Heuristic Evaluation. We feel that this function is currently hobbled by these problems, so we propose a complete redesign to correct the most critical issues. In the current Palm Pilot, the find dialog box has only one search parameter for entering text and lacks any indication of what data the Palm will search (pjc-HE-02). The dialog box also covers only a part of the Palm screen, appearing as if it's searching in the context of the current view (pjc-HE-01). When the search is complete, the results screen is not well organized for the users to easily get information about the results (jh-HE-06). It has only a "Cancel" button, which can be confused with the "Stop" function provided while the search is still in progress (pjc-HE-03). Our redesign intends to address all of these issues.

Figure 5: Find Dialog

"Search In" Selector

In the current Palm Pilot, the find menu has only one search parameter for entering a keyword for searching text. If the user wants to search the date, he can't get the results that he wanted since the current

palm looks up the text within the names not dates (pjc-HE-02). It prompted us to the realize there aren't sufficient search parameters for the users to specify what kind of data they want to search.

We propose two parameters for the search: "Look For" and "Search In". Users can input any text in the "Look For" text field, and choose a search context from the "Search In" pop-up menu. The "Search In" pop-up menu will include application names such as "Date Book", "Address Book", "Mail", "Expense", "Memo Pad", "To Do", and finally "Search All". The search will perform a keyword search on names and contents within the data files for the application that the user selected from the 'search in' menu, using the value in the "Look For" field. If the search includes the Date Book, the Palm will attempt to parse the "Look For" field using several common date formats. If the field appears to be a valid date, all items on that date will be returned, as well as any items matching a text search in any of the recognized formats.

Results Table

In the current Palm Pilot, search results are not well organized for the users to easily get information about the results. It lists all the names of the locations such as 'Datebook', 'Addresses' or 'Mail Messages' even though there weren't any search results within those locations. Also the font size and style of the results is not distinct enough from the appearance of the location names, making it hard for users hard to distinguish between them (jh-HE-06). We propose to use a table to organize results with 'subject', 'location' and 'date' columns. The user will be able to see the most important information about their search results within the table.

Figure 6: Find Dialog with Results

We also propose to put a 'Results:' heading above the table that will show whether the search is still in progress or if it's finished (pjc-HE-03). While the search is being performed, the heading will show the text "In progress…" When the search is finished, it will show how many items were found. Since the labels and positions of the OK, Cancel, and Find buttons do not change, the user will not be disoriented by the completion of the search.

In conjunction with having one more parameter in find menu and a table that shows the results, another problem can be solved. The dialog box of the find menu takes up the whole area of the screen, giving more of an impression of a system-global search, rather than appearing to search only within a single screen or application (pjc-HE-01).

General Consistency Issues

Although the Palm OS provides many features, many aspects of the software are inconsistent within and across applications. We have identified several problems related to this lack of consistency. Like the issues with the Find Dialog, the data supporting these changes comes primarily from Heuristic Evaluation. These changes are therefore not as imperative as the ones pertaining to the calendar

application. However, many of them would be simple to implement, and the resulting unified system would provide a much more comfortable experience for users.

Menu Visibility

In the current Palm Pilot, there is no indication that there is a pull down menu available on the top of the screen (bpg-HE-02, amj-HE-04). We propose to have a menu icon in the upper-left corner of the screen so that the user knows exactly when they can access the menu (Figures 1, 4a, and 4b.) Tapping on the icon would reveal the menu as in the current Palm OS. The icon would not appear in dialogs that do not have associated menus (Figures 2, 3, 5, and 6.) We also found that the meaning of the menu icon on the hardware menu button was not clear. We have used a simpler icon incorporating the text "Menu" in our design. In order for the on-screen display icon and hardware button icon to be consistent, the design of the icon on the hardware menu button should be changed. It would also be reasonable to remove the hardware menu button completely, since its function is now duplicated here. The button could be repurposed for another use.

Help Icon

Our heuristic analysis also predicted that users would fail to recognize the "i" icon displayed in some dialogs as a help mechanism. In order to resolve this problem, we have replaced the "i" icon with a more recognizable question mark icon (bpg-HE-06). See Figures 2, 3, 5 and 6 for examples.

Dialog Cancel Buttons

The user should have an obvious way to safely recover from any mistaken changes they have made to their information or the organization of their information. Several dialogs in the Palm OS lack such a mechanism, and provide only an "OK" button to exit. If the user decides that they want to undo the changes they have made, they may have to manually reverse changes by recreating previous categories or reentering deleted addresses. This may not be possible and is generally undesirable. The easiest way to resolve this is by including a Cancel button on all Palm OS dialogs. The cancel button is not essential for

some applications, such as To Do, because changes are made within a single global window. In situations where there is no dialog context, a cancel button is not appropriate. Thus we propose to add a cancel button specifically to the Edit Categories screen (abm-HE-01, abm-HE-07), the Memo entry screen (amj-HE-13), and the Address Edit screen (jh-HE-12, amj-HE-13). In all instances the button should be placed at the bottom left of the screen with other buttons to the right to maintain consistency. This also resolves an issue of feedback in the Address Edit screen, since the user is clearly choosing to accept or reject changes (jh-HE-13).

Edit Menu Operations

A last problem is the functionality of the Edit menu functions. In the Expense application and the Date Book application, operations such as Copy, Paste, and Select All work with limited functionality. That is they only copy the text that is entered by the user. We propose that if the user selects all of the data of a certain event or expense then the copy and paste functions remember all of the data and perform the job accordingly (abm-HE-02, abm-HE-10, abm-HE-05). Similarly, Undo does not operate as expected in all cases, particularly when editing text (jh-HE-15, amj-HE-14). Because the Undo function performs inconsistently, the user cannot expect to rely on it for recovery from common errors. Our proposal mitigates this problem by providing consistent undo behavior.

Retrospective

This retrospective summarizes our assessment of the techniques we employed in bringing our redesign to fruition. We open with an analysis of the effectiveness of each technique, beginning with contextual inquiry and design then on to the usability evaluation methods (KLM/GOMS, heuristic evaluation, cognitive walkthrough, think-aloud, and interaction relabeling). Finally we conclude with a discussion of overarching themes we observed throughout the project.

Contextual Inquiry

We did not conduct an actual contextual inquiry as part of this redesign project. Rather, the assignment was to analyze the transcript of a CI conducted by two graduate students researching hand-held computers. We were then tasked to develop focus statements for interviewing people who already use Palm Pilots.

The nature of this assignment was problematic in two regards. While we did gain a good understanding of the mechanics of CI, we did not gain first-hand experience conducting a CI (until we did them in lab). Second, in setting our foci, we struggled to understand the objective of conducting these user studies. Were there particular business goals? Were we trying to win converts from competing platforms by making our system more usable? Or were we simply trying to understand how people use their PDAs?

Because we did not conduct CIs using our foci, it's difficult to analyze the effectiveness of this method in the context of this project. We hypothesize that the real value in doing CIs is that they provide the truest data about how users work, and that these data are the building blocks of the next method, contextual design.

As an aside, we participated in a real-world HCI study by conducting our focus-setting meetings in an experimental electronic workspace [the BARN project]. Discussing HCI methodology while being observed by researchers using those same methods proved to be a uniquely gratifying experience.

Contextual Design

Building the work models that form the basis of contextual design was an exhausting, tedious undertaking. But ultimately these models yielded valuable insight into how a particular user manages roles, relationships, and responsibilities. As we began consolidating our ideas for redesigning the Palm Pilot, our initial assessment was that the work models would not prove very useful, since they applied to a different product (Corporate Time). But by taking a closer look at the data and the breakdowns they revealed, we discovered key features (such as color-coded categories) that, if implemented on the Palm Pilot, would allow it to better support the user. This was a valuable lesson, underscoring the importance of separating the users and their work from the specific tools they use to perform their work.

As we pointed out in our retrospective for the contextual design exercise, we felt unduly constrained by limiting our redesign ideas to only the Palm Pilot. In our analysis, we concluded that the Palm Pilot was not the most effective remedy for the majority of the breakdowns presented in the work models. However, we understand this often happens when working for a company that has a particular product to sell.

Keystroke-Level Model

The KLM analyses we performed on Corporate Time and the Palm Pilot were useful for comparing the relative efficiency of the two systems. Although we did not draw directly on the data provided by the KLMs in our redesign, the obvious inefficiencies observed during this exercise informed our later design decisions (such as consolidating data entry onto a single screen).

Heuristic Evaluation

The heuristic evaluation is notable for the vast amount of data it generated. Our group generated over sixty usability aspect reports (UARs). This was the first real experience many of us had using a Palm Pilot, so the "naïve" user perspective was well represented in the data we gathered. Unfortunately, because we were not limited to analyzing any particular aspect or application, the data was highly

unfocused and scattershot, making consolidation a challenge. In hindsight, we over-consolidated our data to the point that when we finally began the redesign, we couldn't interpret our combined aspect statement. Ultimately, we recompiled the HE UARs into a more detailed table (found at Appendix F of this report). One unexpected benefit of this scattershot approach, however, was that we discovered usability problems in other Palm applications that applied equally well to the DateBook application (the focus of our final redesign).

Cognitive Walkthrough

We found cognitive walkthrough to be a less "humane" version of heuristic evaluation. The rigid structure of CW—the predefined task path, the *a priori* description of users, the "four question" template—contributed to the sense that CW is a less flexible evaluation method. And in our case, less flexible translated to less useful. Overall, we found the CW process mechanical and un-engaging, particularly since the predefined task was given to us (setting the task may have been a useful pedagogical exercise). We also struggled with how to evaluate the system when there were multiple paths for achieving the same effect. In general, CW appears to be useful for uncovering problems with perception, affordance, and unexpected system states, but it didn't inspire any new design ideas.

Think Aloud

As with CI, we did not conduct an actual think-aloud; instead we analyzed a pre-recorded TA. Nonetheless, it was an eye-opening experience. We were amazed and exasperated by the failure stories we observed. The user's pain was so apparent and exquisite we actually felt it ourselves, which may explain why the think-aloud was our most significant source of concrete design ideas (with the possible exception of HE).

Interaction Relabeling

We didn't spend enough time on the interaction relabeling method to effectively evaluate its usefulness. The in-class relabeling exercise, while entertaining, also indicated that this method can be a valuable brainstorming tool. It appears to be particularly effective when analyzing future scenarios unconstrained by current technological capabilities.

Recurring Themes

Two overarching issues impacted the redesign experience. As mentioned in the preceding section, not having an initial design objective or focus made narrowing the scope of our analyses extremely challenging. Later, when the focus shifted to the Palm's DateBook application, we found that we had vast quantities of data irrelevant to this contrived focus. We weren't sure if this was intended to be an accurate portrayal of how HCI is practiced in the field or was merely a function of being in a learning environment. We recognize the imperative to drive the course in a certain direction to ensure everyone has an equal opportunity to learn, but it often wasn't clear which aspects of the course were designed to reflect real-world scenarios and which were simple pedagogical contrivances.

Similarly, our understanding of many of the techniques was colored by the fact that there was only enough time to conduct one instance of each method (in some cases, such as with contextual inquiry and think-aloud, we were not afforded an opportunity to conduct the technique at all). Since many of the methods must be conducted dozens of times to be truly useful, our sense of which techniques are most effective was unavoidably biased by the limited opportunity we had to put them into practice.

Despite these shortcomings, we felt the redesign project was an extremely effective introduction to HCI methods and practices.