

ClearPath

Defining A New Direction For The Palm

Group 14: Palm Redesign

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RE: Palm Redesign
DATE: 05 December 2003
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Three months ago, your office issued a challenge to redesign the Palm Pilot interface (without changing the existing hardware structure) with the express goal of increasing our market share and profitability.

We would like to introduce you to the new “Clear Path Palm”, a solution that promises to extend Palm usage into the untapped technical novice market.

Our multi-disciplinary design team, consisting of HCI specialists with backgrounds in computer science, product development, and technical communication, conducted over three months of empirical and analytical HCI research on the current Palm design and we identified over 80 significant problems.

In this report, we review the results of our research and discuss how the “Clear Path” redesign provides a solution for over 40% of our documented problems for novice users.

When they first use the Palm, technical novices need to have a seamless experience and more often than not, they have the exact opposite. We took up the challenge of redesigning a Palm specifically for the novice user population since every future Palm customer will be a new user.

The “Clear Path” redesign introduces several key innovations to support new users who experience frustration during their initial Palm interaction. By providing a simplified flow of operations, in-context task menus, error recovery messages, and a task-specific help system, we provide a clear, consistent way for users to navigate through the Palm as they accomplish their tasks for the first time.

Thank you very much for your time and consideration.

Group 14

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Vision

Three months of usability research have uncovered that Palm novices experience substantial obstacles to task completion. We observed that such obstacles cause frequent, persistent, and severe problems. Our analyses have pinpointed the root causes of this frustration and discomfort; in our redesign of the Palm we seek to solve these significant problems.

We believe that the usability problems that we found are a great danger to the Palm's utility and desirability. We have extensive empirical and analytical data that points to many of the problems that novice users have with the Palm.

Our goal is to reach out to a currently under-served novice population by making the Palm more useable, useful, and desirable. We intend to reduce confusion and increase user confidence to yield a more enjoyable user experience than is currently available.

We seek to accomplish this goal by designing clear paths that guide users from where they are to where they want to be. The redesigned Palm will provide this guidance that novice users need so that at every stage of the process they are comfortable, aware, and informed.

Problem Definition

Our period of observation provided us with specific data so that we could clearly identify high-level problems, and determine how to solve them.

Frame the situation

We consolidated over 80 specific usability problem observations into seven major problem categories (see Appendix A for to tie these categories to specific data).

Problem Category	Explanation
What next?	Lack of direction for how to complete a task
Bad feedback	It is difficult for users to determine the effects of their actions
Too much layering	Multiple screens cause users to lose their place
Bad semantics and semiotics	Button labels do not help users take appropriate action
Bad internal GUI standards	Inconsistently applied standards of clickable areas in the device
Doesn't follow external GUI standards	Violation of universal standards of user interface
No/Bad Help	No guidance to resolve problem situations

Figure 1: The seven major Palm usability problem categories.

These problems share a common thread. Users get lost and encounter problems because there is no single, clear path to guide them. Users do not know where they are, or where they are going.

Problem Definition part 1
Redesign the Palm so that users always know where they are, and where they are going.

Target User Defined

Our usability evaluations consistently targeted the "advanced beginner," the typical Palm novice (See Figure 2).

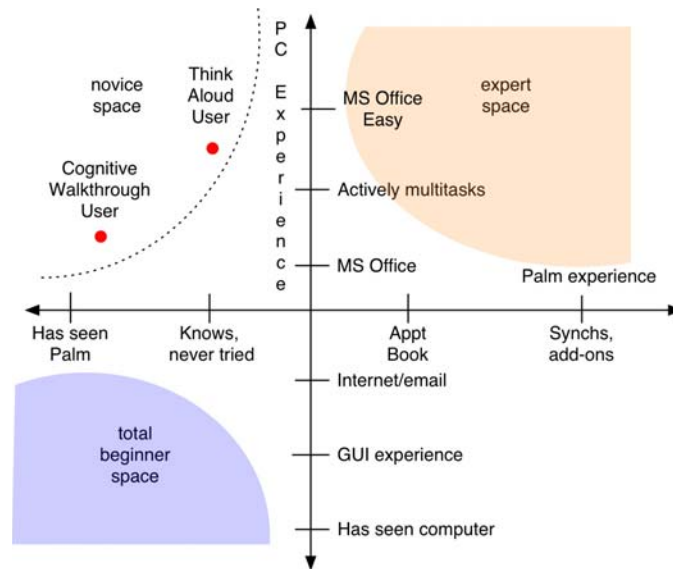


Figure 2: User Characteristics Defined

The advanced beginner we designed for has competent PC skills, but no experience with the Palm. They have a PC at home and use it for web browsing, e-mail, and word processing. At work they use scheduling software. They are familiar with PC GUI standards. They can capably handle common tasks. But this user feels very uncomfortable solving problems on new devices.

High-Impact, Low-Persistency Problems

Our research identified many high-impact, low-persistency problems. Expert users can adapt to these challenges. But we repeatedly observed how high-impact, low-

persistence problems can flummox the novice user. We believe novice users are unlikely to adopt the Palm if their early experiences prove frustrating.

Problem Definition part 2
Redesign the Palm so that novice users always know where they are, and where they are going .

Constraints

Our redesigned Palm uses the same size and resolution monochrome screen on the same hardware. We focused on redesigning the software without upgrading the existing hardware.

Problem Definition part 3
Redesign the Palm on its existing hardware so that novice users always know where they are, and where they are going .

Scope

Because our data focused primarily on using the Palm as a scheduling device, our redesign illustrates the types of changes we recommend within the calendar software. But the design innovations and guidelines we suggest can easily extend throughout the entire Palm, across its many applications.

Problem Definition part 4
Redesign the calendar software on the Palm on its existing hardware so that novice users always know where they are, and where they are going .

Design Principles

We developed the following five core design principles to address the seven aforementioned problem categories:

1. Constrain the path
2. Remove unnecessary screens
3. Provide context for user actions
4. Provide a safety net
5. Standardize the action metaphor

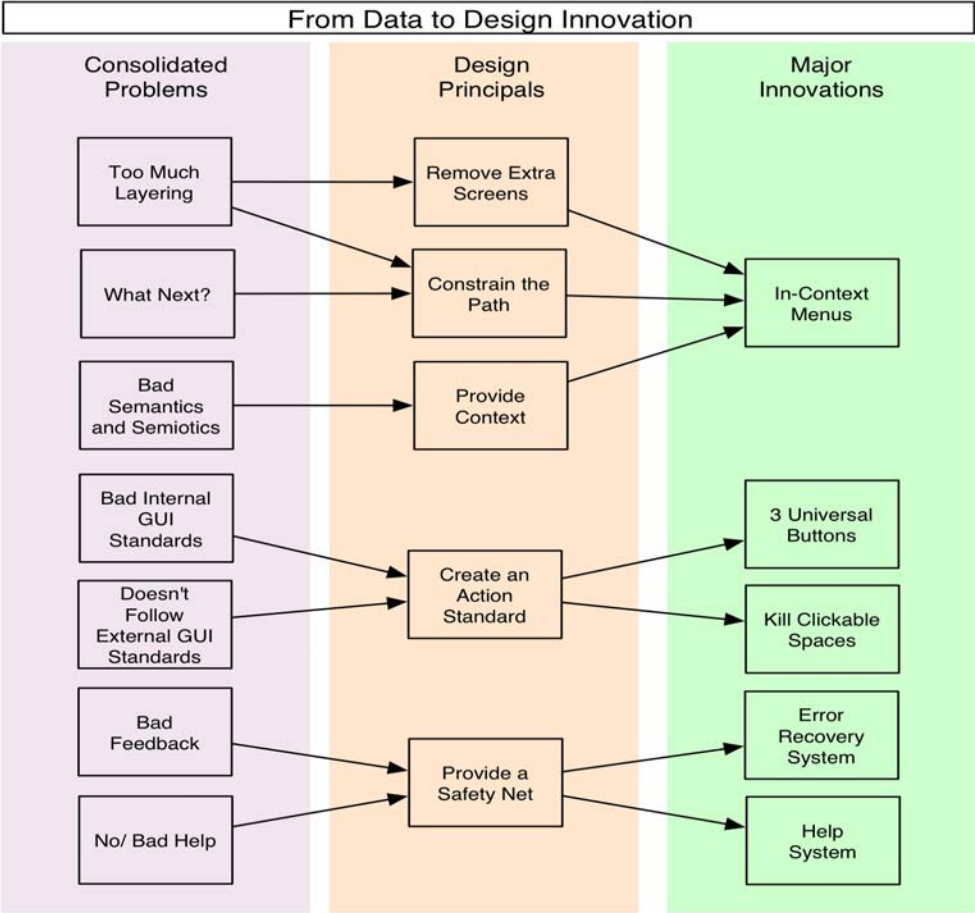


Figure 3: Charting the evolution of core problems to design principles and subsequent major innovations.

Constrain the path

Replace extraneous options that lead to confusion with a singular, pronounced method to accomplish a given task. Provide helpful guidance that is not patronizing to the user. Emphasize clarity over flexibility and limit opportunities for user error and confusion.

Remove unnecessary screens

Replace deep navigation with a broad, shallow structure. This allows fewer steps to get to functionality, exposes previously hidden features, and more clearly links tasks to options.

Provide context for user actions

Show user where they are and what data they are interacting with when taking action. Remove ambiguity as to what results user actions might cause.

Provide a safety net

Even with clear guidance, user failure is inevitable. Support lower skill levels and problem-solving capabilities, and increase their task completion success rate.

Standardize the action metaphor

Clickable items should be consistently and clearly clickable. This eliminates guessing and clarifies where the buttons are and what they do.

Major Design Innovations

Our specific redesign innovations came from the previous five guidelines. While our ideas touch on nearly all aspects of the application, we would like to first present the major innovations in our design that resolve multiple high-level usability problems and inherently reduce the need to solve other, lower-level issues.

Constrained Order of Operations

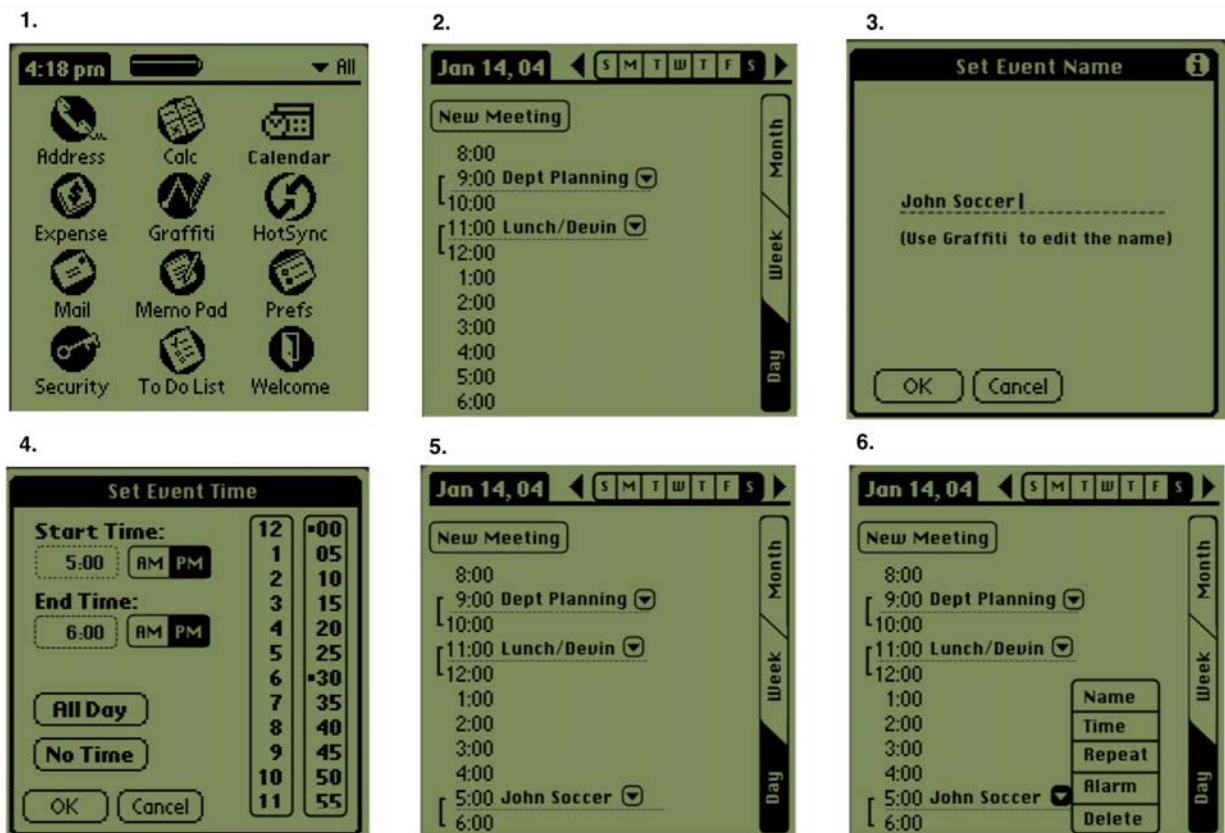


Figure 4: Order of operations for creating a new meeting.

Our think aloud data (TA-01, TA-04) revealed that multiple pathways for task execution caused tremendous confusion. So rather than allow users to wander down multiple pathways, we tightly controlled the structure.

The redesigned Palm uses a single, efficient path and eliminates all other means to make a new meeting. For editing an existing meeting, we reduced the path from three non-intuitive steps into a simpler two-step path by providing an in-context menu.

In-Context Menus



Figure 5: New in-context menu.

We saw that users had trouble getting to the “Event Details” (TA-05, HE-26, CW-05). This was a necessary step to edit alarm, privacy, repeat, date, and time setting. Users did not understand that they had to select a meeting before clicking ‘Details’ and once the details were open, there was a lack of context as to what was being edited because the underlying screen was mostly hidden (TA-04). This lack of context was a trend that needed a high-level solution.

We bypassed the meeting selection step in accessing meeting details by placing the details button proximal to each meeting – giving those buttons a pre-defined context.

Since the use of drop-down boxes is already consistent in the Palm interface and external GUI systems, we expanded the consistency of the drop-downs and leveraged user familiarity with conventions.

The core ideas of this in-context menu were also applied to our help system, and the concept is easily applicable to myriad other Palm applications.

Help System



Figure 6: *New Help System.*

Users found help conspicuously absent (TA-03, TA-04) and inconsistently applied (HE-05). The redesigned Palm utilizes a pervasive safety net to control for the inevitable and unpredictable user problems.

We designed a standardized, ubiquitous in-context help system. Users can access the help system on any page by pressing a slightly modified (with a new label) hardware button. The help system presents a list of all actions a user can access in clear language. After selecting a desired action, the menu closes and the correct button to complete the action flashes. This button must then be activated by the user.

Error Recovery



Figure 7: New Error Recovery Message.

Users make mistakes (TA-01, TA-02, TA-04, TA-05) and even a help system is not enough of a safety net in many situations.

We designed a reactive error recovery system to help guide users to a correct solution. If the user forgets to make a necessary choice, the system provides additional feedback that notifies the user of the problem and gives useful suggestions. As with our help system, this pattern of error recovery is something we recommend for Palm-wide adoption.

Detailed Redesign Walkthrough

Home Screen

The user sees the home screen when turning on the Palm. To access the calendar, user clicks on the "Calendar" icon.



Clarify the Semantics/Semiotics

The home screen is a good example of clarifying the semantic and semiotic relationships, leading to overall increase in clarity.

Our users found great difficulty even finding the calendar. They did not recognize the 3-D icon. Our redesign both changes the image to a more recognizable 2-D icon, and changes the name to "Calendar." Users now see a direct path to accomplish their goals.

Page Redesign Elements and Justifications			
#	Redesign	Problem Table #s	Design Principles or Consolidated Problems
1	Calendar Icon Redesign	1, 14	Semantics/Semiotics
2	Date Book Name Change	1, 14	Semantics/Semiotics

Calendar Day View

We focused on the day view since we had the most data for that view and since the user must go there to input data. The user clicks on "New Meeting" to create a meeting.



Constraining the path

The calendar day view page serves a powerful example of the design consequences of constraining the path for the user. In the previous Palm, users could create a meeting by clicking on an hour, or the lines that extended across the page.

While these options provided flexibility to the expert user, they created great confusion with the advanced beginner.

Our redesign removes these confusing complexities from the path of the advanced beginner and replaces them with a single clear path to action. The user now must click on the "New Meeting" button to create a new meeting.

Page Redesign Elements and Justifications			
#	Redesign	Problem Table #s	Design Principles or Consolidated Problems
3	"New" Button redesign	14, 28	Standardize Action
4	Day/Week/Month Tabs	1	Semantic/Semiotic
5	Unclickable Hours & Lines	29	Standardize Action
6	Remove Time Lines	Unobserved	Path Constraint Standardize Action
7	Remove GoTo Button	Unobserved	Path Constraint

Additional Changes:

"New" Button redesign

- Moved to place of visual prominence and increased in size
- Changed "event" to meeting
- Changed terse label to clear description of function

Day/Week/Month Tabs

- changed from abstract icons to clear text labels
- moved from de-emphasized buttons to prominent legible tabs

Naming a New Meeting

The first step to create a new meeting is to enter the name. A user enters this screen and uses Graffiti (or the hunt-and-peck keyboard) to enter the meeting name.



Constraining the Path

The previous system allowed users to first either set the meeting name or the time. This flexibility presented confusion to our users. But the new redesigned Palm obliges users to first enter a name for the meeting.

This tradeoff of clarity for flexibility

provides a constant and clear path to create a meeting.

The redesigned page also clearly directs the user to enter a name by providing an extra-wide cursor, and prompting the user with clear instructions to enter text using Graffiti.

Page Redesign Elements and Justifications			
#	Redesign	Problem Table #s	Design Principles or Consolidated Problems
8	'Set Meeting Name' Label	28	Semantic/Semiotic
9	Entire screen just for this	28	Path Constraint
10	Extra-wide Cursor	7	What Next?
11	Graffiti Instruction	7	What Next?

Set Meeting Time

The user must now set the meeting time. To set the start time, the user clicks on the hour and minute buttons that correspond to the time she desires. Then she clicks on the appropriate am/pm button. The user then clicks on the end time box and repeats the procedure for setting the start time. Finally, she clicks on OK.

The screenshot shows a 'Set Event Time' dialog box with the following elements:

- Start Time:** A dashed box containing '5:00' and buttons for 'AM' and 'PM'.
- End Time:** A dashed box containing '6:00' and buttons for 'AM' and 'PM'.
- Time Selection Column:** A vertical column of buttons for hours (1-12) and minutes (00, 05, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55).
- Additional Options:** 'All Day' and 'No Time' buttons.
- Final Actions:** 'OK' and 'Cancel' buttons.

Bring the button the action

The redesigned time screen places the buttons for "am" and "pm" next to the times they represent. This brings the buttons directly next to the times they affect.

This move clarifies the semiotic relationship between the buttons and the time, making it clear that they refer to either the start time or the end time.

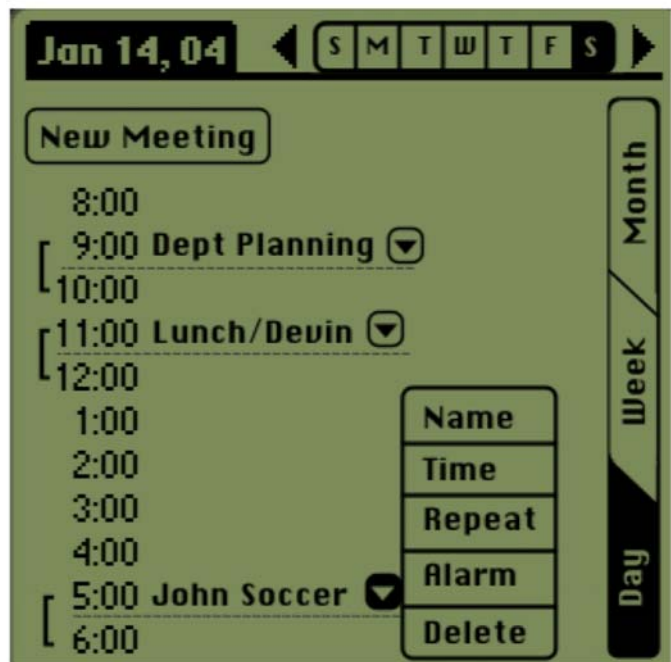
Page Redesign Problems & Justifications			
#	Redesign	Table Problem Table #s	Design Principles or Consolidated Problems
12	AM/PM Buttons	14	Context

Meeting Details

The user can now see their new meeting. From this menu, the user can change the repeating settings, set an alarm, delete the meeting, and change the meeting name and time.

Providing Context for Actions

On the previous Palm, users could only edit a meeting by selecting it, and then



clicking on the "details" button located at the bottom of the screen.

The redesigned Palm places a clickable drop-down arrow beside each meeting. This button locates the editing action directly next to the information it affects. Users can select a meeting and choose an action in a single screen.

#	Redesign	Problem Table #s	Design Principles or Consolidated Problems
13	'Details' redesign	14, 34, 36, *TA-04	Context Button to the Action Remove Extra Screens Constrain the Path
14	New Meeting Underline	Unobserved	Feedback
15	New Repeat/Alarm Icons	1	Feedback
16	Remove 'Private' Options	16	Consistency & Standards

Additional Changes:

New Meeting Underline

- New meetings appear underlined on screen to provide clear feedback

New Repeat/Alarm icons

- Replaced icons for repeat and alarm with more recognizable icons
- New icons appear directly next to meetings they describe
- New repeat's icon uses "recycling" symbol
- New alarm icon is a 2-D clock

Removed Private

- Unobserved feature removed for space considerations

Help System

No interface could ever be foolproof. The Help System provides a safety net for when the inevitable failure occurs.



Safety Net

The help screen appears, strongly labeled, and provides direct links to all the possible actions on that page and deeper. After the user chooses an option, the help window closes and the button that links to the action the user indicated flashes. This both brings the desired action directly to the button and

keeps the user in the context of the page.

By adapting one of the existing hardware buttons to become a help button, Help becomes a universally accessible primary feature.

#	Redesign	Problem Table #s	Design Principles or Consolidated Problems
17	Hardware Help Button	5, 11, 35, *TA-04	Safety Net
18	Help title	Unobserved	Semantics/Semiotics
19	Choice wordings	Unobserved	Semantics/Semiotics Context
20	Direct User's Attention	Unobserved	Button to Action Context
21	Cancel Button	Unobserved	Action Standard

Conclusions

All of our design ideas either come directly from our usability data or are inspired by reasoning based on the trends we found within that data. Nearly all of our usability data went into the design generation process. The one exception was our Contextual Inquiry and Design, which produced data that dealt primarily with the planning and social aspects of scheduling software use. The CI data, while significant, involved planning tasks and coordinating with other people and these areas were outside our scope of merely editing the Palm calendar software with the existing hardware profile. The CI data stuck out amongst the others; it was extremely difficult to merge it into our main problem consolidation.

Also out of scope for our redesign were expert Palm users, but we did keep them in mind and tried not to destroy too much of the benefits the current Palm implementation gives them. A brief GOMS comparison of our redesign to the existing Palm showed that, while constraining a user's path limited their flexibility, it did not decrease their potential efficiency. Since Palms already support experts fairly well, we feel this is adequate consideration of the expert users.

These issues aside, our redesign has addressed the entirety of our problem definition with the full support of three months of usability data. We predict that the more desirable interaction of the ClearPath Palm will more than justify its implementation cost by its growth in the novice user market.

DESIGN RETROSPECTIVE

General observations

- HCI language is evolving
- Tradeoff between documentation and design
- Affinity diagrams are very useful

"HCI language is evolving"

Like other scientific disciplines, HCI has a distinct, professional vocabulary that sets it apart from other fields. It is critical for analysts to understand how to apply the terminology both to bolster HCI's external credibility and to apply its methods properly. But learning this vocabulary takes time, as we discovered early in the term. Even with practice, terms from the Keystroke Level Model (KLM) (ex. commands and arguments) and Cognitive Walkthrough (ex. effect, action, states) proved especially challenging to grasp. The terms are an awkward heritage from other disciplines and bygone times strangely juxtaposed with the world of Computer Science.

"Tradeoff between documentation and design"

We observed an interesting tension between the documentation process and design. HCI practice teaches us that data support is essential—we all embrace this point fully. But effectively documenting our design decisions to the extent that this course requires became a prohibitively time-consuming process. Given an economy of time, documentation ultimately consumed many of the resources that would have been better allocated to the design process. When the documentation process begins to impair design, the pendulum has swung too far in the other direction. One suggestion to

resolve this would be to include current HCI-support tools in the course (such as transcript coding software) that allows students to focus more on the analysis than administration in the assignments.

"Affinity diagrams very useful"

Though not a method itself, Affinity diagramming proved to be one of our most useful tools for transforming data into tangible design ideas. Affinity diagrams exposed crucial but hidden relationships in seemingly unrelated data, which provided organization for methods that lacked it, such as Contextual Design (CD). The diagrams also served as an effective way to vet our design process by distinguishing outliers from larger problem trends. Our recommendation for optimizing this method is to teach students to use Affinity diagrams to find patterns in everything.

Think Aloud

- User's thoughts reveal their approach
- Reality check against other methods

"User's thoughts reveal their approach"

Think-Aloud (TA) enabled our team to acquire a better understanding of our user's mindset. We watched our user, a novice to the Palm, struggle to complete a task that seemed easy for us. This wide discrepancy in our understanding of the task gave us a fresh perspective on how widely KLM experts and novices differ in their ability to accomplish goals. In effect, we learned another lesson from the HCI tenet "the user is not like me." Our user's efforts also demonstrated how novice users engage in problem solving to learn software for the first time.

However, our TA user's experience is not necessarily representative of all Palm novices. For the method to be effective, we suggest that it should always be applied to multiple users.

“Reality Check against other methods”

TA is most valuable when it is used in conjunction with other HCI usability techniques, specifically Cognitive Walkthrough (CW). CW required us to put ourselves in the users' shoes and make assumptions about their knowledge. The TA study confirmed that we cannot predict what users' will do or know—even with multiple CW paths—because the user is not like us. Our TA of a first-time Palm user showed that novices know much less about navigating a device and problem solving when they get lost than we expected. Conducting a TA after CW verified whether our user assumptions were still appropriate, as CW gave us a solid baseline that the TA refined based on those user assumptions.

Contextual Inquiry/Contextual Design

- CI provided rich, useful data
- Patterns lead to seeing the forest for the trees
- CD Models can be difficult to understand

“CI provided rich, useful data”

The Contextual Inquiry (CI) provided very rich data for our contextual design homework. Our CI data revealed important clues about our user's workflow, environment, and external cultural influences. We found the artifact models, in particular, solidified key

concepts in a concrete, understandable format, revealing how elements of the work dynamically interacted and interfered with the efficient completion of the user's tasks.

“Patterns lead to seeing the forest for the trees”

Consolidating models during Contextual Design directed discovery and analysis of unifying patterns in our data. By abstracting key concepts and determining the root causes of breakdowns in the overall flow, we generated innovative and creative solutions to major problems.

In particular, patterns discovered during our artifact consolidation fueled some exciting idea generation. We invented unusual, clever, and original solutions that successfully resolved breakdowns, but were still grounded firmly in our data.

Cognitive Walkthrough

- Everything depends on your user assumptions

“Everything depends on your user assumptions”

We learned that specifically defining user assumptions was crucial to the CW process because assumptions are the lens through which everything in CW is examined.

However, one complication of generating assumptions is that it required our subjective interpretation of the user's background knowledge, and generating incorrect assumptions can have a dramatic effect on the results. For example, we had to revise our CW entirely after making the faulty initial assumption that the user was familiar with the Palm interface given that she was a Graffiti expert.

Because the CW user was too abstract and not at all tangible, understanding what the user will do or will recognize is not very straightforward. Our suggestion is that the role-playing in the CW method should be tightly coupled with a data-derived persona so that analysis could be made of a real, understandable user. Teach your students to match their hypotheses to as many real users as they can.

Interaction Relabeling: Palm ZOO.0

- Added many other ways to judge products
- Unusual thinking led to creative designs

“Added many other ways to judge products”

The usability inspection methods we learned about (e.g. HE, CW, TA) focused on detecting flaws in a work process that led to inefficient use. In contrast, Interaction Relabeling refreshingly emphasized desirability, fun, creativity, emotion – many factors unrelated to task efficiency, time, or productivity. It was refreshing and important to remember that entertainment value can have a tremendous effect on whether a customer will choose to purchase a product and use it.

“Creative practice but not practical design”

Interaction Relabeling’s major advantage is that the method does not impose any physical, mental, economical, or logical constraints. This freedom introduced a level of emotion and drama which were absent in every other usability evaluation method. But it served more as an exercise than a proven method. It did not influence our redesign.

Keystroke Level Model

- KLM provides unexpected benefits
- Format and process can hinder effectively using KLM

“KLM provides unexpected benefits”

KLM forced us to evaluate the naked efficiency of tasks, bringing unexpected results. By concentrating on aspects of a button click—and not the button’s label—KLM stripped buttons of their semiotic presence, and judged them exclusively by efficiency. This focused analysis exposed a tradeoff between semiotic clarity and brute efficiency—and how designers often chose clarity—and a tradeoff between the expert and the novice.

The Keystroke Level Model (KLM) is usually used as a benchmark tool for judging experts’ performance on routine tasks. In our application of KLM to the Palm, we discovered that the model could also be used in other unexpected ways. Too many Ms for a given task on our model, for example, revealed possible cognitive load on users. Comparing the Corporate Time and Palm KLMs uncovered unnecessary steps. This detailed analysis of a sequence of operations helped us to recognize the repetitive nature of a task, and the detection of redundant terminators identified superfluous steps.

“Format and Process can hinder effectively using KLM”

We experienced frequent problems trying to comprehend and apply KLM’s rules and guidelines. Understanding whether an action is a command or argument is straightforward for the command-line interfaces popular when Stuart Card, Thomas Moran, and Allan Newell designed KLM. However, the difference between a command and an argument for a GUI is much less clear and subjective.

Another related issue is the ambiguous phrasing of KLM's rules. While modeling a KLM, we constantly needed to refer back to those rules to decipher their meaning.

Heuristic Evaluation

- Independent evaluation identified different problems

“Independent evaluation identified different problems”

When performed in a group without specific directions, HE revealed a surprisingly rich but disjointed variety of usability problems. The UARs generated were as varied and differently focused as the evaluators themselves. We can see how multiple rounds of HE, as Nielsen suggests, would make the method more valuable. A second round more focused on a particular aspect or application would have added depth to the vivid breadth a single pass created.

Conclusion

Evaluations immediately after using the methods elicited many of the thoughts that comprise this retrospective. Reflective time was not structured into the class, and we lacked the time to properly investigate how the methods build upon one another, or to state perfectly when a method is more appropriate than another method. In professional environments, we will be asked to make on the spot decisions and recommendations. Our suggestion is to provide more practice in allowing students to decide which method to apply for a given situation.

Appendix A

Aggregated Problem Table

	User Problems	Description	Explanation	Evidence
1	Unclear icons	Icons are inconsistent, small, hard to find, or do not map to meaning consistent with other applications or the real world.	While looking at the Home display of the Palm, the user referred to the calculator icon as "dice with numbers".	sd-HE-15 sd-HE-01 jsk-HE-11 smr-HE-08 pab-HE-01 jsk-HE-10 CW – 07 TA-01
2	Too much customization for button mapping	The ability to customize application buttons in preferences is unnecessary, inconsistent, and unintuitive.	Customizing a system application button was not part of the Think-Aloud task. Note: <i>If a prediction was not explicitly supported by the Think Aloud, we assumed "No Evidence".</i>	sd-HE-13 jsk-HE-04 jsk-HE-03
3	Helpful defaults	The system defaults meeting times to a single hour, which matches real-world practice and allows for efficient use.	When the user changed meeting start time to 10am, the default setting automatically changed the meeting end time to 11am, saving the user added steps and reducing the possibility of further error with the AM/PM confusion.	sd-HE-02 sd-HE-03 TA Video [9:03]
4	Menus are not visible	The system wide preference menus are not visible.	The user did not explore the system preference menus. Note: <i>If a prediction was not explicitly supported by the Think Aloud, we assumed "No Evidence".</i>	pab-HE-08 jsk-HE-05 sd-HE-01
5	Inconsistent Help display and system	The help buttons and icons are inconsistent. Some are *i*s, some are *?*s, some are labeled "tips".	During the task, the user expresses a need for a manual (or further instruction). The user did not notice that help was available on almost every screen he used.	jsk-HE-13 jsk-HE-15 TA Video [1:37]
6	Lack of exit	The Welcome application provides an inconsistent exit strategy, where completion is not obvious or clear.	The user did not explore the Welcome application during the Think Aloud task. Note: <i>If a prediction was not explicitly supported by the Think Aloud, we assumed "No Evidence".</i>	smr-HE-09 eh-HE-04 pab-HE-03

	User Problems	Description	Explanation	Evidence
7	Where & when to use graffiti	Graffiti is universally accessible, but users can't enter text or numbers on every screen.	The user was instructed to use keyboard and did not use Graffiti. Note: <i>If a prediction was not explicitly supported by the Think Aloud, we assumed "No Evidence".</i>	smr-HE-01 eh-HE-11
8	Good graffiti shortcuts	Shortcuts and accelerators in Graffiti support efficiency in expert users.	The user never used keyboard shortcut and accelerator features for Graffiti. Note: <i>If a prediction was not explicitly supported by the Think Aloud, we assumed "No Evidence".</i>	smr-HE-07
9	Based off real-life artifacts	Calendar month view looks like a real-world artifact that translates well in the interface.	The user understands calendar views and uses them to scroll through time.	jsk-HE-02 eh-HE-02 TA video [2:40]
10	No OK or Apply button	User doesn't know if the system will save their inputs if they switch views.	During the task, the user identified and clicked on <OK> easily and independently.	smr-HE-06 pab-HE-02 ! TA Video Refutes [1:44]
11	Inconsistent help availability	It is standard to offer online help and documentation per Nielsen's heuristic #10.	The user specifically asks for help while viewing the to-do list, but cannot locate help. Online Help is available, but not noticed by the user (see analysis #5).	smr-HE-02 jsk-HE-09 TA Video [0:50]
12	Inconsistent Drop-down display	Drop-down displays vary from screen to screen. Some use a down arrow, some have hash marks around the field, and some have hyphens.	The user had no problem manipulating various forms of drop-down menus.	eh-HE-07 eh-HE-10 smr-HE-05 jsk-HE-14 jsk-HE-06 ! TA Video Refutes [2:20, 15:01, 18:06]
13	Lack of undo or redo	Users don't have a clear undo/cancel option.	The user never expressed any desire for or used the undo feature. Note: <i>If a prediction was not explicitly supported by the Think Aloud, we assumed "No Evidence".</i>	sd-HE-11 smr-HE-10

	User Problems	Description	Explanation	Evidence
14	Mis-naming	Naming conventions for buttons, menus and functions are inconsistent and often misleading.	The user confuses date book and calendar icons.	jsk-HE-12 jsk-HE-07 eh-HE-06 smr-HE-04 jsk-HE-01 jsk-HE-08 sd-HE-10 CW - 05 CW - 06 TA - 01 TA - 02 TA - 03 TA - 05 KLM-3
15	Graffiti commands confusing	Graffiti commands are hard to use and are not forgiving to the user when they make mistakes.	The user does not use Graffiti during the Think Aloud task. Note: <i>If a prediction was not explicitly supported by the Think Aloud, we assumed "No Evidence".</i>	smr-HE-11 pab-HE-09 sd-HE-05 sd-HE-06 sd-HE-07 sd-HE-08
16	Global inconsistencies	There is no single system-wide password, but instead, specific passwords for local applications.	The user's Think Aloud task does not include any system functions that include security features. Note: <i>If a prediction was not explicitly supported by the</i>	pab-HE-04 pab-HE-06 sd-HE-12
17	Don't know where to click on scroll bar	Users have no visual cue to tell them where to click on the scroll bar to move up or down.	The user's task does not include any system functions that require scrolling with scroll bars. Note: <i>If a prediction was not explicitly supported by the Think Aloud, we assumed "No Evidence".</i>	sd-HE-14

	User Problems	Description	Explanation	Evidence
18	Appointment error has good solution	The system forces the user to select a meeting before clicking <details>, and if the user does not, the system provides an error message stating "You must have a record selected to perform this command."	The user has a problem understanding this error message and how to correct the situation.	sd-HE-04
19	Set time columns easy to confuse	Novice users can become confused by the hour and minute columns when setting meeting times.	The user was able to change meeting start and stop times using the hour and minute columns.	eh-HE-03
20	No warning message for conflicting meetings	Users can create meeting conflicts accidentally without a warning.	No prior possible conflicting meeting data existed on the Palm emulator used for the Think Aloud task and the user task included only one meeting.	eh-HE-05
21	Adding notes an inconsistent feature	The new note function is different from screen to screen.	The user did not use Notes in the Think Aloud task. <i>Note: If a prediction was not explicitly supported by the Think Aloud, we assumed "No Evidence".</i>	jsk-HE-16
22	Constant access to home functions	The user has one-tap access to the home screen, no matter where they are in the Palm.	The user lost his way and used the Home button to find his way back to the desired application.	pab-HE-12
23	Effective home screen	The Palm Home screen displays all applications, so the user doesn't have to recall the options.	The user cannot find the calendar from the Home screen, even with presence of all functions.	pab-HE-14
24	Too hard to delete files	The Palm does not allow standard (or even logical) methods of record deletion.	The Think Aloud task did not include record deletion. <i>Note: If a prediction was not explicitly supported by the Think Aloud, we assumed "No Evidence".</i>	pab-HE-07

	User Problems	Description	Explanation	Evidence
25	Simple/Minimal interface	The majority of screens shown to the user show only a minimum amount of data and interaction capabilities.	The user encounters difficulty while searching for several functions and is unable to locate the needed functions. Either the Palm interface is not in fact simple, or the design is overly minimal as to lack sufficient information to support task completion.	pab-HE-13
26	Inconsistent set time display for new meetings	The Preferences Set Time display looks completely different than the meeting Set Time display. Both are labeled Set Time.	The user's Think Aloud task does not include setting system time in Preferences. The user only sees a single view of setting time for the meeting.	eh-HE-01
27	Calendar day view indicates time, but not AM or PM	Users can select a meeting after 6pm and it displays on the day view without any differing indicator between morning and evening	The user does not set an evening meeting time. <i>Note: If a prediction was not explicitly supported by the Think Aloud, we assumed "No Evidence".</i>	eh-HE-08
28	No obvious system cues for order of operations to set meeting	In the Calendar day view, after clicking an hour, the system only offers a small blinking cursor to suggest that the next step is to enter the meeting name. After the name is set, the system does not prompt the user for further input.	<i>*Note:</i> The user expresses hesitation over how to set intervals after entering "SAUI". Then, the user stumbles upon the <shift> click shortcut on the Palm emulator (which would not apply to the real Palm), eliminating the need for them to discover how to configure a meeting.	CW-01
29	Calendar day-view hours do not appear clickable	Not all button areas have consistent look. Some have round edges while others are square. Some have solid and others have dashed borders.	The user does not have a problem clicking non-standard buttons. He selects days in the month-view calendar, and hours in the day-view calendar.	CW-02
30	Tapping end time field is not an obvious next step	The system does not provide guidance to users for entering meeting end times after setting the meeting start time.	The user sets the meeting end time without difficulty.	CW-03

	User Problems	Description	Explanation	Evidence
31	Problems with caps-lock feedback	Graffiti automatically capitalizes the first letter of every new entered word so a single up-stroke (which would normally indicate pressing *shift*) does not display system feedback, and has no real function.	The Think Aloud task does not include graffiti. Note: <i>If a prediction was not explicitly supported by the Think Aloud, we assumed "No Evidence".</i>	CW-04
32	Identifies unnecessary intermediary steps	Information architecture and small screen size force extra steps.	To set the meeting frequency, the user has to go details >> frequency.	KLM-1
33	<caps lock> redundant upstroke	There are extra steps in many places, the caps lock shortcut being among the most noticeable.	User is forced to use a two step command to set the caps lock when typing things like 'SAUI'.	KLM-2
34	Multiple M's reveal cognitive load	Multiple windows opening on top of each other forces extra mental processing.	M's occur often at screen changes, thus layering of windows adds extra mental processing.	KLM-4
35	4 main buttons underutilized	This means that important real estate is being ignored.	They were not used in our KLM representative task.	KLM-5
36	Too many double-taps	The small screens and layered windows force redundant terminators like this.	Hitting <ok><ok> is redundant.	KLM-6
37	No tools to work together	Difficult to share information between users and their applications and data stores that they employ.	Other than email, user's artifacts do not have any collaborative ability - sticky notes & Corporate Time & physical artifacts.	CD-1
38	Balancing workload	User double booked meetings, had tons of meetings - can't keep up with it.	Role strain on user's scheduling.	CD-2
39	Paper is better sometimes	User used cheat sheets and post-it notes to arrange information at start of meeting.	Some data did not have need for permanence, but did have need for high visibility for current work.	CD-3

	User Problems	Description	Explanation	Evidence
40	Disconnected information	User had information about one meeting stored separately in multiple applications.	Email and Calendars in particular had no direct link, thus looking up info for a meeting was difficult.	CD-4
41	Can't understand colors	Corporate Time colors were not understandable or rememberable.	User kept a custom sticky to say which colors meant what - she gave up priority data for category info (types of meetings).	CD-5
42	Easy to ignore meeting conflicts	User was not warned when meetings overlap.	When creating meetings, user had turned off warnings for times when she creates overlapping meetings - this was a coping strategy because so much HAS to overlap. Also, culturally she HAD to set multiple meetings at the same time.	CD-6
43	User doesn't know security settings	User doesn't know and doesn't care who else can read and write to her Corporate Time schedule.	User is too busy, it's not important enough for her to care, and it has not yet been a problem.	CD-7
44	User switches between tools	It is difficult to bring information into user's Corporate Time schedule.	Email and stickies, for instance, contain lots of data the user wants associated with events, but it's hard to add that data to events.	CD-8
45	Setting aliases is unnecessary	Some functions are unnecessary, but convince the user to fall into unproductivity by using them.	User goes to the trouble of setting aliases for contacts when it is unnecessary - like when she makes one for Peter Centgraf.	CD-9
46	Corporate Time calendar fails to show weekend	The calendar does not show weekend or night events.	User missed several such events, especially since user did not use laptop on weekend.	CD-10
47	Other people can't see user's schedule	Access to user's calendar is limited to herself and some for her secretary.	By design, the user forces students to be bottlenecked by secretary, and user must preserve her free time.	CD-11
48	Hard to see the big picture effectively	User could not see activity across the entire semester on just a screen.	This is important since the user made a physical artifact to accomplish this task.	CD-12

	User Problems	Description	Explanation	Evidence
49	Missing information	User was never given or had lost lots of information, causing a continuous need to request additional information to complete tasks.	User shouts down hallways and writes emails to gather additional needed information.	CD-13
50	No effective way to make tentative meetings	Tentative meetings are not well supported.	User puts a question mark into the meeting titles of tentative meetings.	CD-14
51	Buttons are complex	User performed set sequence without ever understanding why.	List Dates button on new meeting screen was strangely necessary to click.	CD-15
52	Functions unclear	User had to make a new semantic meaning to colors - gave it to her secretary too.	User was not aware of the meaning of the colors that Corporate Time used.	CD-16

Appendix B

Consolidated Heuristic Evaluation UARs

	Combined Aspect Statement	Description	Heuristics Violated	Individual UAR's referenced
HE-01	Unclear Icons	The icons are inconsistent internally to system as well as externally to the real world	Match between system and the real world, Consistency and standards	sd-HE-15, sd-HE-09, jsk-HE-11, smr-HE-08, pab-HE-01, jsk-HE-10
HE-02	Too much customization for button mapping	The ability to customize buttons is unnecessary, inconsistent, unintuitive, and overly used	Match between system and the real world, User control and freedom, Consistency and standards	sd-HE-13, jsk-HE-04, jsk-HE-03
HE-03	Helpful defaults	These are both good defaults that allow efficient use	Match between system and the real world, Flexibility and efficiency of use	sd-HE-02, sd-HE-03
HE-04	Menus are not visible	The menus violate standard GUI practice of showing all functionality that is available	Recognition vs. recall, Consistency and standards	pab-HE-08, jsk-HE-05, sd-HE-01
HE-05	Inconsistent Help display and system	The help buttons and icons are inconsistent. Some are I's, some are ?'s, some are labelled tips	Consistency and standards	jsk-HE-13, jsk-HE-15
HE-06	Lack of exit	Inconsistent exit strategy, if exit is allowed, on the Palm	User control and freedom, Visibility of system status	smr-HE-09, eh-HE-04, pab-HE-03
HE-07	Where & when to use graffiti	Users don't know when they can enter text or numbers and expect to be able to use graffiti in multiple areas	Visibility of system status	smr-HE-01, eh-HE-11

HE-08	Good graffiti shortcuts	Shortcuts and accelerators support efficiency in expert users	Flexibility and efficiency of use	smr-HE-07
HE-09	Helpful defaults	These are both real-world artifacts that translate well in the interface	Match between system and the real world	jsk-HE-02, eh-HE-02
HE-10	No OK or Apply button	User doesn't know if the system will save their inputs if they switch views	Visibility of system status	smr-HE-06, pab-HE-02
HE-11	No help	It is standard to offer online help and documentation per HE10	Consistency and standards, Help and documentation	smr-HE-02, jsk-HE-09
HE-12	Inconsistent Drop-down display	Drop-down displays vary from screen to screen. Some use a down arrow, some have a hashmark, and some have hyphens.	Consistency and standards	eh-HE-07, eh-HE-10, smr-HE-05, jsk-HE-14, jsk-HE-06
HE-13	Lack of undo or redo	Users don't have a clear undo/cancel option	Error prevention, User control and freedom	sd-HE-11, smr-HE-10
HE-14	Mis-naming	Naming conventions are inconsistent and often misleading	Match between system and the real world, Consistency and standards	jsk-HE-12, jsk-HE-07, eh-HE-06, smr-HE-04, jsk-HE-01, jsk-HE-08, sd-smr-HE-11, sd-HE-06, pab-HE-09, sd-HE-08, sd-HE-05, sd-HE-07
HE-15	Graffiti commands confusing	Graffiti commands are hard to use and are not forgiving to the user when they make mistakes	Recognition vs. recall, Consistency and standards, Error prevention, Flexibility and efficiency of use, Help and documentation	
HE-16	Global inconsistencies	Local access to security features menu function, and find function is not globally consistent	Consistency and Standards, Match between system and real world	pab-HE-04, pab-HE-06, sd-HE-12

HE-17	Don't know where to click on scroll bar	Users have no visual clue to tell them where to click on the scoll bar	Match between system and the real world	sd-HE-14
HE-18	Appointment error has good solution	Error message give user a clear solution	Error recovery	sd-HE-04
HE-19	Sometimes there is no scroll bar	This is inconsistent with the rest of the system and prevent visibility of reading progress to the user	Visibility of system status	pab-HE-05
HE-20	Set time columns easy to confuse	Novice users can become confused by the hour and minute columns when setting meeting times	Error prevention	eh-HE-03
HE-21	No warning message for conflicting meetings	Users can create meeting conflicts accidentally without a warning	Error recovery	eh-HE-05
HE-22	Adding notes an inconsistent feature	The new note function is different from screen to screen	Consistency and standards	jsk-HE-16
HE-23	Constant access to home functions	No matter what, user has one-tap access to fully functional home screen.	User control and freedom	pab-HE-12
HE-24	Effective home screen	Palm follows good GUI design in showing all functions immediately so user doesn't have to recall possibilities	Recognition vs. recall	pab-HE-14
HE-25	Too hard to delete files	Palm does not allow standard (or even logical) methods of record deletion	Consistency and standards	pab-HE-07
HE-26	Simple/Minimal interface	The majority of screens shown to the user show only a minimum amount of data and interaction capabilities	Aesthetic and minimalist design	pab-HE-13
HE-27	Button to adjust contrast doesn't fit	Preferences and settings have a standard place of access, thus the extra physical button for controlling contrast doesn't fit in	Consistency and standards	pab-HE-11

HE-28	Inconsistent set time display for new meetings	The set time display has drop down arrows to select time and the Set Time for meetings uses columns.	Consistency and standards	eh-HE-01
HE-29	No AM/PM indicator on day view	Users can select a meeting after 6pm and it displays on the day view without any differing indicator between morning and evening	Visibility of system status	eh-HE-08

Appendix C

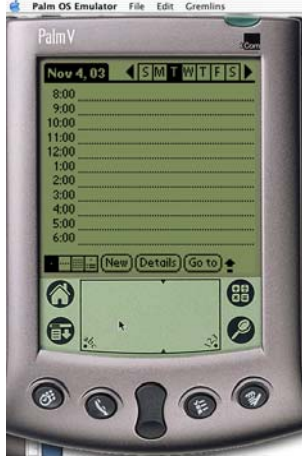
Cognitive Walkthrough UARs

No. CW-01

Problem

Name: No Indication that setting start and end times is the next step

Evidence:



Step 4, Question 1; the group came to a consensus on this point. It is not clear that setting of the start time and end time is the next step in the sequence.

Explanation:

The system fails to provide indication that setting of the start time and end time is the next step in the system. In many scheduling applications, entering a meeting for users starts with entering the meeting name. This interface provides indication that entry begins with meeting title (the dotted line indicates entry) rather than with the setting of meeting times.

Severity or Benefit:

2 - There are multiple ways to bring up to the set time screen so this is not a fatal issue. However, it does cause a fast way of getting to the Set Time screen to be hidden.

Possible solution and/or trade-offs:

Provide indication that that buttons are clickable; use dotted underlining underneath the hour labels.

Trade-offs:

The recommended solution requires screen real estate; this happens to be extremely limited here. This change might allow fewer hours to be displayed on the screen at once. Adding any more visual complexity to the interface might make it too complex for users.

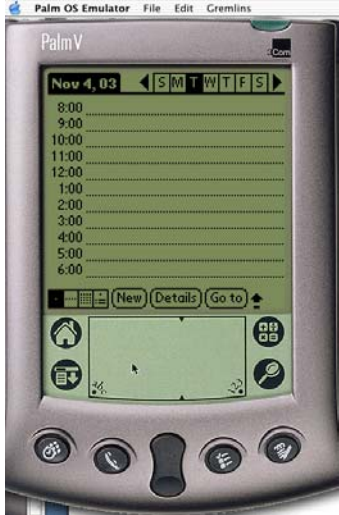
Relationships:

CW-02

No. CW – 02	Problem
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Name: Lack of affordances, standards for clicking on time

Evidence:



Step 4, question 3. Group came to consensus on this point. It is not clear that clicking on the time will yield any actions.

Explanation: Other buttons on the screen provide more explicit and meaningful linkage to the effect that the user is trying to achieve. No GUI standard indicates that the hours are clickable elements.

Severity or Benefit:
2 - This is not a fatal problem as there are other ways to achieve the same and similar effects. However, this is a particularly efficient way to set a meeting and it is not entirely obvious.

Possible solution and/or Trade-offs:
Provide underlining beneath the hour labels.

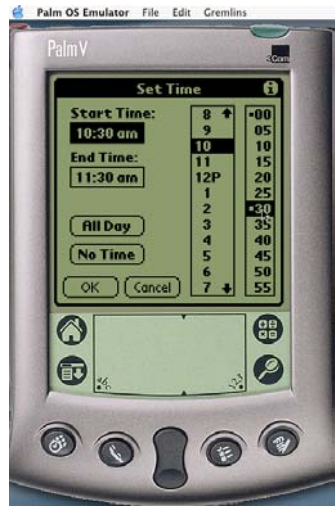
Trade-offs:
This may bring increased visual complexity and clutter and in turn confuse users. This change might allow fewer hours to be displayed on the screen at once. Adding any more visual complexity to the interface might make it too complex for users.

Relationships:
CW-01

No. CW-03 Problem

Name: Tapping end time field is not an obvious next step

Evidence:
Step 6, question 3
Group came to consensus on this point. It is not obvious that clicking the End Time box is the way to get to the next step.



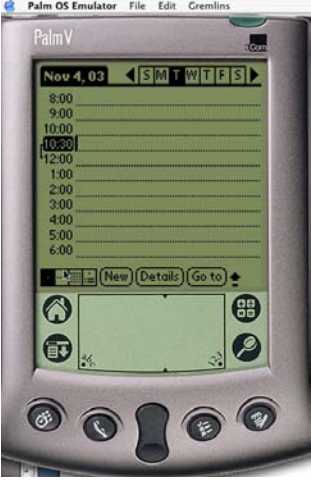
Explanation: It is not obvious that the “End Time” field is clickable; The field is close to buttons that follow GUI standards better and are more clearly clickable.

Severity or Benefit:
3 - This has the potential to cause some confusion. As it stands, the user cannot determine how to set end time correctly. This should be addressed.

Possible solution and/or Trade-offs:
Use a border that indicates that the field is clickable. This could be the dotted border used elsewhere in the Palm GUI. Also, the window title should be changed from “Set Time” to “Set Times” to indicate that the this box is used for setting both start and end times.

Trade-offs:
This may cause visual inconsistencies; solid borders surround the number and hour columns.

Relationships:

No. CW – 04	Problem
Name: Problems with caps-lock feedback	
<p>Evidence: Group came to consensus on this point. Step 10, number 4. The icon to indicate caps-lock (an upwards arrow missing a small piece) is not totally clear.</p> 	
<p>Explanation: There is minimal feedback after caps-lock strokes. After two strokes an upwards arrow missing a small piece appears. This is not a well known GUI standard and does not indicate that caps-lock has been activated.</p>	
<p>Severity or Benefit: 3 - This has the potential to confuse and disorient users. The iconography is neither highly indicative nor intuitive.</p>	
<p>Possible solution and/or Trade-offs: Provide a more obvious feedback to indicate that caps-lock is enabled and differentiate between caps and caps-lock. We propose an uppercase letter “a” to indicate that caps is enabled, and a letter “a” with a lock next to it to indicate caps lock mode.</p> <p>Trade-offs: This may be a confusing mapping; users may understand current implementation better. They may confuse the lock with some sort of security feature.</p>	
<p>Relationships:</p>	

No. CW – 05

Problem

Name: Details button is confusing for this task

Evidence:



Step 12, question 3. Group came to consensus on this question. The details button will confuse the user.

Explanation:

All the properties of a meeting, including repeating properties, are accessible via the “Details” button. This is probably done because system can’t provide buttons for each function that it provides given screen size.

Severity or Benefit:

3 - It works but it does not provide clear or easy access to the repeating meeting settings. This makes the task more difficult to achieve than it probably should be.

Possible solution and/or Trade-offs:

Provide an “R” icon that directly addresses the task of repeating meetings that is separate from other event details.

Trade-Offs:

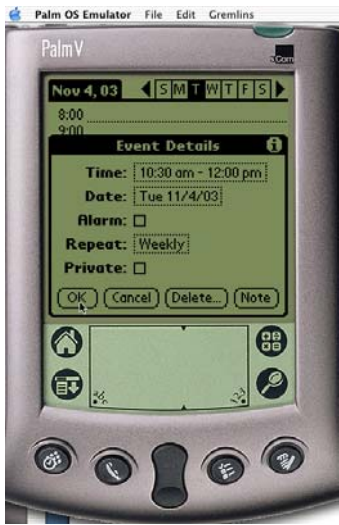
While it provides a clearer link to the repeating meeting option, this introduces increasing visual complexity to the interface.

Relationships:

No. CW – 06	Problem
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Name: Indication of repeating meeting success not significantly noticeable

Evidence:



Step 19, question 4: Group came to a consensus on this point. There is not enough feedback that the task has been completed successfully.

Explanation:

After the process of setting a repeating has been complete, the indication that this has been done is minimal. The text in the repeat box changes from “weekly” but this change is not entirely obvious.

Additionally there is an issue with the “Event Details” window being hidden behind the repeating meeting window.

Severity or Benefit:

3 – Lack of indication of success might be frustrating. Users need clear notice that they completed the task correctly.

Possible solution:

Put an icon indicating daily, weekly, or monthly repetition next to the “Repeat” status box. These icons should be the same as the icons used to switch between day, week, and month modes in calendar view mode. Additionally text should tell the user the details of the meeting rather than just the generic repeating meeting type.

Trade-offs:

This might increase visual complexity and make it more difficult to comprehend the details of a meeting.

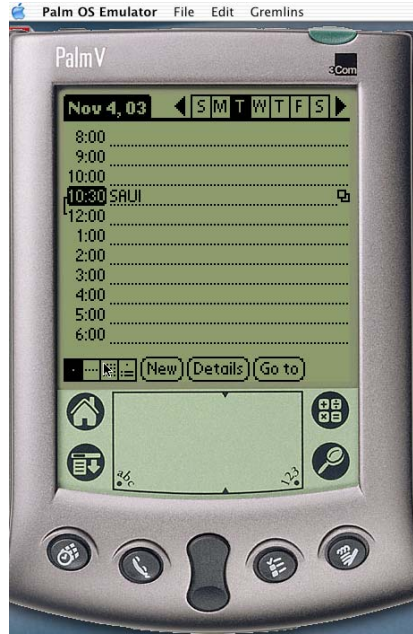
Relationships:

No. CW – 07

Problem

Name: Indication of task completion is poor

Evidence:



Step 20, question 4: Group came to a consensus on this point. The indication provided by the small “repeating” icon does not sufficiently provide information that the task has been completed successfully.

Explanation:

The icon used to indicate success in this task is small, obscure, and abstract. It is located to the right of the screen in a location that may not be in a position that the user will be looking at actively.

Severity or Benefit:

3 – There is some indication that the task was completed as planned but it is fairly obscure and might be confusing to users.

Possible solution:

Change this icon to 'R' or a little circular recycling symbol (see the outlook repetition icon), and move it over just to the left of the meeting name, so that it is more obviously tied to the meeting.

Trade-offs:

This change might obscure the task of scanning meetings. It might also cause the repeating icon to be less visually isolated and obvious.

Relationships:

Appendix D

Consolidated Think Aloud UARs

Combined UAR no.	Combined Aspect Report	Evidence (Video time)	Individuals Referenced
TA-01	Meaning of Date Book icon unclear – User does not know that the Calendar is called the “Date Book”.	00:05-00:53 00:01:27 00:01:36 00:03:31 00:05:09-00:05:36	EH-TA-01 SR-TA-01 JK-TA-01 PAB-TA-01
TA-02	Calendar does not clearly distinguish day hours from evening hours – AM and PM identified as “12A” and “12P”.	00:05:47 00:06:16-00:06:33 00:06:42-00:06:44 00:06:54-00:07:12 00:07:33-00:07:35 00:08:06 00:08:19 00:08:43-00:08:56 00:09:08-00:09:40 00:10:30 00:16:48	EH-TA-04 PAB-TA-02 SR-TA-02 SD-TA-01 JK-TA-02
TA-03	Day, week, month, and To Do view buttons unclear – User does not distinguish what the buttons do.	00:10:01-00:10:13	EH-TA-03 SR-TA-03

<p>TA-04</p>	<p>Repeat function hard to locate – User unable to quickly locate the repeat button which is hidden under Event Details.</p>	<p>00:03:35-00:03:39 00:04:08 00:04:27 00:04:39-00:04:48 00:05:47 00:09:59 00:10:25 00:10:58-00:11:08 00:11:24-00:11:29 00:12:10-00:12:39 00:14:04-00:14:09 00:15:22 00:15:53-00:16:00 00:16:08-00:16:09 00:16:16 00:16:30 00:17:55 00:18:18 00:18:35 00:19:56 <i>00:06(07WrapUp)</i></p>	<p>PAB-TA-03 EH-TA-02 SR-TA-04 SD-TA-02</p>
<p>TA-05</p>	<p>User does not know what a record is – System uses terminology that the user does not understand.</p>	<p>00:01:58-00:02:14 00:19:30 to end of video clip</p>	<p>SR-TA-06 JK-TA-03</p>