Livescribe Pulse™ Smartpen- Attracting First-Time Users

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Introduction

The Livescribe Pulse smartpen utilizes the latest technology to introduce a new and innovative way to write and review notes. It uses a dot-positioning system, an infrared camera, and a built-in microphone to digitally capture handwritten notes and record audio. After users transfer the recorded sessions onto their computer, they can replay their notes and review them while listening to the audio recorded at the time, as if they were reliving the lecture.

We were interested in the Pulse smartpen because we are all college students and we wanted to see how this tool could enhance our note-taking experience. We each experienced difficulties in jotting down the right information while listening to a professor speak in class. The smartpen is able to capture audio as well as handwritten notes, and it would be very useful to have a more informative set of notes to help study. In addition, because it is a very new product, there were sure to be many issues associated with the technology, and we wanted to find out what they were.

Our choice to implement Rapid Contextual Design (RCD) was prudent since that the product had just been released. The short time we had left in the quarter was just enough for a Lightning Fast RCD with which to tackle various issues with technology use.

We first observed the differences between the use of the smartpen versus a regular ballpoint pen. This would include every moment starting from the user's initial contact with the pen to the user's learning of the pen, and concluding with the user's regular everyday adjustment to the pen.

Methods

We immediately encountered several issues with the interview process. At first, we were not sure as to what extent we could trust our participants with the pens, mainly because of the high cost of the device. As an alternative to giving our participants the pen ahead of time, we provided each of them with electronic versions of the Getting Started Guide (GSG), which is included upon pen purchase, and the Pulse Smartpen User Manual (UM) and Livescribe Desktop Manual (DS), which are available for download regardless of purchase. The users were instructed to read as much of the documentation as they would if they had purchased the Pulse themselves. At the time of the interview, users were asked to honestly report which documents they had read, if any, and how much of them they looked at.

All 10 of our initial contextual interviews took place with participants that were first-time users of the product. The participants included undergraduate students from various disciplines, including Bioengineering, Sociology, and Computer Science. The participants were from different contexts with various levels of technological expertise and note-taking techniques. By using participants from different contexts, we were able to capture a better variety of data. This was important for determining underlying user patterns and behaviors for the RCD process.

Our contextual interviews began by meeting with users in person at least 15 minutes before lecture. If they were not given the Pulse the day before, users received it during this 15 minute pre-interview and we answered any questions they had while maintaining a master-apprentice relationship, wherein users were the masters. Our interviews

consisted of observing participant interaction with the pen, especially successes and breakdowns, and how they used the pen to enhance their note-taking experience. Users were asked to pretend as if the interviewer were absent, leaving them no troubleshooting assistance, to simulate a true first-time user-who-had-just-bought-the-pen experience. As part of their interaction with the pen, we also observed how the participants used their available documentation and resources, such as the GSG and the UM, as part of their troubleshooting procedures.

After lecture, our interviews concluded with a 15 minute debriefing, where participants had the opportunity to ask any questions and share feedback on the experience. The interviewers also had the chance to confirm and clarify any interpretations assessed during the interview. This is important during the RCD practice toward making sure that true user practice is captured and conveyed appropriately into the interpretation sessions.

Interpretation sessions were conducted within 48 hours of each interview by at least three group members. After completing several interpretations, we began to see several patterns across users. We also decided to shift our focus toward more advanced users as the novice data we acquired would only reveal patterns common to new technology use. We were able to obtain 4 advanced users; 3 were new ones and 1 was a user from our original set of contextual interviews. We conducted less formal interviews with the advanced users as we observed them for shorter times, at least 30 minutes, as they watched a podcasted lecture. One un-interviewed user was present during most of our meetings and contributed his findings informally. Doing this helped us focus on any patterns of advanced use toward which novice users could be focused.

Results

Our contextual interviews revealed several issues our users faced while interacting with the Pulse. We found many common patterns between our users, such as not reading the official 85-page UM. Other patterns, such as use of the headphones, revealed conflicting opinions. All the patterns we observed helped in inspiring redesigns.

Pulse Smartpen Orientation

User Manual

None of our eight novice users read the 85-page UM before using the pen. While almost all of them had glanced at the GSG, not a single one had browsed the UM before their interview. User 01 (U01), with who m we had multiple Pulse pen interviews, entered a search the Adobe PDF file of the UM after several interviews to find the section on Pulse Quick Commands, which are shortcuts to access certain functions.

Our three advanced users, U09, U10 and one uninterviewed user, browsed the manual several weeks after light use of the pen to become more familiar with the Pulse. They found the UM contained information that they felt was important to even basic use, such as "Warnings". Warnings about the Pulse were placed on page 73 of the UM, and contained cautions against dropping the device, which could "severely damage it or prevent it from working properly." Overall, though, users felt that reading the UM did not change much of their note-taking routine compared to their previous experience. U09 discovered that he could simply begin recording sessions by holding down the Pulse

power button for 5+ seconds, which he preferred over tapping a record button. Aside from these findings, none of the three found the UM to be helpful in making them advanced users.

Getting Started Guide

Our novice users often referred to the GSG to orient themselves to the Pulse, rather than reading the UM. All ten users read or skimmed the GSG before using the pen, if not before their interview then shortly before lecture. Several users referred back to it during their interview to look for specific, basic information. U03 said that he skimmed it in order to "learn the basics", and U05 felt that "everything important about the pen should be in the Guide."

Despite our users' constant reference to the GSG, complications still arose. The GSG did not show users how to set up basic Pulse functions in enough detail; U07 referred to the "Tips & Tricks" section to learn how to use the neck strap but placed it around his neck instead of properly draping it behind his shoulders. Many users felt uncompelled to read the GSG in detail, often skimming and overlooking the “Tips & Tricks” section, which is placed on the outer side of the GSG. U01, U02, and U05 attempted to use the headphones and neck strap, but either needed assistance or gave up because they did not know how to set it up; none of the three looked at the Tips & Tricks in the GSG.

Some users read rather than skimmed the GSG, but did not fully absorb all of the information. U05, who is left-handed, recalled seeing a section about display orientation in it. He referred back to it to learn how to change the orientation, but instead of interacting with the buttons in it, which have orange arrows pointing towards them saying "Tap this button!", he tapped the display orientation button on the inside cover the notebook. U08 reported reading the GSG thoroughly before her interview, but still inadvertently covered the infrared camera on the pen. When informed that she was covering the camera, she said "I thought it was just a comfortable resting spot for my fingers." Despite the information contained in the GSG, users still had problems with Pulse pen use.

Paper Replay Basics

The Paper Replay Basics page (PRB) helped orient some users to the Pulse, but there were mixed reactions to it. Half the users did look at it before their Pulse note-taking interview, but only U08 read it thoroughly. She seemed to find it particularly helpful, reviewing parts of it during her class to better understand the Paper Replay function. She also commented, however, that "it was too busy" as the parts to interact with were not explicitly separated from the page's "boring appearance". None of the novice users interacted with the PRB page much. Several tapped parts of the page to listen to the audio explanations, but none experimented with writing and recording before their class. U03 had skimmed and listened to the beginning parts of the PRB page, but still had to be reminded by the interviewer to press record when lecture began. One user did not read the page at all, as he felt it was "too much to read."

When class began, several users had difficulty initiating a recording session. U01, who did not read the PRB page, and U03, who did, both had to be prompted to press record, but found the correct button at the bottom of the page with relative ease. U04 did not read the PRB but explored the inside-notebook cover extensively, and pressed

"record" on the Interactive Controls replacement-sticker page recording; she was not aware that the button was placed on the bottom of each notebook page. Several users did not stop the session by pressing the "stop" button, but instead pressed the Power button on the pen. We found that not all of our users knew how to properly begin and end a Paper Replay session, and that this occurred even despite some of the looking at the PRB.

The manuals and guides to the Pulse smartpen were found to be inadequate in their ability to orient novice users to the new technology. Not all of the necessary information was in the places our users relied on, and some of it was overlooked even if it was in the right place. Our advanced users found that the UM did not help much in teaching them advanced methods of the pen use, either, but discovered important and useful information that they felt should be in the shorter guides.

Pen Structure

Bulkiness

The pen structure was particularly problematic for users. Three of the novice users explicitly complained about the pen's bulkiness, and all three agreed. U09 said that he gets hand cramps during his classes when taking notes with the Pulse. Unfortunately, the technology within the Pulse necessitates its size, but other structural problems arose, too.

Rolling

The pen is round, which means that it tended to roll when placed on an incline. Three novice users placed the pen on top of their notebook during class and found that it rolled to the screen-side down position. U02 found this particularly annoying, as he liked to view the timestamp on the screen, and continually had roll the pen in order to read it. Our expert users had several experiences of the Pulse rolling rapidly off of a table and onto the floor, which caused a considerable amount of concern.

Power Button

The pen's appearance obscured the power button for two of our users. Because the button is on top of the display screen and is colored the same as the rest of the pen, U05 said it was "not very obvious." However, U07 had no difficulty finding the button, as she had examined the diagram of the Pulse in the GSG.

Ink Cartridge Replacement

Users who were faced with the task of replacing the Pulse ink cartridge did it in a manner that they found simple, yet did not follow Livescribe's instructions. Two novice users, U03 and U05, had to switch the cartridges out; they located the extra ink in the pen case, and then simply used their fingers to pull the old one out and put the new one in. Neither of them hesitated to do so, nor did they ask or look for any assistance. The method was simple compared to the prescribed Livescribe method, which involves inserting the ink tip into a special removal ring and lifting the pen. Our advanced users who experimented with this method found it time-consuming, and on several occasions the loose ink cartridge flew out of the ring and onto the floor. U10 attempted to replace the ink with proper protocol during a lecture, but resorted to using his fingers instead, since the removal ring was taking too much time away from note-taking.

Headphones

The Pulse pen comes with two options for recording: the built-in speaker for mono recording, and the headphones for three-dimensional recording. Not all users chose to wear headphones during their class interviews, and those who did had problems untangling the wires. We found that they had a variety of reasons for choosing whether or not to wear the headphones.

Two users wore the headphones in their ears, since they felt their position in the classroom was far enough from the lecturer that "it would not be offensive". U03 chose to wear them for the 3-D audio effect. U07 removed the headphones from her ears during the lecture and chose to use the neck strap instead. Two other users chose not to plug the headphones into the pen at all, as they felt it would be rude to their professors.

Half of the novice users plugged the headphones in and did not wear them in their ears. We found that they placed the headphones in a variety of places. U01 was shown how to correctly use the neck strap and later wore it during one lecture; U07 wore the neck strap incorrectly later in her class. U02 found the neck strap too confusing and opted to drape the headphone wire around his neck instead, with the ear buds draped over his chest. U05 had a similar idea but was confused about how to place the wire and ended up placing the ear buds over his back instead. U04 left the headphones in her lap, because she felt it would be rude to the lecturer to even have headphones visible, and also because she wanted to minimize recording of her fidgeting.

Our advanced users also record differently from one another. U09 wore the headphones draped around his shoulders to increase the quality of the audio recording, but found the neck strap too cumbersome to use. U10, however, recorded with the built-in speaker because he found that the headphones pick up too much noise from his clothes. However, he noted that the built-in speaker picks up scratching noises from his pen and hand movements across the notebook. Our third advanced user chose not to wear headphones because he felt it offended his professor, who looked at him for taking the headphones out during class.

Certain aspects of the Pulse pen structure are extremely problematic for our users. Our users had problems with pen comfort, keeping the pen safe, and recording quality audio.

Advanced Pulse Features

Bookmarks

The Livescribe bookmark function allows users to flag a point in their audio recording that they can later jump to quickly. The bookmarks can be made during the recording of a Paper Replay session or during playback of the session.

Most of our novice users did not explore the more advanced features of the pen. Several of them skimmed the bookmark function and the audio quality settings, but many were unaware that the functions existed or were unsure of how to use them. Our advanced users made a conscious effort to use the functions and test the variability and usefulness of them.

The novice users were not impressed with the bookmark function. U04 tried to use it after noticing it in the GSG, however, she disliked its design. When she was making bookmarks, she was unsure whether her bookmarks were being made or not and

continually looked at the screen for confirmation after tapping on the bookmark control. U01 learned about the function, but chose not to use it even after multiple sessions since he preferred his own way of marking important information, such as boxing and starring. U03 used the bookmarks function when reviewing his notes, but announced that he would not use it during a lecture since he wouldn't know what information should be bookmarked at that time. While these three users knew about the bookmark function, none of them were avid users of it and did not display much interest in bookmarking.

Our advanced U09 and U10 said that the bookmark function was still not useful to them after several weeks of regular Pulse use. U09 bookmarked during some of his classes, but said it took too much effort to stop taking notes and tap the button at the bottom of the notebook page to make a bookmark. He preferred to continue writing and simply make a noticeable pen mark next to the relevant information. U10 made a conscious effort to try and use the bookmark function, but did not like reviewing with the bookmark function since there was a lack of visual marks in his notes to match the bookmarked audio. Since the user liked to look at his notebook with the audio to study, he found his own system of marking notes with pen lines to be much more efficient and helpful. When he reviewed with the Livescribe bookmark function, he had trouble matching up the bookmarked points to his notes, which made his study session unproductive. Our un-interviewed advanced user remarked that though he had made many bookmarks, he preferred tapping on his notes for emphasis review to jumping thr ough his bookmarks. Even after prolonged pen use, advanced users still did not find the bookmark function a useful tool.

Audio Quality

The audio quality of the recording can be adjusted in several ways through buttons on the inside notebook cover. Microphone sensitivity can be changed from "automatic" to "lecture hall" or "conference room" to account for the room size and background noise. Audio recording quality can be set to "low", "medium", or "high"; this setting affects how much information the recording captures and how much space the audio file takes up. The Livescribe user forums contain several posts inquiring about the size difference of the audio file on "low" or "medium" versus "high" quality recordings. Although the microphone sensitivity is simple to adjust and its button labels are self-explanatory, some users had questions about the audio recording quality.

Many of the novice users were not aware of the settings differences, or did not bother to change it. U01 adjusted the microphone sensitivity for the classroom size when he took his notes, but was unsure about how much of a difference it really made. He said "I feel like I just have to accept the function without knowing how it works." U04 pressed the information button to hear more about the microphone sensitivity before her class, then changed it to "lecture hall", but did not explore the audio recording quality buttons adjacent to it. During replay of her notes, she found the audio to be of poor quality and regretted not knowing about the differences.

Our advanced users tested out the various settings in their classrooms to find the optimal recording quality. U09 found that the automatic setting worked best, as it gave him consistently better audio quality between all of his classes. U10 experimented with a range of audio quality and microphone sensitivity settings in combination, and found that microphone sensitivity made a difference, but not in the way it was designed. He found

the "lecture hall" setting recorded better audio in his small, conference-type classroom than the "conference room" setting did. User 10 also found that "high" audio quality produces the most acceptable recordings for him, and said that it is not worth recording at any lower quality because of the background noises.

The advanced features available at this point from Livescribe were not found to be particularly useful. Neither our novice users nor our advanced users interacted with the functions frequently, and when they did, they were not impressed with the results. Our users found that their own systems of marking important information were better for studying purposes than the Livescribe bookmarking function was. Our advanced users found that audio quality settings made a difference, but quite often it was not for the better.

Analysis of Results

High-Level Affinity Diagram

Please refer to Appendix A.

Modeling

We used work models to organize the complexities of our users' work patterns. Our most important was the sequence model, which represented the ordered steps a user actually carries out in order to accomplish a task. We observed the task of note-taking both with and without the Pulse smartpen, and consolidated each user's steps in detail, complete with any breakdowns, triggers, and intents. We identified breakdowns as things that get in the way of accomplishing the task of note-taking with the Pulse, triggers as things that cause a user to begin a new task, and intents as the reasons that a user does something, whether it is explicit/implicit, conscious/unconscious, or planned/habitual.

Another useful model that we created was the cultural model. The cultural model captures the feelings users have about their activity which may be influenced or constrained by social standards or other cultural factors. Since all of our users were college students, we found that many of them shared the same concerns that were unique to the setting of a university lecture hall or classroom. This was exactly what we wanted to find, and consolidating those issues into a cultural model helped us in redesigning the Pulse with student users in mind.

Consolidated Sequence Model

Through sequence modeling we were able to identify the common patterns users experienced while learning to use the Pulse, how users adjusted to it, and how users had trouble with the pen—as well as when and why they happened. From those individual sequence models we created a consolidated sequence model to guide our visioning process.

The intents highlight many of the concerns our users have when using a smartpen that they may not have normally. For example, one user asked "are you sure this pen isn't going to go crazy on me?" when he read about the Pulse audio feedback. This was a concern directly related to the beeping noises the pen made when the user pressed buttons on the notebook, particularly since he chose not to plug the headphones in.

Several steps detailed under Pulse setup in the GSG are interactive buttons to check the battery level, set the display orientation, and set the time and date. During recording, users want to synchronize the audio recording with their notes being taken at the time. Another intent has to do with the bookmark functionality of the Pulse, where the users want to find their bookmarks when using the software. The intents were extremely useful in discerning what our users care about and want to get out of the Pulse smartpen use.

From these intents we were able to formulate design ideas. For example, the user's concern about the Pulse feedback noises could be resolved by replacing it with visual feedback (a blinking pen light) or tactile feedback (the pen vibrating). It is reasonable for this user to be concerned about causing excessive noise in class, and in response to this we present other options for pen feedback.

Another important intent was preparing the Pulse for use. This intent involved an alarming number of breakdowns that were particularly interesting. One such breakdown was a difficulty untangling the headphones (U01, U05). To address this, there should be some wrapping device to hold the headphones in place during storage. Many users wrapped the headphones around the case but the cords would become tangled in their backpack.

In addition users often had difficulty finding the power button (U05), or they failed to press the record button on the notebook page when they began taking notes (U01, U03, U04). To deal with the oversights of the power button and record button, we tried to make them more salient. The simple addition of a power symbol on the Pulse would be very helpful in making the button stand out from the rest of the pen. We found that the record button's placement at the bottom of the page caused some users to overlook it, and proposed that placing it on a separate flap or card would make it easier to find.

The sequence diagram also draws attention to several points where users branch in how they use the pen. Some users wear the headphones while others do not; some take notes actively while others simply record the lecture; and there are multiple ways that users stop the recording when the class is over. These are differences that we had to keep in mind when visioning our changes to the Pulse pen and its accessories.

Cultural Model

Our cultural model focused mainly on etiquette within the classroom. In our interviews we found a variety of opinions concerning headphone use in the view of a professor or lecturer. All of our users were aware that wearing headphones during a class might seem rude to the lecturer, and we used their explicit reasoning to build several expectations a lecturer has of the class. The variety of headphone use in our interviews gave us information about the considerations users have. Some users (U03, U09) felt that the quality of the audio recording was very important, while others (U04, U08) felt that how the lecturer and their classmates might view them was more important. All the expectations and considerations in the cultural model were important in our visioning and design, since they inform the options that users have in setting up and using the Pulse smartpen during class.

Design driven by the data

Summary of Findings

The Affinity Diagram walk and the models we constructed during analysis allowed our group to identify the common issues across all users. Once these issues were identified, we knew that they were supported by the data in our results and could continue on to the visioning and prototyping processes. This important part of the RCD process ensures that any hot ideas that the group members propose addresses an issue that originates from the data we acquired. Without the data to support the issue, the hot idea is nothing more than a blatant redesign that may or may not help the user. In user-centered design, each implementation should be focused on addressing real issues that users had problems with, rather than addressing something that may not be a problem for the users at all.

Our affinity walk and models gave rise to mainly documentation issues. Novice users across the board avoided the 85-page Manual and preferred the GSG. Many advanced features of the pen, the very functionality that separates the Pulse from regular pens, were unknown to the novices. The PRB page was disregarded due to its poor design and lack of organization. Headphone use was awkward and often frustrating for users, both technologically and culturally, leading to a disregard of an otherwise important feature. Structural issues were also a problem for users. Pen bulkiness and rolling, display awkwardness, and ambiguous design all contributed to breakdowns in Pulse use.

Design ideas

We contrived several hot ideas based off these data-driven issues. The Quick Start Guide (QSG) became a favorite idea and the redesign of the GSG became a central focus of our project. The audio settings were another idea stemming from poor documentation. Redesigning the pen structure became a favorite idea, especially for advanced users. A tutorial was proposed in order to orient novices toward advanced usage.

In order to better associate the design ideas to the issues they address, we conducted several visioning sessions. These visions consisted of a vision for a revamped GSG, a vision for the pen's structure, and a vision for the notebook.

We decided to pursue a QSG revision of the GSG. This was motivated by the constant reference users had to the GSG and the lack of basic use orientation from the documentation. We made a decision to change the guide's name from GSG to QSG. Several group members began to call the guide a Quick Start towards the beginning of the interviewing process, after they noticed that our users were using the GSG as a quick way to learn about the pen. The idea was that users would read the QSG to get a basic familiarization of the pen and not have to constantly refer to it. This constant reference would be addressed by an inclusion of pertinent info, such as that found in the manual that was not originally included in the GSG.

Another of our visions revolved around notebook control structure. Users had a hard time with advanced features like bookmarks and the NAV plus due to poor documentation. Some kind of flap was envisioned that would incorporate all of the essential controls that a user needed for each note-taking session. This would cut down on the searching a user conducted for the various settings. this vision also incorporated a tutorial that would orient users toward functionality of these various controls.

The original tutorial did not provide information that will help the users take notes. In our design prototype our users found that there was too much information cramped in. So in the end we've condensed the tutorial more and more, but still providing enough information to get new users writing knowing all the advanced features of the pen.

Though we doubted we would be able to test any prototype redesigns of the pen structure, we proposed several ideas for its redesign based off the issues we discovered. A lot of users said the Pulse was uncomfortable, one advanced user said he got tired after using the pen for a long period of time, 30 minutes or more. A red LED light provides visual feedback that the Pulse is recording audio. This LED would be located near the LCD screen. In addition to this another multi-color LED would be located at the top of the pen. This would function to digitally change the color of the recorded writing notes. U01 and Prototype User 01 both suggested this idea.

Several other ideas came up in the process of our project that we were never able to fully explore or investigate. First of all, we found a lot of interesting user data about problems with the software. This included issues with the search function, problems with navigating audio, and inconsistencies in the pen's recording abilities. In particular, users had problems with audio playback and the inconsistency of the search. Other issues that arose were just that the overall replay was un-intuitive. However, we felt that investigating the software would detract from the rest of our work because there is so much to look at in the software.

From our prototype interviews, users expressed their dislike for the flap design we had proposed. It was too bulky compared to the original controls on the bottom of the notebook pages. One user also said that the flap would take up more room on the already small tables in the lecture halls. Prototype User 01 said we could design a hand held control card. This tied back to our original interview data findings that a few users held the GSG in their free hand while note taking.

Prototyping:

Getting Started Guide Prototype

Methods

Using the data from both novice and advanced users, we determined what was and wasn't helpful to users, what they did and didn't look at, and what they needed to know in order to start using the basic functions of the Pulse smartpen. Since all of our users relied largely on the GSG to orient themselves to the pen use, we decided to put the essential information in there in a format that was easy to read and understand. The goal of the new QSG is to give the user a fast and simple presentation of the pen and how to care for it and use it correctly.

Results

The important functions to new users were: how to set up the time, date, and display orientation; how to install the Livescribe Desktop software and charge the pen; how to mute the pen's feedback noises; and how to record with the Paper Replay session and use the headphones. We also made sure to include warnings about Pulse use and care. We took some of the information from the existing GSG and removed other information from it that was not relevant to the way users actually use the pen.

The Paper Replay section was reformatted so that it answered several questions that our users had about the function, and had clear sections about recording audio and starting Paper Replay. Within both sections, we reformatted and added information that allows the user to choose from the several methods of recording audio and starting Paper Replay. Diagrams and information from the UM were added in order to clarify and make the information easier to understand.

The Tips & Tricks section in the original GSG was all about recording audio, so that was moved under the Paper Replay section and given one prominent page of the QSG, so that users would notice it easily.

Analysis

Prototype interviews with new novice users showed that our new QSG was more helpful in orienting users to the Pulse pen; they had less questions about how the pen was supposed to work and what to do. However, one user was too impatient to even read the short guide, and instead inquired about the technical aspects of the Pulse. Two of the interviewees did not like the placement of the warnings section on the first inside page; they felt that it was something that should be on the back to be less intimidating and discouraging. Users also had trouble figuring out how to stop recording, although due to the new QSG instructions they had no problem beginning a Paper Replay session.

Documentation Prototypes

Advanced Tutorial

Methods

Each section and subsection contained a differently colored information bubble that invited interaction. The numerical organization of these sections addressed the issue of disorganization in the original PRB. The information bubbles invited interaction, and the order of sections was meant to orient the user in increasingly advanced methods.

We redesigned the PRB into an “Advanced Tutorial” to counteract the intimidation and disorganization that novice and advanced users experienced with the PRB. The tutorial was designed as a walk-through meant for orienting the user toward full familiarization with the pen. Four sections were constructed: create your sample session; controls familiarization; audio settings; and NAV Plus orientation

Results

We discovered that users were overwhelmed by the amount of “info buttons” in the tutorial. The inclusion of the Audio settings section was found redundant by P03, as she asked, "why not record at high quality all the time" in reference to better audio quality.

Analysis

The K.I.S.S. (Keep It Simple, Stupid) principle would have been handy in this design, as less information bubbles would have been more inviting to user interaction. Further input from advanced users revealed that audio settings other than high resulted in distorted recordings, making a majority of the pen’s purpose obsolete. As a result, we decided to remove the Audio Settings section and instead advise the user about how to

achieve the best possible recording quality. Less information bubbles would also be more inviting.

Tips and Tricks

Methods

Advanced user interviews were conducted to take note of any techniques the developed after extensive experience with the pen. Anything that the users did to exploit the pen's features was investigated during a podcast lecture session, which was used in order to better focus on users' techniques rather than natural setting. We also browsed the Livescribe forums for any techniques posted by Pulse users across the country.

Results

Data revealed that even after reading the GSG, there were still questions about the true capabilities of the pen. We observed that advanced users preferred not to make use of the bookmark controls, as "I can make one faster on the paper" (U9). U10 and our un-interviewed user took advantage of the pen's camera as well, making outstanding symbols on key areas of their notes. Advanced users also slowly demarcated sections of importance so that during software replay, their emphasis would be mimicked by the camera.

U1, U9, and U10 attempted to synchronize their audio to their notes by rewriting sections of their notes so that the camera would record the thickening of certain notes. Advanced users preferred not to use the earphones and kept the quality on high as their recordings were otherwise defunct. The un-interviewed expert user proposed that the keyboard printed inside the notebook should allow users to name their recording sessions. This would eliminate the need to record the date and time as the identification for a page. Forum users suggested the use of elastic bands to keep the pen from rolling off an inclined surface,

Analysis

The "Tips & Tricks" section replaced the "NAV Plus Basics" page (which was reduced to a portion of the "Advanced Tutorial") in order to make use of the pen's full functionality. Many of the advanced users' techniques were incorporated in a similar style to the tutorial page: a short written explanation of a technique, and a longer audio recording for elaboration.

After several prototype interviews, we found that simplicity prevailed again. Users preferred a concise explanation of a technique as they were impatient to become familiar with the pen.

Pen Structure Prototypes

Method

A majority of the redesign ideas come from data gathered from the users' interaction, complaints, or ideas. After we built the Affinity Diagram we had a whole section for structural problems so when we walked the affinity as a group we posted a lot of design ideas for the pen.

Results

We came up with several structural redesigns for the pen. We added a pen grip and proposed a slimmer size and lighter weight. U02 said “the pen is too big” and that it hurt his hand.

Due to data from U06, who had to confirm the Pulse was recording by turning it to see the screen, we proposed a red LED light be inserted next to the LCD to indicate that the pen is recording audio. U01 mentioned a design idea about having different ink show up on the Livescribe software, which might be implemented by a multi-colored LED light on the top of the pen for different "digital" color inks that also flashes to confirm that a selected button has been tapped. This would also help our users who were looking for more feedback when using the Pulse, such as U04, who did not want audio feedback.

Because some of our users (U05, U02) had trouble finding the power button, we proposed adding a universal power symbol on power button. As another troubleshooting mechanism to address the camera problem U08 had, we proposed that a beeping sound occur if the infrared camera is obscured.

Nearly half the users found problems with the Pulse’s perfectly rounded shape because it would roll. On the Livescribe support forum, one pen user wrote about the problem and the user and other replies in the thread had offered novel solutions such as putting a rubber band around the pen.

None of our novice users knew that there was a proper way to remove the ink using the removal rings located on the USB connector or the pen case. Instead they just pulled it out with their fingers. We felt that finger-removal should be made easier by having a fingernail groove towards the tip of the Pulse ink cartridge.

Analysis

The broad idea in the structural redesign to is to increase comfort and saliency of the pen. We did not get a chance to test the paper prototypes of pen structure mainly because it's not possible to test paper prototype of an object's structural redesign. The only thing we could have done was add a pen grip and build a mock up pen clip and see how those parts worked.

Prototype Interviews

A combination of three prototype interviews together contributed to additional data on the prototypes for a new Advanced Tutorial, notebook flap, and QSG. Some common observations made throughout these interviews point out the impracticality of some of the design features.

The first prototype user (P01) noted a preference for alternative methods for bookmarking rather than the bookmark control. P01 found it inconvenient to stop in the middle of note-taking in order to bookmark an important point. P02 had a similar reaction to the bookmark function, noting it would be "too much hassle" to stop in the middle of writing in order to tap the bookmark button. P02 also preferred to use an alternative method (i.e. drawing a star) in order to bookmark a point in her writing. Another notebook feature P01 found superfluous was the jump button to navigate audio sessions. After discovering that audio could be navigated by tapping various sections of the notes, he found the jump button impractical. P01's reaction to the QSG was minimal.

P01 did mention, however, a point similar to that of other prototype users- that the warnings on the guide should be on the back cover instead of upfront. P03 made a similar comment about the QSG warnings, asking why the warning points were so immediate. Another important point observed in P03's interview was inadequate information about recording sessions; she was unsure how to stop recording a pen session once it completed.

The observations made in our prototype interviews entailed a number of points about the hardware, but focused mainly on the notebook redesign and aspects of the new GSG (i.e. the QSG).

Discussion

Initial Findings

Livescribe's Pulse smartpen has showcased both innovative features that our users have found useful as well as negative aspects that conflict with user work behaviors. Our team formed new design concepts based on concrete user data. Our initial contextual interviews lent valuable data to our affinity diagram. From this, our team was able to derive several significant findings about fresh user experiences with the pen.

We discovered one point of interest to be the importance of the GSG. Users had decidedly refused to read the 85-page UM before using the pen and instead depended on the GSG to orient them with the product. So, the GSG served the vital responsibility of providing first-time users basic instruction on how to use the Pulse and facilitating user adaptation to this new technology. Livescribe's original GSG, however, had failed to provide adequate information for beginners.

Major Design Recommendations

After visioning as a team, we took into account user data to incorporate a newly designed guide- the QSG. This new design reformatted the original layout to display the most immediately required information first, warning points last, and useful diagrams to illustrate proper usage of the pen. Coupled with a new Tips & Tricks page, this QSG is intended to better facilitate the needs of first-time users. Similarly, a second aspect of the product that failed to aid first-time users was found in the PRB. As many users initially found this tutorial in the notebook to be unimportant or not useful, our team generated a new Advanced Tutorial that was more concise, more practical, and less intimidating than the original one.

A third, major finding that emerged from our design process was the imperfect structure of the Pulse smartpen. Users in our interviews often had problems that conflicted with their work behavior. They felt that both the pen's bulkiness and neck strap contributed to the structure's cumbersome experience. Even more, these two factors would interfere with the process of audio recording. In considering structural redesign ideas, we took into account the work behavior of users as well as user concerns about comfort, safety of the pen, and recording quality audio. Though our team was unable to physically implement our prototype ideas into the pen, we recommend a number of redesigns. For a new Pulse smartpen to adequately fulfill the needs of first-time users in a university environment, the following changes can be made: addition of a rubber grip,

slimmer size, less weight, universal power symbol, addition of a clip to prevent rolling, and a grooved ring near the end of both the stylus and ink cartridge to make ejection easier.

Future Research

Since time was limited to a short 8 weeks, the majority of our research focused on the experience of first-time users with the hardware portion. It was unfortunate that technical and physical aspects prevented our team from evaluating our structural prototypes, we hope to see teams follow our traces to carry out what we left incomplete. Of course, this consists of only half of the product. Future evaluations of the product's design should include investigation of the software, the Livescribe Desktop. Our team initially found user problems with the interface of the software, which included poor handwritten symbol recognition, slow synchronization of audio and pen strokes, and slow note page loading. As the prevalence of sharing digital information over the internet has increased, additional investigation should also address the design of Livescribe's Pencast™ sharing online. Our team hopes to see future design research complete our work in these domains.

Glossary of Terms

3D Recording Headset
Headphones/earbuds.

Getting Started Guide
A pamphlet included in every Livescribe Pulse™ smartpen box. Short manual we've redesigned and renamed the Quick Start.

GSG
See Getting Started Guide.

Livescribe
The company who manufactures the Pulse™ smartpen.

Livescribe Desktop
Software product by Livescribe for reading digitized notes on a PC.

Livescribe dot paper
The special paper with dot pattern to be recognized by the pen during writing. Licensed from Anoto company.

Paper Replay
Act of replaying your notes with the pen through the pen's built-in speaker.

Paper Replay Basics
The first page of every livescribe dot paper notebook. This introduces the users to the pen's features. Included in every notebook sold by Livescribe.

PRB
See Paper Replay Basics.

Pulse smartpen
Product name.

Pulse Smartpen User Manual
85 page manual, which users download from the Livescribe website.

Quick Start or Quick Start Guide
Our redesign of the Getting Started Guide.

QSG
See Quick Start or Quick Start Guide

UM
See Pulse Smartpen User Manual

Appendix A: High-Level Affinity Diagram