

Mobile Health Thesis Summary



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Background

Objective: Using data from a sleep self management study involving Personal Sleep Monitoring Devices (PSMD), demonstrate the effectiveness of recording mobile health (mHealth) usability data at **multiple time points, disaggregating data, representing data using visualization techniques, and using qualitative data to explain changes in usability scores.**

Materials and Methods: PSMDs were used by participants (N=20) age 65 and above for 4 weeks. System Usability Scale (SUS) was measured at weeks one and four and the end of study interview was conducted at week four. Data analytics included descriptive statistics, aggregate and question level scores, slope chart data visualizations.

Typical (Bad) usability study data visualizations: Only at one time point, only mean and standard deviation, no in depth analysis of qualitative data

Mean Scores and Sample Comments of Heuristic Evaluation of MSM App

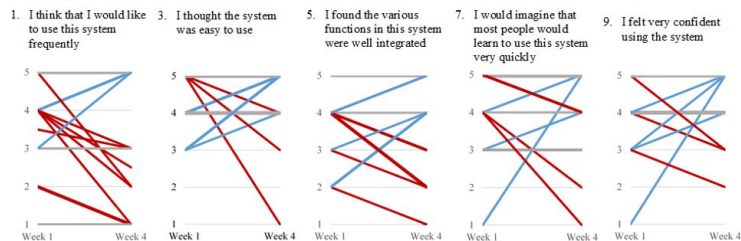
Usability Factor	Mean (S.D.)	Sample Comment
Visibility of System Status	1.40 (0.89)	Home icon was too subtle
Match between System and the Real World	0.80 (1.30)	I thought the question mark icon was the help button. I was surprised it was the "about me" button
User Control and Freedom	1.20 (1.10)	Sometimes the "back" button went to an unexpected place
Consistency and Standards	1.00 (1.00)	Lines, color and font have not been followed consistently in all screens within the system
Help Users Recognize, Diagnose, and Recover From Errors	1.00 (1.41)	Some of the areas of the system should provide prompts or error messages
Error Prevention	0.80 (0.84)	Menus are too deep; increases cognitive load and working memory to remember where things are located
Recognition Rather Than Recall	0.80 (0.84)	Color highlighting is not used to get the user's attention
Flexibility and Efficiency of Use	1.00 (0.45)	Users do not have the option of clicking directly on the menu item or using a shortcut
Aesthetic and Minimalist Design	1.40 (0.89)	Visual layout is not well designed
Help and Documentation	1.00 (1.41)	There should be a general help button for the 6 major buttons

Statements	Mean (SD)
Overall, I am satisfied with how easy it is to use this system.	1.73 (0.704)
It was simple to use this system.	1.67 (0.724)
I could effectively complete the tasks and scenarios using this system.	1.53 (0.516)
I was able to complete the tasks and scenarios quickly using this system.	1.40 (0.507)
I was able to efficiently complete the tasks and scenarios using the system.	1.67 (0.724)
I felt comfortable using this system.	1.53 (0.640)
It was easy to learn to use this system.	1.40 (0.507)
I believe I could become productive quickly using this system.	1.73 (0.704)
The system gave error messages that clearly told me how to fix the problems.	3.47 (0.834)
Whenever I made a mistake using the system, I could recover easily and quickly.	2.40 (1.404)
The information (such as on-line help, on-screen messages and other documentation) provided with this system was clear.	2.67 (1.397)
It was easy to find the information I needed.	1.67 (0.900)
The information provided for the system was easy to understand.	1.67 (0.724)
The information was effective in helping me complete the tasks and scenarios.	1.67 (0.724)
The organization of information on the system screens was clear.	1.60 (0.632)
The interface of this system was pleasant.	2.00 (1.069)
I liked using the interface of this system.	1.97 (0.915)
This system has all the functions and capabilities I expect it to have.	2.40 (1.549)
Overall, I am satisfied with this system.	2.00 (1.254)

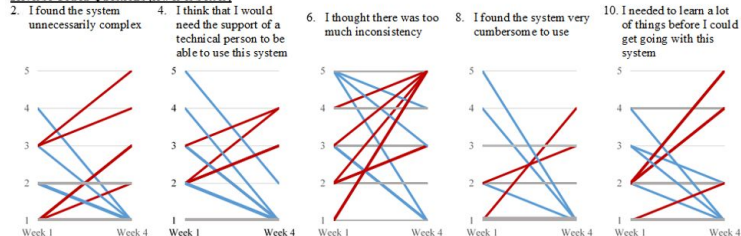
My work

- Created slope charts in Tableau and Excel to show amount of change in how participants scored usability between two time points (by question and overall)
- Coded 80 pages of qualitative responses to post-study survey given to participants using NVivo
- Developed qualitative analysis summary table and grouped qualitative responses into emerging themes to explain changes in usability scores
- Literature Review and lots of background research on mHealth applications

1. Slope Charts organized by question



Reverse Coded Questions (lower is better)



2. Qualitative Responses (Sample)

Q1

Tell me about your experience wearing the monitor? What was it like for you having a wrist sensor on? Do you think it changed you in anyway?

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It was fine. It was fine actually, after the first day I didn't notice it. Only time I noticed it was in the shower and it was talking to me. Always white lies. (changed you?) Yes, I was more mindful of my sleep.

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I found it very comfortable to wear and most of the time didn't even know that I was wearing it. So it was not an issue at all. It was very comfortable. (changed you?) No, I was totally unaware, I forgot I was even wearing it.

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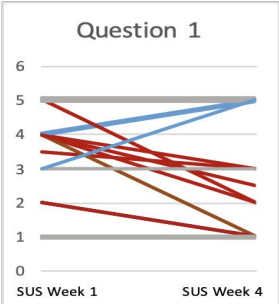
I hardly knew it was there. (changed you?) Not a lot, no

3. Qualitative Analysis Summary Table (Sample)

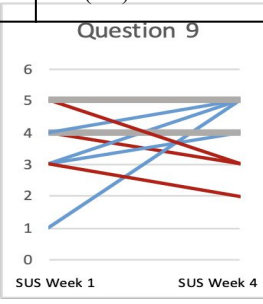
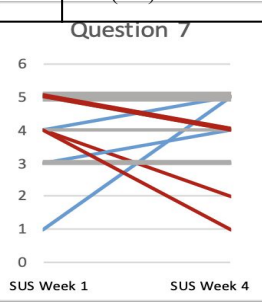
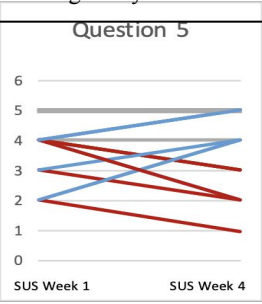
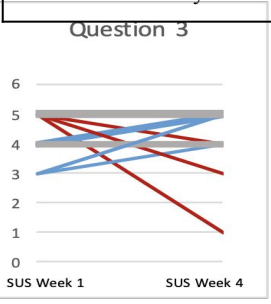
Question	Theme	Exemplar Quotes
Q1: I think that I would like to use this system frequently. Q6: I thought there was too much inconsistency in this system.	Data Device Distrust	<ul style="list-style-type: none"> "I didn't totally trust the data that was coming out of it." "The battery issue was the biggest. And I couldn't see any rhyme or reason as to why. It would last a week one time and then 2 days another time." "I didn't trust (the device), so I just stopped using it."
Q2: I found the system unnecessarily complex.	Device Confusion	<ul style="list-style-type: none"> "I wasn't willing to spend a lot of time trying to figure it out." "So, if they could think of a way to explain this using a metaphor."
Q3: I thought the system was easy to use. Q9: I felt very confident using the system.	Capable	<ul style="list-style-type: none"> "(The device was) Not difficult (to use) at all." "Capable yeah, interested enough to improve my capabilities, probably not."

Simple Explanation

1. System Usability Scale (SUS) scores were recorded at two points in time as seen to the right in “SUS Week 1” and “SUS Week 4”
2. If you only had the chart to the right of Average and Standard Deviation, you might think that participant’s responses did not change very much
3. But looking at the slope charts below, it is clear that a lot of participants answers changed between weeks 1 and 4 (denoted by the slope lines connecting two points)
 - a. So having participants complete the SUS questionnaires at multiple time points is important because it allows them to adjust to the mHealth intervention that they are using and explore more of the features
4. These slope chart visualizations are good for showing changes in data at a high level
5. I then used the qualitative survey responses to try to explain why these changes in scores occurred



	Week 1 Avg (SD)	Week 4 Avg (SD)
<i>*Higher Score is better</i>		
Overall Average	75.2 (11.2)	72.3 (11.2)
1. I think that I would like to use this system frequently.	3.4 (1.3)	3.0 (1.7)
3. I thought the system was easy to use.	4.3 (0.7)	4.4 (1.0)
5. I found the various functions in this system were well integrated.	3.6 (1.0)	3.5 (1.3)
7. I would imagine that most people would learn to use this system very quickly.	4.3 (1.1)	4.2 (1.2)
9. I felt very confident using the system.	4.2 (1.1)	4.4 (0.9)



Results and discussion

1. Developed better method to record and visualize usability data
 - a. Better to record data at multiple time points, disaggregate data, represent data using visualization techniques, and use qualitative data to explain changes in usability scores
2. Helped Professor Leblanc with submission to journal of Computers, Informatics and Nursing(CIN)
3. Learned a ton about mobile health, digital health, and usability studies (among other things)



Results: The mean and standard deviation of the overall usability scores between weeks one and four seemed to have no significant change. When observing slope chart visualizations however, there seemed to be significant changes in SUS scores. Qualitative interview data was used to clarify why these changes in SUS score occurred.

Discussion: This method demonstrates that there is insignificant change at the aggregate average and standard deviation level. Slope chart visualizations and reporting data at overall and question level is important to perform comprehensive data analysis.