CS6750 – Assignment M2

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Abstract—For multitasking individuals that engage in physical activities while listening to MOOC lectures the iPhone Udacity application demands constant, physical user interaction. To bridge this Gulf of Execution while maximizing user safety, attention and information retention, this project shall explore supplemental interface features for effective studying while multitasking.

1 NEEDFINDING EXECUTION 1 – SURVEY

1.1 Survey Summary

The following statistics are summarized from the survey done by OMSCS students and other participants throughout the past seven days. Twenty-three people responded to the survey. Over 60% of the responders responded to exercising 3-5 times per week while listening to audio material at the same time. More than 2/3 of the responders felt satisfied with touch screens as the main interface with their phone while 1/3 felt either neutral or dissatisfied with the interface. Almost 80% of responders multitask between 2-4 tasks on their phone at any one time. A multiple choice question on limiting factors for multitasking, led to the fact that participants are limited by 3 general categories: the physical dimensions of a small screens, the interactions of applications with either the operating system or with each other (considering multiple applications are used), and the human limitations of cognitive load activities which always bade for attention. Lecture material is equally well absorbed visually as well as auditory by participants and most participants spend the late hours of the day on lecture material. The majority of participants would also preffer to exercise or eat in tandem to watching lectures

1.2 Takeaway

The takeaway from this survey has provided some very important points for possible design requirements. Most participants od multitask and do so in the late hours while either eating or exercising. Application limitations are the big-

gest factor limiting the participants from successful multitasking, where the applications either have poor interaction between each other or the operating system, forcing the user to lose focus from absorbing material.

1.3 Bias Control

Confirmation bias was reduced by asking the users about their needs, rather than focusing on possible redesign prototypes. Observer bias was reduced by having other peers review the survey prior to issuing it. The peers were not part of the persons taking the survey. Social Desirability bias was reduced only by inquiring about objective evidence; no design details were included in any of the questions posed. Voluntary response bias is minimized in conclusion by comparing the results gathered through the survey process together with those gathered by other needfinding exercises. Recall bias was avoided by not asking any questions on the survey that required memory recall. Only the opinions on current usability will be asked in the survey.

2 NEEDFINDING EXECUTION 2 - INTERVIEW

2.1 Interview Summary

The interviews led to similar conclusions as the survey, which is a telling sign that the needs are very similar. The persons interviewed pointed out to multiple application that must be managed while studying, as well as the necessary task of application switching and interacting whenever information retention was necessary. Some participants found that there are aspects of on-campus studying that is still missing from the online MOOC experience which would help facilitate learning, but overall found that online delivery to be most convenient. More specifically, the form of instant concept correction which occurs in a live dialog is missing. Where during a live lecture, a student can ask questions in real time, in an online setting, concept understanding has to be taken to Piazza, away from Udacity, and small misunderstandings which are left alone throughout the video lectures can compound as the student continues to study. Interestingly, there is a well-known methodology for learning whereby a person who is studying the subject should know it well enough to explain it to another person in mundane terms. One participant stated that that form of studying is extremely helpful, and at the same time completely missing from the online experience,

whereby verbal recitation of material towards other students is not feasible and is limited to text based interactions only.

2.2 Takeaway

The takeaway form the interviews included multiple reasons for choosing an online delivery platform as well as the some drawbacks that interviewees saw to it. In general, most users are satisfied with their means of interaction and content delivery, however, most would also like to improve and advance the experience to allow for easier content retention. Users typically do not see lecture material as a primary time-consumer and relegate the task to non-critical times of the day, often pairing it with other mundane tasks in a multi-tasking fashion. Participants often chose to listen to audio versions of the material only, ignoring the video, or increasing the playback speed two-fold to rush through the lecture faster. As such, it is evident that a need for a better interface between the lecture material and a user's understanding and retention of material requires a reduction in Gulf of Execution.

2.3 Bias Control

Confirmation bias is controlled by interacting with the user on a personal level and focusing on the user needs and use scenarios, rather than possible prototype features. Observer bias is minimized by having the interview questions previously reviewed by external peer review, prior to the interview process. Additionally, the interview process is set up to flow as a conversation rather than a list of questions in order to obtain required data. Social desirability bias is minimized as part of interview question writing and peer review. Each question is analyzed in order to avoid hinting towards potential prototype features within the question text itself. Voluntary response bias is controlled by varying the interviewee poor of responders. Since the interview process is not able to gather as many participants as the survey plan, the variety of interviewees is crucially important. Recall bias is avoid also during the question review process, making sure that no question asks a user to recall any past events, feelings, facts or statistics.

3 NEEDFINDING EXECUTION 3 - ANALYSIS OF EXISTING UI

3.1 Analysis Summary

The Analysis of existing User Interfaces have all shown that modern technological advancements attempt to minimize the visual attention required for non-critical tasks.

Modern automotive interfaces contain two interaction methods the touch screen on the central console and the steering wheel controls. The central console is the main interface and is most used for important tasks such as navigation planning, settings tuning or application navigation. The steering wheel controls allow for tactile control of functions without demanding visual attention of the driver. Additionally, microphones mounted in the car and activated through the steering wheel allow for command based control of vehicle functions which mimic those user on the touch display, allowing for user interaction for those expert users who know the menu system to control advanced functions while also keeping visual attention to the act of driving.

Apple AirPods are a pair of wireless ear buds with advanced controls of the iPhone built into them, allowing the user to enact certain controls without using the phone. The key features of interface of the AirPods are tapping on the device, or using the built-in Artificial Intelligence assistant, Siri, functionality to control advanced functions. Similarly to the automotive steering wheel controls, the AirPods leverage AI assistance and minimal haptic controls to allow for dynamic advanced user control of the main device. Siri, however, still requires some interaction as the setup for completely hands-free operation required advanced knowledge.

Alexa on the other hand is a completely hands-free artificial intelligence. Alexa, by Amazon, is a microphone/speaker device which can control any IoT enabled device in the home, and relay any information requested from the web. From smart locks and lights to weather forecasts and purchase orders Alexa, like many other personal assistants, provides a truly hands free experience to its users and requires the lowest user experience level.

3.2 Takeaway

User experience level is very important in evaluation these interfaces. For automotive and iPhone users, knowing the menu system before using hands-free assistants is important as navigating and determining proper commands depends on knowing the available functions of the main device. Alexa, on the other hand controls fairly simple and straight-forward devices such as locks, lights, and purchases which are either single function devices or mundane tasks, lower the bar of experience for its user.

3.3 Bias Control

Confirmation bias, observer bias and social desirability bias is only minimized by the researcher through distancing of personal preferences from proper evaluation. Lacking peer involvement in this needfinding plan makes controlling these biases in any other way not feasible. The researcher himself must maintain some integrity in attempting to distance opinions, beliefs and prior knowledge from the process of determining possible candidates to evaluate. Voluntary response bias and recall bias are also not applicable to this needfinding plan since no users are interviewed or surveyed.

4 DATA INVENTORY

4.1 Who are the users?

The users are predominantly of adult age (18+) and lead busy lives where multitasking is necessary throughout the day. Most have higher physically demanding tasks active in parallel to lecture material absorption and in prefer to leave lecture material to low-cognition part of their daily schedules.

4.2 Where are the users?

The users are located worldwide and more specifically surrounded by physically demanding activity. Whether on a bicycle, an automobile, preoccupied with children, or at work. Users are NOT behind a study desk with only the MOOC platform active and no other distraction.

4.3 What is the context of the task?

The context of the task is a multimodal environment, biding for user attention from multiple senses. Generally the user is preoccupied with either visual or tactile engagement in one task while simultaneously engaged in an auditory and cognitive load of the lecture material.

4.4 What are their goals?

The goal of the user is to achieve as many tasks as possible in the same time with the best overall results. More specifically, the user would be attempting to maximize the visual, tactile, or physical load of one task, while also maximizing the cognitive retention of material from the MOOC lectures. The ultimate goal would be to perform both actions simultaneously without each one biding for the sensory resources of the other.

4.5 What do they need?

The needs of the user is to facilitate as much of a separation in sensory demands between multiple tasks as possible. Namely, to minimize cross functional sensory demands form tasks which do not require them, other than for lack of a better user interface.

4.6 What are their tasks?

The active task of the user is to perform a low cognitive action such as driving, exercising, or household chores. The cognitive task of the user is to absorb lecture material with the least amount of physical interaction.

4.7 What are their subtasks?

The subtask of the user is to provide the least amount of physical interaction with the MOOC delivery platform, allowing full physical attention to the active task and provide the maximum cognitive attention to the lecture material.

5 DEFINING REQUIREMENTS

5.1 What are the requirements of the interface?

- The interface should implement a form of Artificial Intelligence which requires no physical interaction to control and allow for basic task enabled functionality.
- The interface should contain no visually demanding functions and minimize required tactile functionality as much as possible.
- Any implemented commands or tactile controls should be intuitive or maintain a low Gulf of Evaluation/Execution in order to perform the necessary task.
- Since a redesign of current existing applications used by the users is out of scope for this project, then the interface must include the capabilities to interact with any and all necessary applications that the user is required for proper material absorption.

5.2 What criteria would evaluate the success of a prototype?

- Counting the number of steps a user takes to accomplish a task.
- Counting the time it takes for a user to perform their desired task.
- Rating the level of distraction from their main goal, in order to accomplish the necessary task.
- Rating the time required to master the prototype by a new user.
- Rating the number of sensory perceptions required by the prototype.
- Counting the number of wrong commands or actions prior to correct action by users.
- Rating the level of distraction that he prototype introduces versus the original interface.
- Rating the level of material retention by users while using the interface.
- Counting the number of time a user had to navigate backwards in a lecture due to the use of the interface causing loss of focus.

6 CONTINUED NEEDFINDING

6.1 What original questions remain?

The original question, not necessarily answered by users, which remains is a hint towards the best interface style to move forward with. Most users do not

approve of full Artificial Intelligence automation and prefer to keep some control of processes. Some users do not, or cannot, remember all necessary click sequences in order to access advanced functions in simple tactile interfaces such as the AirPods or automotive controls. The answers gathered successfully defined a need, but not necessarily the solution to that need.

6.2 What new questions arose?

New questions which arose include specifics of applications and functions used most often which require interface prototyping. Addressing all possible interface interaction may not be feasible and focusing on the biggest need may drive user interest better than attempting to cover a broad range of tasks. \

- Which two or three tasks require the most context switching?
- What is the most annoying feature of the current set of applications used?
- Which features are missing from the current applications which you would find invaluable if incorporated?

6.3 What exercises do the new questions require?

The new question would reqire a rework of the Survey and interview question lists as well as a larger pool of candidates. The new questions posed require a slightly deeper dive into personal use and thus the interview needfinding plan would be more suitable. However with this plan, attaining at least fifteen interviews would be time-consuming and difficult to attain a broad range of candidates. However, this exercise would lead to the best answers for the questions posed.

7 APPENDICES

7.1 Appendix A – Survey questions and results

1. How often do you perform a physical activity while also listening to audio material (music, audiobooks, lectures, etc.)?
2. How satisfied are you with "touch" being the main interface on your phone?
3. In general, how many tasks do you switch between when using your phone?

4. In general, how many different activities can you multi-task at any one time?
5. What, if any, technological features or constraints limit your ability to multi-task?
6. How do you best absorb lecture material?
7. At what time during the day do you watch lecture materials?
8. In general, which activities do you feel comfortable in combining for multi-tasking?
9. Which activity would you want to perform while also absorbing lecture material?
10. The current implementation of MOOC platforms is adequate teaching complex concepts.

Response	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
1	3-5/ week	Neutral	2-4	2-4	not sure. cant think of any	Audio; Visual; Live lecture	Dinner-time Late at Night	Eating and Watching; Listening and Watching; Exercising and Watching; Driving and Listening; Occupational Work and Listening	Exercise; Eat	Strongly Agree
2	0-2/ week	Satisfied	2-4	5+	small screen size	Visual; Other	Early Morning Mid-Day Afternoon Dinner-time Late at Night	Eating and Watching; Listening and Watching; Exercising and Listening; Exercising and Watching; Driving and Listening; Occupational Work and Listening; Other	Exercise; Work; Eat; Sleep	Agree
3	3-5/ week	Neutral	2-4	Only 1	None. I'll perform one task across multiple applications but try not to multi-task.	Live lecture	Dinner-time Late at Night	Eating and Watching; Exercising and Listening; Driving and Listening	Exercise; Eat	Neutral

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4	0-2/ week	Neutral	2-4	2-4	I only have 2 hands - But since you said technological, I suppose that means my eyes and voice are not sufficient to fully support multitasking	Other	Early Morning Mid-Day Afternoon Dinner-time Late at Night	Eating and Reading; Eating and Watching	Exercise; Take care of kids; Eat; Drive; Sleep	Agree
5	3-5/ week	Very satisfied	2-4	2-4	none	Live lecture	Dinner-time	Eating and Reading; Eating and Watching; Exercising and Watching; Occupational Work and Listening	Work; Eat	Agree
6	3-5/ week	Neutral	Only 1	Only 1	running	Audio	Dinner-time	Exercising and Listening; Exercising and Watching; Driving and Listening; Driving and Watching	Sleep	Strongly Agree
7	0-2/ week	Satisfied	2-4	Only 1	The app reseting when it loses focus	Audio; Visual; Other	Late at Night	Eating and Reading; Eating and Watching; Listening and Watching; Exercising and Watching; Driving and Listening; Driving and Watching	Exercise; Eat; Drive; Sleep	Agree
8	3-5/ week	Satisfied	2-4	2-4	cognitive load	Audio; Visual	Dinner-time Late at Night	Listening and Watching	Exercise	Neutral
9	3-5/ week	Very satisfied	5+	2-4	Youtube video cant run on background	Audio; Visual	Early Morning Dinner-time	Eating and Watching; Listening and Watching; Exercising and Listening; Driving and Listening	Other	Agree
10	3-5/ week	Satisfied	2-4	2-4	Screen real-estate. Ease/speed of typing on screen vs keyboard.	Audio; Visual; Other	Dinner-time Late at Night	Eating and Reading; Eating and Watching; Listening and Reading; Listening and Watching; Exercising and Listening; Exercising and Watching	Exercise; Eat	Agree

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11	3-5/ week	Satisfied	2-4	2-4	-	Visual	Dinner-time; Late at Night	Eating and Reading; Eating and Watching; Exercising and Listening; Driving and Listening	Take care of kids	Agree
12	20+/ week	Satisfied	2-4	2-4	No technological features	Audio; Visual	Dinner-time	Eating and Watching; Exercising and Listening; Exercising and Watching; Driving and Listening; Occupational Work and Listening	Exercise	Agree
13	0-2/ week	Neutral	2-4	2-4	none	Visual	Afternoon	Eating and Reading; Eating and Watching; Listening and Reading; Listening and Watching; Driving and Watching; Occupational Work and Listening	Exercise; Work	Agree
14	0-2/ week	Satisfied	5+	5+	The speed of switch-ing, would be nice if it was quicker.	Audio; Visual	Late at Night	Eating and Reading; Eating and Watching; Listening and Watching; Exercising and Listening; Exercising and Watching; Driving and Listening; Occupational Work and Listening	Exercise; Work; Eat; Drive; Sleep	Neutral
15	3-5/ week	Satisfied	On-ly 1	Only 1	More of an attention thing, not technology	Audio; Visual	Dinner-time	Other	Other	Neutral
16	3-5/ week	Very satisfied	2-4	2-4	The difficulty of the task	Live lec-ture	Afternoon; Late at Night	Eating and Watching; Exercising and Listening; Driving and Listening; Occupational Work and Listening	Sleep	Strongly Agree
17	3-5/ week	Satisfied	2-4	2-4	children	Visual	Late at Night	Eating and Reading; Eating and Watching; Exercising and Listening; Driving and Listening	Exercise; Eat; Drive	Agree

18	3-5/ week	Neutral	2-4	2-4	Going back and forth among different apps in mobile	Audio; Visual	Mid-Day Afternoon Late at Night	Eating and Reading; Eating and Watching; Listening and Reading; Listening and Watching; Exercising and Listening; Driving and Listening	Exercise; Work; Eat; Drive	Disagree
19	0-2/ week	Satisfied	2-4	2-4	no	Audio; Visual	Mid-Day Afternoon	Listening and Watching; Exercising and Listening; Driving and Listening	Other	Neutral
20	3-5/ week	Satisfied	2-4	2-4	no extra fingers	Audio; Visual	Early Morning Dinner-time Late at Night	Eating and Watching; Exercising and Listening; Exercising and Watching; Driving and Listening; Occupational Work and Listening	Eat	Neutral
21	6-9/ week	Dissatisfied	2-4	2-4	Navigating lectures/quizzes while working out and/or driving.	Visual	Afternoon Dinner-time Late at Night	Eating and Watching; Listening and Watching; Exercising and Watching; Driving and Listening	Exercise; Eat; Drive	Disagree
22	3-5/ week	Dissatisfied	Only 1	2-4	n/a	Visual	Mid-Day	Listening and Reading	Work; Take care of kids	Agree
23	0-2/ week	Satisfied	2-4	2-4	No convenient mechanisms to switch or combine views within the application/interface	Visual; Live lecture	Dinner-time Late at Night	Eating and Watching; Exercising and Listening; Driving and Listening; Occupational Work and Listening	Eat; Drive	Agree

7.2 Appendix B – Interview questions and results

1. For absorbing lecture materials, how do you plan the time for best retention?
   - Morning person so do active work in the morning but lectures are not high activity task so done in afternoon when time is available.
   - Play video at double speeds. Visual thinker so double speed works. Most of the time the video refresh the reading.

- Wait for late at night when most of family is asleep and lectures can be watched in headphones.
2. Is there any obstacle which gets in the way between the material and your ability to retain the information?
    - If you got some degree of prior knowledge its easy, but for new topics I have to figure out whole new world. Lectures are still in the lower quality time. But coding is done in the morning, regardless of the subject.
    - Distractions from other applications on phone which interrupt video playback or bide for my attention.
    - I have to stop playback in order to write down notes or type them in another application. It would be nice if this was a feature built into the application, like Notes on Udacity, tied to a specific video.

3. Are there any daily tasks during which you would like to listen to some form of study material, but cannot due to some lack of technological capability?
    - Do not multitask
    - Cooking cleaning or washing can have other lectures on the background.
    - Driving. Tried listening to lecture during exercises but it ruins the experience since exercising usually requires some upbeat music for motivation and background rhythm setting.
4. Which technological innovation of a consumer device has the greatest impact to your daily life?
    - On demand nature of videos on the web, schedule around our requirements.
    - Double speed is useful.
    - Virtual assistance AIs like Alexa or Siri.
5. Which parts, if any, of on-campus studying do you feel is missing from online studying?
    - Articulating ideas and expressing them out verbally has more power than just writing them out. Something to do with neural connections with speaking out which reinforces them.

Writing Visual and Speaking are different and are all required for proper learning.

- In an on-campus setting when you are unsure of content, corrections are instantaneous, otherwise mistakes compound as in online studying.
- Physical human interaction factor

6. Do you find the tools available to you for learning, adequate to learn everything you desire to know?

- Everything is very fragmented. 5-10 different sites for different video content, 3-5 forums. There is no one way to put it all together to catalogue your learning and guide going forward.
- You have to watch the video then go to piazza to do the discussion. It would be better if Piazza was integrated directly into Udacity videos.
- Feedback loop for misunderstandings or review takes too long. It is quicker to ask questions in a peer-to-peer setting.