Assignment M2:
CS6750 – Human-Computer Interaction

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***Abstract*—Microwave ovens were a revolutionary technology when they were introduced. Seen as an all-in-one cooking device their ubiquitous interface is designed to perform a wide range of cooking tasks. This work explores their use in shared spaces and if an interface redesign can better suite their users.**

1 PARTICIPANT OBSERVATION

1.1 Execute and report results

The first needfinding activity was *participant observation*. I began with this needfinding activity, because its results will help steer the development of the following needfinding activities. See figure 1 for the microwave interface used.

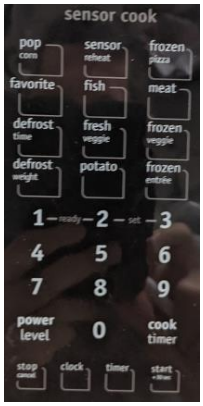

***Figure 1*—Microwave interface used in the participant observation activity.**

The interface was comprised of 29 buttons (open-door button not shown). Additionally, each button (except the open-door button) included either a numeric or text label. The interface has four different modes to start cooking. This includes a numpad, ready-set-shortcuts built into the numpad, shortcuts for sensor cooking, and a shortcut for adding time in 30 second increments. The raw data for this needfinding activity can be found in *Appendix 8.1 Participant observation*.

1.2 Summarizing the takeaways

The location for the needfinding activity was a breakroom for nurses. It was a shared space and created the intended spotlight effect. The spotlight effect is the "tendency for people to believe that their actions and appearance are more likely to be noticed, judged, and remembered by others than is actually the case." (Savitsky, Epley, & Gilovich, 2001) The location helped create an *in situ* experience and is appropriate for the planned post-event protocol activity.

In this environment I made several mistakes operating the microwave. For instance, I have never had a microwave where I had to press *cook timer* before entering the time. Since I was not pressing *cook timer*, I was accidently using the ready-set shortcuts which I quickly learned.

The sensory cooking functionality is not easily learned. I had to review the manual to understand its use. For instance, you should not use sensor cooking on food that weighs less than 4 ounces, with beverages, with a pizza over 12 ounces, raw foods, or in repeated succession. Further, I cannot make sense of the layout of the sensor cooking shortcuts. The layout does not seem to group functionality or food type.

1.3 Steps taken to avoid bias

To avoid *confirmation bias*, I focused on collecting quantitative data. For instance, the total number of buttons and labels, number of different modes, and key input sequences for each mode.

To mitigate *recall bias*, I recorded then entire participant observation. Also, I followed the think aloud methodology to capture my observations.

2 POST-EVENT PROTOCOL

2.1 Execute and report results

The second needfinding activity was a *post-event protocol*. The same microwave was used as the one in the participant observation activity. Each participant was handed instructions with detailed subtasks for a series of beverages and foods to cook.

There were four participants (two females and two males). The age of the participants was 32, 62, 73, and 75. Three of the four participants used the numpad interface. All four used the mode that they predominately used on their home microwave. The users did not scan and consider all buttons. Instead, they start with the mode they are most familiar with and then scan until they find the functionality for the current task. Three of the users were able to give a reason to change the power rating. This question was used to gauge their expertise rating. Based on this question three of the users were expert users and one was a novice. All users reported that they use a microwave at least four times a week in a shared space. Users were more likely to step away and perform another activity then watch their food cook. See *Appendix 8.4 Post-event protocol responses* for the complete set of responses.

2.2 Summarizing the takeaways

Three of the users stumbled while using the microwave. However, one user was quite efficient. On further questioning, they mentioned their microwave at home requires pressing *cook timer* before entering the time. I would also describe this user as an early adopter of technology.

The participants tended to use the test microwave in the same fashion as they use their microwave at home. For example, if their preference was to use a numpad at home, they were likely to use the numpad in this activity. This may imply that the redesigned interface should include the most prominent microwave design to leverage the user's existing knowledge.

2.3 Steps taken to avoid bias

To avoid *observer bias* the interaction between myself and the participant was scripted. A complete set of instructions were given to each participant at the beginning of the activity. See *Appendix 8.2 Post-event protocol instructions* for complete details. Each question of the post-event protocol activity was also scripted. See *Appendix 8.3 Post-event protocol questions* for complete details.

To lessen *social-desirability bias* I limited background information. Each user was told I was taking a human-computer interaction course and asked if I could observe them using a microwave and ask follow-up questions. The fact that I was planning to redesign an interface was not discussed. Further, I have purposefully

avoided designing the interface until after the needfinding activities. Limiting potential for socially desirable responses.

The post-event protocol inherently reduces *recall bias* by conducting the interview immediately after the participant completes the needfinding activity. Also, the interview was recorded, so it could be reviewed when collating data.

3 SURVEY

3.1 Execute and report results

The third needfinding activity was conducting a survey. PeerSurvey was used to design the questionnaire which consisted of 11 questions. There were two demographic questions and the rest of the questions focused on microwave usage. See *Appendix 8.5 Survey questions* for complete set of questions.

In total there were 25 respondents (8 females and 17 males). The participants age ranges fells into three ranges:

- 11 participants were 18 – 29
- 10 participants were 30 – 39
- Four participants were 40 – 49

The survey included three questions that asked the respondent to rank their first, second, and tertiary interface preferences. The interface rankings in order of preference were numpad, shortcut, dial, smart, and other. This ranking closely matched the interfaces the respondent had at home. In order of popularity the interfaces were numpad, dial, shortcut, smart, other. 76% of respondents described their microwave's interface as organized. While 76% of respondents reported that they were more likely to multitask then watch their food cook. See *Appendix 8.6 Survey responses* for complete set of responses.

3.2 Summarizing the takeaways

The demographic information was useful in that it identified that none of the respondents were 50 or older. However, I believe this demographic information is more indicative of Georgia Tech students than microwave users. I see this as a failure in the administration of the survey. The survey should have been made available to nonstudents.

Participants tend to rank the interface they own at home as their preferred interface. The reason may simply be that they bought the microwave with their preferred interface. However, it may also have to do with their familiarity with the interface. A similar trend occurs the post-protocol even activity where participants tend to use the interface they have at home.

76% of respondents report that they multitask while operating their microwave. Additionally, 84% of respondents state they predominately use their microwave to reheat food versus cooking raw food. The high number of multitaskers leads me to believe this is a task that could be simplified to minimize *cognitive load*. While the number of respondents simply reheating food leads me to think the interface could emphasize reheating food and deemphasize cooking raw foods.

3.3 Steps taken to avoid bias

To lessen *confirmation bias* I had a colleague review my survey questions before publishing the survey. I explained that I was planning to design a new microwave interface and the survey needs to avoid leading questions.

To reduce *observer bias* I had the same colleague review my conclusions based on the raw data collected. Explaining my intention to simplify the interface of microwaves for use in shared spaces.

To avoid *socially-desirability bias* I have focused my attention on the needfinding activities and have intentionally not started designing the interface. By doing this I hoped to avoid having a response that would appear socially desirable.

To mitigate against *voluntary-response bias* I will only view the collected survey data as a starting point that I must support with other needfinding methods. When summarizing takeaways about interface preferences above I referenced a similar trend in the *post-event protocol* for this reason.

4 DATA INVENTORY

4.1 Who are the users?

The intended users are persons who use a microwave in a shared space. For example, an office breakroom or café. The post-event protocol includes questions about power rating and defrost mode to categorize the user as a novice or expert

user. Microwaves are so ubiquitous it appears most adults understood the features and were categorized as expert users.

The survey only had respondents in the age range of 18 – 49. I believe this better describes the demographic of Georgia Tech students than microwave users. This was a failure in my administration of the survey. To correct this, I will readminister the survey and make it available on platforms that have a broader audience.

4.2 Who are the users?

In the participant observation and post-event protocol activities the users were in a breakroom in a hospital. Their environment was intentionally a shared space. However, for the survey I choose to be indiscriminate of whether the respondent was at home or in a shared space. The motivation was to collect background information that would be useful to know when designing for shared spaces. For instance, what are the most common interface used at home? A new design may leverage this knowledge by extending an interface that users already know.

4.3 What is the context of the task?

76% of the survey respondents reported that they were multitasking while using the microwave. However, the survey did not follow up with what the other activity was. For instance, they may be cooking on the stove, talking on the phone, or watching television. Better understanding the contexts of the users could lead to a better design. This was a failure in the design of the survey, and another question will be added to the survey.

4.4 What are their goals?

The primary goal of using a microwave is to heat a beverage or food. However, why does a user choose to use the microwave instead of the stove top? Question three of the post-event protocol asked how many buttons they scanned and considered. All users responded by saying they scanned until finding the first method for accomplishing the task. Further, 76% users reported they multitask while using the microwave. The goal when using the microwave is to relegate cooking to a background task.

4.5 What do they need?

The user will need a microwave and the beverage or food item to heat up. They may need cookware (e.g., plate, bowl, or utensil). The user will also need to know how to prepare the item. Will they need to unpackage the item or rinse it?

More interestingly, the participant observation activity had a series of six items to prepare. For each I needed to have a sense of how long to cook the beverage or food. The time depends on weight, density, and preference. The defrost functionality has two separate shortcuts, one to defrost by time and another to defrost by weight.

4.6 What are the tasks?

The survey included a question asking what food they most commonly cooked in the microwave. Based on this 84% of survey respondents list a food that would be reheated (e.g., leftovers). I distinguished cooking from reheating if the item being heated was raw. The other 16% came from raw food items like popcorn, rice, and pasta. Another task that was not represented in the write-in responses was defrosting. However, the functionality was probed in the post-even protocol activity.

4.7 What are the subtasks?

The post-event protocol included a list of subtasks as part of the tasks to complete. The user was asked to open the microwave door, place the food insider, set the microwave timer, and remove the food when done. Placing and removing the item from the microwave put the user directly in front of the microwave. The necessity to be in close proximity will affect which interfaces will be appropriate or not.

5 DEFINING REQUIREMENTS

5.1 Learnability

The users are multitasking while using the microwave and do not examine the functionality of each button. From observations during the post-event protocol activity, users will scan a microwave they have never seen and begin pressing buttons within seconds. Based on these observations the new design will place an emphasis on *learnability*. The metric for evaluating success will be number of

seconds till first button press. This can be compared directly to the recording taking in the post-event protocol activity.

5.2 Accessibility

The survey did not show as wide of range of user ages as expected. As discussed previously, the survey will need to be updated and rerun. Nonetheless, we did still have a relatively wide range of ages from 18 – 49. A secondary goal of the new design will be to prioritize *accessibility*. The metric for evaluating success will be the number incorrect button presses.

5.3 Functionality

Looking at the data inventory tasks the microwave is used primarily to reheat food. However, it's not the only *functionality* needed. Less frequently users cook and defrost using the microwave. This flexibility should be kept, but deemphasized in the interface. The metric for evaluating success of functionality will be qualitative. Does the user feel the deemphasized features are too inconvenient?

6 CONTINUED NEEDFINDING

The majority of survey respondents reported they multitask while using the microwave. Yet, the survey did not identify the specific tasks that they were doing while using the microwave. The post-event protocol activity asked the participants to prioritize their goals. However, this question would be more appropriate in the survey, because more responses are needed.

The survey had zero respondents over the age of 49. Noticing this older demographic missing made me realize that there was a missed opportunity to ask questions on accessibility of microwave interfaces.

Both the participant observation and post-event protocol activities were beneficial. However, these unanswered questions would be better served by updating the survey and re-administering it.

7 REFERENCES

1. Savitsky, K., Epley, N., & Gilovich, T. (2001). Do others judge us as harshly as we think? Overestimating the impact of our failures, shortcomings, and mishaps. Journal of Personality and Social Psychology, 81(1), 44-56. http://doi.org/10.1037/0022-3514.81.1.44

8 APPENDICES

8.1 Participant observation

Observations

- 29 total buttons
- On first glance it felt like there was a lot of text to read.
- Microwave was resting on countertop. Buttons at bottom were hard to see.
- Buttons 1, 2, 3, start, and stop had different functionality depending on context.

Popcorn

- Duration: 2:00 minutes
- Mode: Numpad shortcut (unintentional)
- Experience: Did not work the way I expected. Regardless, the interface did what I wanted. I pressed 2 and before I could enter 0, 0, start the microwave started running for 2 minutes.
- Correct key sequence: 2

Coffee

- Duration: 2:30 minutes
- Mode: Numpad
- Experience: Was difficult to enter time. I expected to hit 2, 3, 0, then start. However, hitting 1, 2, or 3 automatically starts the microwave for 1, 2, or 3 minutes.
- Correct key sequence: cook timer, 2, 3, 0, start

Butter

- Duration: 30 seconds

- Mode: +30 seconds
- Experience: I wanted to cook the button for 15 seconds. However, I settled for +30 seconds and watched for 15 seconds.
- Correct key sequence: cook timer, 1, 5, start

Oatmeal

- Duration: 3:00 minutes
- Mode: Numpad shortcut (unintentional)
- Experience: Still did not understand 1, 2, and 3 were shortcuts. Again, it did what I wanted and this is where I started to understand the interface.
- Correct key sequence: 3

Frozen dinner

- Duration: 4:00 minutes
- Mode: Numpad
- Experience: I hit cook timer, 4, 0, 0, but then kept hitting cancel instead of start. I confused the start and cancel a few times. The microwave was relatively low for me, and these keys were at the bottom and difficult to see.
- Correct key sequence: cook timer, 4, 0, 0, start

Poultry

- Duration: 10:00 minutes
- Mode: Defrost shortcut
- Experience: I used the defrost timer, but it was due to the research I had already done for the assignment. Until recently, I never knew the difference between defrost and microwaving for the same duration at full power.
- Correct key sequence: Defrost time, 1, 0, 0, 0, start

8.2 Post-event protocol instructions

- Subtasks
    - Open door and place item inside
    - Close door and select time
    - Count off 10 seconds
    - Remove item
    - Count of 10 seconds

    - Repeat for next task
- List of beverages and foods to prepare
    - Pop a bag of microwaveable popcorn
    - Reheat a cup of coffee
    - Melt butter
    - Cook instant oatmeal
    - Cook a frozen dinner
    - Defrost 1 lbs. of poultry

8.3 Post-event protocol questions

1. You used ___ mode. What was your reason?
2. Is this normal method at home?
3. What percentage of the buttons did you scan and consider?
    a. 1% - 25%
    b. 26 % - 50%
    c. 51% - 75%
    d. 76% - 100%
4. Reviewing the keys now, are there any that are ambiguous? How many?
5. Can you give a scenario where you would change the microwave's power rating?
6. Can you explain the defrost functionality?
7. How many times a month do you use the microwave outside your home?
    a. 0
    b. 1 – 3
    c. 4 – 9
    d. 10+
8. Prioritize the following goals when using a microwave:
    a. Complete this task and move onto the next
    b. Warm your food to the correct temperature
    c. Do not overcook food
9. Do you watch your food while it cooks or return when it dings?

8.4 Post-event protocol responses

Participant 1

1. Numpad; I know how long to cook food and will check when done. Too lazy to learn functionality.
2. Yes
3. B
4. No; 0
5. No, no idea what it does
6. Used to defrost meat
7. C
8. A, C, B
9. Watch unless butter

Participant 2

1. Numpad; More control
2. Yes
3. Scan until I find something that works
4. Yes; All but numpad 4 – 9
5. Defrost meat
6. Uses lower power to defrost and pulsates on and off
7. C
8. C, A, B
9. Dings

Participant 3

1. Numpad; It is a habit
2. Yes
3. B
4. No; 0
5. Defrost or melt butter
6. Lower power, runs for a minute, stops for 10 seconds, and repeats
7. D
8. B, C, A
9. 50/50

Participant 4

1. Shortcuts; Lazy, easy, convenient
2. Yes, if obvious

3. Scanned until I saw button
4. Yes, 2 buttons; favorite, potato (is it by time or weight)
5. Melt butter
6. Lower power
7. C
8. A, C, B
9. Dings

8.5 Survey questions

1. Select your age.
    a. Under 18
    b. 18 – 29
    c. 30 – 39
    d. 40 – 49
    e. 50 – 64
    f. 65+
2. Select your gender.
    a. Male
    b. Female
    c. Other
3. How many times a week do you use a microwave oven?
    a. Yes
    b. No
4. Choose first preference of interface for selecting a time on a microwave.
    a. Shortcut
    b. Dial
    c. Numpad
    d. Smart
    e. Other
5. Choose second preference of interface for selecting a time on a microwave.
    a. Shortcut
    b. Dial
    c. Numpad
    d. Smart
    e. Other

6. Choose third preference of interface for selecting a time on a microwave.
    a. Shortcut
    b. Dial
    c. Numpad
    d. Smart
    e. Other
7. Which interface do you use to select time on your microwave?
    a. Shortcut
    b. Dial
    c. Numpad
    d. Smart
    e. Other
8. Would you describe your oven's interface as organized or cluttered?
    a. Organized
    b. Cluttered
9. When using your microwave oven if it your only task or do you multi-task?
    a. Only task
    b. Multitask
10. What food or beverage do you most commonly cook in your microwave?

8.6 Survey responses

1,18-29,Female,5+,No,Shortcut,Numpad,Smart,Shortcut,Organized,Multi-task,Coffee

2,30-39,Female,1-4,Yes,Numpad,Smart,Dial,Numpad,Organized,Only task,"Tea,"

3,18-29,Male,1-4,No,Dial,Numpad,Smart,Numpad,Organized,Multitask,re-heating coffee

4,30-39,Male,5+,Yes,Shortcut,Numpad,Smart,Shortcut,Cluttered,Multitask,Frozen Trader Joe's meals

5,40-49,Male,5+,No,Shortcut,Numpad,Other,Shortcut,Organized,Multitask,left-overs

6,30-39,Male,1-4,Yes,Numpad,Shortcut,Other,Numpad,Organized,Only task,popcorn

7,18-29,Female,1-4,No,Numpad,Dial,Shortcut,Dial,Cluttered,Multitask,popcorn and pre cooked meals

8,18-29,Female,5+,No,Shortcut,Dial,Numpad,Dial,Organized,Multitask,"warm up rice, meat, vegetables"

9,30-39,Female,5+,Yes,Numpad,Shortcut,Smart,Numpad,Cluttered,Only task,Warm up coffee

10,30-39,Male,5+,No,Shortcut,Smart,Numpad,Shortcut,Organized,Multi-task,Tea/Coffee

11,18-29,Male,5+,No,Smart,Dial,Shortcut,Smart,Organized,Multitask,leftovers (commonly veggies with some rice)

12,18-29,Female,5+,Yes,Smart,Numpad,Shortcut,Numpad,Organized,Multi-task,Leftover meals

13,30-39,Male,1 - 4,No,Numpad,Shortcut,Dial,Numpad,Organized,Only task,re-heat dinner

14,18-29,Male,1 - 4,No,Numpad,Dial,Shortcut,Dial,Organized,Only task,Pizza

15,30-39,Male,5+,Yes,Numpad,Shortcut,Other,Numpad,Organized,Multi-task,Leftovers that need reheating

16,30-39,Male,5+,No,Numpad,Shortcut,Other,Numpad,Organized,Multi-task,Rice

17,18-29,Male,1 - 4,No,Dial,Numpad,Smart,Dial,Organized,Multitask,Leftovers

18,40-49,Male,5+,Yes,Dial,Smart,Numpad,Dial,Organized,Multitask,Rehashing coffee

19,40-49,Female,5+,Yes,Numpad,Shortcut,Smart,Shortcut,Organized,Multi-task,"Leftovers. Not beverages. Dumplings, rice, vegetables, meat."

20,40-49,Male,5+,No,Dial,Dial,Dial,Dial,Organized,Multitask,Warm milk for café lattes and reheat food

21,30-39,Male,1-4,No,Numpad,Shortcut,Dial,Numpad,Organized,Multi-task,Pasta

22,18-29,Male,5+,Yes,Shortcut,Numpad,Dial,Numpad,Cluttered,Multitask,Vegetables

23,18-29,Male,1-4,No,Numpad,Dial,Shortcut,Numpad,Organized,Only task,Everything that I eat can probably be reheated in the microwave.

24,18-29,Male,1-4,No,Numpad,Dial,Smart,Dial,Cluttered,Multitask,Chicken

25,30-39,Female,5+,No,Shortcut,Numpad,Dial,Shortcut,Cluttered,Multi-task,chicken nuggets