Re-Thinking Meditation in a Digital Age

A Muse Headband™ Assessment and Proposal
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Executive Summary

Due to increased research in mental health resources as well as proven benefits of meditating, meditation is an increasingly common practice which is shown to reduce stress, lower blood pressure, and increase mindfulness in everyday situations.

Over the course of a semester, a team of five students in the School of Information and Library Science taking INLS 718: User Interface Design sought to evaluate and assess Muse™, a health device which tracks a user’s brainwaves and provides insights into their meditation session using audio feedback, EEG readings, and other analysis. The purpose of the evaluation was to inform the team for a redesign of the mobile application interface. The team focused on user research, hierarchical task analysis, use case scenarios, and universal design principles for an analysis of the current Muse™ system, which all helped inform the redesign.

The team had five initial design decisions for the redesign of the Muse™ application:

1. Simplify the process by eliminating redundant option choices
2. Create a “Journey” function to streamline a user’s progress
3. Make the visualizations more interactive and intuitive
4. Enable a “Do Not Disturb” Mode and change screen during sessions
5. Create a consistent, updated brand guide for the application

A usability test conducted on five participants gathered key user feedback on the application prototypes. The team focused on key pain points that seemed to cause frustration and misunderstandings among users. For example, one participant revealed that some of the colors (e.g. light green) were not visible to people with red-green colorblindness. The user testing proved to be extremely valuable, garnering two key strengths and two key weaknesses that the team could use for future considerations.
**Key Strengths:**

- The interface aesthetics including the visual layout, color scheme
- Features that related to the gamification of the app

**Key Weaknesses:**

- The placement of the “session” selector
- Design of the toggle button
- Accessibility of colors choices

Based on user feedback, the team re-iterated the interface of the prototype and included the following design decisions:

- Changed the “Journey” icon to provide better intuitiveness
- Changed colors for more accessibility
- Added an informational tutorial icon
- Switched the layout of the “Meditate” page

The purpose of this redesign was to enhance the user experience of the Muse™ application and device integration. The redesign intends to create a more seamless interface with reduced visual clutter, which is more in line with the meditative process. While feedback from users was positive in many ways, there are still opportunities for future work with design iteration and further testing.
1. System Overview (Conceptual Model)

1.1. System Description

The Muse Headband™ is a meditation device that reads users’ brainwave patterns for guided meditation sessions. The system pairs a physical, external headband which measures brain activity — electroencephalography (EEG) feedback — with a local mobile application to deliver these sessions, providing real-time feedback via both a visual and auditory interface.

The session features sounds of nature that correlate to the user’s levels of brain activity; for instance, as the user relaxes, the sounds become more peaceful (e.g. a gentle stream), and if there is a higher level of activity, the sounds become more violent (e.g. heavy rainfall). After each meditation session, data is recorded so that the user can view Muse-generated insights on their mindfulness progress. Users are also able to record journal entries of their meditation sessions, complete personal meditation challenges, and share their session results via third-party applications.

1.2. System Scope

In order for a user to get brainwave data, they must use the headband; however, they are also free to use the mobile application as a standalone system for independent meditation sessions. Due to the time constraint of the project, the prototype will be at an early stage for user testing. Additionally, the current system is only in English although there are plans to incorporate other languages in the future.

This project will focus on the original Muse™ application and will exclude the newer update, Muse 2™, which was released October 30, 2018. Because no one on the team is an expert on meditation or on EEGs, the team will not attempt to redesign the data analysis feature of the system (including what constitutes “calm time” and “birds chirping”).
1.3. System Goals

This system will help guide users through meditation practices, whether they are new to meditation or are already familiar with it. The hope is that the system will either gradually introduce meditation for newcomers or provide long-term meditators with another way of incorporating it into their schedule. The system hopes to use real-time data for good; in this case, using EEG feedback to users both during and after sessions.

Ultimately, the company’s tagline, “Meditation Made Easy,” is at the core of the system as it hopes to increase overall engagement with meditation. The Muse™ application has a tremendous amount of upside as it incorporates Jakob Nielsen’s second usability heuristic — the “Match Between the System and the Real World” — successfully by speaking the user’s language (rather than system-oriented terms).^1

Other goals of the system include:

- Increasing overall engagement time with meditation
- Increasing calm points and the number of recoveries in session
- Raising awareness of mindfulness meditation practices
- Providing accurate information to the user on their brainwave activity for each session

The objective of this particular project is to assess the current state of the mobile experience and to provide recommendations for future iterations. In order to gauge the success of the project, the team has identified two success metrics for the project:

- Over 50% of users are able to clearly understand the data provided to them
- Over 50% of users would recommend the new system to a friend

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2. System Users

2.1. Target Audience Description

The target user group for Muse™ consists of young adults to independent senior adults, with most users being between 18 and 70 years old. Infants and young children are purposefully excluded from this user group. However, due to the wide age ranges Muse™ designs for, perceptual abilities, motor skills, and any physical limitations can vary, and therefore the design should be mindful of any accessibility issues such as hearing impairment, vision impairment, and/or a loss of motor skill(s).

All gender identities are included in this user group, although it is also acknowledged that there are studies which suggest that people who identify as female are more likely to report on the benefits of meditation, as opposed to those who identified as male. Additionally, there is research which suggests that those who identified as women were more likely to both meditate at least once a week and once or twice a month than those who identified as male. While this does not necessarily suggest or imply that the Muse™ system is targeted more toward a female audience, this does provide more insight into meditation practices as a whole.

The team understands that while users will have a wide range of background education, there is a higher tendency for people who are in high-stress situations to meditate, as there are proven studies which show the benefits of meditation for anxiety, depression, and emotional regularity. The majority of their work and/or home environment will be fast-paced and social, which sometimes can be a high stressor in our user’s personal life. Additionally, the team acknowledges that the user group’s home life will be diverse — including both traditional and non-traditional type families — which will also contribute to

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our user’s motivations, frustrations, and goals. Because of the product’s high cost (approximately $200 per headset), most Muse™ users identify as financially stable and have steady incomes.

Users will all share one common trait — an interest in meditation — with almost all being at least moderately comfortable with the idea of meditation itself. According to a 2014 study published by the Pew Research Center, 40% of adults meditated on a weekly basis and over 50% of adults had meditated at least once in the past year.\(^5\) We are able to conclude that most users will have some prior meditation and/or mindfulness experience already and are looking for a way to complement their already-established practices.

Additionally, the user group is very interested in seeing how health technology can benefit them, making them eager and willing to try Muse™. The majority of users will first learn about the product from personal recommendations from friends, family, and/or medical professionals. The team will keep in mind that some will have never tried a physical health device for meditation before, while others might be more experienced.

The group has varying frustrations and stressors in both their lives and meditation practices which are also important to note. Common stressors in life include work/school, pressure, and anxiety-inducing situations. When it comes to meditation, some common frustrations include: unfamiliarity with meditation, lack of satisfaction in their meditation sessions, and an inability to keep up a consistent practice despite wanting to.\(^6\)

The user group is comfortable using technology to complete tasks and for the most part are at least computer-literate. They may have varying experience with using health applications, but a majority of users will have knowledge of how health apps function. They will be familiar with the collection and storage of their health data being used to provide them insights on their health, but might also need reminders as to how the data is exactly being used and stored, especially as more people are getting anxious about data privacy.\(^7\) The group has varying knowledge of health devices, but a majority of the users

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have experience with a health device and/or system. The user group will include those who use various devices (i.e. desktop, laptop, mobile, smartwatch), but a majority of users use their mobile device at least once a day.

The group varies in their motivations to use the application. A majority of the users are motivated to use the application for general wellness. The other portion of users is motivated to use the device to treat a health condition (e.g. anxiety, high blood pressure, heart-related issues). A small portion of our users are not motivated by either of these, but rather are just curious about their brain activity.

Our users may experience varying levels of limitations of using the system, with the most common limitation being the number of times users has to commit to a consistent meditation practice. Other limitations include comfort with technology, home (and meditation) environments, and expendable income.

The users of this system vary on their level of open-mindedness to closed-mindedness, but a majority of users are open to new ideas. As mentioned previously, the majority of users are excited to gain health insights from Muse™ and are therefore very willing and forgiving at first with the application and headband. The user group does not heavily lean towards outgoing or reserved personalities; furthermore, users may be outgoing and enjoy sharing information about their health or may be reserved and private.

Our users know how much they value wellness, health, work, family and friends (social life), learning, and self-awareness. While each user’s personal values will vary, it is important to glean the stance on these values from our user group to better understand their potential use of the Muse Headband™.

Finally, our users also have personal goals and motivations in using the Muse Headband™ and application. Their personal goals will vary, but common goals include: lowering stress, gaining more control over their mind, and improving overall wellness.

2.2. Summary Data on Characteristics of Target Audience

https://www.mobihealthnews.com/content/study-many-health-apps-insecure-do-not-conform.eu-privacy-requirements
The table below shows a consolidated summary of information mentioned in **Section 2.1.** Target Audience Description.

### Target Audience Characteristics Chart:

<table>
<thead>
<tr>
<th>Demographics</th>
<th><strong>Target User Traits</strong></th>
</tr>
</thead>
</table>
| ● Age ranges from 18 and 70 years old  
● Understands English |

<table>
<thead>
<tr>
<th>Physical and Psychological Characteristics</th>
<th><strong>Target User Traits</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>● Due to the large age range, may have limitations on perceptual abilities and motor skills, including vision and hearing impairment</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Working Environment</th>
<th><strong>Target User Traits</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>● High-stress, fast-paced working environment (includes professional and academic settings)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Income</th>
<th><strong>Target User Traits</strong></th>
</tr>
</thead>
</table>
| ● Identifies as financially stable  
● Has steady income |

<table>
<thead>
<tr>
<th>Meditation Knowledge and Experience</th>
<th><strong>Target User Traits</strong></th>
</tr>
</thead>
</table>
| ● All are interested in meditation  
● Most users will already have some prior meditation and/or mindfulness experience  
● Most users will know someone who also has experience with meditation |

<table>
<thead>
<tr>
<th>Computer/IT Experience</th>
<th><strong>Target User Traits</strong></th>
</tr>
</thead>
</table>
| ● Ranges, but the majority will identify as being average to above-average in technology proficiency  
● Somewhat familiar with medical health applications/systems  
● Comfortable using technology for most tasks |

<table>
<thead>
<tr>
<th>Cognitive Characteristics</th>
<th><strong>Target User Traits</strong></th>
</tr>
</thead>
</table>
| ● Might have concerns regarding data privacy  
● Excited to see how health technology can benefit them  
● Fairly open-minded and shows a willingness to try |

<table>
<thead>
<tr>
<th>Motivations</th>
<th><strong>Target User Traits</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>● The majority of users are motivated to use the application for general wellness and/or to treat a health condition such as anxiety or high blood pressure.</td>
<td></td>
</tr>
</tbody>
</table>

### 2.3. Persona Models
### 2.3.1. Primary Persona (Maya)

**Persona Summary:**
A young and successful millennial who just started her job at a well-known law firm. Suffers from mild anxiety and is looking for a balance between her work and social life.

#### Maya

![Maya's Image]

**Day-to-Day Life**
Maya has a full-time job at a prestigious law firm and wants to one day become an accomplished lawyer. When she isn't at work, she enjoys going to dog parks and coffee shops with her friends. She finds her life stressful and feels like she must constantly change tasks, which is why she wants to use Muse to become more self-aware and mindful, as well as help alleviate her anxiety. She sees Muse as a calming tool where she can focus on her internal thoughts and not worry about external pressures.

Most of her day is spent working on the computer. She hates checking emails and attending team meetings. Sometimes, she wears earbuds so that she can listen to music while she focuses on her work. During especially busy times of the year, she may not leave the office until 8 or 9 p.m.

**Engagement with Meditation**
Maya has practiced yoga for 9 years. She has practiced meditation for 4 years after a friend recommended it to her.

**Meditation Environment**
Maya prefers to pull up a YouTube video to listen to meditation instructions while she sits on a rug in her living room. She aims to dedicate at least 30 minutes a week to meditation or yoga — usually on the weekends — but sometimes cannot make time for it because she has social events to attend or errands she needs to run.

**Goals + Motivations**
- Incorporate Muse into her daily life and already-established mindfulness practices to help reduce her anxiety
- Analyze her brainwave data
- Become more mindful; be calm

**Frustrations + Pain-Points**
- Finds the dashboard to be too cluttered
- No connectivity to other apps (e.g. Apple Health)
- Feels like the headset does not always accurately portray her meditation sessions
- Does not find the FAQ Help Page useful
- Feels like data can be hard to interpret at times

**Personal Values**
- Work-life balance
- Learning
- Self-awareness

**Physical Abilities**
She has the average hearing.

**Technological Proficiency**

<table>
<thead>
<tr>
<th>Novice</th>
<th>Expert</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loves to use her iPhone and relies on it for everything—productivity apps (to-do lists, reminders), entertainment apps (YouTube, Pinterest, Spotify, Pandora), work apps (Gmail), health (sleep tracker), personal information management (photos). She is a heavy social media user—Instagram and Twitter are her favorites. She tends to peruse her phone during her lunch hour or during breaks at work. Maya is always open to trying out new apps, though, especially if they are health-related apps.</td>
<td></td>
</tr>
</tbody>
</table>

**Perceptions of Health**
Maya is an avid "quantified-selfer." She tracks daily steps, caloric intake, and heart rate. She likes how she can use her phone to see all of her health data at any time and any place. She is attracted to Muse because she learned that it can track her brain waves.
2.3.2. Primary Persona (Zachary)

Persona Summary:
An undergraduate student who is balancing working on campus, hanging out with friends, studying for his classes, and applying to full-time positions for post-graduation. He is interested in the latest technology fads and cares about his health.

Zachary

Day-to-Day Life
Zachary is a full-time student who takes classes 10AM-3PM during the week. After class, he works at the UNC IT Help Desk as a student IT specialist, and his primary job is to welcome any students or faculties with IT questions. He uses a desktop computer for work and a laptop for personal uses. He gets online frequently and spends approximately 4 hours per day browsing and streaming. After work, Zachary goes home to do homework.

Engagement with Meditation
Zachary has never tried meditating before, so he might need guidance on how to meditate and how to use Muse to assist the process.

Meditation Environment
While Zachary has never meditated before, he is open to trying to meditate in the comfort of his own bedroom, at his desk chair.

Goals + Motivations
- Wants to join a large, corporate company after graduation
- Eager to use Muse as a guided meditation
- Willing to promote Muse to his friends who also feel overwhelmed by their schoolwork

Frustrations + Pain-Points
- Does not have much time during the day to meditate
- Wishes there was a way to ‘showcase’ his meditation log to friends (i.e. a social component feature)
- Finds it hard to concentrate due to the abrupt audio stopping reminding him to adjust the headset
- Finds the tutorial hard to understand

Personal Values
- Self-Control
- Work-Life Balance
- “Stay Hungry”

Physical Abilities
Zachary has the average hearing.

Technological Proficiency
Novice

As a millennial living in the fast-developing digital world, he embraces technology as an essential part of his life. He feels very comfortable using the Internet to do online searches and is willing to learn about any kinds of “new cool gears” that could benefit his life.

Perceptions of Health
Zachary really cares about his physical health as he frequents the gym quite often. Although he has several stressors in her life, Zachary has never thought about giving his mind a rest until now. Because of this, he is attracted to Muse as she believes it could guide him to be spiritually healthy.

"If I can't even take care of myself, how can I take care of someone else?"

Age: 21
Work: Full-time 4th year undergraduate student at UNC-Chapel Hill
Education: B.S in Business Administration, B.S Statistics
Home-Life: Lives with his girlfriend

Reserved Outgoing
Closed-Minded Open-Minded
Low work ethic Strong work ethic

Zachary is a hard-working, studious, introverted student who is always curious about new stuff.
2.3.3. Secondary Persona (Anne)

Persona Summary:

An accomplished clinical therapist who has a heavy caseload and is interested in seeing how she can incorporate the latest technologies and research into her practice.

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Anne

**The greatest wealth is health.**

- **Age:** 52
- **Work:** Clinical Therapist
- **Education:** M.S., Social Work, B.S., Psychology
- **Home-Life:** Empty nester, mother of two adult children

**Personality**

<table>
<thead>
<tr>
<th>Reserved</th>
<th>Outgoing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed-Minded</td>
<td>Open-Minded</td>
</tr>
</tbody>
</table>

Anne is calm and fairly reserved, and more introspective than outgoing. She is very open-minded and willing to try new things or hear about others’ experiences.

**Day-to-Day Life**

Anne has been working as a therapist for the last 20 years, specializing in college-age counseling. She sees trends among her clients, many of which struggle with anxiety and depression.

**Engagement with Meditation**

Anne has been meditating for many years, and she does not personally need the assistance of Muse. She does, however, see its benefits and think that it is a great way to get clients involved in meditation.

**Meditation Environment**

Anne prefers walking meditations to clear her mind and usually meditates during walks around her neighborhood.

**Personal Values**

Anne values her work-life balance, and sees many negative effects of spending too much time stressing about work. She is very aware of how important a healthy mental state is and wants to ensure that she is taking care of herself. She is always open to new ways to practice self-care, whether they are through more traditional ways or innovative ways like Muse.

**Physical Abilities**

Anne sometimes has trouble hearing, and often asks people to repeat themselves.

**Technological Proficiency**

<table>
<thead>
<tr>
<th>Novice</th>
<th>Expert</th>
</tr>
</thead>
</table>

**Perceptions of Health**

As a therapist, Anne holds wellness in high regard. It is a large part of her home and work life, and she views mental and physical health to be equal.

**Goals + Motivations**

- Ensure that she should still be recommending Muse and that it is up-to-date
- Help her clients cope with mental health issues such as anxiety and other life struggles
- Connect with her clients by promoting Muse

**Frustrations + Pain-Points**

- Sees millennials who are addicted to their phones
- Sometimes sees technology as a distraction
- Feels like the application has too high of a learning curve as many of her patients stop using it after 2 sessions
3. User Task Analysis

3.1. Task Analysis Overview

This task analysis includes hierarchical descriptions and essential use cases for 2 primary user goals the team has identified for Muse™ users: completing a meditation session and analyzing meditation session data.

3.2. Task #1: Complete a Meditation Session

3.2.1. Hierarchical Description for Task #1

3.2.2. Essential Use Cases for Task #1

This next section identifies use cases for the following sub-tasks:

1) Opening the Muse™ Application
2) Customizing the Session
3) Pairing the Muse Headband™
4) Starting the Session
5) Finishing the Session
Essential Use Case #1: Opening the Muse™ App

User Intention: To start a meditation session

<table>
<thead>
<tr>
<th>Task</th>
<th>User Action</th>
<th>System Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>To start a session</td>
<td>Display intuitive visual interface so users can begin session</td>
</tr>
</tbody>
</table>

Use Case Scenarios:

- **Maya**: Maya just had a long week at work and is looking forward to decompressing this weekend. As she is trying to incorporate meditation into her weekly routine, she decides to take a moment and use Muse™ before she goes out to dinner with her friends. She turns her lights down, sits down in her living room in her typical meditation area, grabs her headset, and opens the Muse™ application on her phone.

- **Zachary**: Zachary just finished his last class of the day and feels the need to unwind. He has one hour until he has to drive to work, which isn’t enough time for him to start an assignment, so he chooses to meditate for half an hour in his bedroom before work.
**Essential Use Case #2: Customizing the Session**

**User Intention:** To customize a meditation session based on personal preferences and meditation goals

<table>
<thead>
<tr>
<th>Task</th>
<th>User Action</th>
<th>System Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1.</td>
<td>Customize duration</td>
<td>Provide options for different lengths of times</td>
</tr>
<tr>
<td>2.2.</td>
<td>Customize sound</td>
<td>Provide options for varying soundscapes</td>
</tr>
<tr>
<td>2.3.</td>
<td>Select exercise</td>
<td>Provide a selection of exercises, restrict access to exercises that require prerequisites</td>
</tr>
</tbody>
</table>

**Use Case Scenarios:**

- **Maya:** Maya only has time for a 15 minute session, so she wants to be able to make sure her session only lasts for 15 minutes. She wants to be able to customize the duration so that she can reach her weekly goal of 30 minutes of meditation. She was unable to meditate during the week because she was forced to work late in the evenings, so this long session should help make up for that while also giving her a good amount of time to decompress before the weekend. She chooses the beach soundscape because she enjoys the sounds of the waves. She loves the fact that she can change the soundscape, so each session feels new and not repetitive. While she has used Muse™ before, she is still on the “Muse Essentials” Collection. She is going to choose a session from a few times back because it has been a while since she has used Muse™.

- **Zachary:** Zachary has a whole hour to spare and does not want to work on homework or study. Instead, he wants to meditate for an extended amount of time: 45 minutes. Because he is a novice at Muse™, he decides to go with the default “Rainforest” sound noise because he trusts Muse™ and its default setting. He wants to build his meditation skills and will start from “Muse Essentials” to help start his practice.
Essential Use Case #3: Pairing the Muse™ Headband

User Intention: To use the Muse Headband™ in partnership with the Muse™ application

<table>
<thead>
<tr>
<th>Task</th>
<th>User Action</th>
<th>System Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.</td>
<td>Put on Muse Headband™</td>
<td>Allow headband to adjust and fit users’ heads</td>
</tr>
<tr>
<td>3.2.</td>
<td>Turn on phone Bluetooth settings</td>
<td>Synchronize with phone Bluetooth connection</td>
</tr>
<tr>
<td>3.3.</td>
<td>Turn on headband</td>
<td>Power band on response</td>
</tr>
<tr>
<td>3.4.</td>
<td>Calibrate headband</td>
<td>Sense brainwaves and establish a baseline based on reading</td>
</tr>
</tbody>
</table>

Use Case Scenarios:

- **Maya**: Maya has used YouTube tutorials before, but she likes that Muse™ uses an external headband to sense her brainwaves and provide very customized sessions. She wants to get right into her session so that she makes the most out of her busy schedule. She needs the headband pairing process to be quick and seamless.

- **Zachary**: Zachary is skilled at technology and already has his Bluetooth settings on. He finds the headband intuitive to pair, but is a little uncomfortable putting on the physical headband as it takes some time to adjust so that it fits his head.
Essential Use Case #4: Starting a Meditation Session

User Intention: To receive real-time feedback on their meditation process

<table>
<thead>
<tr>
<th>Task</th>
<th>User Action</th>
<th>System Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1.</td>
<td>Click “Start Session” on user interface</td>
<td>Ensure that the guided meditation session has the user’s customized preferences.</td>
</tr>
<tr>
<td>4.2.</td>
<td>Follow audio guide to meditate</td>
<td>Vary sounds in the session based on user’s brain activity.</td>
</tr>
</tbody>
</table>

Use Case Scenarios:

- **Maya**: Because Maya has an event that she needs to get to after my meditation session, she needs the session to be intuitive and quick to start. She likes that she receives intelligent audio guides during her session.

- **Zachary**: Zachary wants to start a weekly meditation practice around this time, because he always have a one-hour gap between class and work around this time. He is eager to see how Muse™ can help guide him and he enjoys the guided noises to give me real-time feedback.
Essential Use Case #5: Finishing a Meditation Session

User Intention: To be able to reflect on their practice after each session

<table>
<thead>
<tr>
<th>Task</th>
<th>User Action</th>
<th>System Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1.</td>
<td>Record journal entry</td>
<td>Store reflections in system application</td>
</tr>
<tr>
<td>5.2.</td>
<td>View results</td>
<td>Display user reflections in a consistent area in the application</td>
</tr>
</tbody>
</table>

Use Case Scenarios:

- **Maya:** Maya finds that reflecting on how she feel after meditating is an important part of the meditation process for me. She is using Muse™ to reduce her anxiety and become more mindful. By reflecting on her thoughts after the session, she is able to write down her mindful thoughts. It is important for her to record these thoughts so that she can look back at them. When she is in the midst of a crazy work week, sometimes it is difficult to see past the stress of impending deadlines. Looking back at notes she wrote when she was at her most mindful helps her take a step back and think about more important aspects of life.

- **Zachary:** Zachary is still a little doubtful on whether he actually feels better or if it is a placebo effect, but he does feel like his head is clearer and feels ready to go back to campus to start his afternoon work shift. He decides to keep a bullet journal and write down his thoughts and reflections there, instead of recording it in the application.
3.2.3. General Description of Task Characteristics for Task #1

Users will likely perform this task daily, and sometimes multiple times each day. As the main task of the Muse™ application, users will go through it any time they wish to meditate. For those with a consistent meditation practice, this could occur every day. Those that are beginners may only conduct a session once or two times a week. Session duration is user-specified, but in most cases ranges from 10 to 20 minutes to complete the entire process.

Completing a meditation session is not very complex, as users are guided through audio and visual cues from the Muse™ application. The inherent difficulty of completing a meditation session is based on the user’s ability to calm their mind; the task may be perceived as more difficult to users who have a “stormy” session, indicating active brainwaves. The task is well structured through the guidance of the application. Users are prompted to move throughout the sub-tasks, and meditation itself is guided through audio cues that signal brain activity and session completion.

This task is typically conducted in a calm, quiet setting, such as the user’s home. The user’s goal is to achieve a calm state of mind, and their physical surroundings should reflect this. Users will generally sit during the session, so they may be located in a chair, on a couch, or on a comfortable spot on the floor. The user does not need any tools aside from the Muse Headband™ and the device that houses their application.

The task is inherently personal, as users will meditate predominantly privately. Meditation itself has been practiced since prehistoric times, especially in religious and spiritual contexts (Taoism and Buddhism). Through time, it has become a mainstream practice and part of the larger health and wellness landscape. Completing a meditation session with the assistance of Muse™ is a change from the way meditation has traditionally been practiced, so it may produce cultural changes.

Using the Muse™ app to complete a meditation session does not require any training, and first-time meditators are able to follow the instructions in the application to successfully complete the task. When things go wrong, audio assistance helps the user figure out what the problem is. For instance, issues can occur if the Muse Headband™ is not clean as this
prevents proper brainwave readings. The Muse™ application directs users to remove the headband, make sure it is clean, and make sure the fit is proper for the brainwave detection. The settings on the Muse™ application features a help section that directs users to online help and customer care through external links to the Muse™ website. There is a link to frequently asked questions that may be helpful if a user experiences a common problem. The settings also contain a link to a demo of the product, which would be useful to users returning to the application after some time away.

As the primary task of the Muse™ system, this task is necessary to complete the other task of viewing data across sessions. Completing the session is necessary to generate data that fuels other aspects of the application, such as seeing trends and statistics, receiving “awards” based on goals, and accumulating “calm points.”
3.3. Task #2: Analyze Meditation Data in Application

3.3.1. Hierarchical Description for Task #2

3.3.2. Essential Use Cases for Task #2

This next section identifies use cases for the following sub-tasks:

1) Setting a Meditation Goal
2) Completing a Challenge
3) Tracking “Calm Time” Data Across Multiple Meditation Sessions
Essential Use Case #1: Setting a Meditation Goal

User Intention: To track meditation progress, specifically the duration of meditation sessions

<table>
<thead>
<tr>
<th>Task</th>
<th>User Action</th>
<th>System Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1.</td>
<td>Select this week’s goal</td>
<td>Display progress bar that compares the number of minutes meditated to the goal. Show week date range.</td>
</tr>
<tr>
<td>1.2.</td>
<td>Select next week’s goal</td>
<td>Show the current goal time (e.g., 10 mins/week) on the “Next Week's Goal” button.</td>
</tr>
<tr>
<td>1.3.</td>
<td>Adjust meditation time goal</td>
<td>Allow user to efficiently scroll through hours column and minutes column; confirm time with Set! button</td>
</tr>
</tbody>
</table>

Use Case Scenarios:

- Zachary: Zachary’s weekdays are filled with classes and work shifts, so he wants to set his daily meditation goal of one hour, which is the length of his lunch break. He wishes that setting the meditation goal would guide him the right way to relieve his pressure and relax. He sets the personal meditation goal every day in the morning and adjusts the flexibly according to schedule changes.

- Anne: Anne preaches mindfulness practices in her clinical counseling work and therefore wants to set a personal meditation goal for herself so she can help use her own experiences to benefit her clients. She wants to select a weekly meditation goal of two hours, which allows her to space out her sessions throughout the week. She hopes that by setting this goal, she can connect with her own clients who also meditate. She will set her personal meditation goal every Monday morning when she comes into the office.
Essential Use Case #2: Completing a Challenge

User Intention: Become motivated to use Muse™ to meditate, feel a sense of accomplishment

<table>
<thead>
<tr>
<th>Task</th>
<th>User Action</th>
<th>System Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1.</td>
<td>Select challenge level</td>
<td>Present goal clearly and prominently. Goal statement is located directly under the Level 1 Challenge bar in the “Me” tab.</td>
</tr>
<tr>
<td>2.2.</td>
<td>Read instructions</td>
<td>Explain to user why they should engage in the challenges. Provide incentives to the user by stating facts about successful device use. Show when the current challenge was started. Display inspiring images.</td>
</tr>
<tr>
<td>2.3.</td>
<td>Meditate for target length of time</td>
<td>Display progress of ratio of meditation minutes completed for that challenge. Progress bar helps the user visualize where they are on the journey.</td>
</tr>
</tbody>
</table>

Use Case Scenarios:

**Zachary:** Zachary first noticed the Muse Challenge™ while he was exploring the mobile application. Curious about it, he started to explore this function further. The challenges are somehow different from the normal meditation he is used to as it has some special methods to guide him. Because of this novelty, he feels curious about how these challenges work. Unfortunately, he does not have much time now and would rather look at this feature more later, during the weekend, when he has a more flexible schedule.

**Anne:** Because she take a mindfulness approach for clients and recently discovered the Muse Headband™, she wants to know all the features it provides so she can accurately inform her clients. She periodically checks to see if there are any new insights or features the application has. She want to complete simple challenges that the application suggests.

Essential Use Case #3: Tracking “Calm” Time Across Sessions
User Intention: Become motivated to use Muse™ to meditate, feel a sense of accomplishment

<table>
<thead>
<tr>
<th>Task</th>
<th>User Action</th>
<th>System Responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.</td>
<td>In timeline, compare “Calm Time” data</td>
<td>Show the number of minutes meditated during each session juxtaposed behind the number of minutes “Calm time” in the timeline graph. The graph should display “Calm Time” minutes in a different color than the “Session time” minutes.</td>
</tr>
</tbody>
</table>

Use Case Scenarios:

- **Zachary**: “Calm Time” is the data Zachary really cares about, as his primary goal of using the system is to relieve himself from outside pressures, as he sets aside one-hour for formal practices on a regular basis. He wants to know how long he has “calmed down” during the session and wants to try to improve his “Calm Time.” He would like to keep tracking his “Calm Time” and record the data with the hope of seeing an overall improvement in his meditation quality.

- **Anne**: Anne is curious about her own “Calm Time” and thinks it would be interesting to compare with her clients. Even though she does not need the assistance of Muse™ to meditate, she wants to make sure that she is clocking in her own “Calm Time” as well so I can see the data and log it in.
3.3.3. General Description of Task Characteristics for Task #2

Users will access and analyze their meditation session data according to their different habits, as some users might enjoy keeping tracking their data right after completing the meditation and others might want to learn about the data once in a day or in a week. Data is directly retrieved by brain-sensing technology to reflect the user-specific measurements on meditation. Data will include key metrics that reflect the meditation quality and meditation habit, such as the length of “calm time” and weekly goals, and data can be found within the Muse™ application.

To retrieve data from meditation, users will be guided through the simple process from setting up the goal or challenge, completing the goal and then see the visualized data within the app to analyze. There would be no external difficulty within the process as the user interface of Muse™ is functional and clear, but the internal difficulty, which is the ability of users to calm down their minds, might make data look complicated as users who cannot calm down will see waving brain waves that are hard to analyze.

This task is the standard process of completing the full meditation goal or challenge that users should follow. Setting the goal as the first step is essential for users to determine their purposes of taking a meditation session, and the app will provide users with choices to have challenges in different purposes and length. Users are encouraged to take challenges daily to develop the habit, and they will be guided through selecting challenges, reading instructions and meditating to complete the session each time they use Muse™. After completing the meditation session, users can track data related to their meditation — such as “calm time” — to understand their meditation quality.

As the primary goal of taking meditation sessions is to attain inner peace, the task is highly recommended to be conducted in a quiet and calm setting. Additionally, users are suggested to sit or lie down to fully relax their bodies and minds as to better calm down. Users would not need other tools to facilitate this process unless they would like to export and visualize the data by themselves. Data reflected from meditation sessions should be totally private and can only serve users themselves to monitor and improve the meditation quality.
Using the Muse™ app to track data does not require any guidance. Based on data retrieved from the brain-sensing headband, users will know their total “calm time” and session time during their meditation session, and users will be encouraged to keep track of their challenges and goals to further motivate them using the Muse™ app while meditating. Also, users can view their meditation data displayed both according to sessions and cumulatively to better analyze their performance.
4. Recommendations for New System

4.1. Design Decisions Overview

After a systems analysis, the team identified five potential problems for the system and recommends a corresponding design alternatives for the user interface. These decisions were made as a team and seek to improve the overall functionality and usability of the system. The following section outlines each design decision proposal, alternative solutions which were considered, and a rationale/justification based on previous literature for each decision made. The following table summarizes these decisions:

<table>
<thead>
<tr>
<th>#</th>
<th>Potential Problem</th>
<th>Design Decision</th>
<th>Justification</th>
<th>Relevant Universal Principles of Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unnecessarily complex process for session customization</td>
<td>Simplify the process by eliminating redundant option choices</td>
<td>Eliminates cognitive load on user</td>
<td>Law of Simplicity, Hick’s Law, False-Bottom Effect</td>
</tr>
<tr>
<td>2</td>
<td>Weak in-app incentives</td>
<td>Create a “Journey” function to streamline a user’s progress</td>
<td>Eliminate information overload; provide stronger incentive</td>
<td>Storytelling, Layering</td>
</tr>
<tr>
<td>3</td>
<td>Data visualizations are confusing and do not provide clear information</td>
<td>Make the visualizations more interactive and intuitive</td>
<td>Incorporating data visualization best practices on the application</td>
<td>Form Follows Function, Comparison</td>
</tr>
<tr>
<td>4</td>
<td>Distractions while meditating</td>
<td>Enable a “Do Not Disturb” Mode and change screen during sessions</td>
<td>Users will be fully immersed in the session rather than wanting to interact with application</td>
<td>Entry Point</td>
</tr>
<tr>
<td>5</td>
<td>Visual elements are unclear and inconsistent</td>
<td>Create a consistent, updated brand guide for the application</td>
<td>Consistent icons will provide affordances, eliminating confusion from user</td>
<td>Consistency, Iconic Representation, Uniform Connectedness</td>
</tr>
</tbody>
</table>
4.2. Design Decision #1: Simplify the Meditation Configuration & Customization Process

4.2.1. Description

This design decision refers to the meditation setup configuration and customization, a key component of each user meditation session. The images below show screens that a user interacts with each time they set up a session, and both of them could benefit from a redesign.

The image on the left shows where users select their session length, which includes both buttons up to 45 minutes and a scrolling selector for a length of up to 3 hours and 59 minutes. The image on the right shows the soundscape selector, which comes with only one soundscape preloaded and four others available for download. Although there are only five total soundscape options, they do not all fit on one page.
4.2.2. Alternatives Considered

Having two separate ways to select length confuses users, as it is not immediately clear how the buttons and scrolling component work together. Because of this, there should only be one way to select length on the session length page. Additionally, having the buttons at the top seems to prompt users of recommended session length (i.e. no longer than 45 minutes), but the effect of this is lost with further customizability below. The suggested alternative is to simply have the scrolling selector. For the soundscape page, the alternative suggestion is to have all available options pre-downloaded with the application, and make the cover images slightly smaller to display them all on one page.

4.2.3. Rationale

The rationale for having only one way to select time (the scrolling selector) is to simplify the user interface and cut down on confusion for the user. The Nielsen Norman Group advocates for simplicity of interfaces, in one article, they state: “As the number of choices increases, so does the effort required to collect information and make good decisions. Featuritis can be an exhausting disease for users.”

Because this is an aspect of the interface that users encounter each time they enter a session, it is especially important not to overload them with a cluttered interface. This can also be justified by Hick’s Law, as “users bombarded with choices have to take time to interpret and decide, giving them work they don’t want.”

By keeping the soundscape page condensed and pre-loaded, it will reduce user fatigue. In preliminary conversations with users about the current application, they were hesitant to press the download button on alternate soundscapes since they perceived it as taking more time or extra payment. Having everything on one page will cut down on the possibility for the false-bottom effect, where users believe there is no more additional content.

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4.3. Design Decision #2: Create a New Reward System

4.3.1. Description

The current Muse™ interface has a limited gamification experience, which includes inviting users to join challenges of finishing four sessions in a week.

Nevertheless, the current system does not give users rewards for completing these challenges other than leveling up and introducing new challenges once old ones are completed. Simply leveling up is not a strong incentive for users — especially since there is no way to connect social profiles (i.e. there is no “friending” feature). These weak incentives will not give users strong motivations to continue focusing on the challenges, nor would it help the user focus on their meditation.

The image on the right shows the description of a challenge, and the reward of completing challenges — leveling up — is listed. As mentioned above, a reward would not serve the purpose of giving users strong motivations to complete challenges, nor increasing the user engagement of the system. Because of this, the team feels strongly that this could be an area to expand upon when redesigning the system.

The image to the right shows another attempt of gamification the system currently has in place: “Muse Points.” It is unclear as to how these points serve a purpose in the application or how they are gained.
4.3.2. Alternatives Considered

The team proposes to improve the experience in the application by designing new gamification components and giving out stronger rewards for different completion goals. The current Muse™ user interface has a few gamification components, such as challenges, weekly goals and "Muse Points", but the reward of completing goals is not motivating and is instead ambiguous. The team proposes three solutions:

1. **Introducing badges and stickers** for users who complete challenges or buy with Muse™ points
2. **Introducing a leaderboard** for users to compete with other Muse™ users around the world
3. **Introducing the “Journey”** to make users feel like the real player starting the personal journey of the product usage.

The team believes that the third option — introducing the “Journey” — would be most successful alternative solution. In this option, users are able to view highlights from their meditation journey (e.g. leveling up, keeping a streak) both as a list view and a "map" view. They will be allowed to share their milestones with this feature, too.

4.3.3. Rationale

Introducing the “Journey” function would be the most recommended option as it has several benefits, which include:

- **Disclosing features progressively** as the users become more experienced in using the product
- **Helping users avoid errors** and makes the product pleasing to use
- **Providing information about the progress of the user’s journey** as they become more familiar with the application, which can inspire and motivate them to continue using the system
4.4. Design Decision #3: Re-Visualize the Data

4.4.1. Description

Another feature of the Muse Headband™ — and arguably its most advanced — is that it can track brainwave data in real-time during meditation sessions and provide post-session data to the user via three types of visualizations, each which serves a unique purpose (see chart on next page).

This proposal will focus on three separate instances where data is visually displayed:

1. “Me” Dashboard Homepage → Chronological Data
2. “Me” Dashboard Homepage → Gamification and Progress Data
3. Individual Session → EEG Data

One overarching issue with the current application is that it violates the *Form Follows Function* universal design principle, which states that “beauty in design results from purity of function.” The system tracks different types of data (and displays each type of data differently), which can confuse users who are already dealing with a potential learning curve of the system as a whole. A potential breakdown may occur when a user gets frustrated with not being able to understand the data they are seeing and might blame themselves or feel incompetent, leading them to abandon the product altogether.

As the no one on the team is an expert with interpreting EEGs, this project will not attempt to redesign the data analysis function. However, the team feels like they can incorporate more data visualization best practices in the user interface.

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### Summary of All Data Visualizations in the Muse™ Mobile Application:

<table>
<thead>
<tr>
<th>#</th>
<th>Description</th>
<th>Current Issue</th>
<th>Interface</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A general dashboard visualization of <strong>meditation session minutes</strong>. Includes “Calm Time”, overall session time, and self-guided meditation time data. Visualized by a responsive bar chart which is color-coded which users can swipe left and right.</td>
<td>There is little affordance to tap the icons to switch between different data sources. Additionally, the responsiveness is not beneficial to the user as there is cognitive overload.</td>
<td><img src="image" alt="Meditations" /></td>
</tr>
<tr>
<td>2</td>
<td><strong>Gamification-specific data</strong> including total session minutes, the number of “birds” (occurs during “Calm Times”) and recoveries, and total “Muse Points.” Icons are paired up with statistics gathered from data.</td>
<td>These icons take up a large majority of the screen and provide affordances to the user to tap on them; however, they are unclickable and do not provide much information on what this data actually means.</td>
<td><img src="image" alt="All Meditations" /></td>
</tr>
<tr>
<td>3</td>
<td>Each session has a <strong>detailed brainwave chart</strong>. Users can scroll chronologically, as well as zoom in and out of the chart. Graph features include “raw data,” “bird regions,” and “recoveries,” which can all be filtered.</td>
<td>While there is rich data, there is no context and therefore is unhelpful toward the user. There is no interpretation for this visualization.</td>
<td><img src="image" alt="Brainwave Chart" /></td>
</tr>
</tbody>
</table>

4.4.2. Alternatives Considered

To better present the chronological session time data on the dashboard, the team proposes using pre-defined benchmarks instead of the “apples-to-apples” comparison technique, which fails due to the seemingly different types of data it presents. This way, users can select personal goals in the settings and can view their current state progress relative to their goals they select. The idea is that the upper range of the x-axis will be the number of minutes a user chooses and the user can easily see if they have met the goal or not. The bar would then be color coded — green or yellow — depending on if they have reached their goal or not.

Another alternative design decision for this chronological data visualization is to incorporate 3D touch, making the chart interactive with a purpose. The user would then be able to get more information on a particular day or session if they want to by holding down a particular bar down with more pressure. If they do not have 3D touch, the system will automatically default so that they simply tap the bar to view a pop-up of day data.

Next, the team recommends adjusting the large icons on the home dashboard. This will be detailed more in Section 4.6. Design Decision #5: Clarify Visual Cues of Elements.

Lastly, providing context is essential for Muse™ as the application is making an assumption users understand what raw EEG data means — which is not the case. To eliminate this uncertainty, the team recommends including explanations and/or in-depth contextual information on it when they tap or hold down on a specific piece of data on the session page. The team also recognizes third-party applications which are compatible with Muse™ data and proposes including a button to export their raw session data and a button to share their data (which would open up their phone’s sharing options).¹³

4.4.3. Rationale

The alternatives presented follow the Universal Design Principle of **Comparison**, which describes several techniques for making valid comparisons (an issue especially apparent with the first visualization technique).\(^{14}\)

These alternative solutions also follow the best practices which are mentioned in the article “**Seven best practices of data visualization in 2018**,” which include agreeing on a methodology and determining the desired outcome (in this case, rewarding the user for their meditation practices).\(^{15}\) Right now, these 3 types of data visualizations are inconsistent with each other and require high effort by the user to understand.

These alternatives also draw on several of Jakob Nielsen’s **Usability Heuristics**, such as **Consistency Standards** as users should be familiar with Muse™ terminology and icons.

Finally, by including explanations and/or interpretations about a user’s EEG data, users will hopefully have a better understanding of how their meditation session went — which is a major system goal. By incorporating this design decision, this will ideally reduce cognitive load on the user and will avoid making them do “visual math.”\(^{16}\)

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\(^{16}\) Data Visualization: Chart Dos and Don’ts. (2017, August 19). Retrieved from [https://guides.library.duke.edu/datavis/topten](https://guides.library.duke.edu/datavis/topten)
4.5. Design Decision #4: Enable a “Do Not Disturb” Mode

4.5.1. Description

The system user interface still shows notifications when the user is engaged in a meditation session, which can hinder a user’s experience with the application. Unexpected audio notifications and banner displays can highly distract the user, making it more difficult for them to be in the moment. This design decision aims to mitigate phone-prompted interruptions that originate outside of the Muse™ application.

4.5.2. Alternatives Considered

To combat this issue, during the calibration phase, Muse™ will produce a pop-up that will ask the user if they would like to turn on the “Do Not Disturb” mode on their phone. The pop-up window will tell the user that by turning on the “Do Not Disturb” mode, the user will not receive notifications for the entirety of the meditation session.

In the system settings, there will be a toggle button that will allow the user to permit Muse™ to automatically turn on “Do Not Disturb” mode for every session. This configuration shortcut is meant to reduce the amount of set-up time required before a user can engage in a meditation session. The image to the right shows what a toggle button might look like in the system settings.

Additionally, the background video of the leaves blowing in the wind that plays during the meditation session can be a visual distraction for users. The leaves blow more energetically in the wind and the rain becomes heavier if the Muse Headband™ detects that the user’s mind is wandering. If users are instructed to keep their eyes closed during the session, there should be no video to tempt them.
The new design will make the screen appear black with only an alternating pause or play and an exit button during the meditation session. The phone screen will enter its own “Do Not Disturb” mode.

The picture below shows an early draft of the team’s proposal.
4.5.3. Rationale

These design decisions rely on several principles relating to visual design and interactive design.

“Flexibility and efficiency of use” is one of Jakob Nielsen’s User Interface Design heuristics, which states that the system must allow users to tailor frequent actions. The toggle button for configuring the “Do Not Disturb” mode is an example of an accelerator — it speeds up the interaction for the expert, or in this case, frequent, users.¹⁷

Interruptions are strongly related to multitasking behavior. By turning off the phone’s ability to receive notifications, we are reducing the interruption cost (i.e. the cognitive cost of switching between activities).¹⁸ The user’s mind does not have to shift from thinking about the notification message to the meditation task at hand.¹⁹

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4.6. Design Decision #5: Clarify Visual Cues of Clickable Elements

4.6.1. Description

This design decision concerns the visual design within the Muse™ application for interactive or “clickable” elements. The application needs a more standardized design pattern for these interactive elements so that users know when elements are clickable or static. The image to the right shows the current view of the user’s personal data dashboard.

At first glance, users might think these are all clickable. However, the icons circled in dark orange are clickable and the icons circled in blue are not. This is confusing to the user because both icons follow these same general design pattern: an icon surrounded by a circle. They are the same size, and the non-interactive diamond icon is even the same color as the interactive icons. Elements that are not consistent in behavior should not be consistent in their visual representation.

This redesign will include an enhanced user interface pattern library in which the team will define how interactive elements should look and behave. This will standardize interactive visuals for the app and provide a consistent user experience.20

It is frustrating for the user when they expect an element to be interactive and it produces no action. However, it is even more of a design issue when an element is interactive and provides function, but is not discovered because it is not perceived as clickable.

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The image below shows the top of the user’s personal data dashboard. The very top of this page features a profile summary section with various elements within it; elements within the blue box are non-clickable whereas the profile picture, circled in orange, is clickable as it allows the user to change their profile image.

The profile picture does not provide cues that it allows for this functionality. Interactive functionality would be more expected if the image was accompanied by an edit icon. This redesign will feature strong visual cues that this item is editable by aligning it with the team’s interactive design patterns.

Next, the image to the right shows the expanded data of meditation sessions. With several preliminary usability tests, the team has found that users expect to click on the graph to see more detailed information about their session. Currently, when users click a bar on the graph, they are not provided this expected functionality; instead, they are returned to the very beginning of the graph which is unexpected and frustrating.

Harnessing meditation data is a large benefit of using the Muse Headband™ and this non-interactive element is perceived as clickable; therefore the redesign will make it interactive. The team will ensure that this interactive element will use the same language as other clickable elements in the redesign.
Lastly, Muse™ provides users with several different types of meditation sessions, which are displayed as icons (circled in yellow on the image to the right). Based on preliminary user testing, these items were not perceived as interactive by most users.

The icons are smaller than typical buttons (Apple’s Human Interface Guidelines recommend a minimum of 44 px by 44 px for tappable areas) and therefore are not perceived easily as an interactive element. If a user does not understand this, they will not be able to access the other types of meditation, losing a large part of the functionality of the application.

This redesign will include a revamped visual representation of this menu that also aligns with our new pattern library for interactive elements.

Note: The latest Muse™ system update (Muse 2™) includes five types of health data the product is able to record. Due to the scope of the project, the team is only focusing on the original application with two types of data it records, labeled “Mind” and “Timed,” respectively.

---


4.6.2. Alternatives Considered

Interactivity is such a core experience of any user while using an application. For this reason, there is simply no alternative to creating a standardized interactive design pattern library. The alternative would be to keep the visual design language the way it is now, which is confusing to users. This redesign aims to create the most frictionless experience possible so this alternative is not an option for us.

4.6.3. Rationale

Usability for interactive elements is enhanced when elements provide an affordance that they are clickable.23 Usability for interactive elements within an entire app is further enhanced when the pattern is consistent across the app. We are creating standards to minimize friction within the app, expose all functionality, and deliver the best possible user experience.

---

5. Proposed System Description

5.1. System Architecture


Note: See Appendix A for sketches the team used and Appendix B for individual panels of the proposed system.
6. Usability Inspection

6.1. Overview

After the interactive prototype launch, the team conducted preliminary user testing to better understand how users interact with the system. The team decided to test five potential users, as usability expert Jakob Nielsen suggests that “testing with 5 people lets you find almost as many usability problems as you’d find using many more test participants.”

Participants were administered a Qualtrics survey, where background information, qualitative answers, and quantitative data were all stored. Prior to the test, the evaluators explained the goal of the system, the scope of the user group, and the task to be supported. Evaluators were most interested in learning about strengths and weaknesses of the prototype design, focusing on both functionality and aesthetic of the interface. Overall, the usability testing was successful and helped the design team identify major strengths and weaknesses of the design, which are explained in detail in the following section and outlined in the chart below:

<table>
<thead>
<tr>
<th>#</th>
<th>Key Finding</th>
<th>Strength or Weakness?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aesthetics</td>
<td>Strength</td>
</tr>
<tr>
<td>2</td>
<td>Gamification</td>
<td>Strength</td>
</tr>
<tr>
<td>3</td>
<td>Placement of “Session” Selector</td>
<td>Weakness</td>
</tr>
<tr>
<td>4</td>
<td>Toggle Design</td>
<td>Weakness</td>
</tr>
<tr>
<td>5</td>
<td>Accessibility of Color Choices</td>
<td>Weakness</td>
</tr>
</tbody>
</table>

Note: See Appendix C for the moderator script and Appendix E and Appendix F for a list of the pre and post-questions in the Qualtrics survey.

6.2. Participant Demographics

As mentioned in the previous section, five participants were chosen for usability testing using a convenience sample. The test was a between-subjects design, with the only difference being a placement of an icon on the “My Journey” page. 2 participants had heard of Muse™ before the testing session and 2 had not (1 participant chose to not answer the question). The five participants were all fairly young, with an average age of 22 (with an age range of 22-25 years old). All five users self-reported their technology proficiency as being “Above Average” and all five users had prior experience to meditation.

When asked about their experience(s) with meditation, each participant gave a personal and different answer, showing the wide range of use this application might have on people. Several responses participants had when asked about their previous experiences with meditation include:

- “I briefly attempted to use an app to meditate.”
- “I would not use the word meditate, but I consider myself a self-aware and reflective person”
- “My experience is intermittent and not committed. I used to meditate through sports practices, but it’s not a habit.”

The frequency of meditation also varied among participants; three reported having last meditated this past month, one reported having last meditated in the past year, and one reported having meditated in the past week (see chart below).
Participants also each self-reported on a scale of 1 to 7 (with 1 being not at all stressful and 7 being extremely stressful) how stressful felt their work, academic, and personal environments were. Overall, the most stressful environment was reported as being “Academic” with an average of 5.8 out of 7. It should be noted 100% of the people interviewed were students and participated in user testing during the second to last week of class, which could also contribute to this high score. The averages for each are shown in the chart below.

**Stress Levels Based on Environment:**

<table>
<thead>
<tr>
<th>Type of Environment</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work</td>
<td>2</td>
<td>5</td>
<td>3.25</td>
</tr>
<tr>
<td>Academic</td>
<td>5</td>
<td>7</td>
<td>5.8</td>
</tr>
<tr>
<td>Personal</td>
<td>2</td>
<td>7</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Participants were also asked to rate their familiarity with wearable devices, personal health, and meditation (with 1 being not at all familiar and 7 being extremely familiar). None of the participants reported having a lot of familiarity with any of the categories; however, personal health had the highest average with a mean of 4.5.

**Participant Familiarity:**

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wearable Devices</td>
<td>2</td>
<td>2.75</td>
<td>2.75</td>
</tr>
<tr>
<td>Personal Health</td>
<td>2</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Meditation</td>
<td>3</td>
<td>3.25</td>
<td>3.25</td>
</tr>
</tbody>
</table>
6.3. Prototype Strengths

6.3.1. Strength #1: Aesthetics

**Description:** When asked about what they liked about the app, 4/5 participants commented that they liked the prototype’s aesthetics.

**Rationale:** Participants thought that the colors were “positive”, “clean”, “soothing” and “pretty” which aligned with our goal of creating a color palette that would reflect how the user would feel: calm and relaxed. One participant denoted the progress map as especially attractive and liked how the way that it showed the progress with nodes was straightforward.

**Future Considerations:** The team did need to make adjustments to the color scheme based off of Weakness #3: Accessibility of Color Choices.

6.3.2. Strength #2: Gamification Feature

**Description:** Participants overall also liked the gamification aspect of the app.

**Rationale:** One participant, a regular meditator, said it reminded him of the “Headspace” application, but did not feel like it was bad because he felt like he could easily learn the system. Another participant said that she liked the streak feature. Participants also liked the familiarity of the gamification features because it reminded them of other health-related apps.

**Future Considerations:** The team will add a feature to allow users to share their weekly or monthly progress. We integrated gamification features so that users could compete with themselves and with their friends.
6.4. Prototype Weakness

6.4.1. Weakness #1: Placement of “session” selector

**Description:** Users found the placement the “session” selector confusing.

**Rationale:** One of our participants noted that it was more logical to select the session before the time length, because he wanted to know what he was getting into before he selected how long he’ll be doing it. Another participant said that she was confused about how to start a session. She was also unsure about the difference between the mediation types.

**Future Considerations:** Future versions of the app may better integrate cardiovascular data like heart rate and blood pressure (for the heart symbol) in addition to the brain waves. That way, users can track how their heart activity corresponds to their brain activity.

6.4.2. Weakness #2: Toggle Design

**Description:** The toggle design — particularly the map icon in the right toggle button — is confusing.

**Rationale:** One participant said that “Toggle right button looks like jump rope, looks like board game.” Another person said they immediately knew it was the toggle button (for task 4) but mentions that it is because he is an iPhone user -- do Android users know?

**Future Considerations:** We changed the map icon in the toggle button to look more like a physical map.
6.4.3. Weakness #3: Accessibility of Color Choices

**Description:** Colors used in the initial prototype were not conducive for those who have visual impairments.

**Rationale:** One of the participants who is color blind could not differentiate the colors used in the bar graph. He especially had difficulty seeing the blue-green color used for the mind meditation bar. He also could not differentiate between the main color on the bar and the lighter color of the ‘calm time.’

**Future Considerations:** The team changed the hue of the blue-green color to be more green and solidified our new color choice with the participant. The team also changed the color of the ‘calm time’ to be white, allowing for greater visual differentiation, and added a legend in the graph.
7. Comparison with Muse 2™

On October 30, 2018, Muse 2™ — a new headband with updated health technology — was launched, leading to a revamped user interface of the application.

The chart below shows some of the differences between Muse™ and Muse 2™:

<table>
<thead>
<tr>
<th>PRODUCT</th>
<th>Details</th>
<th>Muse™ (Original)</th>
<th>Muse 2™</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>$199</td>
<td>$249</td>
<td></td>
</tr>
<tr>
<td>Real-time feedback on...</td>
<td>Mind (EEG)</td>
<td>● Mind (EEG) ● Heart (HRV + Pulse Oximetry) ● Body (Accelerometer) ● Breath (PPG + Gyroscope)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MOBILE APPLICATION</th>
<th>Details</th>
<th>Muse™ (Original)</th>
<th>Muse 2™</th>
</tr>
</thead>
<tbody>
<tr>
<td>Features</td>
<td>See Section 4: Recommendations to see detailed analysis of the Muse™ application</td>
<td>From the Apple App Store: Version 18.3: ● Access Breath, Body and Heart Meditations with Muse 2 ● Leveled audio for consistency ● Tooltips to help with new meditations ● Improved Breath Meditation to be more responsive ● Heart &amp; Breath results graph improvements for better accuracy ● Bug fixes and performance updates</td>
<td></td>
</tr>
</tbody>
</table>
The team was pleased to learn that several of the design decisions mentioned in this report were addressed in version 18.3 of the mobile application (released December 3, 2018), including the graph representations.

Before the Update:  

![Graph Settings](Image)

Update:  

![Updated Graph](Image)

Proposed Design:  

![Proposed Design](Image)

Additionally, Muse took steps to help those who are new to the device and/or meditation by incorporating "Tooltips to help with new meditations" in the latest version of the application. After usability testing on the prototype, the design team for this project also found out that many needed or wanted some guidance when setting up a meditation and therefore included an informational “Step-By-Step” tutorial on the home screen.

Other improvements to the application were focused on the new features (i.e. heart monitoring) and therefore the team cannot compare all of the changes mentioned. Another change, “leveled audio for consistency”, is something the team was curious about but was unable to test or design for since user testing did not require participants to use or calibrate the headband.
Looking back at the project success metrics (system clarity and user satisfaction) set at the beginning of the semester, the project can be considered successful. During usability testing, participants were asked whether they would recommend the new system (prototype) to a friend and all said yes, leading us to believe satisfaction with the system was high.

System clarity was slightly harder to gauge because users were not as familiar with terminology (i.e. Calm Points, Birds) but through think aloud interviews, every user could find the day and session they were the least calm; therefore, the team feels comfortable that they would able to understand the most essential data.

Internally, the team believes the project was successful based on the completion the sequential deliverables which each built upon each other. Background research on meditation and its current and potential users, hierarchical task analysis, and the semester-long study of universal design principles all were vital parts to the completion of this final report.

Each member of the design team was passionate about benefits meditation can provide and brought diverse backgrounds and knowledge on the subject. While all designers, the team was fundamentally interdisciplinary with a diverse skill set, including UI design, usability testing and evaluation, accessibility expertise, and analytical skills.
APPENDIX

APPENDIX A: Low-Fidelity Wireframe Sketches

“My Journey” Sketches:
APPENDIX B: Proposed User Interface (Individual Screen Panels)

“Me” Dashboard:
“My Progress”:

Note: This page includes a streamlined, chronological timeline of meditation sessions (left) and a “Journey” feature, which shows milestones in a user’s meditation journey (right).
“Meditate” Screen: New Customization Design

Meditation Type
- Real-time brainwave feedback (EEG) teaches you the art of focus.

Session
- **Muse Essentials**
  - Day 2: Training a Puppy
- **eMindful Life**
  - Day 1: Mapping the Wandering Mind
- **Dr. Deepak Guides M**
  - Day 1: Our Essential Nature

Meditation Length
- 0 hours 15 min

Soundscape
- Desert
- Beach
- Rainforest

Begin

Meditation Type
- Tune into your heart rate and HRV to optimize performance.

Session
- **Heart Essentials**
  - Day 2: Influencing your Heart

Meditation Length
- 0 hours 15 min

Soundscape
- Healing Drum

Begin
Meditation Type

Learn how to use your breath to find calm and fight stress.

Session

**Breath**

Day 1
Intro 4/6 Long Exhale

Meditation Length

<table>
<thead>
<tr>
<th>0 hours</th>
<th>15 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16</td>
</tr>
</tbody>
</table>

Soundscape

4/6 Long Exhale

**Begin**

Meditation Type

Discover how your posture can bring you physical relaxation.

Session

**Body Essentials**

Day 2
Finding Stillness

Meditation Length

<table>
<thead>
<tr>
<th>0 hours</th>
<th>15 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>16</td>
</tr>
</tbody>
</table>

Soundscape

Wind Chimes

**Begin**
Meditation Type

Explore our guided content and keep your meditation streak alive with a timed meditation session.

<table>
<thead>
<tr>
<th>Meditation Length</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 hours</td>
<td>15 min</td>
</tr>
<tr>
<td>1</td>
<td>16</td>
</tr>
</tbody>
</table>

Soundscapes

- Desert
- Beach
- Rainforest

Begin
Session Visualization:

Settings:

- Do not Disturb
- Do a demo
- Account Settings
- Help
- System Settings

Journal
APPENDIX C: Moderator Guide for Usability Inspection

Testing Materials:

- Qualtrics Link
- Prototype on Phone
- Moderator Script

Moderator Script:

Hello [NAME]. Thank you for volunteering to participate in this study. My name is [NAME] and I will be walking you through our tasks today. I will mostly be reading from a script to ensure each testing session is as consistent as possible.

The goal of this study is to get feedback on a prototype that a team of designers in the School of Information and Library Science have worked on during the semester.

All of the tasks we are going to complete today should take around ten minutes total, but don’t worry about going too fast or too slow. There is no right or wrong action, because I am testing the system, not you. I will ask you to think aloud while you complete tasks so that I can get an idea of the thought process behind your behaviors. Your input is very valuable to our research so please be as honest as possible when providing feedback. If you have any questions as we go along, don’t hesitate to ask. Do you have any questions for me so far?

Your responses will be confidential and the recordings will be deleted at the conclusion of this study. Before we get started, please read this online consent form and, if you agree, follow the instructions on the screen and let me know.

[BRING UP QUALTRICS SURVEY PAGE 1: INFORMED CONSENT PAGE]

Thank you.
Now I’d like you to answer a few questions about yourself and your previous experience with meditation. Please let me know if you’d like me to repeat anything or if you have any questions.

[PRE-TEST QUESTIONNAIRE ON QUALTRICS]

Now I’m going to ask you to try doing some specific tasks. Please remember to think aloud as you complete each task.

Task 1:
[GIVE the participant the prototype on a mobile device]

[GIVE the participant the first scenario print-out]

Please read this aloud.

Scenario 1: “You want to start a new meditation session using the Muse app. You would like to meditate for 10 minutes. Please show me how you would do that.”

[ASK] When you feel like you have completed the task, please state “I have completed Task 1” to the moderator.

[OBSERVE: What do they click on first to customize the session?]

[ASK] Does anything stand out about this page?

[AT THE END OF THE TASK, RESET TO DEFAULT DASHBOARD PAGE]

Task 2

[GIVE the participant the second scenario]

Please read this aloud.

You want to see which day in the last week you were least calm. Go to that day. Please tell us about what happened during that session?

[OBSERVE: Do they go to the graph or look at the numbers?]
[ASK once they get to the specific day of meditation]

On a scale of 1 to 7, how confident are you about understanding your meditation session data?

Does anything stand out about this page?

**Task 3**

[Give the participant the third scenario] **Please read this aloud.**

You notice that you can still receive notifications on your phone, and you do not want to become distracted during your meditation session. You would like to enable the “Do Not Disturb Mode.” Please show us how you would do that.

When you feel like you have completed the task, please state “I have completed Task 3” to the moderator.

[Observe: Do they stay within the application or go to their phone settings?]

[At the end of the task, reset to default dashboard page]

**Task 4**

[Give the participant the fourth scenario] **Please read this aloud.**

You want to share your meditation results with your friends to show them your progress. How would you go about doing that?

When you feel like you have completed the task, please state “I have completed Task 4” to the moderator.

[Observe: Where do they go first in the app? Do they click on the map icon?]

[At the end of the task, reset to default dashboard page]

[End tasks]
[ASK] Thank you. That concludes the task portion of this test. Now we are going to ask you some questions about your impressions of the Muse app.

[OPEN POST-TEST QUESTIONNAIRE ON QUALTRICS. MODERATOR ASKS THESE AND TYPES THE PARTICIPANT’S ANSWERS INTO QUALTRICS]

Great! That concludes our final task.

Do you have any more questions for me?

Thank you so much for your participation in this study.

Have a great day.
APPENDIX D: Informed Consent Form

Purpose of This Study:
The purpose of this study is to get feedback on a prototype that a team of designers in the School of Information and Library Science have worked on during the semester. The team is interested in seeing if people can accomplish certain tasks and are interested in how users perceive the application.

Participant Rights:
Your participation in this study is completely voluntary and you have the right to withdraw your consent any time. If for any reason you are uncomfortable during the session and do not want to complete a task, you may say so and we will move on to the next task. Results of the study will be made after December 4; if you would like to learn about the results we find, you are welcome to email us and we would be happy to share them with you. Any response you give will be completely anonymous.

Procedure:
In this usability study, we will first start by asking you a series of background questions. Then, we will ask you to complete 5 tasks on the prototype to the best of your ability. Lastly, we have several follow up questions regarding the prototype and the tasks you completed.

What is Muse™?
The system we are about to show you is Muse™, a health application which is designed to be paired with an external headband capable of gathering real-time EEG data. The headband guides users through meditation sessions by providing audio feedback depending on how active the mind is (e.g., birds chirping for a “calm” mind and pouring rain for a more active mind). The goal of the system is to ultimately provide users a way to track meditation session data using EEG data. The scope of the system is limited due to the time constraint of the project (1 semester) and focuses on users who are at least somewhat interested in meditation and/or health technology.

Consenting:
By signing your name below, you are acknowledging that you read and understand the information on this form and that any questions you might have about the session have been answered.
APPENDIX E: Pre-Test Questionnaire

1. How old are you?
2. How would you describe your technology proficiency?
   a. Below Average
   b. Average
   c. Above Average
3. Have you ever meditated before?
   a. Yes
   b. No
   c. I can’t remember
4. In 1-2 sentences, please describe your experience(s) with meditation.
5. When was the last time you meditated?
   a. Today
   b. This week
   c. This past month
   d. Sometime in the past 6 months
   e. Sometime in the past year
   f. Over a year ago
   g. I have never meditated
6. How would you describe the following environments (with 1 being not at all stressful and 7 being extremely stressful)?
   a. Work
   b. Academic
   c. Personal
7. Before today, have you heard of Muse™?
   a. Yes, I have heard of Muse™
   b. No, I have never heard of Muse™ before today
8. Please rate your familiarity with the following (with 1 being not at all familiar and 7 being extremely familiar):
   a. Wearable Devices
   b. Personal Health
   c. Meditation
APPENDIX F: Post-Test Questionnaire

1. What two things do you like about the Muse app?
2. What two things do you not like about the Muse app?
3. Do you have comments or suggestions for us?
4. Would you recommend this system to a friend?
   a. Yes
   b. No
   c. Maybe