PROJECT SOUNDMIND

Interactive music therapy mobile application that creates positive associations for users with PTSD, depression, and anxiety.

BRIAN FEMMINELLA, University of Southern California
TRAVIS CHEN, University of Southern California
LUCY SCHAFER, University of Southern California

Summary

SoundMind is a company dedicated to finding research-based, innovative, and accessible solutions to address the growing mental health crisis that one in four people in our world face. Our passionate team consists of 7 students across top universities throughout the United States including the University of Southern California, Purdue University, and Drexel University.

Our mission stems from our passion to make society more empowered to live bolder and stronger, regardless of their past. Our academically-driven research is backed by human emotions that invest in ensuring the strongest correlation between understanding and execution. SoundMind Solutions is committed to advancing the field of mental health research and connecting that with the latest mental health technologies at the palm of your fingertips.

Our vision is to build SoundMind into one of the most reliable and accessible interactive user experience brands of the 21st Century. We believe that through innovative software backed by research driven from human experiences and emotions, we can make the usage of mental health resources a trend, like fashion, but different.

Inclusion

SoundMind is dedicated to using the latest research methods on how to mitigate indicators surrounding post-traumatic stress disorder (PTSD), traumatic brain injury (TBI), depression, sexual assault and severe stress. Our team is similarly committed to addressing mental health issues that underrepresented communities, including the Veteran community, LGBTQ+ (Lesbian, Gay, Bisexual, Transgender, Queer/Questioning and more), BIPOC (Black, Indigneous, People of Color) face due to the inequalities that our society inherently constists of. We are working directly with university research centers across the nation, including USC Institute of Creative Technologies, University of Southern California, Drexel University and University of Notre Dame to find solutions to mitigate triggers and provide resources to build stronger coping mechanisms for those struggling with trauma, depression, and anxiety.

Innovation & Product

Our team is currently developing SoundMind, a positive association mobile application that tailors to the individual needs of its users through music therapy and brain exercises that targets specific parts of the brain. According to Absolute Markets Insights, the global mental health applications market value is expected to reach nearly USD $3.9 Billion in value by 2027 as the use of smartwatches, smart screens, Internet of Things (IoT) devices, and as other healthcare technologies become more prevalent and easily

adoptable. Similarly, just in the United States, the mental health mobile application expected industry revenue is approximately $600,000,000.

However, there are limited prominent, intuitive mental health mobile applications on the market that utilize individualized-care for music therapy and brain exercises that target the individual user. SoundMind's products and services will be a leader in firsthand research-based-approach mobile applications to address mental health conditions and needs, particularly to those suffering from trauma, depression and anxiety. It is designed to create a positive association experience for its users, using machine learning and artificial intelligence to understand the users' likes and dislikes of a variety of sounds to create layered soundscapes to develop the best sounds that positively associate with the user.

SoundMind is committed to creating an interactive and intuitive mobile application designed to utilize the latest research on how to mitigate factors that exacerbate attacks, severe stress, and trauma symptomatology. The key music player will create soundscape layers that are tailored specifically towards the user through an onboarding process through machine learning and artificial intelligence. It will use a Tinder navigation model of swiping "right" to inform of favorable sounds and "left" to indicate unfavorable sounds to layer various sounds. The mobile application will include interactive 3D characters as users navigate the app, creating a personalized end product. The following will address core features of the beta version of the application, however, additional plans are in place:

Music Therapy with Rapid Response Feature: The app will utilize state-of-the-art technology by using machine learning to learn about a users' music preferences to create individualized sonic profiles to build a music playlist that provides a positive association experience for the users. The music can be deployed at immediate instance through our signature Rapid Response button, for example, when a user is experiencing episodes or attacks of their mental health conditions to alleviate their signs and onset feelings.

Brain Exercises: A total of 6 stimulating, and intriguing brain exercises will help train the user's brain to grow and develop through neuroplasticity. Games will include word matching, treasure hunting, world-building, car racing, brick blocks, and cup swaps. Stress, anxiety and depression often lead to memory loss, and this game-stimulating portion will entice users to return to the app due to its engaging and challenging nature.

SoundMind Research:

SoundMind prides itself in being a research-based and research-driven project aspiring to provide innovative and accessible solutions for the growing mental health crisis. It is because of the lack of variety in treatment for disorders like PTSD, Depression, TBI, and others that SoundMind came to be. Our research team has conducted extensive research to investigate the symptoms, causes, typical treatment options, and more for these mental health issues. Furthermore, our team has used this research to develop novel solutions that have been incorporated into our app. Our research-driven approach has allowed our mobile application to become tailored to each user and their struggles by incorporating a

music therapy and a brain training portion of the app. These two research-based features are being designed to utilize the principles of neuroplasticity, the idea that your brain *can* change.

What Makes Our Project Important?

The growing mental health crisis intensifies the need for SoundMind's development. According to the WHO, 1 in 4 individuals are impacted from a mental or neurological disorder. Our target audience is individuals dealing with post-traumatic stress disorder, traumatic brain injury, depression, and traumatic experiences, such as sexual assault. Our goal is to reduce and mitigate the struggles that these individuals face everyday. And those struggles are real. PTSD and major depressive disorder (MDD) are highly comorbid, as studies have found an estimated 54% of individuals diagnosed with MDD also met the criteria for a diagnosis of PTSD. The comorbidity rates were consistent even after controlling for overlapping symptomatology (Elhai et al., 2008).

Increases in suicidal ideation have been observed among individuals diagnosed with PTSD. Comorbid major depression could be a catalyst in the association of suicidality in PTSD. The correlation of increased suicidality and PTSD was observed across various population samples from veterans to victims of sexual assault (Panagioti et al., 2012). Previous studies have also noted that patients struggling with PTSD have shown impaired executive function when tested against trauma-exposed controls. Significant deficits in executive function across all tested areas were observed among the PTSD patients and comorbid depression is thought to moderate the impairment of function (Olff et al., 2014). It is exactly these difficulties and symptomologies that we acknowledge at SoundMind and we hope to provide some relief through our research-based, innovative, and accessible solutions.

Music Therapy

Our research began by conducting reviews of the literature surrounding music therapy and its potential in helping individuals suffering from PTSD. This work led us to explore the concept of thanatosonics, the phenomena that the boundary between sound and violence becomes blurred under extreme psychological and social pressures (Daughtry, 2014). The idea of thanatosonics operates on the principle that sensory input can be associated with a traumatic event which can disrupt the routine of an individual's everyday life through unexpected triggers (Daughtry, 2014). Research has shown that one of the most difficult symptoms that persons experiencing PTSD suffer from is intrusive memories and/or flashbacks of a traumatic event. Music therapy demonstrates potential to kickstart neurobiological mechanisms involved in healing traumatic experiences as an innovative method to address the difficult symptoms of PTSD.

In order to understand the mechanism through which music can be used as a therapeutic tool for individuals struggling with a wide array of mental health issues, I would like to first introduce a chemical compound, dopamine. Dopamine is a critical neurotransmitter observed within the brain's reward pathway - associated with the ventral tegmental area (VTA) and the nucleus accumbens (NA) (Stegemoller, 2017). The VTA and NA are involved in cortical remodeling and long term potentiation, key processes responsible for learning and re-learning associations (including associations of sounds and experiences). Neuroimaging techniques show that listening to music that the individual considers

enjoyable activates the reward pathway. An idea is famously known as the Hebbian theory, states that "neurons that fire together wire together". Together, the Hebbian theory and the evidence of associations between music and the reward pathway indicates grand potential for music therapy, because pairing music with a behavior can create a neurological association.

This discovery serves as the basis for music therapy and renders music a possible therapeutic tool to condition behavioral responses, such as unwelcome triggers. Thus, we can initiate long-lasting behavioral changes by triggering the simultaneous firing of targeted neurons by pairing musical rhythms with psychological and physical activities, such as breathing or heart rate (Stegemöller, 2017). This finding is the reason SoundMind was born, because music therapy has the potential to change the world of mental health care and that is precisely what our project is aiming to accomplish. Attenuating some of the most difficult symptoms of challenging disorders like PTSD, TBI, Depression, and Anxiety through the power of music can create more comfortable lives for many individuals.

In addition to dopamine release in the reward centers of the brain during enjoyable music, serotonin is another neurotransmitter that has been associated with feelings of satisfaction from expected outcomes. Researchers found that serotonin levels were elevated when individuals were listening to pleasing music (Altenmüller & Schlaug, 2015). This finding further suggests the therapeutic potential of music through neurological associations. For many years, serotonin has been associated with disorders such as Major Depressive Disorder (MDD) and Generalized Anxiety, because a typical treatment plan involves antidepressants, most commonly Selective Serotonin Reuptake Inhibitors (SSRIs). SSRIs operate by slowing the reabsorption of serotonin to increase the levels of the neurotransmitter that your brain processes. This treatment has proven to relieve symptoms of anxiety and depression; therefore, it is promising that the same compound is released by listening to enjoyable musical rhythms. SoundMind celebrates this finding, because it highlights the potential of therapy that goes beyond prescribing pills. SoundMind strives to develop a mobile application that can provide custom, tailored, and individualized sound profiles for each user. This project emphasizes the user's preference; therefore, we plan to incorporate features that allow users to customize their sounds within the music therapy section of our app.

When thinking about music therapy, we must make a distinction between music and nonsensical sound, because there is a difference in the effectiveness of nonmusical noise that lacks meaning and musical rhythm that initiates a neurological response on the reward pathway. Nonmusical noise can impose negative impacts, specifically it can commence maladaptive neuroplasticity, causing more stress and worsening impairments of cognition and memory (Stegemöller, 2017). On the other hand, music promotes neuroplasticity demonstrated through the promotion of cognitive abilities through music therapy in TBI and PTSD patients (Stegemöller, 2017). Additionally, research has shown increased self-esteem and reductions in feelings of worthlessness when music therapy is implemented into treatment plans. Furthermore, music has demonstrated the ability to enhance resilience in patients, to provide them with the ability to regain control of their own lives, and to promote community connectedness (Landis-Shack, Heinz, & Bonn-Miller, 2017). Other studies have presented evidence that music can help modulate anxiety and stress through pathways that reduce cortisol levels

Additional studies have been shown to improve self-esteem and awareness of the environment and self, as well as to modulate anxiety, stress (such as lowering stress hormone cortisol levels), mood,

and promotion of feelings of self-control in patients with mental disorders (Novotney, 2013). Music also increases the release of endorphins (natural painkillers), oxytocin, and endogenous opioids (stress and pain-reducing hormones) (Landis-Shack, Heinz, & Bonn-Miller, 2017). Through the extensive reviews of literature surrounding music therapy, it became clear to our research team that music is a powerful therapeutic tool worth investing in. We believe that all our research points to the success and promise of music therapy that we hope to achieve through this project.

Binaural Beats

After extensive research revealing the potential of our app with music therapy, SoundMind began to investigate a subset of music therapy research by exploring binaural beats. Binaural beats act as an auditory illusion for one's ears; by sending different frequencies to each ear. The mathematical difference between the two frequencies is processed via neural mechanisms associated with mood, memory, and attention (Lane, 1998). Some recent studies have demonstrated that binaural beats can have a positive effect on a person's mood and anxiety levels, so we decided to run our own study to evaluate the effectiveness of auditory binaural beats. Through a partnership with Magic Horizons, we gained access to a MH Virtual Reality headset with a library of monaural music and binaural beats. Our study's findings suggest that binaural beats can reshape the way that we approach music therapy.

We wanted to explore the neurological basis behind binaural beats' effectiveness and its potential application into future technologies. We created a two part study in which participants randomly received auditory and visual stimulation in a Magic Horizons virtual reality headset, pictured in Image 1. The VR headset provided six different beats: four binaural beats (alpha, beta, theta A, and theta B) and two monaural beats (sunny island music and dreamy beach music). Our binaural beat study was conducted to measure the effect of binaural beats versus monaural beats on an individual's heart rate (measured via Apple Watch, Nike Series), mood (measured by the POMS test), and anxiety levels (measured via the STA-I test). Whether a participant received monaural or binaural beats was chosen at random by the researchers, rendering it a blind study.

Our results were promising and led us to begin to integrate binaural beats into our music therapy portion of the app. Binaural beats demonstrated great potential and created an entire new platform for SoundMind. Noteworthy figures from our study with binaural beats can be found below. Significantly, our study demonstrated the dramatic effects of monaural versus binaural beats. One can see in Figure 1 that both the monaural beats (Sunny I and Dreamy B) showed very similar heart rate trajectories, not fluctuating much from the participant's initial heart rates. However, the binaural beats demonstrated a larger average decrease in heart rate after the priming exercise. The most promising result that our study found was that the participants who receive theta B waves indicated the most promising results through the dramatic slowing of heart rate that persisted through after the VR headset had been taken off. This has huge implications for the use of binaural beats in our project.

NOTE: *t0 = initial heart rate (HR), t1 = HR measured post-priming, t2 = HR measured after 3 min on the headset, t3 = HR measured after 10 min on the headset, t4 = HR measured after 15 min on the headset, t5 = HR measured after 20 min on the headset, t6 = final HR measured post-STA-I and POMS test. (Applies to Figures 1-4).

Figure 1. Average heart rate changes t0-t6 for both monaural and binaural beats

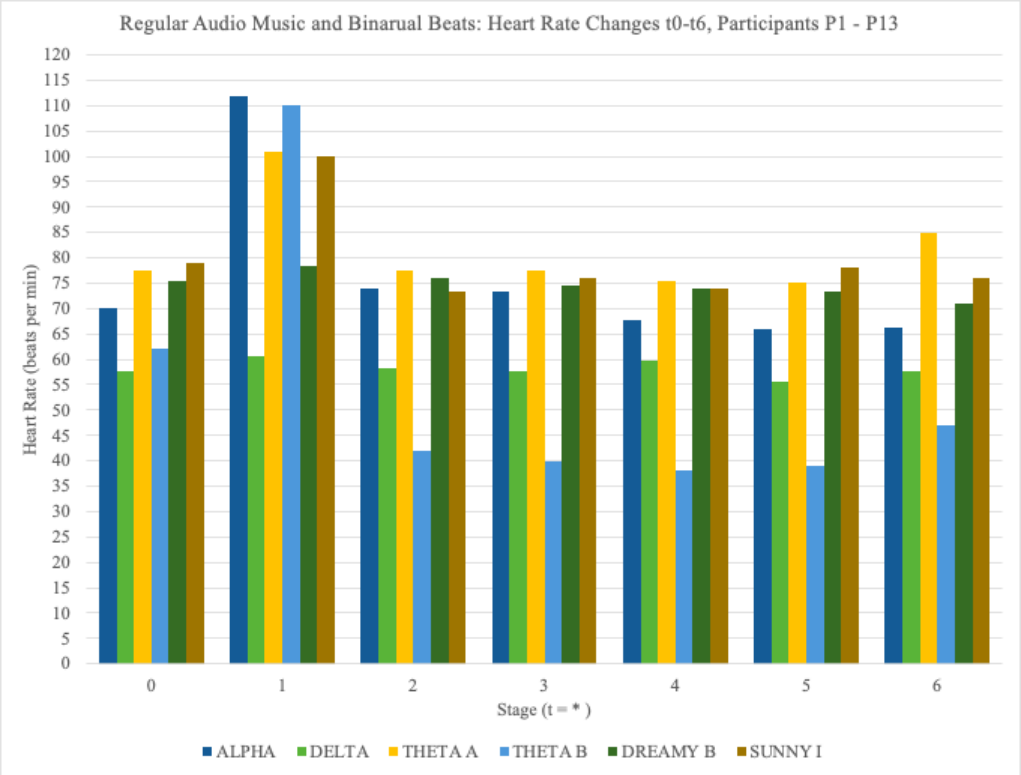
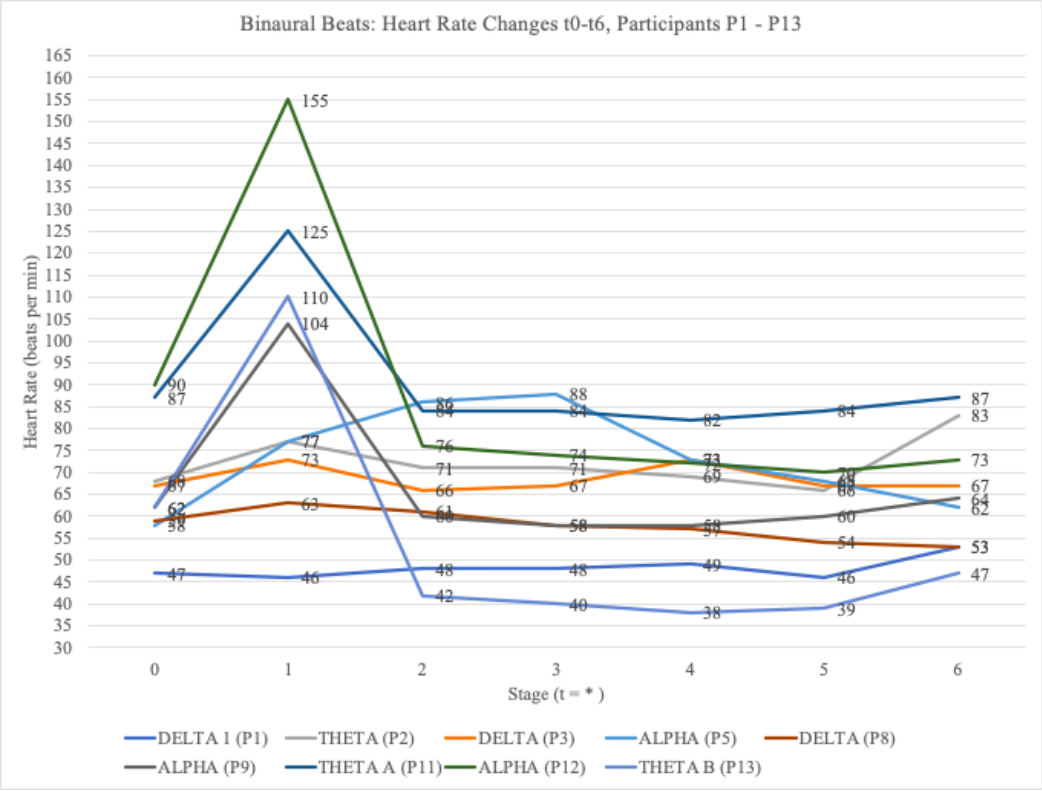


Figure 2. Average heart rate changes t0-t6 for binaural beats only



With growing concerns of a mental health crisis amid the COVID-19 pandemic, binaural beats have the potential to reshape music therapy. As aforementioned, music's benefits range from increasing the release of endorphins, oxytocin, and endogenous opioids (stress and pain-reducing hormones), to increasing self-esteem and reducing feelings of worthlessness (Landis-Shack, Heinz, Bonn-Miller 2017). Additionally, with more and more veterans facing and struggling with PTSD, TBI, and other stressors, binaural beats could provide some alleviation of these symptoms. With the ever growing field of virtual reality technologies, like Magic Horizons, there is much more research that must be conducted to measure the effectiveness of binaural beats and the neurobiological mechanisms on which they operate, but our study has already demonstrated promising potential of auditory binaural beats to enhance mood and lower heart rate. In the future, pending possible funding, SoundMind hopes to be on the forefront of binaural beat research by collecting real time data through user testing.

Image 1. Participant in binaural beat simulation wearing Magic Horizon Headset

Brain Training and Memory Games

One of the largest initiatives at SoundMind is to create not only therapeutic measures using music therapy, but also to take steps towards preventing some of the most difficult symptoms in disorders such as PTSD. Some of these symptoms include intrusive memories, anxiety and panic attacks, and cognitive impairments. Because there is a gap in research on the preventative side of trauma and mental health, we were inspired to begin to develop our brain training feature of the app as well.

Understanding the importance of mental health care is what inspires the efforts of our project. The impairment of cognitive and executive functions when battling PTSD and comorbid depression can lead to memory loss and can bring hardships in completing everyday tasks. We plan to incorporate exercises that will allow users to improve the overall health of their brains, with a focus on attenuating symptoms that are indicative of executive function impairment.

Experiences of chronic stress and trauma that have been linked to post-traumatic stress disorder (PTSD) are related to a number of cognitive deficits, including memory and learning impairments. Attention has been shown to be affected by PTSD as well, with increased attention focused on negative information and filtering out positive information, leading to imbalance attentional biases (Norris, 2013). Stress and fear, as experienced through trauma, activate the amygdala, a brain structure associated with fear responses and aggression (*The Impact of Trauma on Adult Sexual Assault Victims*, 2019). In turn, the amygdala activates the hypothalamic-pituitary axis (HPA), causing release of neurohormones that impair hippocampal learning (*The Impact of Trauma on Adult Sexual Assault Victims*, 2019). The hippocampus, a structure involved in memory formation, then exhibits impaired functioning, leading to fragmented memory formation or intense, hyper-aroused memories under stressful conditions (*The Impact of Trauma on Adult Sexual Assault Victims*, 2019). Effects on hippocampal activity have been shown to affect pattern separation as well, the ability to effectively process new events and experiences and integrate these into existing memories. These deficits are related to effects on mood and cognition as well (Hoos,

2012). Understanding exactly where certain symptoms of PTSD manifest in an individual's brain, SoundMind is designing the brain training portion of our project to target areas associated with cognitive deficits to encourage neuron growth. It will include a 6 mini game series which each target different regions of the brain that are affected by PTSD. Our memory games are meant to operate on the principle of neuroplasticity, introduced earlier, and they are meant to act as an engaging method of brain training to encourage blood flow, activity, and new neural connections to form in targeted areas, such as the hippocampus and the prefrontal cortex.

We plan to incorporate a 6 mini game series in which each game serves as a brain training exercise for a variety of cognitive impairments and side effects/symptoms of certain mental disorders. The memory game team on our project is designing the games to target the following:

1) Verbal memory impairment

2) Logical memory impairment

3) Depression and anxiety

4) Concentration deficits

5) Decreased cerebral cortex activity

6) Selective attention deficits

The SoundMind project links growing research within neurobiology to practical, applicable therapy tools. This has the potential to reduce the prevalence of intrusive and burdening symptoms of PTSD, thus addressing the growing mental health crisis that we are facing today.

Inequalities within Mental Health Care

When we speak about developing innovative and accessible solutions, we must acknowledge that there are underrepresented communities that face disparities compared to majority groups in terms of health care access. At SoundMind, we are committed to reaching the veteran, LGBTQ+, and BIPOC communities who are at higher risk of psychological stress and mental disorders because of societal inequalities. The added stressors that these communities face has been correlated with poorer health outcomes and the evidence again and again demonstrates that communities of color especially face difficult mental struggles because of this added stress. Asian American students were 1.6 times more likely to have seriously considered attempting suicide than their white counterparts. The US Department of Health and Human Services reported that Black individuals are 20% more likely to report experiencing psychological distress (2019). Native Americans have the highest rates of PTSD than any other racial or ethnic group (Bassett et al., 2014). Only 33% of Latinx adults with a mental illness receive treatment in the United States (SAMHSA, 2018). It is startlingly clear that racial disparities exist in the mental health field, which is why we are committed to ensuring access and solutions to all communities, especially those underrepresented.

Closing Statements

Traumatic events have the capability to have undesirable impacts that can manifest in your physical health, even years post-trauma. For example, studies have found a positive correlation between childhood trauma and problems of physical health occurring later into adulthood, such as: heart disease and diabetes (Muskett, 2013). The consequences following trauma and the impossible symptomology of trauma and stress related mental disorders is the fire that fuels the efforts of SoundMind. We strive to provide accessible, innovative solutions to address the growing mental health crisis that 1 in 4 individuals face today. Our target industry is wellness and mental health care; therefore, we expect to attract a similar following of mobile applications like Headspace and Calm. In 2017, Clam was 200th in the top grossing iOS app list. By 2020, they rose to 22nd (Business of Apps, 2020). After only 2 years from our launch, we hope to make it into the top 20 of the top grossing iOS app list through our continued dedication to research-based and research-driven work. Additionally, through our continued efforts, we hope to reach 50 million downloads within 2 years of launch, slightly less than Calm was able to reach in a period of 6 years (Business of Apps, 2020). Therefore, our goal is to reach a wider audience than rivaling companies, to acknowledge and address the issue of underrepresented communities in mental health care, and to provide a novel platform that encourages mental wellness.

Overall Landscape Review (Ensuring The Project will Work)

Other efforts out there to address the growing problem of the lack of resources for individuals with PTSD, depression, and anxiety include current mobile applications on the app store, like Humm.ly (a music therapy app; venture funded) and HealthTunes (also a music therapy app; nonprofit). Both are music therapy applications that attempt to provide calming music to users, however, are mainly pre-recorded recordings of music that are no different than one's personalized Spotify playlist. They similarly do not detect and understand the users' preferences and needs, and are not tailored towards users with PTSD, depression, anxiety -- individuals who often experience sound triggers for their trauma and/or experiences.

Of the existing music therapy mobile applications on the app store market, SoundMind's value proposition stands firmly in the ability to relieve stress, mitigate onsets of traumatic, depressive and anxiety attacks, and overall improve the mental health of users through core features including the music composer and brain exercises. Through in-house research, we have discovered that music benefits range from increasing the release of endorphins, oxytocin, and endogenous opioids, to increasing self-esteem and reducing feelings of worthlessness (Landis-Shack, Heinz, Bonn-Miller 2017).

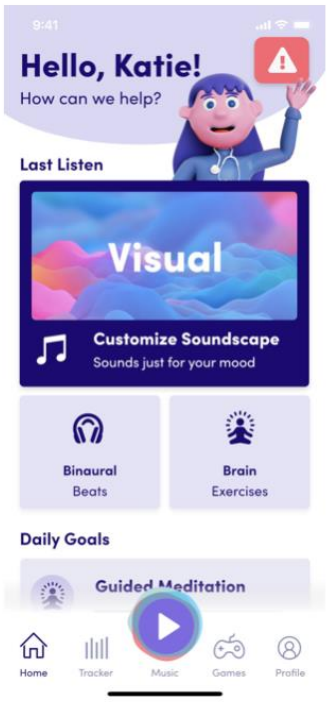
SoundMind's mobile application is designed to create an interactive mobile application experience for its users to be the world's first music therapy application that tailors specifically to the end-user. Targeted to users with PTSD, depression, anxiety, and trauma, it is designed to create a positive and well-rounded experience through interactivity. Through machine learning and artificial intelligence, the technology understands the users' likes and dislikes of a variety of sounds to create layered soundscapes to create the best sounds that positively associate with the user. By using a Tinder navigation model of swiping "right" to inform of favorable sounds and "left" to indicate unfavorable sounds to layer various sounds, the music composer learns to build the best soundscape to create a positive SoundMind experience for the user. On such a model, BIPOC member Romir Karnik noted that such an action "makes the most sense since users will be used to the Tinder-model of swiping right to indicate likes, and swiping left to indicate dislike."

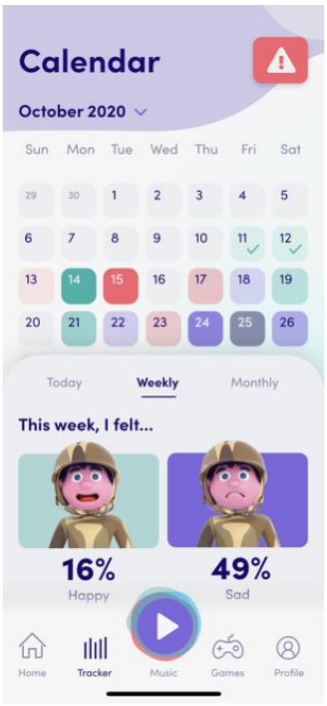
Karnik is also part of the LGBTQ+ community and seeks therapy due to mental health concerns of depression and anxiety.

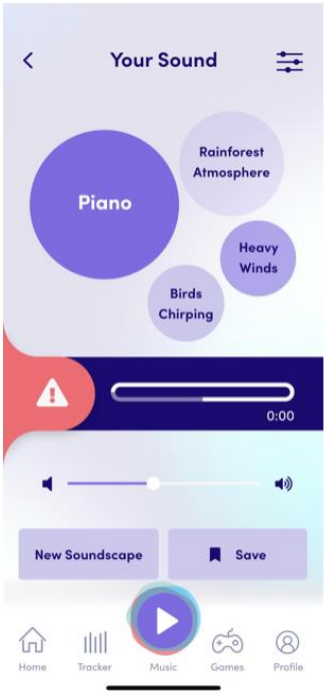
Furthermore, the application's Rapid Response feature, a key feature of our app available in the event of a near-suicidal attack or traumatic event, is built directly in the app and deployable should users feel the need to inform their loved ones of their current location. The application will also contain six brain exercises that will include binaural beats, specifically designed sounds intended to boost concentration, creativity, sleep, and mood. The brain exercises will include word matching to improve verbal memory impairment; treasure hunt to boost logical memory performance; world-building to mitigate depression and anxiety; car racing to boost cerebral cortex activity and engagement; music blocks to improve concentration; and cup swapping to improve selective attention.

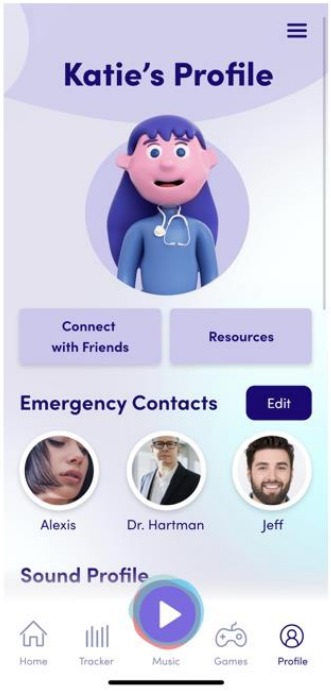
Amongst existing music therapy mobile applications on the app store market, SoundMind will be the first to create an individualized experience for its users through a personalized music composer that understands the user's needs and wants, in addition to stimulating brain exercises that help improve the cognitive functions of end-users, including memory and concentration. When asked if his organization would find value in a product like SoundMind's, L.L.Bean CEO Steve Smith said; "A tool like this to be in the quiver...for businesses to be able to use and have available for employees to tap into, almost for their own self medicating...would be fantastic." This is just one example of corporations now turning their heads and priorities to prioritizing mental health for their teams. The mental health mobile application space is expected to reach a global market value of $3.9 Billion in 2027. In the United States, nearly 33% of the total population (97,375,000) are diagnosed with post-traumatic stress disorder, traumatic brain injury, depression, and/or anxiety. With such a large amount of people suffering from mental illness, COVID-19 Nurse Cassie Butler put it best: "this lil' creation will save so many lives."

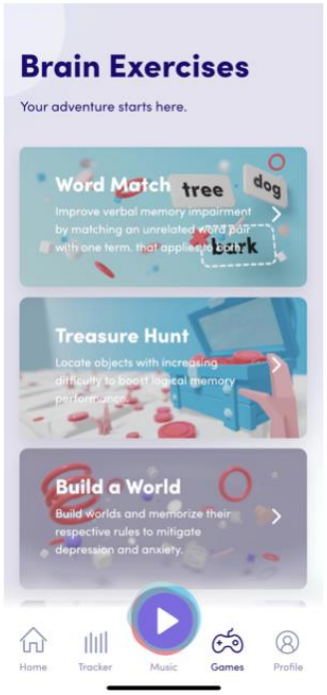
Proposed User Interface Designs











References

Altenmüller, E., & Schlaug, G. (2015). Apollo's gift. *Progress in Brain Research Music, Neurology, and Neuroscience: Evolution, the Musical Brain, Medical Conditions, and Therapies*,*217*(79), 6123rd ser., 237-252. doi:10.1016/bs.pbr.2014.11.029

Bassett, D., Buchwald, D., & Manson, S. (2014). Posttraumatic stress disorder and symptoms among American Indians and Alaska Natives: a review of the literature. *Social psychiatry and psychiatric epidemiology*, *49*(3), 417–433. https://doi.org/10.1007/s00127-013-0759-y

Business of Apps. (2020). Calm Revenue and Usage Statistics. Retrieved 15 November 2020, from https://www.businessofapps.com/data/calm-statistics/

Daughtry, J. M. (2014). Thanatosonics. *Social Text*,*32*(2), 25-51. doi:10.1215/01642472-2419546

Elhai, J.D., Grubaugh, A.L., Kashdan, T.B., Frueh, B.C. (2008). Empirical examination of a proposed refinement to DSM-IV posttraumatic stress disorder symptom criteria using the National Comorbidity Survey Replication data. *Journal of Clinical Psychology*, *69* (4), 597-602.

Government of Canada. (2019, March 26). The Impact of Trauma on Adult Sexual Assault Victims. Retrieved September 08, 2020, from https://www.justice.gc.ca/eng/rp-pr/jr/trauma/p4.html

Hoos, M. (2012, August 30). How PTSD Impairs Learning and Memory. Retrieved September 08, 2020, from https://www.cuimc.columbia.edu/news/how-ptsd-impairs-learning-and-memory

Landis-Shack, N., Heinz, A. J., & Bonn-Miller, M. O. (2017). Music therapy for posttraumatic stress in adults: A theoretical review. *Psychomusicology: Music, Mind, and Brain*,*27*(4), 334-342. doi:10.1037/pmu0000192

Lane, J., Kasian, S., Owens, J., & Marsh, G. (1998). Binaural Auditory Beats Affect Vigilance Performance and Mood. *Physiology & Behavior*, *63*(2), 249-252. doi: 10.1016/s0031-9384(97)00436-8

Muskett, Coral. (2013). Trauma-Informed Care in inpatient mental health settings: A review of the literature.International Journal of Mental Health Nursing, 23(1), 51–59.

Norris, J. (2013, July 03). Interactive Software Helps Veterans Suffering from PTSD. Retrieved September 08, 2020, from https://www.ucsf.edu/news/2013/07/107291/interactive-software-helps-veterans-suffering-ptsd

Novotney, A. (2013, November). Music as medicine. Retrieved July 06, 2020, from https://www.apa.org/monitor/2013/11/music

Olff, M., Polak, A.R., Witteveen, A.B., Denys, D. (2014). Executive function in posttraumatic stress disorder (PTSD) and the influence of comorbid depression. *Neurobiology of Learning and Memory*, *112*, 114-121. doi: 10.1016/j.nlm.2014.01.003

Panagioti, M., Gooding, P., & Tarrier, N. (2012). A meta-analysis of the association between posttraumatic stress disorder and suicidality: the role of comorbid depression. *Comprehensive Psychiatry*, *53*(7), 915-930. doi: 10.1016/j.comppsych.2012.02.009

Substance Abuse and Mental Health Services Administration. (2018). *National Survey on Drug Use and Health* [Data Table]. Available from SAMHSA Website: https://www.samhsa.gov/data/report/2018-nsduh-detailed-tables/

Stegemöller, E. (2017, February 28). Exploring the Mechanisms of Music Therapy. Retrieved July 06, 2020, from https://www.the-scientist.com/features/exploring-the-mechanisms-of-music-therapy-31936/amp