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EEG and Sonic Platforms to Enhance Mindfulness Meditation

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ABSTRACT

Extensive research into the wide-reaching benefits of mindfulness is currently taking place in the fields of psychology and neuroscience. Parallel to this, cutting edge technologies are becoming more accessible. This article documents a new movement in Human-Computer interaction design in which artists and designers are employing new technologies to research and explore the practice of mindfulness. This paper explores three interactive designs that encourage mindfulness through sensors and novel input technology. We begin by giving an overview of the historical background of the Electroencephalogram (EEG), before going on to discuss the physiological processes of meditation and the history behind the clinical practice of mindfulness. We show how two artists are employing EEG sensors that measure the electrical activity of the brain to visualise mindfulness meditation practices. A design that uses respiration sensors to record the breath patterns of the user to trigger distinct soundscapes that directly relate to the correlation between breath and meditative state is then discussed. Lastly, we conclude by debating the future of the three artworks.

Keywords: EEG Devices, Interactive Art, Mindfulness Meditation, Human-Computer Interaction, Sonic Studies.

1.0 Introduction

In 2014 Time Magazine declared that the far-reaching cultural and academic interest in mindfulness is such that we have entered the age of the Mindful Revolution. Buddhists have coveted the practice of mindfulness for centuries, since the 1970's there has been an increase in interest in the psychological and physical benefits of mindfulness practice in fields as diverse as design, education and modern warfare training. In the fields of psychology and neuroscience there is deluge of new research into how mindfulness can benefit our daily lives. We notice a correlation between the growing cultural interest in mindfulness practices and the increasing pace of technological progress. Contemporary western societies are saturated with ever growing and evolving technologies; our bodies have become embedded with, and connected to technology in such a way that the boundaries between the biological and the digital have become intertwined. Although technology can fracture our attention, it

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can provide design tools, methods and practices that help focus our attention in highly engaging ways. We demonstrate a new movement amongst artists and designers working at the intersection of mindfulness and emerging technologies. In order to explore how technology is being used to promote mindfulness and bring our attention back to the present moment we examine three sensor-driven installation art applications: *Narcissus Brainwave* (2016), *Visualise your Mind* (2015), and *Sonic Cradle* (2012).

2.0 Methodology

This paper acts as a resource to scholars at the emerging intersections of human-computer interaction design, sonic studies and mindfulness studies. It also contributes to the fields of healthcare and psychology and argues that more research into the potential for EEG headsets and Sonic Sensors to promote mindfulness practices needs to be conducted. Through analysis of the following research questions we show how the visualisation and sonification of mindfulness has the potential to enhance meditative experiences.

- In what ways can artists use sensors to encourage the practice of mindfulness?
- Do wireless EEG devices have the potential to help mindfulness?
- Interactive design has the potential to engage with and inspire the user: how can this potential be employed to promote the practice of mindfulness?

In order to contextualise this research we first trace the fleeting and fascinating history of the EEG and show how EEG headsets are employed by researchers to measure the specific electrical activity of the brain. We then take the reader on a brief tour of the history of mindfulness practice before elucidating how designers and artists are using Brain-computer interface devices that use EEGs. Narcissus Brainwave and Visualise Your Mind are two interactive designs that use EEG headsets. Sonic Cradle is an interactive sensor-driven design that has the potential to use EEG sensors in the future. The three projects in this paper used qualitative thematic analysis to analyse the user's needs. The data was then grouped into themes that described the success of each project. We conclude by discussing future directions for the three projects. More detailed description of each methodology used for the projects is in the sections below.

3.0 Background on EEGs

We begin our journey with a history into how technology has been used to record brainwave data. Research findings, generated using EEG sensor based technology, have revolutionised discoveries in neuroplasticity. Moreover, the changes in the human brain resulting from mindfulness meditation practices can now be visualised and understood in new tangible ways due to EEG headsets.

In 1924 Hans Berger recorded the first human brain activity by an EEG. EEG sensors measure the electrical activity of the brain. Brain cells communicate by producing electrical signals; an EEG measures this activity. Berger was trained in medicine and neuro-psychiatry. Berger wanted to demonstrate that the electromagnetic fields of the human brain could be used for telepathy. Although the signals he detected were unsuccessful for this purpose, the EEG was widely adopted by clinicians and scientists.

Brainwaves observed with an EEG allow researchers to record brain wave patterns. Humans have five brainwaves: Gamma Beta, Alpha, Theta, Delta. The frequency of the brainwave is associated with its speed and measured in cycles per second. Different frequencies indicate different types of activities. Delta waves have a very low frequency (below 4 hertz) which occur during sleep. Alpha waves, 8 to 13 hertz, occur during relaxed times. Beta waves, 15 to 40 hertz, are the next fastest, and they occur when actively thinking. Gamma waves (greater than 40 hertz) have the highest frequency and are involved in higher mental activity.

3.1 Gamma waves and meditation

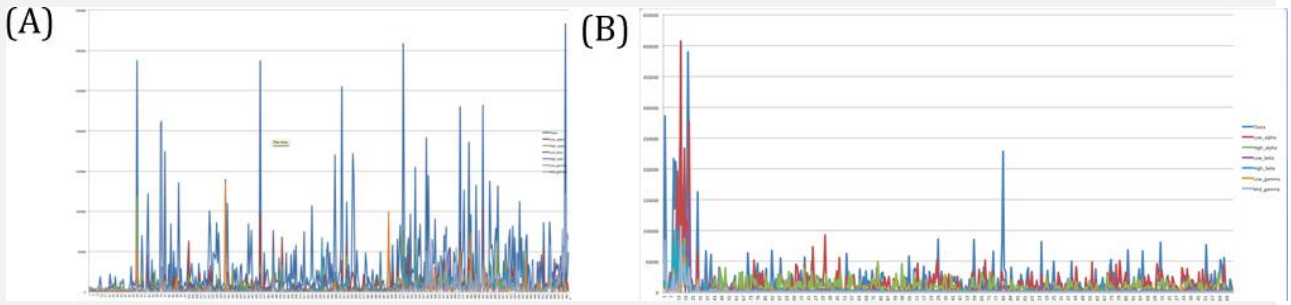
Each brainwave serves a unique purpose and helps us to cope with various situations, whether it is to facilitate the process of learning new information, or to help us calm down after a long stressful day. Our ability to move through the different brain wave frequencies plays a large role in how successful we are at managing stress, focusing on tasks, and getting a good night's sleep. If one of the five types of brain waves is either overproduced or under produced in our brain it causes problems.

Gamma waves are the fastest brain waves measured on an EEG. Gamma waves relate to the speed we mentally process experiences, and our ability to focus, and richness and depth of sensory experiences. People with high gamma activity have exceptionally vivid and rapid memory recall. In a high gamma state the brain can process information quickly, remember it, and retrieve it later. High gamma activity corresponds to a state of peak performance. Elite athletes, musicians and high achievers in all fields produce more gamma waves than average.

Gamma waves have been documented to help with attention and focus (Collura, 1993). Individuals with high level mental processing and functioning exhibit greater gamma activity (Fries, 2001; Jia X, 2011; Yi-Yuan Tang 2007). Gamma waves are important for learning, memory and information processing. Neuroscientists believe that gamma waves link information from all parts of the brain. Thus, the entire brain is influenced by gamma waves.

In a study with Buddhist monks, it was found that gamma activity increased in a meditative state of compassion (Jia X, 2011). Some research suggests that mindfulness meditation enhances compassionate behaviour (Davidson, 2004). A study that performed sleep high-density EEG recordings, in long-term meditators of Buddhist meditation practices and meditation naive individuals, indicates that meditation practice produces measurable changes in brain activity. Therefore, meditation is the optimum way to increase gamma activity.

Figure 1: (A) Normal brainwaves and (B) meditative brainwaves both from a practitioner with 2 years of experience.



4.0 Mindfulness

Research demonstrates that mindfulness can greatly enhance our health and wellbeing (Hofmann, 2010; Jha, 2007; Jon Kabat-Zinn, 1998; Lazar, 2011; Mitchell, 2013). The clinical practice known as 'mindfulness' has been around since 1979 when Jon Kabat-Zinn introduced his Mindfulness-Based Stress Reduction (MBSR) program as part of the University of Massachusetts Medical School. Kabat-Zinn adapted the Buddhist tradition of mindfulness for the clinical setting in order to help with psychological conditions such as stress and chronic pain management.

Mindfulness dates back around 2600 years ago to the beginning of Buddhism. The Buddha's teachings, or *Dharma,* were not a doctrinal belief system, rather a collection of principles and practices that offer

support and encouragement in the universal quest for happiness and spiritual freedom; a "system of training that leads to insight and the overcoming of suffering" (Williams & Kabat-Zinn, 2011).

Buddhist meditation encompasses a variety of meditation techniques that aim to develop mindfulness, concentration, tranquillity, and insight. Increasingly, non-Buddhists are adopting Buddhist meditation techniques. Psychologists and psychiatrists are increasingly using these techniques to help alleviate a variety of health conditions such as anxiety and depression.

The etymology of the word 'mindfulness' can be traced to the concept of *Sati* (Pali) or *Smrti* (Sanskrit). There has been much debate surrounding the exact translation of *smrti* and *sati* and while mindfulness is generally accepted as a broad translation, the grand semantic breadth of each word must be taken into consideration when looking for a direct translation. The cultivation of *Sati*, or non-judgmental mindful-awareness, sits at the core of Buddhist practice. To practice mindfulness is possible without Buddhism but the practice of Buddhism is not possible without mindfulness. According to Jon Kabat-Zinn" Mindfulness practice means that we commit fully in each moment to be present; inviting ourselves to interface with this moment in full awareness, with the intention to embody as best we can an orientation of calmness, mindfulness, and equanimity right here and right now."(Williams & Kabat-Zinn, 2011)

John Kabat-Zin describes mindfulness as way to understand the events of our lives with equanimity. He proposes that by maintaining an attitude of non-judgmental direct observation and keeping attention to the present moment we are able to see more clearly the characteristics of our mind and body process (Jon Kabat-Zinn, 2009). To practice mindfulness means being continuously aware of the present moment; the following interactive designs are built to enable users to do this.

5.0 Brain-computer interface devices that use EEGs and Sonic Platforms

We believe that interactive design and art applications have the potential to engage with and inspire a user to practice mindfulness. The first art works we discuss are *Narcissus Brainwave and Visualise your Mind*. They are both brain-computer interfaces that encourage mindfulness meditation though an EEG device. The participant's EEG data is recorded using a headset called the NeuroSky MindWave. The MindWave is an EEG that uses dry sensors. The NeuroSky was used to give participants feedback of their brainwave activities while undertaking mindful-based activities. The visualization of the participants' brainwaves provided a tool to help develop mindfulness practice.

Sonic Cradle, the third project, does not currently use an EEG headset but uses two respiration sensors that track diaphragm and chest breathing. However, in future iterations of the project, the team is planning to incorporate another EEG headset similar to the MindWave called Muse. Therefore, we still believe it is an important project to discuss when analysing how interactive installation art can encourage mindfulness.

In the following three examples we sought to discover whether EEG devices and other biofeedback devices have the ability to encourage the practice of mindfulness in users. We discuss how interactive applications support and promote the practice of mindfulness through direct visual brainwave data feedback and sound based interaction. We examine how wireless EEG devices can engage the user and promote the practice mindfulness. We outline three novel installation artworks that sought to incorporate human-computer interaction to encourage the practice of mindfulness.

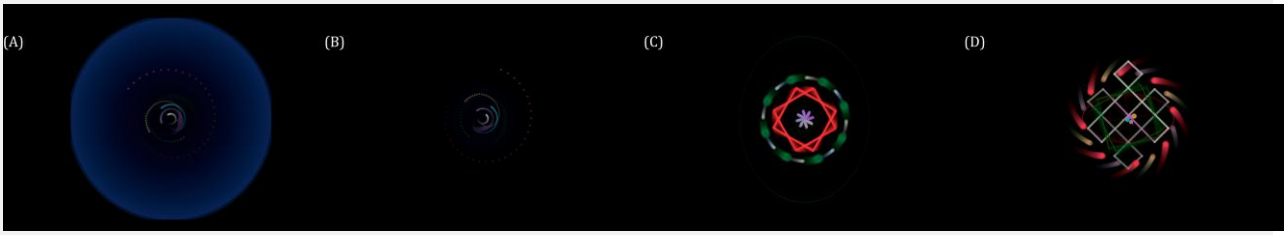
6.0 Narcissus brainwave

Narcissus Brainwave (Figure 2 and 3) is a compelling example that promotes mindfulness through the use of a novel sensor-driven design that visualises the users' brainwaves while they meditate. The installation uses the EEG headset MindWave. Users are invited to wear the MindWave headset and sit in meditation. EEG data is sent to the program processing through the MindWave device. After they have

meditated, *Narcissus Brainwave* displays their brainwaves during the different states of meditation they had endured. The participant's brainwave data creates digital paintings based on Tibetan Buddhism Mandala patterns. The aesthetic visualisation patterns of Mandalas were created to enable users to discern different brainwave states of meditation. In Carl Jung's understanding of the Mandala, it is a psychological expression of the totality of the self (Jung,1972).

The first user study was conducted to develop the visualisation rules that would enable an evaluation of brainwave changes between meditative and non-meditative state. Raw data from the MindWave was collected to distinguish four states of mind which were then represented as visualisations (a, b, c, and d) respectively). By correlation of these factors, the size and pattern of the Mandala pattern was determined.

Figure 2: Narcissus Brainwave (2016) Young dong Kim. (A) Distraction: the Mandala breaks into 8 divisions from the center and expands outward – this break symbolises the dissolution of the Tibetan sand Mandala at completion. (B) Relaxed: The user is trying to meditate. (C) Meditation status: Mandala pattern appears. The size of mandala represents how deep the meditation status is. (D) Deep meditation status: An eternal knot appears when the gamma brainwave's amplitude exceeds a certain level.



User study two was designed to analyse the discernibility of the visualisation patterns. 7 out of the 11 participants were able to discern differences between the visualisation patterns.

Participants viewed the pre-recorded visualisation patterns of meditators and were asked to evaluate them. The majority of participants (7 out of 11) could differentiate between the patterns of meditators and non-meditators. Through user study two, it was also reported that colour theme, scale of pattern and the rate of change are important factors to differentiate between the visualised patterns representing the different levels of meditative state. A colour theme was set to distinguish each brainwave with the highest amplitude to enable users to recognise their brainwave status, also the scale of the pattern (expansion or contraction) was subsequently set to monitor status changes in meditation.

The audience can view the user's individual brainwave-visualisation as the user meditates in situ, it can also be viewed after the meditation experience is over. By using EEG sensors to visualise brainwave data the user is able to see how their meditation status changed during the session. The 'rate of change' is the time required to reach the different levels of meditation. Meditators, who are more experienced practitioners, take less time to attain a meditative state. *Narcissus Brainwave* allows users to distinguish between meditative and non-meditative states through a logical, aesthetic approach.

Narcissus Brainwave uses patterns to integrate multiple dimensions of information instead of viewing graphs of brainwave data. The final visualisation rules have been made based on a conceptual model of the meditation stages. User testing and an interactive development process validate the discernibility of visualisation patterns of meditators and non-meditators.

Figure 3: Narcissus Brainwave (2016). Top and Bottom shows individual visualization viewed by the audience and then by the user after meditating.

Narcissus Brainwave has the potential to enable practitioners a greater understanding of the effects of meditation on their brainwave activity. By viewing how their mind state changes dynamically during meditation, users can explore the effect of various meditation techniques and discover the ones that are most beneficial for their practice. For non-meditators, the use of this tool enables them to perceive brainwave changes as soon as they start meditation. This immediate feedback can encourage and inspire people who hesitate to practice meditation because of the perceived prejudice that meditation is hard to attain. This may give encouragement and inspiration to the users. Non-meditators may be curious whether the custom-made software program is showing their meditation states properly or not. With this curiosity, they will continuously use the software and experience benefits of mindfulness. Users who have a MindWave headset can access and download the published software easily.

7.0 Visualise your mind

Figure 4: Visualise your Mind, Zhe Peng Rui interface design using the MindWave NeuroSky to link users brainwaves with the website and iPhone application (2015).

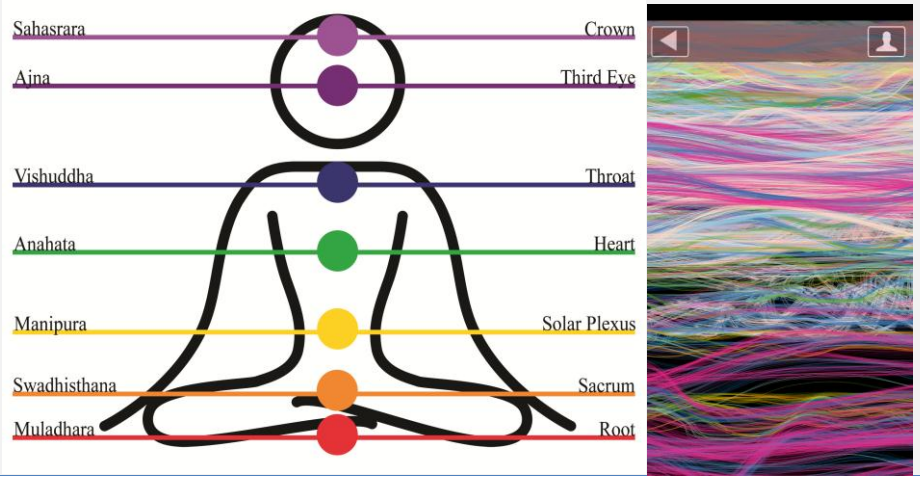
Visualise your Mind (Figure 4) is a new platform to visualise brain wave data in meditation using EEG sensor technology. This project incorporated two different ways of interacting with EEGs headsets. In the first interaction, users put on an EEG headset while meditating and are then able to view their

brainwaves in a visualisation chart (see Figure 5 left). It is intended that the visualisation chart be used to evaluate and promote the users meditation practice. In the second interaction using EEG headsets, users can create abstract paintings using their brainwave data during meditation (see figure 6).The data visualisation patterns reveal users' live brainwave data: alpha, beta, gamma, theta, delta waves and meditation and attention levels. As a result users could monitor their progress in meditation, and create abstract paintings using data from their own brainwaves. The artworks in *Visualise your Mind* were controlled directly by users brainwave data. In order to distinguish the meditative state of the users brainwave data, the chakra colours system was adopted. Chakra colours use seven different colour schemes (Figure 6). Violet was depicted for the highest meditation state because it has the strongest wavelength (Wills, 2014).Magenta, the combination of red and violet, was used to depict meditators deepest relaxation stage (Figure 6).

Figure 5: (Left) Wave patterns' colour, frequency and amplitude. Different colours depict different meditation values used to create the Mind Painting artwork. (Right) Users recorded data visualisation chart.

In order to develop *Visualise your Mind,* a user needs analysis study was conducted. Firstly we analysed the design requirements for an application and website. Secondly we collated experts' and users' suggestions to find appropriate mindfulness tutorials. The user study contained an online qualitative questionnaire and interviews with 42 participants. We used thematic analysis to group the data into themes and develop the design concept. The results from the user study found most participants were less informed about EEG brainwave data, but had literacy about websites and apps.

Figure 6:(Left) Chakra colour scheme; (Right) *Visualise Your Mind*: Abstract Painting generated by users brainwaves via EEG sensor output.



The website and mobile applications were designed to be used in correlation with the EEG headset MindWave. Users were encouraged to use an EEG headset while they practiced the mindful-based tutorials. From the users' needs analyse study, the website and mobile application were developed to include mindful-based tutorials such as guided meditations and relaxation exercises, created by Patty

Kikos and Tripura Yoga. From the mindful-based tutorials, the user study revealed participants preferred the breathing exercises and body scans featured in the tutorials.

Visualise your Mind promotes mindfulness using novel EEG sensors, input and output technology to generate brainwave data. It also promotes mindfulness through the use of its website and phone application.

8.0 Sonic cradle: A sound-based interaction for mindfulness

Sonic Cradle (Figure 7) is an interactive design invention that encourages the user to enter a state of mindfulness meditation using spatial sound. It aims to "intentionally promote the specific pattern of awareness and attention characteristic of mindfulness meditation" (Kornfield, New edition, December 1989) in an easily accessible way. The user is suspended in a hammock within a darkened chamber fitted with respiratory biofeedback sensors to initiate and guide the surrounding sound. By focusing on a real-time correlation between respiration and the sonic experience the user is offered a tangible creative mode through which an understanding of the relationships between breath and meditation is made possible. Within this contemplative space, usually filled by external distraction, the user has the opportunity to focus on their inner sensations and how it relates to their cognitive and emotional wellbeing.

Much like the previous work we discussed, *Narcissus Brainwave* and *Visualise your Mind,* this interactive design transforms the unseen effects of meditation practice into a sensory commodity. Unlike the innovative designs using EEG devices, *Sonic Cradle* was initially created as an interactive medium that uses no visual stimulation. However, it is important to discuss this piece as it assists us in uncovering our research questions on how we can design mindful-technologies in human-computer interaction. The absence of visual stimuli and the suspension of the user are both design concepts that aim to free the user of external distraction and interoceptive senses in order to facilitate full concentration on internal sensations.

The creator of *Sonic Cradle* Jay Vidyarthi, designed a Max 6 patch. The respiration data is then sent through the patch to create an individualised soundscape that is played through four Mackie MR5MK2 speakers surrounding the chair and a large subwoofer situated below it. Two respiration sensors are attached to participants' abdomen and thorax to measure chest expansion (Thought Technology's SA9311M and ProComp2 encoder: 32 Hz) (Vidyarthi, 2012).

Figure 6: Sonic Cradle (2014).

(Vidyarthi, 2012). From the speakers an evolving spatial soundscape emerges. The system enables the user to create different sounds by breathing in different ways, using their breath to shape and form the pre-recorded clips into their own personal meditation soundtrack. The clips randomly play through different speakers to keep the soundscape individualised and interesting for the user. The goal of the experience is to use the participants' prior knowledge and their psychological attributes to keep them

engaged and generate an individual immersive sound experience(Vidyarthi, 2012).

Sonic Cradle's sounds are designed to guide the user back to their breath and on-going enquiry into the influence the breath has on the heard environment. Originally, the sounds were created by the artist, however, the sounds were too similar and therefore, thirty sounds were crowd sourced from different musicians and sound artists(Vidyarthi, 2012). When mental distractions arise the user's breath will continue to influence the surrounding sound, retriggering focus on the sound-breath loop.

When the users' hold their breath for a full 4 seconds, the user will feel vibrations from the subwoofer and a chime. Then, a new sound will be added to the experience. As the soundscape gets more complex, the user has to hold their breath for longer periods of time making it harder to call upon new sounds. This creative process will enable the user to explore the immersive experience with their breath (Vidyarthi, 2012).

Timing and ratio is also influence in the soundscape. The length of the inhale and the exhale manipulate the reverberation of the sound. For example, if the participant takes a slow breath, they will feel like they are in a larger room. If the participant breathes from their abdominal area more than their chest, they will experience a louder sound.

However, if the user gets overwhelmed with the number of sounds, they are able to breathe rapidly to get the sounds to disappear. This gives the user a constant sense of control over their own environment(Vidyarthi, 2012). Figure 7 describes the tangible similarities between a typical mindfulness meditation practice and the paradigm created by *Sonic Cradle.*

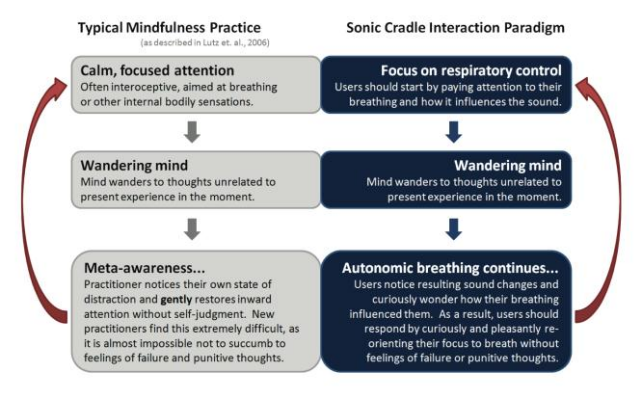
Sonic Cradle was subject to a qualitative investigation with 39 selected participants at the TED *active* conference in Palm Springs, California 2012. Participants were grouped into those who had no meditation experience and those who had some experience. A short interview was conducted after the experience. A subsequent systematic analysis that used three independent data coders resulted in the following report of 14 primary themes that emerged in the participants' use of *Sonic Cradle*.

Common themes for both beginners and those who had some experience included: relaxation, floating sensation, exploration of the soundscape, yearning to continue the experience, visual imagery in their mind, bodily sensations, loss of time, meditative-state, association with other meditative practices, semi-conscious state, and revelations and discoveries. Interestingly, only those with some meditation experience noted an intense engagement with sound. Similarly, those in this group also noted a direct correlation between the Sonic Cradle experience and that of meditative practice. Only those in the no meditation experience group noted feeling personal epiphanies (Vidyarthi, 2012).

Much as *Narcissus Brainwave,* has the potential to provide non-meditators with non-judgmental and tangible feedback regarding their meditative practice, so *Sonic Cradle* has the opportunity to encourage and inspire users to take up the practice of meditation.

As the creator of *Sonic Cradle* Jay Vidyarthi notes, a feeling of failure can be common in those starting out on their meditation journey. The lack of formal instruction regarding meditation while using *Sonic Cradle* is intentional: the continued sonification of the breath process provides a situation whereby the user is perpetually reminded of their breathing-state. "The Sonic Cradle interaction paradigm aims to enable the calm refocusing of attention to proceed unencumbered as a natural response to the interaction paradigm, potentially providing an experience which parallels more advanced mindfulness practitioners" (Vidyarthi & Riecke, 2014).

Figure 7: Jay Vidyarthi, Mindfulness Meditation Practice versus Sonic Cradle Interaction Paradigm (2014).



As we have already seen, *Narcissus Brainwave* and *Visualise your Mind* in generously transform the actual physical imprint of meditative data into visual data. One of the exciting questions that *Sonic Cradle* unveils sits at the intersection of design, psychology and the sonic experience: can meditation really help us to listen better?

The surprising result of an "intense engagement with sound" reported by users with some meditation experience suggests that more enquiry is needed. According to H. Ellie Falter mindful practice techniques can be employed to deepen sonic understanding and enhance our connection to music (Falter, 2016). The intimacy of sound has the potential to change the way we experience time and blur the edges of our physical and mental perception. Similarly, the practice of mindfulness has been shown to have the potential to expand our notions of consciousness, enhance somatic awareness, and thus enable a greater mind-body harmony. *Sonic Cradle* uses interactive technology to highlight the aesthetic experience of listening in order to remind us of the timelessness of presence. Within this perpetual continuation of 'now' a narrative is revealed that enables us to consider time as a type of infinite object (Zinovieff, 2013). The sound that is experienced in *Sonic Cradle* can therefore be viewed as a tool that enables a direct relationship to the infinite nature of both time and consciousness. This human-computer paradigm truly is at the cutting edge of interaction design.

9.0 Future work and Conclusion

As consumer EEG technology continues to increase in reliability, two of the projects discussed in this paper will continue to evolve in an iterative design process. *Visualise your Mind* is currently being developed further to be supported by the Emotiv for a research study with 100 Junior Medical Officers (doctors) to discover if using the visual feedback from the EEG device will help develop their meditation practice. This research project is aimed at increasing the resilience of junior medical officers. It also seeks to generate results from an eight-week compassion focused mindfulness meditation course. If successful, this will support a wide spread roll-out across New South Wales Health's junior medical workforce. Secondary benefits may accrue to patients in the form of (a) more empathic doctors and (b) physicians who have become personally familiar with mindfulness meditation and thus better able to identify patients who may also benefit from the practice. This project will be innovative in some areas over and of the growing interest in mindfulness meditation-based techniques to enhance resilience and reduce stress. The research study will use EEG's for enhancement to improve practice, engagement in mindfulness in an occupational setting.

Visualise your Mind currently uses the Neurosky Mindwave headset, however, due to the limitations of the device, it is not suitable for clinical use. The headset has a sampling rate of 1Hz and only has one electrode positioned on the forehead. The wide error margin for the data is a huge issue when testing for reliability in the data. In a current future study of Visualise your Mind will we use the Emotiv Insight headset. EMOTIV Insight is a 5-channel, wireless EEG headset that records brainwave data. The Insight has a wider distribution of sensors surrounding the head and therefore offers greater data accuracy.

Sonic Cradle provided an immersive soundscape that assisted users to focus on their breathing rather than thoughts and experiences. One of the most common negative comments that participants had while interactive with the soundscape was their distaste for specific sounds. Currently, there is no recorded pattern to which sounds the users were irritated with (Vidyarthi & Riecke, 2014). Therefore, in future iterations, the group of artists working on the project want to incorporate EEG data from the Interaxon Muse headset. The muse headset enables the system to know when the user is in a state of focused attention. With the new data, the artists are looking at removing distracting sounds from the soundscape and playing with the volume depending on what type of meditative state the participant is currently experiencing.

This article has outlined three innovative interaction design and art applications that use breathing sensors and EEGs to visulisalise and sonify brainwaves in order to encourage mindfulness. Though the use of EEG and respiration data, we defined how applications have the potential to promote the practice of mindfulness, especially for novice practitioners. The three examples illustrated novel ways in which Interactive art can promote the practice of mindfulness through sensory installations using visual and sonic stimuli. The success of *Visualise your Mind* and *Narcissus Brainwave* have shown that wireless EEG devices do have the potential to improve and inspire mindfulness practice. We hope the three pieces inspire new ideas to develop interactive visual and soundscapes that can keep a user on a path to regular meditation sessions. We intend that this research inspires and informs the work of other artists, designers, and researchers to develop applications that can assist both novice and experienced meditators in their practice.

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