Sonic Cradle: Investigating Meditative Aspects of an Interactive Technology

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ABSTRACT

Sonic Cradle is an interactive system designed to encourage a meditative attentional pattern akin to *mindfulness*. Users are comfortably suspended in a dark chamber where they use respiration as a means to focus and control an immersive soundscape. Basic interpretive qualitative methods along with three quantitative scales, Affect Grid, Toronto Mindfulness Scale, and State-Trait Anxiety Inventory, that assess mood, mindfulness, and anxiety, respectively, were used to analyze data of 30 participants after 15-minute sessions of both *Sonic Cradle* and self-guided relaxation. This paper is part of a larger study and will only discuss the Toronto Mindfulness Scale. Results suggest that *Sonic Cradle* may help to induce a mindfulness-like state and offers a unique experience compared to simply trying to relax in a dark room without any assistance. With mounting evidence implying mindfulness meditation as an effective practice for self-regulation, our results are promising that *Sonic Cradle* can be an effective tool in cultivating and increasing psychological well-being. Moreover, *Sonic Cradle* can be instrumental in introducing mindfulness to non-meditators or those who are unable to learn mindfulness through more traditional means.

Author Keywords

Relaxation, biofeedback, immersion, mindfulness, sound, music, persuasion, self-regulation, stress, psychology, research through design.

1. INTRODUCTION

Today's society is full of pressures and stress. Clinicians and researchers alike are actively seeking preventative measures for people to self-regulate and manage their stress in a healthy way [1]. While technology has traditionally been viewed as creating a culture of distraction, some researchers have embraced our technologically expanding society and have began to develop tools to help people get psychological support.

Biofeedback, physiological sensors used to externally manifest one's internal states, is one such technology that has been shown to be therapeutic [2]. *Sonic Cradle* (see **Figure 1**) is a system that incorporates respiration to sound biofeedback in a way that enables users to engage and learn stress-reducing techniques in a playful fashion. As described in [3], *Sonic Cradle* "comfortably suspends users in complete darkness, enabling them to shape a peaceful soundscape using only their breathing". The system's physical characteristics are designed to limit distractions and input from the outside world in order to deemphasize irrelevant aspects of physicality and encourage users to actively co-create their experience. *Sonic Cradle* is unique in that its aim is to draw attention inward on the sensation of breathing and its influence on sound, as opposed to a visible external stimulus.

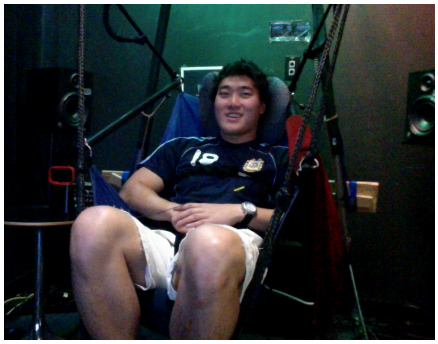

Figure 1. A user suspended in *Sonic Cradle* during the interview. The lights are turned on for documentation purposes; normally the participant would be in complete darkness.

Sonic Cradle has been designed to simulate *mindfulness meditation*, an intentional and non-judgmental focusing of attention to the present [4], by helping users focus on their breathing in order to reach a mindful-like state. The concept of mindfulness has been developed well within the Buddhist tradition over the past 2,500 years and has eventually made its way into Western culture [4]; Mindfulness is defined as "the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally." Similarly, a mindful-like state is having particular qualities of attention and awareness that allows insight into the nature of mind and world. Mindfulness meditation is a therapeutic technique increasingly being used in clinical practice to help people cope with stress [5].

Some therapeutic technologies, such as virtual reality environments, distract users from negative experiences [6], and borrow concepts from meditation to support the self-regulation of stress through some form of internal awareness [7]–[9]. One example is InteraXon's Muse, a consumer-level EEG headband whose first application guides users through a focused attention exercise similar to

meditation. Muse guides users to focus on counting their breaths and provides real-time neurofeedback to help them identify and respond to their own active mind.

Sonic Cradle has been analyzed with basic interpretive qualitative interviews in a purposive sample, where the majority of participants reported mindful-like experiences [10], [11]. However, meditative aspects of participants' subjective experiences have yet to be captured with accepted psychological questionnaires. Here, we used the Toronto Mindfulness Scale and complemented it with qualitative interviews to better capture the meditative aspects of participants' subjective experience and how those experiences in *Sonic Cradle* may reflect the convoluted and subtle nature of mindfulness compared to self-guided relaxation (control condition). Due to the scope of this short paper, we will only focus on the Toronto Mindfulness Scale because we believe this questionnaire relates most to what *Sonic Cradle* is trying to achieve. Namely, introducing non-practitioners to mindfulness meditation in an organic and playful way. The long-term goal of *Sonic Cradle* is to educate people about mindful self-regulation in order to motivate independent stress management.

The Toronto Mindfulness Scale (TMS) is a 13-item, two-factor, 11-point Likert scale. It "focuses on *curiosity*, or act of wanting to learn, and *decentering*, a shift in thoughts from personally identifying with thoughts and feelings to relating experience to a wider field of awareness". An example question from the *curiosity* factor is: "I was curious to see what my mind was up to from moment to moment". And, one question assessing the *decentering* factor is: "I was more invested in just watching my experiences as they arose, than in figuring out what they could mean." The scale has a high internal consistency ($\alpha = .95$) [12].

In this research note, we report on our current findings of how *Sonic Cradle* compares to a self-guided relaxation control condition in a within-subject, repeated measures design. In the control condition, participants were simply asked to relax without any technological feedback; this way, we could see if the main attribute of *Sonic Cradle* (technological feedback) does in fact help people reach a mindful-like state better than what they could achieve with no technology present. Since all other factors are present in the control condition, this particular control represents what participants can do to relax just by themselves and allows us to test whether *Sonic Cradle* provides additional benefits. With a more general population sample, inclusion of accepted instruments (TMS) and an extended qualitative interview we will be expanding upon previous work with both *Sonic Cradle* [3, 13] and interactive technologies designed to aid people with their well being. Furthermore, we will be taking the analysis to the next level with more scientific measures and a more controlled experimental set-up. We found this system has the potential to not only reduce stress and arousal in the short-term, but also to demystify the process, experientially educating people about mindfulness and its benefits.

2. METHODS

We recruited a total of 30 naïve volunteer participants through advertisements, signage, and word-of-mouth. Selected participants had no respiratory problems and considered themselves in good health to ensure they were not at risk of discomfort from prolonged exposure to *Sonic Cradle*. We told participants only that they would experience an interactive soundscape where they can control sounds with their breathing in order to avoid any potential bias of participants' experience towards meditation. SFU REB approved this study.

2.1 Experimental Design

A within-subjects design was used in order to make a direct comparison between two conditions, self-guided relaxation and *Sonic Cradle*. That is, all participants experienced both conditions in two separate sessions, in balanced order. We matched the two groups by meditation experience ("no meditation experience", N=15 vs. "some meditation experience", N=15), as suggested by Chiesa and colleagues [13], to avoid confounds of meditation experience. Participants were given questionnaires three times, before both sessions (T1), after the first session (T2), and after the second session (T3).

2.2 Procedure

Participants, upon entering the lab, were first briefed and given an informed consent form. Next, before each of the two 15 min sessions, the Toronto Mindfulness Scale was assessed using SFU's online *Websurvey* tool.

For the first session, participants either partook in self-guided relaxation or used *Sonic Cradle*. In the *Sonic Cradle* condition, we replicated the procedure from Vidyarthi's [14], where participants were fitted with the breathing sensors, seated into the hammock-chair, and then given the following instructions, which were taken verbatim from Vidyarthi's [14] initial experiment with *Sonic Cradle*:

"*As you know, you will be controlling sound with your breathing. There are three things you need to know before you get started. First, if you want to add more sound to your environment and increase its complexity, you simply have to stop breathing and remain still. You can hold your breath in, out, or anywhere between. Second, if you feel like you've lost control of the system or are overwhelmed, you can simplify your sound environment by breathing as quickly as possible. If you breathe quickly for long enough, you will eventually return to complete silence. Finally, the session will end in approximately 15 minutes, at which point simply sit and wait for me – I will return and instruct you further. If you wish to end the session early for any reason, feel free to ring the bell sitting beside you. Before we get started, could you please repeat these three points back to me so I can be sure that you understand them?"*

In the self-guided relaxation condition, participants were seated in the same hammock-chair and asked to simply relax for 15 minutes. After each of the two sessions, the TMS was again administered and we conducted a short, semi-structured interview where the participants' articulated their experiences, recorded with a digital camera. While still seated in the hammock chair, participants answered additional questions, were asked to compare their experience between the two sessions, debriefed, and thanked.

2.3 Data Analysis

We transcribed and coded 30 interviews in NVivo, software for qualitative data research. Primary themes were pre-determined based on previous findings [11] and themes were added based on the initial text frequency search of the interviews. We scored the questionnaires and conducted a 2-way repeated measures ANOVA in SPSS.

3. RESULTS

The TMS was used to obtain mindfulness ratings throughout the experiment and evaluate the effectiveness of both self-guided relaxation and *Sonic Cradle*. A 2-way repeated measures ANOVA (Condition: Self-guided Relaxation vs. Sonic Cradle × Time: before vs. after each session) was conducted for the TMS *curiosity* scores and the TMS *decentering* scores separately. There were no main effects or interactions for the TMS ***curiosity*** scores, indicating no greater curiosity for *Sonic Cradle* (M = 35.83, SD = 2.21) than self-guided relaxation (M = 33.83, SD = 2.21) and no significant change in score from before exposure (M = 33.75, SD = 1.95) to after exposure (M = 35.92, SD = 2.32). There was a significant main effect of time for the TMS ***decentering*** score, however, $F(1,29) = 7.55$, $p = .010$, with decentering scores increasing after exposure (M = 41.27, SD = 2.19) compared to before exposure (M = 38.08, SD = 2.06) (see **Figure 2**).

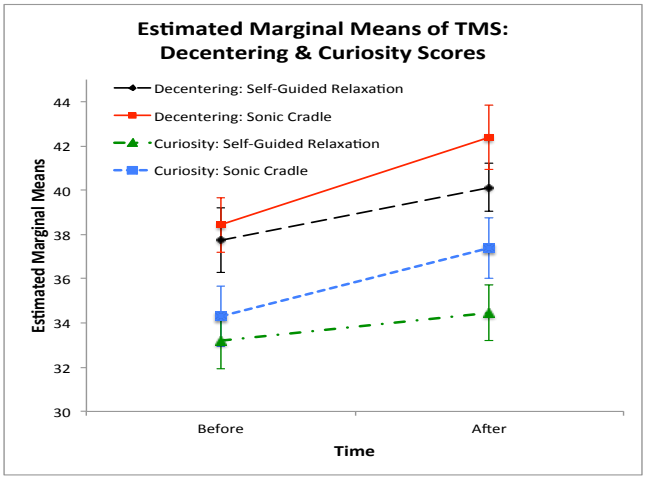

Figure 2. Estimated marginal means of the TMS: decentering score for both conditions (self-guided relaxation and *Sonic Cradle*) before and after each session.

There was no significant main effect of condition. Although **Figure 2** suggests a trend towards a stronger decentering increase for *Sonic Cradle* as compared to the self-guided relaxation, the condition×time interaction did not reach significance, $F(1,29) = .076$, $p = .785$. There was no noticeable difference in the scores for subjects after self-guided relaxation based on the order of condition (i.e., whether the subject experienced *Sonic Cradle* or self-guided relaxation first).

Those with no meditation experience and those with some meditation experience shared the majority of the themes coded in the analysis of the qualitative interview data, which highlights the uniformity in experience reports across participants even when separated into two mutually exclusive groups. Furthermore, the relative number of participants coded within findings by group supports the primary themes extracted from a previous study, such as *a Relaxing and Refreshing Experience*, *a Positive and Emotional Response*, and *Personal Development and Epiphanies* [11]. It is striking how similar a result was found given the two sample populations were dissimilar and this study used more control means. Given the scope of this paper, we will focus here on the theme most closely relating to the Toronto Mindfulness' *decentering* score - *Clarity, Reduced Thinking, and Emptiness*. In fact, as Vidyarthi and colleagues [3] point out, clarity of mind is directly related to well-documented understanding of mindfulness in general. And, in their initial study, they found *Sonic Cradle* was successful in eliciting clear-minded thinking, which suggests that the system may introduce experiential elements of mindfulness. Preliminary data analysis suggests that meditation experience does seem to play a role in this study. Compared to self-guided relaxation (N=8), more people (N=10) reported *Sonic Cradle* having similar properties to meditative practice. Moreover, more people reported reduced thinking and emptiness, epiphanies, and a relaxing and refreshing experience after *Sonic Cradle* compared to the control condition. In particular, more participants reported *Clarity of Mind, Reduced Thinking or Emptiness* with *Sonic Cradle* (N=13), as compared to self-guided relaxation (N=10). One participant articulated this theme when asked what they thought about *Sonic Cradle*:

P17: "The Sonic Cradle really helped, a lot actually. It's a really dynamic, free-floating experience. Your mind is engaged without having to think. So, it's keeping you distracted but not, maybe not think critically. You're not distracted by other things, and you're able to just relax."

4. DISCUSSION

Much debate has spurred around the concept of what mindfulness is [15] and some have warned not to equate mindfulness simply with relaxation [16]. The semi-structured interviews given by participants seem to suggest that while both self-guided relaxation and *Sonic Cradle* are relaxing, *Sonic Cradle* seems to hold some special qualities (i.e., many people reported not having experienced

something like this before) and provoke unique emotional and physical responses. While previous work only connects *Sonic Cradle* to mindfulness through qualitative data in a limited sample, this study shows a quantitative triangulation in a randomized controlled study. With the addition of a quantitative measure, we can now offer an idea that *Sonic Cradle* may, indeed, induce participants with an experience related to mindfulness, though it remains unclear if it is significantly more beneficial than self-guided relaxation; an increased TMS decentering score has been shown to be indicative of mindfulness meditation experience [17].

In keeping with *Sonic Cradle's* intended long term goal, to help people independently manage stress via mindful self-regulation, this study not only confirms the qualitative findings of participants finding clarity, reduced thinking, and emptiness, but also supports this qualitative finding with a validated, quantitative questionnaire that assess mindfulness (i.e., the TMS *decentering* questionnaire). Lau and colleagues (2006) define *decentering* as the "awareness of one's experience with some distance and disidentification rather than being carried away by one's thoughts and feelings". The increased *decentering* score we found after *Sonic Cradle* shows that participants were able to emotionally detach themselves from their thoughts and feelings while still acknowledging that they are there. The qualitative findings suggest that those with no meditation experience seem to find *Sonic Cradle* more helpful than self-guided relation in reaching a state of mindfulness, reporting a greater clarity of mind. A significantly increased TMS *decentering* score together with the related interview theme highly suggest that *Sonic Cradle*'s novel interaction design helps ease the user into a meditation and guides them into a mindful-like frame of mind by playfully engaging users to focus on their breath with sound. *Sonic Cradle* shows potential to implicitly teach people how to manage their psychological well-being in an intuitive and pleasant manner.

5. CONCLUSION AND FUTURE DIRECTIONS

Expanding evidence implies mindfulness meditation as an effective practice for mental self-regulation. In an effort to equip people with the tools to cope with stress, *Sonic Cradle* has shown to be effective in getting people into a mindful-like state. However, further research with more participants is needed to assess if *Sonic Cradle* provides a clear benefit over a simple self-guided relaxation, and how this might interact with prior meditation experience. Our qualitative data suggests that specifically non-meditators might benefit most from *Sonic Cradle*.

The next step is to look at the rest of the qualitative themes in the interviews as well as the other two questionnaires, the Affect Grid and the State-Trait Anxiety Inventory. We hope to discover if *Sonic Cradle* is significantly different than self-guided relaxation for these other measures and, if so, what the underlying reasons are behind what makes *Sonic Cradle* unique and effective.

Another potential future study can look at other quantitative measures, such as EEG, to track the progress of meditation. We initially collected data with the Emotiv EPOC EEG Headset. However, we did not include this data in the current study over concerns that the EEG may interfere with the overall experience.

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