Mindfulness Teddy Bear

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Abstract

As the prevalence of mental health disorders rises within
children and young people (CYP) there is a pressing need
for cost-effective and feasible interventions. The current
paper introduces the development of The Bear, an
interactive toy that provides mindfulness-based practice
targeted at CYP. Alexa voice recognition technology will be
employed to enable interaction with the device. This device
aims to extend from evidence supporting the use of
mindfulness based practice within CYP. Features will
include different sessions adapted from evidence-based
mindfulness techniques. Such technology will enable young
people to practice mindfulness in their own time, targeted at
their own concerns. Throughout the paper the development
of the bear is described and findings from a prototype
demonstration are discussed. The prototype demonstration
returned largely positive results and highlighted areas for
future research.

Author Keywords

Alexa Skill; Child Welbeing; Mindfulness; Breathing
Exercises; Mental Health

CCS Concepts

•**Human-centered computing** → **Usability testing;
Sound-based input / output;**

Introduction

Within the United Kingdom evidence supports a consistent increase in the prevalence of long-standing mental health conditions in children and young people (CYP), aged 4-24 years. This increase in prevalence is accompanied by rising demand for counselling services, hospital admissions for self-harm and referrals to Child and Adolescent mental health services.

Three quarters of life-time mental health problems occur by the age of 24 [7]; often lasting into adulthood with devastating social-emotional, health and economic costs. Failure to meet needs for mental health services may negatively affect CYP education, career outcomes, feelings of self-esteem and self-efficacy [11]. Such findings paired with evidence supporting positive outcomes following early access to appropriate healthcare highlight the need for early interventions.

In this paper, we propose *The Bear*, an interactive device supporting both auditory and touch receptions, enabling CYP to access mindfulness-based interventions.

With increasing pressures on mental health services, mobile applications (apps) have offered an innovative, user-friendly solution that could overcome barriers associated with accessibility and availability [3], [12] and [8]. Clinical research has shown positive outcomes in the use of digital interventions in common mental health disorders. The development of the Bear aims to expand the benefits of app usage to target CYP.

Most available apps attempt to translate the principles of Cognitive Behavioural Therapy and mindfulness-based practice; however, few are reported to contain evidence-based content [8], [10]. Of the sample presented by Bry et al. (2018), only a quarter of apps targeted at CYP had more than one evidence-based component [4]. In contrast, features of the Bear will include material adapted from evidence-based mindfulness techniques.

To enable interaction with the bear Alexa voice recognition technology will be employed. The intuitive nature of voice technology is utilised to enhance usability; this aims to increase the ease at which a child can express their emotive state.

The bear will provide a user-friendly, inexpensive intervention for mental health concerns in CYP. The bear aims to aid prevention and improve accessibility to interventions, with the potential of easing pressures on services.

Walk Through

Our mindfulness bear comes with a storybook manual. The book tells the story of the bear helping a small child at a party. When read aloud, the phrase "Alexa, asked the bear" activates the bear via the Alexa Skill. The bear then responds with the phrase described in the manual; "Would you like to do mindfulness or breathing exercises". It is at this point the user should choose the option they wish by saying it out loud. If the user chose mindfulness, the bear will simply read aloud a mindfulness script. If however the chosen option is breathing exercises, the bear will ask the user to hold it's paws. In the bear's paws are vibration units. The bear will then instruct the user to breathe in through the nose when they feel vibration in the paws, then breathe out through the mouth when the vibration stops. The bear will also speak soothing words to the user. Both the mindfulness and breathing exercises aim to calm the user.

Related Work

Mindfulness-based practice and CYP

Mechanisms of mindfulness include focused attention, decentring and emotional regulation. Through mindful practice, thoughts, feelings and body sensations are noticed and understood to not reflect oneself, instead to be 'just' episodic states which should not be subject to judgement
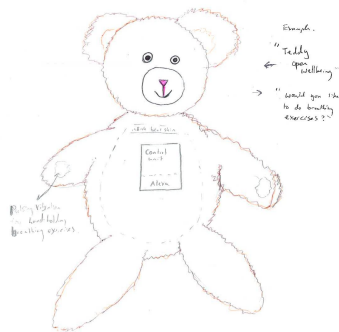
Figure 1: Early sketch of *The Bear*.

[18]. Following the efficacy of Mindfulness-based interventions within adults, interventions have been modified to target CYP. These modifications can include decreasing session length, increasing tactile sensations, and increasing repetition. A meta-analysis of peer-reviewed studies into the efficacy of mindfulness-based intervention in CYP proved encouraging [18]. Positive outcomes have been demonstrated across both clinical and non-clinical samples, group and individual sessions as well as school-based practice [15].

Mindfulness-based practice and Psychological Disorders
A growing body of research documents the efficacy of mindfulness-based interventions within CYP. The efficacy of mindfulness based practice has been established within a number of clinical disorders including anxiety, depression and Attention Deficit Hyperactivity Disorder [5], [6]. Additionally, mindfulness-based practice has been linked to improvements in other domains including physical health, enhanced attention and emotional regulation [15], [13], [1], [16] and [9]. Reduced emotional regulation is associated with a variety of psychological disorders, including depression and anxiety, which are prevalent in CYP. Neuroimaging studies have highlighted dysfunction in the frontal limbic system to be associated with emotional dysregulation. Mindfulness practice has been associated with increased prefrontal activation and improved prefrontal control over amygdala responses; a mechanism proposed to underlie the relationship between emotional regulation and mindfulness-based techniques. Research supports that this improvement in emotion regulation may underlie the positive outcomes from mindfulness-based practice, including symptom reduction in psychological disorders, including depression and anxiety [6].

Mindfulness-based practice and Tangible
Research presented by Aslan et al., 2016 explores the addition of tangible somaesthetic designs to mindfulness-based practice [2]. A haptic heart beating in synchrony with the user, and a stuffed animal that matched the users breathing by expanding/contracting were introduced. The paper suggests that users with complex needs may benefit most from tangibles, however such devices may distract from a meditative state rather than enhance it. While the objects described in this paper were focused purely on representing the users own heartbeat/breathing patterns in a haptic manner, the use of providing a haptic representation of another individuals breathing is an avenue for future research. Work on TANGEON focused on how the novice mediator may benefit from tangibles. Applying a tangible component to pre-existing interfaces can aid meditative practices in inexperienced individuals [2]. However, the idea of tangibles hindering introspection is something to be considered within the design of the Bear.

Voice Recognition and CYP
Pantoja et al. (2019), aimed to explore the interaction of children with voice user interfaces (VUIs)[17]. VUIs were embedded within toy-like tangible housing. While within a social-play setting, the authors observed that children wanted to physically interact with the voice agents, and that these could redirect behaviour and promote social interactions. However, the paper raised the issue of the possible misuse of technology; children were observed to do what the VUI instructed without question. Further concerns of the interaction of children with VUIs may arise from privacy concerns [17]. Not all Alexa skills require a privacy policy, additionally Amazon users are not explicitly informed of privacy policies. However, it is reported that although users interact with skills using voice commands,

Figure 2: Mindfulness Bear Alexa Skill Icon.

Figure 3: *The Bear* with the Raspberry Pi and Vibration Units installed.

audio is not made available to developers. Text transcripts are available, which is proposed to removed personally identifiable features of the interaction. A further issue that arises was highlighted in January 2017. Reports emerged of a 6-year old girl ordering a $160 dollhouse, and four pounds of sugar cookies, without her parents knowledge, whilst interacting with an amazon echo dot. Further concern followed when more devices attempted to order the dollhouse triggered by the reporting of the story on a TV morning show.

Design

Ideas & Prototypes

During the development of *The Bear*, we brainstormed and experimented with different technologies, prototyping tools, and base components. We developed *The Bear* incrementally, building on previous sketches (e.g. figure 1) and prototypes, influenced by heuristic analysis. We considered different modes of tactile interaction with the bear, including inflating "lungs" in the bear, and having the bear recognise non-verbal emotional responses. Through a literature review we discovered a breathing toy [2] and a soft balloon-interface which could identify rubs, hugs, and punches [14].

We embedded the vibration units (for breathing exercises) in the paws of a teddy bear because our target demographic of CYP often have their own stuffed toys and bears and it provides a friendly and calming tangible interface. In addition, rather than simply using an audio mindfulness script, we wanted to encourage positive intimacy with the system through hand-holding and breathing "together" with *The Bear*.

Implementation

The bear contains a Raspberry Pi running Raspbian OS (Debian Linux for Raspberry Pi). This OS provided compatibility with the Amazon Voice Service SDK, and was a good development environment for controlling the hand vibration units. Initially the Alexa Skill was going to run on the Raspberry Pi inside the bear, however due to constraints with the Alexa Skill publishing system and sound transfer through *The Bear*, in the experimental iteration of *The Bear* the Skill runs on an Amazon Echo Dot alongside the bear. The hand vibration is achieved through a Python script enabling GPIO pins in a (user-specified and customisable) pattern to power 2 vibrating mini motors in the paws. The developed Mindfulness Bear Alexa Skill is relatively simple; when invoked it asks the user whether they want to do Breathing Exercises or Mindfulness Exercises, and then based on the user's selection reads out a pre-selected mindfulness script and associated audio clips (e.g. a relaxing music clip).

Evaluation

To evaluate the usability of the bear, we initially asked our test participants to make the bear engage in breathing exercises. We informed them that *the bear* used an Amazon Echo Dot (*Alexa*) but other than that, they had no guidance to how it operates. After noting some initial observations, we then gave them a story book manual 4 which they were told to read out loud. If they were still unsuccessful in making the bear operate following this, we intervened and either got the bear working or, when we were experiencing network connectivity problems, a video of the bear working was played. In both scenarios the participants listened to the breathing exercise script and felt the vibration in the paws.

Initial Observations

Only 2 out of our 17 participants were successful in activating *the bear* without the manual. We observed two different approaches to this task. 14 out of the 17 participants started their efforts by talking to the bear. Most

Figure 4: Page 1-4 of the manual telling the story of a bear arriving to a party and doing breathing exercises with a distressed child

opting to start with a nice greeting, saying some variation of "Hello bear, do breathing exercises". The other 3 instead tried to find a hidden button, under the fur to squeeze or move the bear into yoga positions.

Some participants then clocked on to the fact that the Amazon dot is triggers by saying "Alexa" but without further guidance they struggled to activate our amazon skill ('The bear') instead of an alternative mindfulness/breathing exercise skill from the amazon skills store. One misunderstanding resulted in the Alexa telling the participant about beer then asking if the participant if they wanted to hear its impersonation of Vicky Pollard (from the TV show Little Britain).

Evaluation of the Manual
Our story book manual was designed to trigger our Alexa skill with the phase " 'Alexa?' Asked the bear" followed by a pause. 5 of participants, unprompted, expressed their love for the manual. Due to temperamental network connectivity problems the Alexa wasn't able to understand all our participants during the experiment, thus we have inconclusive results on the success rate of using the manual. We observed that some participants felt a disconnect between the voice (Echo Dot's English, male voice Brian) and the bear. If the participants had not already engaged with the bear physically in the initial stage of the experiment, some extra prompting was sometimes needed for them to "hold on to [the bear's] paws and focus on your breathing". All participates followed the exercise through, breathing with the vibration until the end.

Post Usability Test Survey
We ran a questionnaire on 16[1] of the participants from the usability study, grading their agreement with six statements

on a Likert Scale - five gradations from strongly disagree to strongly agree.

11 out of the 16 participants agreed or strongly agreed with the statement "*I felt comfortable using the bear*" and 9 agreed or strongly agreed with "*The bear helped me to relax*". 13 agreed or strongly agreed that the paw vibration helped engagement with the structured breathing exercises, though some participants suggested using a drawn-out on-off curve rather than being on for the inhale and off for the exhale.

Even with the basic behaviour of the vibration motors, several participants stated afterwards that the vibration made breathing along with the script much easier and that it felt more effective.

While our participants were all over 18, 10 responded positively to "*I would be happy to give this bear to a child*". Several participants commented that more could be done to make the device more child friendly including selecting a child-centric mindfulness script and a more child-like voice option for Alexa more akin to narrators or characters in cartoon shows.

Our participants also indicated that more would be need to be done to make using the device comfortable in a public setting, with 14 out of 16 responding negatively to "*I would feel comfortable using this bear in public*". Owing to some networking issues on the day of testing, 10 responded negatively to "*The speech recognition was easy to use and interact with*" indicating that perhaps an Amazon Echo is not the ideal device to be used with any kind of variable Wi-Fi signal, particularly if the device is designed to be portable.

Evaluation Summary
Our results show that more than half the participants were relaxed by the process and would give the bear to a child. However a lot of improvements could be done to make the

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[1] one of the usability participants did not complete the post usability test survey.

bear friendlier and easier to interact with.
Below is a list of limitations to our evaluation.

- Test participants were the wrong age bracket. Our target users are aged 4-14, all our participants were aged 18 or over.

- The usability test was conducted in a small, quiet space. Making a quite intense environment that could make the participant feel anxious or uncomfortable which could have affected the results.

- People behave differently when they know they are being observed. If we were able to collect the initial results without two observers directly in front of them, participants may have felt more comfortable to try different approaches to making the bear work - more touch or more phrases. It was noted that many participants were reserved at first, unsure whether they should reach for the bear.

- Network connectivity problems. The Amazon Echo dot struggled to connect to the internet for some of the participants. This meant for some, Alexa said it could not connect and so we moved on to plan B (the video). For others, Alexa just listened for longer. When the participant continued to read the story book manual pass the activation phrase it caused the Alexa to misunderstand. When we then intervened and stopped after the end of the activation phase it would work. This temperamentality may have affected how the participants perceived the bear's ease of use.

- The breathing exercise script explicitly mention "impending projects" which may have caused more stress among our participants (mostly university students taking a break from work by taking part in our usability test).

- Our participants were all found in the University of Bristol Merchant Ventures Building (mostly Computer Science students) this lack of diversity may have skewed results.

Conclusion
In the current paper we have introduced the Bear, an interactive toy designed to increase accessibility to mindfulness based techniques for CYP. The use of voice recognition and haptic receptions aims to enhance usability and efficacy within CYP. Research has been highlighted demonstrating the effectiveness of mindfulness within different settings, supporting the applications of the Bear across a range of settings. The device hopes to target both prevention and early intervention with the potential of increasing accessibility to treatment. User feedback from the prototype study were largely positive, revealing people would recommend the bear to appropriate ages. Additionally, the prototype study revealed avenues for future research.

Future Work
If we were to extend the project further, there are a few directions we could take it. The first would be to remove the Alexa integration with our own voice recognition system. The use of Alexa allowed users to perform actions they should not be able to. For example, accessing Alexa's own breathing exercises. We could also add additional features to the bear. These features could include a variable vibration function, where the user can adjust different settings about the vibration units such as how long they vibrate and how powerful they are. Another feature could be an earphone jack in the bear, so that the user can do the exercises in a loud environment.

Contributions

- Bridget Ellis - 20%
- James Farrington - 20%
- Rachel Howard - 20%
- Freddie Jones - 20%
- David Sharp - 20%

REFERENCES

[1] Angela D Adkins, Ashvind N Singh, Alan SW Winton, Gerald F McKeegan, and Judy Singh. 2010. Using a mindfulness-based procedure in the community: Translating research to practice. *Journal of Child and Family Studies* 19, 2 (2010), 175–183.

[2] Ilhan Aslan, Hadrian Burkhardt, Julian Kraus, and Elisabeth André. 2016. Hold my heart and breathe with me: Tangible somaesthetic designs. In *Proceedings of the 9th Nordic Conference on Human-Computer Interaction*. ACM, 92.

[3] David Bakker, Nikolaos Kazantzis, Debra Rickwood, and Nikki Rickard. 2018. A randomized controlled trial of three smartphone apps for enhancing public mental health. *Behaviour research and therapy* 109 (2018), 75–83.

[4] Laura Jane Bry, Tommy Chou, Elizabeth Miguel, and Jonathan S Comer. 2018. Consumer smartphone apps marketed for child and adolescent anxiety: A systematic review and content analysis. *Behavior therapy* 49, 2 (2018), 249–261.

[5] Molly Cairncross and Carlin J Miller. 2016. The effectiveness of mindfulness-based therapies for ADHD: a meta-analytic review. *Journal of attention disorders* (2016), 1087054715625301.

[6] Britta K Hölzel, Sara W Lazar, Tim Gard, Zev Schuman-Olivier, David R Vago, and Ulrich Ott. 2011. How does mindfulness meditation work? Proposing mechanisms of action from a conceptual and neural perspective. *Perspectives on psychological science* 6, 6 (2011), 537–559.

[7] Ronald C Kessler, Patricia Berglund, Olga Demler, Robert Jin, Kathleen R Merikangas, and Ellen E Walters. 2005. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of general psychiatry* 62, 6 (2005), 593–602.

[8] Joyce HL Lui, David K Marcus, and Christopher T Barry. 2017. Evidence-based apps? A review of mental health mobile applications in a psychotherapy context. *Professional Psychology: Research and Practice* 48, 3 (2017), 199.

[9] Gayle L Macklem. 2010. *Evidence-based school mental health services: Affect education, emotion regulation training, and cognitive behavioral therapy*. Springer Science & Business Media.

[10] Nicole Martinez-Martin and Karola Kreitmair. 2018. Ethical issues for direct-to-consumer digital psychotherapy apps: addressing accountability, data protection, and consent. *JMIR mental health* 5, 2 (2018), e32.

[11] Sally McManus, Paul Bebbington, Rachel Jenkins, and Terry Brugha. 2016. Mental health and wellbeing in England: Adult Psychiatric Morbidity Survey 2014. A survey carried out for NHS Digital by NatCen Social Research and the Department of Health Sciences, University of Leicester. (2016).

[12] David C Mohr, Heleen Riper, and Stephen M Schueller. 2018. A solution-focused research approach

to achieve an implementable revolution in digital mental health. *JAMA psychiatry* 75, 2 (2018), 113–114.

[13] Amy J Morgan, Ronald M Rapee, and Jordana K Bayer. 2016. Prevention and early intervention of anxiety problems in young children: A pilot evaluation of Cool Little Kids Online. *Internet Interventions* 4 (2016), 105–112.

[14] Kosuke Nakajima, Yuichi Itoh, Yusuke Hayashi, Kazuaki Ikeda, Kazuyuki Fujita, and Takao Onoye. 2013. Emoballoon. In *International Conference on Advances in Computer Entertainment Technology*. Springer, 182–197.

[15] Filip Raes, James W Griffith, Katleen Van der Gucht, and J Mark G Williams. 2014. School-based prevention and reduction of depression in adolescents: A cluster-randomized controlled trial of a mindfulness group program. *Mindfulness* 5, 5 (2014), 477–486.

[16] Randye J Semple, Jennifer Lee, Dinelia Rosa, and Lisa F Miller. 2010. A randomized trial of mindfulness-based cognitive therapy for children: Promoting mindful attention to enhance social-emotional resiliency in children. *Journal of child and family studies* 19, 2 (2010), 218–229.

[17] Luiza Superti Pantoja, Kyle Diederich, Liam Crawford, and Juan Pablo Hourcade. 2019. Explorations of Voice User Interfaces for 3 to 4 Year Old Children. In *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM, LBW0177.

[18] Sarah Zoogman, Simon B Goldberg, William T Hoyt, and Lisa Miller. 2015. Mindfulness interventions with youth: A meta-analysis. *Mindfulness* 6, 2 (2015), 290–302.