



Shepherd Center

Development and Testing of a Technology Enhanced Intervention to Support Emotion Regulation in Military mTBI with PTSD



Tracey Wallace, M.S., CCC-SLP & John Morris Ph.D.
Shepherd Center, Atlanta, Georgia

Problem

Military veterans with mild traumatic brain injury (mTBI) and post traumatic stress disorder (PTSD) often experience debilitating stress and anxiety. Diaphragmatic breathing is effective in reducing stress and anxiety; however, some military veterans with mTBI and PTSD report it is challenging to:

- Learn the technique
- Pace their breathing
- Initiate use in times of
- Remember to practice

Research Objective

Develop and test Android Wear smartwatch app to assist people with mTBI and PTSD to manage stress through diaphragmatic breathing. Later, integrate it with a stress detection biosensor.

Solution Development

Development followed user-centered, participatory design principles by including target users throughout the development process, resulting in multiple iterations (7 "builds"). The initial design concept was led by a clinician with expertise in mTBI cognitive rehabilitation in collaboration with a psychologist with expertise in PTSD treatment. Eleven military veterans with mTBI and PTSD contributed to development through participation in a focus group (5 participants) or completion of usability testing through "sit-by" demonstrations (6 participants) along with 4 clinical experts in PTSD and mTBI (a speech-language pathologist, 2 clinical psychologists, and a clinical social worker). Refinements incorporating feedback gathered in the sit-by testing informed development of a beta version of the app.

Key Features: Customizable visual, tactile and auditory guidance to pace relaxation breathing, reminders to practice and feedback on changes in heart rate and stress.



- 12 male/2 female, ages 29-50, 2 years to 24 post-onset of injury
- Participating in SHARE Military Initiative, a comprehensive rehabilitation day program in Atlanta, Georgia, USA

Testing Protocol

- In-clinic training with behavioral health specialist
- Take-Home testing for 2-4 weeks

Measures

Effectiveness evaluated via interviews and patient reported outcomes:

- Stress ratings before/after each breathing session
- Goal Attainment Scaling (GAS) to measure impact of extended use;
- PTSD symptom severity via the Posttraumatic Checklist-5 (PCL-5)
- Changes in anxiety, depression and psychological well-being via the Beck Anxiety Inventory (BAI), the Beck Depression Inventory (BDI) and the Flourishing Scale.



Qualitative Feedback – User Comments

- "Can I have one?", "It's pretty cool", "I'm very impressed with it", "I think it's the single best thing I've gotten from this therapy program," "I don't want to give it back."

What they liked:

- Privacy – option to use discreetly so others cannot see or hear
- Hands-free practice of breathing exercises (vs on smartphone)
- Quick access provided by wearable format
- Reduced risk of loss
- Vibration/ tactile cues
- Ability to set reminders to practice
- Video demonstration

Concerns:

- Fine motor control required for small screen
- Lack of flexibility in setting alarms
- No feedback on progress

Results

Other Feedback

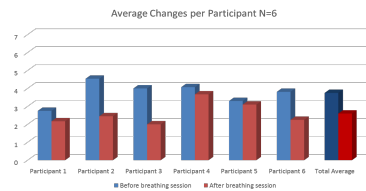
On a scale of 1-10, where 1 is low and 10 is high...

How helpful do you find breathing for relaxation?
@ Enrollment: average of 5.8 (ranging from 1-10)
@ Completion: average of 8.6 (ranging from 4-10)

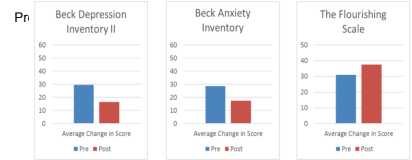
How well do you feel you perform the technique?
@ Enrollment: average of 3.8 (ranging from 1-7)
@ Completion: average of 8.3 (ranging from 4-10)

How likely would you be to continue to use BreatheWell?
Very, Somewhat or Not at all: Very = 86% of participants

Before/After Session Stress Ratings



The average stress rating collected after breathing sessions declined from 3.75 on a 7-point scale (7 is highest stress) before a breathing session to 2.6, equating to a moderate clinically meaningful reduction in stress rating. ***Only 6 participants' stress ratings were collected.



Average anxiety symptom severity reduced from Moderate to Low. Average depression symptom severity reduced from Moderate Depression to Borderline Clinical Depression. Responses on the Flourishing Scale, a measure of psychological well-being, improved by 6 points on average at study completion, indicating an average per-item improvement of 0.75 points (meaningful change = >0.5 points).

Reduction in PTSD Symptom Severity and Goal Attainment

- Half of the participants also had 5+ points or greater reduction on the PCL-5 measure of PTSD symptoms at study completion. This reduction indicates an effective response to treatment. Further, four of these participants had 10+ points or greater reduction in responses, indicating clinically significant and meaningful change.
- All 14 participants performed at 'Expected' or higher levels on their GAS goals for how well they used the technology to achieve an individualized, person-centered goal related to stress management (remember to practice breathing, perform the breathing technique accurately, etc.). This correlates to interview data indicating 100% felt the app was helpful to them.
- Additionally, all 14 participants performed at 'Expected' or greater for GAS goals for learning to use the app from a technical aspect, which was important to consider given the coexistence of memory impairment experienced by target users. This correlates to interview data indicating 86% found the app "very easy" to use

Integration with Biosensor – Feedback on Concept

At study completion, participants were asked if it would be helpful if the app could tell when they were getting stressed and somehow suggest that they may want to try some deep breathing. 100% responded "yes":

- "Hell yeah. I'd be inspector gadget of the new millennium. I would wear it all of the time."
- "I think other situations could have gone differently if I had one. Like maybe I'd still be able to see my wife and kids."
- "Yes. If my wife suggests it to me I get so pissed off, but if it comes from a phone a watch or a wristband...how pissed can you be at that?"

Status: Exploring the efficacy of using multiple modes of stress detection, such as galvanic skin response and heart rate variability combined with machine learning and/or context awareness. Many existing technological methods of stress detection either are not well studied, are not wearable, are unstable or have a high rate of error, primarily due to false positive readings.

Conclusions

The results of this study suggest BreatheWell Wear is a clinically effective means of stress management for some people with PTSD and TBI. The qualitative measures used in this study indicate wearables, such as smart watches, may be well received by and useful for this population. The results validate previous research supporting slow, deep breathing as an effective stress management tool. The extent to which can be generalized is limited because the study did not control for the participation in other interventions that may relieve PTSD symptoms.

Future Directions

New directions based on both participant and researcher experiences during the clinical testing of the app were recently incorporated in version 2.0. More extensive clinical testing has been initiated for version 2.0 with a focus on impact and comparative effectiveness.

Upgrades in version 2.0:

- Reminder feature expanded with increased customizability
- Periodic user queries about well-being through ecological momentary assessment to refine collection of impact data
- Addition of a progress tracking screen within the companion app (which resides on the user's paired phone) to provide feedback to the user including changes in heart rate, stress ratings, well-being ratings, goal attainment (related to practice of relaxation breathing) and frequency of breathing practice

Potential Additional Directions

- Development on Apple Watch
- Integration with external stress detecting biosensor to leverage data captured and aid the user in anticipating onset of episodes of stress.

