You Can't Force Calm:

Designing and Evaluating Respiratory Regulating Interfaces for Calming Technology

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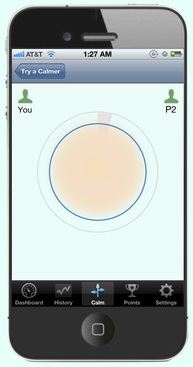
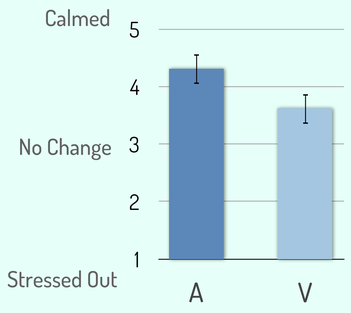
Device	Specialty Device	Smart Phone	Desktop
User Attention	Full Attention	Semi Attention	
Practice Duration	1-5 mins	5-20 mins	> 20 mins
Stimulus	Continuous	Rhythmic	
Type of Guidance	Auditory	Visual	Physical Contact
Evaluation	Self-reported Score	Breathing Rate	
Social Interaction	None	Asynchronous	Synchronous

Breathing Rate



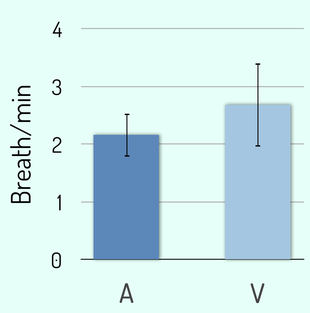
(Visual) = Guide = User

Self-reported Calming Effects



A > V (p=0.038)

Breathing Rate Reduced



A < V (p>0.05)

Abstract

Interactive systems are increasingly being used to explicitly support change in the user's psychophysiological state and behavior. One important trend in this vein is systems that support calm breathing habits. We designed and evaluated techniques to support respiratory regulation to reduce stress and increase parasympathetic tone. **Our study revealed that auditory guidance was more effective than visual at creating self-reported calm. We attribute this to the users' ability to effectively map sound to respiration, thereby reducing cognitive load and mental exertion. Interestingly, we found that visual guidance led to more respiratory change but less subjective calm. Thus, motivating users to exert physical or mental efforts may counter the calming effects of slow breathing.** Designers of calming technologies must acknowledge the discrepancy between mechanical slow breathing and experiential calm in designing future systems.

System

Our Breathwear System consists of a belt-based respiration sensor and an iPhone application. The sensor measures diaphragmatic expansion data and transmits the data to the phone via Bluetooth 4. The application consists of a 1-minute breathing drill. Our drill design uses two different modes to guide users' breathing. First, our visual guide uses size-changing circle to indicate diaphragmatic expansion as it provides a relatively good mental model for the expansion. Second, our audio guide uses fading ocean sounds as the signals for inhale and exhale.

Study

We conducted a randomized order within-subject experiment with 14 students. Users read a given assignment and tried our breathing drills. We measured breathing rate change during the entire study and conducted post-study surveys and interviews.

Auditory guide performed better than visual guide possibly because it imposes less cognitive load and give more 'natural' sense to users. Moreover, while subjects found visual guide less calming than audio, it led to more change in breathing rate compared to the given reading task. This discrepancy reveals that mechanically inducing slow breathing does not always lead to experiential calm; it may even exasperate it.

Conclusion

We conducted an evaluation of visual and auditory methods of intermittent pacing of respiration via a mobile phone. **Consistency between breathing representation and human mental mapping was found to be significant. It was also found that a decrease in breathing rate does not necessarily mean an increase in subjective calm.** This has implications for the design of calming technologies. **Over-exertion during slow breathing may oppose its calming effects. As such, calming technology must address both experiential as well as mechanistic factors.**