Calming Technologies

Neema Moraveji
Learning Sciences and Tech Design
Stanford University
neema@stanford.edu

Neekaan Oshidary
Symbolic Systems
Stanford University
oshidary@stanford.edu

Roy Pea
Learning Sciences and Tech Design
Stanford University
roypea@stanford.edu

BJ Fogg
Persuasive Technology Lab
Stanford University
bjfogg@stanford.edu

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Abstract
Calming technologies are interactive systems that help users maintain optimal cognitive, physiological, and emotional resting state even while they performing tasks. We attribute the emergence of calming technologies to the widely acknowledged benefits of stress- and anxiety-reduction in physical health, productivity, and performance. We describe observed approaches to calming technologies and motivate researchers of personal informatics to consider how their work aligns or is at odds with the goals of calming. Personal informatics, persuasive systems, and calming technology overlap due to the prevalence of sensors and feedback in an attempt to influence user behavior.

Keywords
Calming technologies, personal informatics, stress, sensors, persuasive technology

ACM Classification Keywords
H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction
The field of human-computer interaction has traditionally addressed questions around how to offer desired interactive functionality in a form that is easy to understand and efficient to use. The field emerged at a

time when computing systems were not especially common and laypeople did not spend a majority of their workday using computers. As a result, research methods such as contextual design [5] emerged that attempted to uncover the explicit and latent needs of workers to devise appropriate interactive systems to address those needs.

For a great number of information workers, however, interaction with computers now constitutes a significant proportion of their day. While the question of how to devise appropriate interfaces still exists, designers of interactive systems must now wrestle with their success; the impact that these interactive systems are having on users must be acknowledged. We are concerned specifically with addressing the impact ubiquitous technology access has on stress, anxiety, and the impact and side effects of feeling overwhelmed or tense.

By making the effects of ubiquitous access and computing understood, we begin to build theories and principles for designing technologies that counteract these problems. This paper represents a move in that direction: a research agenda and call-to-action for the study of calming technologies.

Calming technologies

We define *calming technologies* (CT) [1] as computing systems that attempt to reduce stress and increase the user's capacity to maintain optimal resting state even while performing work. Interactive systems may have calming components or exist completely for the purpose of calming users. Various approaches to calming are explored in this paper.

Interactive systems have traditionally attempted to use explicit actions and the affective state as inputs to respond to. Specifically, affective computing is concerned with "the study and development of systems and devices that can recognize, interpret, process, and simulate human affects" [8]. The motivation for such systems is to advance the development of modern interactive system design. In contrast, calming technologies are concerned with improving the physical and cognitive wellbeing of their users by increasing relaxation and reducing stress.

Calming mechanisms and approaches

The word 'calm' is used here to connote the concept of reducing agitation, stress, anxiety, and fragmentation of attention while increasing relaxation, tranquility, focus, and being composed or levelheaded. Put simply, we have not identified a word better than 'calm' that aptly describes this neutral state of being.

In reviewing existing calming technologies, we identified three primary calming mechanisms at work: physiological, cognitive, and emotional. These approaches all interact and any calming technology might use one or more mechanism and approach to achieve its goals. We present the three below, along with respective design approaches.

The goals of calming technology represent a departure from traditional systems whose primary goal was to address a user need in the most efficient and effective manner possible. Instead, CT asks designers to evaluate the extent to which their interface helps the user maintain a relaxed and aware state of body and mind.

Physiological
Use the physiological mechanism aims to influence users to adopt a relaxed yet alert physiological disposition and to develop the habit of doing so while not using the technology. Such technologies may influence the perceptual, autonomic nervous system, skeletal, respiratory, or muscular systems.

Cognitive
Use of the cognitive mechanism aims to promote a composed and levelheaded state of mind where the user can focus on a single task for a sustained duration without distraction and without anxiety. Approaches include reducing distractions, increasing the salience of foreground tasks, and augmenting memory.

Emotional
Use of the emotional mechanism helps users maintain a positive outlook or interpretation on one's life experience. This mechanism is closely tied to the other two mechanisms. Approaches may include inspiring and motivating users to such a degree that external stresses are ineffective.

Autonomic interaction design

It is the autonomic nervous system (ANS) that regulates the body's state of stress, anxiety, or calm. This system functions in large part below consciousness.

The ANS is divided into two parts: sympathetic (preparing or mobilizing the body for action or reacting to stress) and parasympathetic (returning the body to a resting state). Calming technologies can address either or both sides and can attempt to influence both sensory (afferent) and motor (efferent) components of the ANS.

Sympathetic nervous system (SNS)
The SNS prepares the body for a fight-or-flight response – or stress. This includes dilating the bronchioles, increasing the rate and force of heart contraction, and dilating the pupils, among other automatic organ actions. The SNS prepares the body for physical action but prolonged activity of the SNS can cause physical harm.

Parasympathetic nervous system (PNS)
The PNS works to maintain or prepare the body to be at "rest and digest" in a neutral state where a fight-or-flight response is not necessary. The PNS activates organ actions that we often associate with being in a un-stressed state: digestion, sexual arousal, and "contraction of the ciliary muscle to the lens, allowing for closer vision" [8].

Interactions between computing system and the autonomic nervous system exist below one's conscious control. *I.e.*, in these cases, the computer is attempting to influence the user's physiological state in a way that the user may not have direct access to themselves. Therein lies the potential value of calming technologies: they hold great potential for influencing the body in ways that humans currently have a decreased level of control.

The role of personal informatics in calming

Researchers of personal informatics [6] (PI) have acknowledged the large potential utility of a combination of sensors and appropriate feedback to enhance user understanding of themselves, their environments, and the impacts of their habits and behavior. The goals of personal informatics overlap with the goals of calming technologies in that some PI

systems attempt to use sensed data to reduce stress. However, many PI systems are in direct opposition to the goals of CTs in that their goal is to increase the user's understanding of new data, present new information, and deliver new insights.

The results gained from research on personal informatics can be brought to bear on the issues that calming technologies attempt to address. These include novel sensor design and feedback mechanisms. The inclination of self-tracking researchers to build new sensors to track once-unknown quantities can be used to track data that can be used to reduce user distraction and anxiety. In calming technologies, presenting the user with new information must be done carefully so as to ensure that users use the new information to increase their level of relaxation.

The self-knowledge or insight that personal informatics strives to instill in users is likely *counter* to the goal of calming technologies. In the latter, the goal is not understanding of once-ignored information but, rather, reducing distractions and improving focus on desired stimuli. This paper motivates the need for more PI researchers to address the goals of calming technology.

Conclusion

The study of calming technologies presents an opportunity for HCI researchers to both acknowledge the impact of computing systems on users as well as motivate work that works explicitly to maintain calmness in users. The benefits of sustained physical relaxation and levelheaded clarity of thought have yet to be explored fully as the scientific focus has been on the detrimental effects of stress. We plan to further investigate this field of study and develop a theory of calming technology that describes how technology design can positively effect user state and potential pitfalls that can emerge in the process.

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