Embodied Self-Regulation with Tangibles

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ABSTRACT
We briefly describe our research program exploring the design space of embodied self-regulation, focusing on a tangibles-based approach to providing support for the management of attention and emotional state.

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Embodied Self-Regulation; Tangible Interaction; Peripheral Interaction; Work Practice; Wellbeing.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION
Computational tasks are a large part of the workday for many Americans. Current interfaces and systems have come into question in recent years for inadvertently disrupting quality attention and focus, leading to scattered, distracted, and inefficient work practices and suboptimal mental and emotional functioning [1]. Efforts to address this issue include development of specialized, minimally distracting digital applications within which to work [2], software that blocks or limits the use of the most distracting applications [3], and software that encourages and/or enforces break-taking and other non-computational techniques for enhancing focus such as physical activity [4].

Our research takes a novel approach to addressing this problem, combining insights from tangible computing, embodied interaction, and quantified self research within Human Computer Interaction, and building upon promising insights and results within the ADHD (Attention Deficit and Hyperactivity Disorder) research and clinical communities. We are engaged in designing a physical/computational intervention that enables embodied self-regulation of attention, and that provides tools for self-reflection about attentional challenges, toward optimal management of work practice and attentional state.

Figure 1. Fidget toys are often recommended to parents of children with ADHD as a means to aid focus and attention management. This is a screen capture of an online store's section of Fidget Toys for ADHD.

RELATED WORK
Research has demonstrated that physical fidgeting contributes to improved academic test performance for those with ADHD [5], and the use of 'fidgets' is commonly recommended for children and adults with ADHD [6]–[9], with entire online storefronts that specialize in such objects (see Figure 1). Fidgets help those with ADHD to maintain appropriate focus and attention through stimulating *and* calming properties [6], [7], depending upon the context and the fidget. Fidgeting is also a commonly observed behavior among those *not* clinically diagnosed with an attentional issue [10], [11]. Researchers have hypothesized that fidgeting is a coping mechanism the body employs to promote natural stimulant release, enabling the mind to focus on tasks. [12]–[14]—essentially, those who fidget seem to be self-regulating their own attentional capacity. Researchers have noted parallels between the motor activities of doodling, fidgeting, and fiddling with objects and the patterns of activity in the default network of the brain [11].

The hand is uniquely and powerfully interconnected to the sensory and cognitive systems. Neurologist Frank Wilson summarizes the importance of considering the hand: "Any theory of human intelligence which ignores the interdependence of hand and brain function, the historical origins of that or the impact of that history on the developmental dynamics in modern humans, is grossly misleading and sterile" [15]. Berninger has observed

through brain scans that sequential finger movements such as in writing activate large brain regions involved in language and working memory [16]. The effects in the nervous system due to manipulating the hand for writing are far beyond that involved in typing or even in interacting with touchscreens [15]–[18]. Conceiving of the hand as an access point to major internal systems and a key instrument of embodied self-regulation, we posit that tangible experiences can act as powerful mediators of attention and cognition.

Work within the psychological literature on self-regulation can largely be divided into two interrelated branches with considerable debate regarding the subtlety in constructs used [19]. That is to say there is yet malleability in definitions and how the topic is addressed. The first branch of self-regulation theory is concerned with what some term "self-control" in amplifying or dampening behaviors towards achieving goals. The second branch of self-regulation is concerned with emotional regulation in modulating specific emotions, moods, stress, and core affect [19]. While this categorization seems relatively neat on its surface, some scholars argue that behavior responses are aspects of embodied cognition and that affect is the link between the embodied mind and behavior expression [20]. That is, self-control and emotion regulation may not truly be distinct topics of study. Self-regulation is interrelated with both attention management and the body's role in stimulus and habituation [19-22].

Recent work has begun to establish the relationship between self-regulation and computer-based tasks as we are conceiving it [23, 24]. The work of Yeykelis, et al reveals an unexpectedly high frequency of task interruptions to engage self-regulation mechanisms [24]. That said, the work was expressly concerned with switching among on-screen interactions and not exteriorized bodily behaviors in the space around the computer.

HCI practitioners have built a number of interaction technologies that exploit physiological effects. Inspired by Chinese meditation balls, Philips created wood LED-studded *Mind Spheres* as "a useful aid for de-stressing and regaining a state of mindfulness at home or work" [25]. This project engages bodily movement and tactile sensation towards influencing affective and cognitive states—specifically meditative consciousness. The *Relax!* pen by Alonso senses telltale motions associated with stress and provides a calming tactile response at the periphery of the user's attention through the hand [26]. These tangible experiences work to encourage self-regulation and demonstrate the potential for further work specifically targeting mechanisms of self-regulation through the hand.

RESEARCH APPROACH

As means towards exploring and designing tangible interactions that digitally enhance the behaviors under investigation, we built two play objects to further our work: simple toy-like applications using the Sifteo programmable tangible platform. We were inspired by two existing analog object interactions—the act of popping bubble wrap (Figure 2) and the Newton's Cradle desk toy (Figure 3)—to build both tangible applications. Our goal was to prompt feedback and gather insight into the behaviors at play, as well as the qualities of objects played with [27, 28].

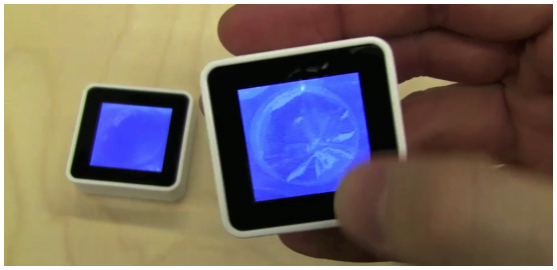

Figure 2. Fidget Widget: Infinite Bubble Wrap

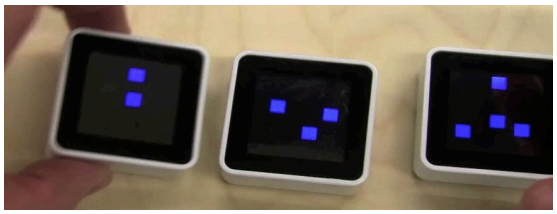

Figure 3. Fidget Widget: Rock the Cradle

Expert Reviews of Design Provocations

We furthered our exploration of the design space through expert reviews with the attendees of CHI 2013 to elicit insight and feedback with the Sifteo applications just detailed [27, 28]. We conducted nine reviews among a varied range of researchers and practitioners. These reviews each lasted from five minutes to nearly an hour. Our expert reviews included think-aloud sessions and semi-structured interviews grounded in these HCI experts' own doodling, fidgeting, and fiddling behaviors as well as relevant aspects of their backgrounds.

Each of our nine reviewers reacted positively, even enthusiastically to the Fidget Widget concept. Reviewers consistently spoke of the tactile and tangible experience of items in their hands, a theme that dominated all other commentary. Issues of pliability, softness, satisfying clicks, squeezes, edges, and overall tactile stimulation arose repeatedly. Several other design themes arose as well; see our previous publication for more details on these [27, 28]. Conversations with many typical computer users reinforced this sentiment that individuals have strong, specific, and idiosyncratic preferences for the experience of the items they play with while working. To our knowledge, little work has been done to develop an integrative understanding of the practices and preferences associated with fidgeting, fiddling, and doodling behaviors and objects. We were inspired to use a novel approach to collect a broad sampling of qualitative data on the objects that people have on their desks and use in their everyday interactions alongside their computers. We currently have a paper in submission to DIS

2016 outlining research we have conducted that investigates these properties.

Briefly, we conducted an online survey using social media tools, to gather a wide corpus of fidgets that people use in everyday life (see Figure 4). We have analyzed the properties of these objects, and are currently collaborating with an expert in the management of ADHD, to design and study the use of novel sensor-enabled physical 'Fidget Widgets' and accompanying self-reflection software. Users engaged in focused digital work will manipulate the Fidget Widgets in their hands as they work, toward improving their ability to focus. Afterward, they will use the self-reflection software to access information about when they fidget, what the work context was at the time, and their attentional state as measured by sensors and self-report, toward better self-awareness and self-management.

Figure 4. A sampling of 132 objects from 91 study participants. See http://fidgetwidgets.tumblr.com for more.

CONCLUSION

We have briefly presented ongoing work to define a design space for self-regulation in human computer interaction, focusing on a tangibles-based approach to provide support for the management of attention and emotional state. We believe these concepts and approaches are of value to those who will attend the workshop, and would be excited to present our work and engage in discussion about the potential for tangibles to address mental health concerns.

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