Tangibly Reducing Sedentariness in Office Workers

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Abstract

It is claimed sedentariness is as much a threat to long-term health as smoking or unhealthy eating, and is not mitigated by bursts of physical activity. Desk bound office workers are particularly vulnerable to this risk, given the inherently sedentary nature of their roles. To tackle this problem in HCI, we have focused largely on smartphones apps whilst embracing a general trend towards automating data collection of behavior. We argue that placing technologies in the environment, leveraging ambient displays and Tangible User Interfaces (TUIs), can offer a more effective approach for tackling sedentary behaviors in an office environment. We include a brief design of a device we intend to use to evaluate these ideas.

Author Keywords

Tangible User Interfaces; ambient feedback; behavior change; sedentary behavior; office workers

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous. H.5.2 User Interfaces: User-centered design.

Introduction

Over the last decade, evidence has emerged to suggest a new threat from modern lifestyles that should be

Figure 1: SitCoach [4]; an example of a smartphone app from HCI research for tackling sedentariness
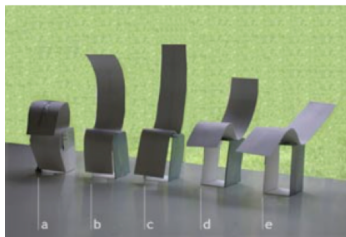

Figure 2: Breakaway [12]; a small desktop sculpture that reflects a user's sedentariness through a series of poses.

treated just as seriously as other lifestyle health risks, such as smoking and unhealthy eating. Sedentariness, typically sitting or lying down for long periods, is associated with a range of short and long term physiological [14] and psychological health issues [23].

The most serious long term risks from sedentariness (chronic disease) are independent of levels of physical activity, so even those following the recommended levels for regular exercise may be at risk if they spend large periods of time being sedentary [6]. Particularly affected are desk-based office workers who often spend the majority of their day being sedentary [18][24]. For example, a recent study found office workers were sedentary for 82% of their work hours and much of that was accumulated in bouts of greater than 30 minutes [20].

Sedentariness has gained increased research attention in HCI, with researchers examining how technology can be used to better understand and change sedentary behavior. However, the focus has largely been on smartphone apps and, mirroring approaches for physical activity, automating capture of sedentary behavior.

In this paper, we challenge that trend and suggest an alternative approach. We propose that by using a dedicated device with a TUI we can realize the proven efficacy of *participatory* self-monitoring, which is largely lost with automated data collection, and provide better feedback and triggers to break up sedentary bouts by using an ambient display. We provide a proposed design that we intend to use to evaluate this approach.

Related Work

Studies demonstrate that interventions to reduce sedentariness in an office context can be effective (e.g. [10], [15]). Those focused exclusively on reducing sedentariness, in contrast with those also attempting to increase physical activity, have been found to be most effective [17]. In a recent review of intervention studies, self-monitoring and adding objects to the environment were the two most effective Behavior Change Techniques (BCTs) for reducing sedentariness in an office context [8].

In HCI, we have mostly tackled sedentariness through building smartphone apps (e.g. [4]; see figure 1). There are examples of HCI researchers moving beyond the smartphone, although these typically use passive ambient displays but do not include a TUI. For instance, [12] created Breakaway (see figure 2), a small sculpture that was placed on a desk and the pose and gesture of the sculpture adapted to indicate to the user how long they'd been sedentary, based on seat sensors.

More recently, [7] created MoveLamp, which used light color and intensity to inform the user of levels of recent physical activity and sedentariness. They found it was effective in increasing frequency of movement, and from interviews, they were able to conclude preferred lighting colors and intensities for representing escalating levels of inactivity.

There are also a few commercial devices focused exclusively on reducing sedentariness, such as the Darma seat cushion [5], but the more common approach is smartphone apps and combining it with a

focus on increasing physical activity (e.g. 'Human' iOS app [11]).

Two Limiting Trends

In reviewing the literature and commercial devices, we have identified two trends for tackling sedentariness in HCI that we believe should be challenged.

Smartphone bias

In both HCI research and commercial solutions, most use a smartphone as the primary interaction device.

There are two key issues with this. Firstly, smartphone reminders are context insensitive and momentary in nature. They interrupt users at point in time, without considering if it is a good time to trigger a break from their current task. Users often find these annoying and quickly learn to ignore them [19]. Secondly, smartphones are 'noisy'. As a multi function device, reminders are 'mixed' up with notifications from other apps, and app engagement has to compete with typically more alluring apps, such as email and social media. Users can pick up their smartphones intending to do one thing, but get distracted, and end up doing something else [9]. The simple message of breaking up bouts of sedentariness is easily lost in this noise.

Automated Tracking

In personal informatics there is a trend towards automating the collection of behavior data, and approaches to tackle sedentariness are no exception.

Although understandable, as the manual tracking of data can be burdensome, by automating tracking we lose the essence of one of the most effective behavior change techniques for reducing sedentariness: self-monitoring [8]. It is argued self-monitoring works, amongst other things, because the act of participating in the tracking can provoke more deliberate choices about behaviors and encourages reflection [26]. Furthermore, the closer temporal proximity to the behavior that the tracking occurs, the more effective the outcomes [2]; for example, photos taken at the same time as the behavior occurs have proved more effective than recording behavior at a later time [27].

By automating data collection, we not only lose these benefits, we also introduce a new problem to be solved: how to motivate sufficient engagement with the technology to reflect on behavior and benefit from other BCTs in the app or device. Evidence suggests apps and wearables struggle with this; abandoning these technologies is the outcome for many users [16].

A Different Approach

Our argument is that by creating a dedicated device with an ambient approach, instead of momentary reminders, and using a TUI, to support timely and participatory self-monitoring, we would mitigate these issues and provide more effective support for reducing sedentariness in office workers.

Dedicated device

We see an advantage in a dedicated, single purpose device focused solely on sedentariness. Approaches focused on both reducing sedentariness and increasing physical activity are not as effective as those with a sole focus on sedentariness [17], and, in contrast to 'noisy' smartphones, a well designed single purpose device should make it simpler to understand in early use and have lower cognitive demands.

Figure 3: The Internet Button by Particle [21]

Additionally, for office-based sedentariness we do not need the mobile context offered by a smartphone; sedentary behavior is largely accrued in one physical location (sitting at a desk), so, arguably, the solution can be effective operating solely in that same context.

Ambient feedback
An ambient display that communicates increasing sedentariness risk inherently solves the context insensitive issue of smartphone reminders. It is present in awareness but not distracting, a key advantage of ambient approaches. It can also act as a subtle disrupter to engrained and habitual sedentariness [3]; an environmental change that can nudge someone into more conscious awareness of their ongoing sedentariness, whilst respecting their autonomy to decide when is optimum to take a break.

In contrast to a wearable solution, a desk-based device can take advantage of peripheral vision by using this ambient approach.

TUI
We propose that a simple tangible interaction with a dedicated device at the point of performing the desired behavior may be sufficient to provoke increased conscious awareness of behavior. It is the middle way between the extremes of full automation, preferred in personal informatics, and the arduous diary based approaches often taken in traditional interventions.

Additionally, we believe that the simple association between trigger, interaction, behavior and reward is conducive to habit formation; regular break takers typically exhibit high habit strength [25] and, generally,

habits are thought to increase the likelihood of long-term behavior change [22].

Proposed Concept for Evaluation
To evaluate these ideas, we propose a simple device based on the "Internet Button" [21] (see figure 3). This is a commercial device that is a highly configurable button with a series of LEDs. Installed on a desk, the LEDs would indicate with color and intensity the accumulating risk of being sedentary. At intermittent intervals, when the risk is getting significant, it would attempt to be slightly more intrusive, by subtly pulsing the LEDs. Sedentariness would be monitored with a seat sensor.

Whenever a user stands they would 'self monitor' by simply hitting the button, and would receive a light pattern as affirmation the push has been received and provoke a subtle 'reward' response. There would be a set of different light patterns chosen randomly to offer ongoing novelty.

To evaluate the impact of this device, we plan to measure changes to psychological variables from the Theory of Planned Behavior [1] that we would expect to be influenced by self-monitoring, feedback and reward techniques. In addition, we will also evaluate if this approach is conducive to habit formation by measuring automaticity gains. Finally, we will assess how it impacts the number of sit/stand transitions and overall office-based sedentary time.

Conclusion
We have argued that by being smartphone centric and automating data capture for sedentariness, we are missing out on the potential of emerging technologies

to support reducing sedentariness. We suggest using ambient feedback and a TUI, in a simple desktop device, to increase sedentariness risk awareness and support participatory, but not burdensome, self-monitoring. We believe this will mitigate the issues with 'annoying' reminders on smartphones whilst leveraging the efficacy of self-monitoring to better support reducing sedentariness in office workers.

Looking forward 10 to 15 years…
Behavior occurs in situ, not in a screen. We know environment and context are significant influencers on human behavior. Thus, as technology can increasingly be embedded in our physical environments, and not locked in 'computing devices', we foresee devices tailored to changing individual behaviors to be placed and used in spatial and temporal proximity to where behaviors are enacted. Novel and context appropriate physical forms and associated tangible interactions will support these devices being placed in the home, for example, as part of the home, not as pieces of technology. They can be used both to disrupt existing behaviors 'just in time' by adjusting the presentation of triggers, for example, and also support the building of new, healthier habits.

Acknowledgements

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