Open Affect-Responsive Systems: Toward Personalized AI to Beat Back the Waves of Technostress

David Agogo,[1,*] Leona Chandra Kruse [2]

[1] Information Systems and Business Analytics Department
Florida International University
Miami FL 33199, USA

[2] Institute of Information Systems
University of Liechtenstein
9490 Vaduz, Liechtenstein

Abstract

We review existing system-based solutions to the growing problem of technostress. Based on an analysis of 102 digital applications for stress management, we find several significant limitations in the approaches of these tools and sparse evidence of their effectiveness in dealing with technostress. Thereafter, we propose a blueprint for an autonomous software agent that not only addresses the root of technostress by building user resilience towards technostress, but also generates contextually rich information that system creators and organizations can act upon to be more responsive to the experiences of individual users. The operation of the OARS (Open Affect Responsive Systems) is described with a user story.

Background

Practically everyone who uses technology is becoming more vulnerable to technostress as technology continues to embed itself into our everyday lives. This has prompted the creation of digital support tools to help people address this problem. Most of the available tools target general stress management and promote wellbeing by simulating offline relaxation-based interventions. Of the few that specifically target technology as a cause of stress, the majority focus on monitoring and controlling user exposure to their devices. However, this mechanism itself is likely counterproductive. Constant monitoring and abundance of data constitutes a form of surveillance that increases feelings of pressure and triggers more technostress. There is need to switch focus from addressing acute symptoms of technology-induced stress to figuring out ways to address the root of the problem.

We propose a blueprint for a digital support tool that not only addresses the root of technostress by building user resilience towards technostress, but also generates contextually rich information that system creators and organizations can act upon to be more responsive to experiences of individual. We call this class of tools the *Open Affect-Responsive Systems* (OARS).

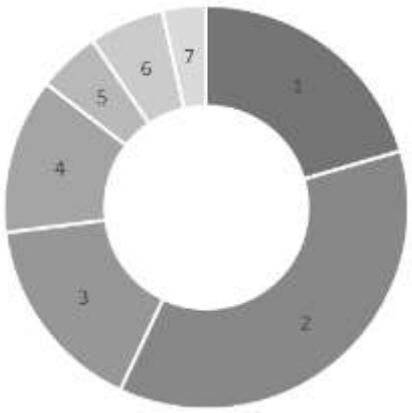
Used interchangeably, the terms technostress and digital stress broadly refer to both immediate and drawn out stress responses attributable to potential or actual technology use (Agogo & Hess 2008). In practice, there are an abundance of digital-based solutions addressing this problem, but we do not have any systematic account on their mechanisms.

Research Findings

We analyzed 102 digital applications that are available on popular application stores or are referred to in articles about dealing with technostress. We found seven common mechanisms among them (Figure 1) that generally follow one of three approaches: (1) modification of IT features and its use routines; (2) modification of individual reactions to IT stressors; and (3) temporary disengagement from IT such as online/offline venting (cf. Pirkkalainen, et al. 2017). Note that each tool can apply more than one mechanism. Given their technological nature, can these tools in fact inject more stress into the issue of dealing with stress? To answer this question, we peaked behind the veil at the theoretical mechanisms that justified how these different classes of tools were designed.

Some tools (35%) were created based on widely acknowledged intervention approaches (e.g., cognitive-behavioral therapy (CBT) and mindfulness), while others (36%) didn't explicitly refer to neither theory nor intervention approach that would evoke confidence in their effectiveness. The majority (70%) were static systems, with pre-programmed responses while others were adaptive (30%), with most of those applying artificial intelligence (AI) at their core (24%). Of that subset, apps applied AI for different purposes - from identifying patterns in users' emotional state based

* Corresponding author: dagogo@fiu.edu



1: Monitoring (e.g., *Life Charge App* and *Welltory*)

2: Simulating offline relaxation intervention (e.g., *Pocket Yoga, Colorfil*, and *Fidget Spinner*)

3: Information and guidance (e.g., *Head to Health*)

4: Virtual support group (e.g., *Beyond Blue* and *7 Cups*)

5: Gamification (e.g., *Forest: Stay Focused*)

6: Controlling exposure (e.g., *Digital Detox*)

7: AI as counsellor (e.g., *Wysa* and *Tess*)

Figure 1: Mechanisms to Mitigate Technology-related Stress in Commercial Digital Applications

on their interaction with their mobile device to acting as a virtual counsellor and conversational agent.

Unfortunately, using AI as a constant monitor and interpreter of behavior can lead to increased contact with technology that may in turn trigger negative affective responses. At the same time, scholars (e.g., Weizenbaum 1976) have warned that users may build strong attachment and dependency to their AI counsellor. This is despite how far off AI tools still are from being truly conversational and assistive for health purposes (Strickland, 2018). We believe the potential for the use of AI in helping users to deal with technostress is still nascent. Before this can be achieved, there is need to think systematically about the architecture of a system in which AI plays a theoretically supportable role in warding off the waves of technostress.

Architecture of an Open Affect Responsive System

OARS are a class of autonomous software agents are designed to drive improvements on the individual user level, system level as well as the organizational level. OARS have a four-stage system architecture (identify, formulate, evaluate and learn) that is iterative and employs AI to learn adaptively. These four stages occur across five subsystems which are independent modules that can be developed separately and in parallel to deliver a fully functional OARS (see Figure 1). Where possible, OARS integrate user feedback (collected as asynchronous pull data, instead of the synchronous push of constant monitoring – although that form of input may be possible as well). Such nudge-based user feedback can be used as labelled training data for constant learning and improvement of the OARS, as well as the development of user phenotypes which can make a personal AI possible. The architecture of OARS supports the application of multiple theoretically supported resilience-building mechanisms to make users less vulnerable to technostress. Based on contemporary stress management literature, we discern three promising mechanisms for delivery via OARS: active stress management (CBT), mindful monitoring (Acceptance and Commitment Therapy (ACT)), and hormesis. Let us here focus on hormesis to instantiate OARS and demonstrate its use.

Hormesis is the principle underlying Stress Inoculation Therapy (SIT). It describes a biological phenomenon where exposure to low doses of a toxic substance can actually have a beneficial effect, although exposure to those same toxins in larger amounts might prove lethal (Meichenbaum 2007). Such approach has been recommended for a broad range of issues and found to be "at least moderately effective" (Flaxman & Bond 2010). SIT itself involves exposing individuals to milder forms of stress to bolster coping mechanisms and confidence in future coping behavior.

For the system to leverage hormesis approach to help improve users' ability to deal with technostress, the system must be capable of delivering periodic low doses of typical IT stressors to users. When users asynchronously indicate they are experiencing an issue with the system (e.g. using a hotkey), OARS can restore system to its normal functioning and provide users with guidance to reframe such situations in the future. If implemented according to this and other design guidelines we propose, such operation of an OARS should increase the preparedness and confidence of users in the face of future unanticipated IT breakdowns. In the following section we offer a descriptive vignette of a user's experience with the proposed OARS, along with a screenshot of the system prototype in action (Figure 2).

OARS in Action (Hormesis Approach)

Jane logged onto her computer to complete the months accounts. She had recently installed a new accounting software and was hoping the experience went smoothly. During the installation, she had enabled the OARS add-on that came with the software. Her understanding was that she could press the ctrl-f12 hotkey if the system was not running as desired and her personal AI would drop in to help out. Within a few moments, she noticed the system felt

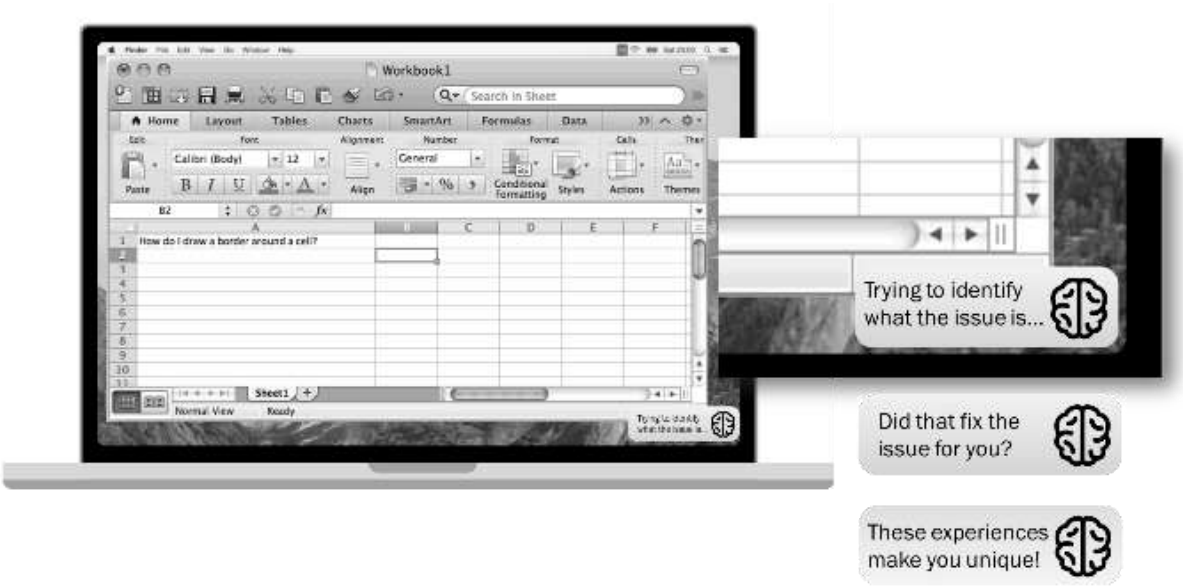


Figure 2: Screenshot of Prototype OARS in action

a bit unresponsive. Her attention started to drift from the task at hand and even though she didn't realize it, her heart began racing slightly as the nerves emerged. At that instant, the faded outline of a small notification window began to gently fade into view at the bottom right of the screen. It caught her eyes and she absent mindedly hit the hotkey while continuing to scroll through the application. A few seconds later, the full notification faded into view with the message "Trying to identify what the issue is…". She ignored it and continued working. A few short moments later, the notification message changed to "Did that fix the issue for you?". She paused for a micro-second as if to remind herself of the issue she had previously experienced, then she leaned back into her seat and continued working, the system seemed a little snappier. What Jane didn't realize at that time was that the OARS had created a temporary processor bottleneck to simulate the slowing down on the processor that happened occasionally during the final computation phase of running the accounts. She would realize this in a few moments when she closed the application and received a final status message from the OARS "These experiences make you unique!".

Conclusion

In summary, we can view OARS as personalized AI tailored to individual and organizational needs. The system learns from prior experience and improve its capability and user training. We also expect organizational learning to occur that results in a better understanding of the states and needs of its individual members, therefore creating a more desirable and stress-free work environment. This, in turn, would pay back in better performance.

References

Agogo, D., & Hess, T. J. (2018). "How does tech make you feel?" a review and examination of negative affective responses to technology use. *European Journal of Information Systems, 27*(5), 1–30.

Flaxman, P. E., & Bond, F. W. (2010). A randomised worksite comparison of acceptance and commitment therapy and stress inoculation training. *Behaviour research and therapy, 48*(8), 816-820.

Meichenbaum, D. (2007). Stress inoculation training: A preventative and treatment approach. Principles and Practice of Stress Management, 3, 497–518.

Pirkkalainen, H., Salo, M., Makkonen, M., & Tarafdar, M. (2017). Coping with Technostress : When Emotional Responses Fail.

Strickland, E. (2018, June 25). Layoffs at Watson Health Reveal IBM's Problem With AI. IEEE Spectrum, (June 2018). Retrieved from https://spectrum.ieee.org/the-human-os/robotics/ artificiall-intelligence/layoffs-at-watson-health-reveal-ibms-problem-with-ai

Weizenbaum, J. (1976). Computer power and human reason: From judgment to calculation. San Francisco, SF: W. H. Freeman.