Turning Security Monitoring into an Engaging High Performance Task

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***Abstract*—We present a novel method to improve the engagement and performance of security guards in tasks involving the monitoring of multiple video feeds. The method is based on multiplexing to the monitoring task symbiotic activities that are entertaining in nature and supportive to (not detracting from) this task. A longitudinal crossover experiment that lasted 10 days on n=15 security guards confirmed the method's superiority in terms of task engagement and performance with respect to the standard method.**

I. Introduction

Monitoring multiple video feeds for suspicious events is a critical security operation related to the protection of border crossings and large commercial or government property. We documented that multiplexing entertaining tasks in a security monitoring task can directly improve engagement and indirectly performance. We call such multiplexed tasks *symbiotic activities*. The subject group were security guards monitoring multiple video feeds in a university campus. The guards' interaction with the monitoring apparatus was minimal and the challenge for them was to stay awake and be engaged in their task by maintaining interest in boring videos for hours on end (Fig. 1**a-b**). In the rare occasion a reportable event was taking place, the guard had to alert the security force. Because reportable security events were so rare, we had to randomly plant such events using actors and simulations, in order to quantify guard performance.

II. Methodology

We quantified engagement by taking into account three types of indicators: physiological, observational, and kinetic. Specifically, we monitored the guard's breathing function via a thoracic piezoelectric transducer. Breathing tracks respiration and in turn respiration tracks metabolic rate [2]. In the absence of any substantive physical activity, metabolic rate is mainly defined by energy consumption in the brain. Hence, in the case of the sitting guard, breathing is an indirect indicator of alertness. We also monitored the guard's face via visual imaging to determine bouts of apparent sleep. In addition, the guard wore bracelets with embedded 3D accelerometers on her/his wrists and ankles, which allowed us to quantify levels of agitation. Boredom, which leads to task disengagement, has been associated not only with tendency to fall asleep but also increased fidgeting [3].

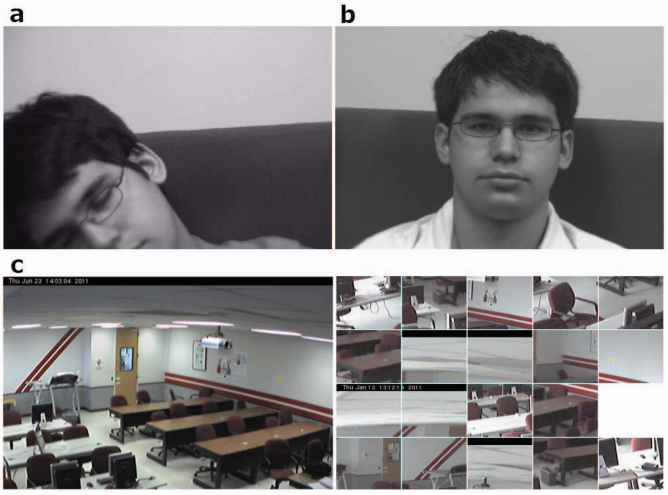

Fig. 1. Characteristic facial snapshot of a security guard from the data set during: **a,** A non-symbiotic session when he was often falling asleep; **b,** A symbiotic session while he was playing the slide puzzle. **c,** Security video feed and secondary display with the live feed arranged as a slide puzzle.

III. Experimental Design

The experimental procedures were approved by the University of Houston's Institutional Review Board (IRB), and were performed in accordance with the approved guidelines. Informed consent was obtained from each subject before conducting the experiments. We had a balanced experimental design, where we monitored engagement and performance of $n = 15$ guards in 10 sessions (4 hr each). Half of these sessions were normal sessions (control) and the other half interventional sessions (with symbiotic activities). There was an array of symbiotic activities that the guard was free to choose at any point during a session. These activities included a slide puzzle, a shooting game, and others. All these options were designed to maximize attention to the security monitoring task in imaginative and fun ways. For example, the slide puzzle that the guard was trying to solve on a secondary display using

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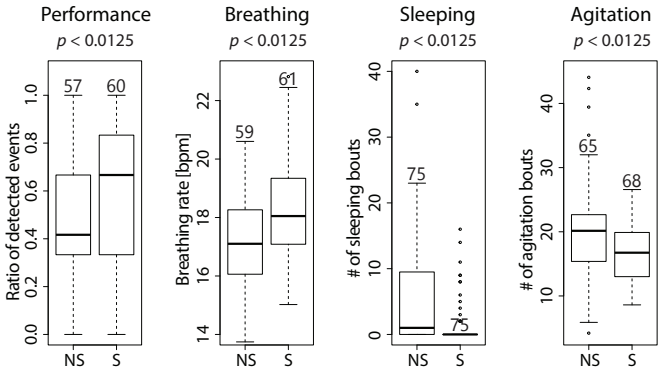

Fig. 2. Distribution of performance scores, breathing rate, sleeping bouts, and agitation bouts per experimental scenario. NS denotes the Non-Symbiotic activity experimental scenario while S denotes the Symbiotic activity experimental scenario. There are significant differences between the two experimental scenarios for all variables. Under the S scenario the guards perform better; they are also more engaged, as it is suggested by the higher mean breathing rate and the minimal number of sleep bouts. It is interesting that under NS conditions the guard's behavior gravitates between high incidence of sleep bouts or high incidence of agitation bouts.

a mouse, was made up of randomly arranged pieces of the live security feeds (Fig. 1**c**). In the shooting game the guard using her/his smartphone as a wand, had to 'shoot' bees that were occasionally flying through the video feeds. In both cases the guard in order to play the game had to pay attention to the security displays, interacting with them via ubiquitous office or personal devices.

IV. Results

The results were remarkable. There were significant differences in all physiological, observational, and kinetic indicators of engagement between the two experimental groups, which translated to significant performance gains for the interventional scenario (Fig. 2). It is interesting that these differences were standing even after Bonferroni correction for multiple comparisons (adjusted level of significance $\alpha_c = 0.05/4 = 0.0125$).

Acknowledgment

We reported the results of a small pilot study preceding this field study, as Work in Progress in [1]. This material is based upon work supported by NSF award # IIS-1049004 entitled: 'Improving Human Engagement and Enjoyment in Routine Activities'. Any opinions, findings, and conclusions or recommendations are those of the authors and do not necessarily reflect the views of the funding agency.

References

[1] P. Buddharaju, D. Shastri, A. Mandapati, S. Vaidya, and I. Pavlidis. Who said monitoring is boring? In *CHI'11 Extended Abstracts on Human Factors in Computing Systems*, pages 2041–2046, Vancouver, British Columbia, May 7-12 2011.

[2] S. Bursztein, P. Saphar, P. Glaser, U. Taitelman, S. de Myttenaere, and R. Nedey. Determination of energy metabolism from respiratory functions alone. *Journal of Applied Physiology*, 42(1):117–119, 1977.

[3] M. Martin, G. Sadlo, and G. Stew. The phenomenon of boredom. *Qualitative Research in Psychology*, 3(3):193–211, 2006.