Who Said Monitoring Is Boring?

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Abstract
In this article, we extend our previous work [1], which blended gaming in monotonous security tasks to increase operator engagement and enjoyment. Specifically, we expand from a single game presented in [1] to an assortment of games that appeal to different tastes. These include a shooting game, a racket game, and two puzzle games. All games are designed in a way that attracts instead of detracting attention to the monitoring screens. In addition to the game set, we also include a web browser capability symbiotic to the monitoring task. All these applications are tested in a quite realistic pilot experiment, where subjects are monitoring live security feeds. This is in contrast to the experiment on a pre-recorded video feed reported in [1]. The results demonstrate that subject engagement and enjoyment is significantly higher when the monitoring task is multiplexed with imaginative interactive options. This improvement in job satisfaction is achieved without sacrificing performance, as measured by detection of suspicious activities.

Keywords
Human-Computer Interaction, security monitoring, human engagement and performance, computer games

ACM Classification Keywords
H5.2. Information interfaces and presentation: User Interfaces – Evaluation/methodology, Input devices and strategies, Prototyping, Interaction styles.

General Terms
Experimentation, Human Factors, Performance

Introduction

Alas, some of the most critical activities in our society are among the most boring ones. Security monitoring is a quintessential example, where guards have to scan through rarely interesting security feeds for hours on end. The aim is noble – to protect valuable assets and human lives. The process, however, is downright boring and has a corrosive effect on job satisfaction, something that ultimately may compromise performance.

Monotonous tasks, such as security monitoring, can benefit from some excitement that an entertainment option could offer. The question is how exactly. Many studies show that some forms of entertainment (e.g., games) can improve human performance at work [4] or education [2]. For instance, Chao et al. introduced a game application for computer administration tasks [3]. Several computer games have proved effective enhancers of human behavior. For example, Dance-Dance Revolution [5], and EyeToy [6] were found to increase physical activity. Game design by Khaled et al. emerged as a persuasive alternative for smoking cessation [7].

Introducing a form of entertainment in a monotonous task implies some sort of interruption. Studies show that interruptions, when appropriate, do not negatively affect performance at work. In fact, they reduce boredom in many cases [8]. Hence, an innovative form of interruption may render monitoring more enjoyable.

Based on this principle, we have recently introduced a mildly interactive computer game in security monitoring [1]. The operator was using an iPhone as a wand to catch apples that occasionally were falling on the video security feeds. The game design encouraged attention on the security video feeds while offering some entertainment. This was a symbiotic design where the `break' option managed to attract instead of detracting attention from the job. This certainly casts the concept of `interruption' in a whole new light.

In the present article, we take this to the next level by introducing an assortment of gaming options that ascribe to the same symbiotic spirit, but cater different tastes. These include a shooting game, a racket game, and two puzzle games. Most importantly, we extend the space of symbiotic design beyond games, by including a mini-browser option. Web browsing is a ubiquitous activity and we experiment with an initial design to see if it can be multiplexed with the monitoring task.

The results of a controlled pilot experiment on live security feeds, demonstrate the significant entertainment value of all these options. This is achieved without any negative effects on the operators' performance. Our latest work opens the way for large-scale field studies and points to an ever-expanding set of symbiotic interactive options.

Experimental Design

We used the security video fees from three cameras in corresponding computer labs at the University of Houston. Use of these feeds for the purposes of this research was authorized by the local Institutional Review Board (IRB) and university administration.

A total of 4 participants (3 males and 1 female) volunteered for this study. The experiment featured two trials of hour-long monitoring for each participant. The '*without symbiotic activity*' trial represented the standard monitoring task. The '*with symbiotic activity*' trial represented the monitoring task laced with the specially designed interactive options. The order of trials was randomized to ensure unbiased results.

Slider puzzle where puzzle pieces are formed using live video footage

figure 1. Experimental setup – Participant monitoring live security video footage while solving a slider puzzle

During the experimental trials, we staged random unlawful activities in these lab rooms, such as stealing (e.g., stealing books, laptops, and some documents) as well as property damage (e.g., destroying posters).

Figure 1 illustrates the experimental setup. Before the experiment began, the participants were asked to complete a biographic questionnaire. After completing the questionnaire, they were asked to relax for 3 minutes. We let the participants listen to soft/calm music during the relaxation phase. This helped to isolate effects of other stress factors that the participants may have carried from earlier in the day.

Then the participants were asked begin the trail by monitoring the live security feeds from three lab rooms, and to record any suspicious activities they notice. Based on their responses, we derived measures of performance.

The participants were also required to fill out feedback forms at the end of each trial. Their responses in these forms, along with the application usage record, were used to quantify the engagement and entrainment value of the `without symbiotic activity' versus `with' symbiotic activity trials.

Below we describe the interactive symbiotic applications that were available to participants during the `*with symbiotic activity* trials.

Wand Games

The design of these games is similar to the 'Apple Catching Game' presented in [1]. They are based on a client-server architecture, whereby the game runs on the server (Mac) and is controlled via an iPhone (the client). The two new games in this category are: a '*Shooting Game*', where the player aims to shoot

enemy objects and a '*Racket Game*', where the player aims to send a ball back to the screen. In both cases, the player uses an iPhone as the wand.

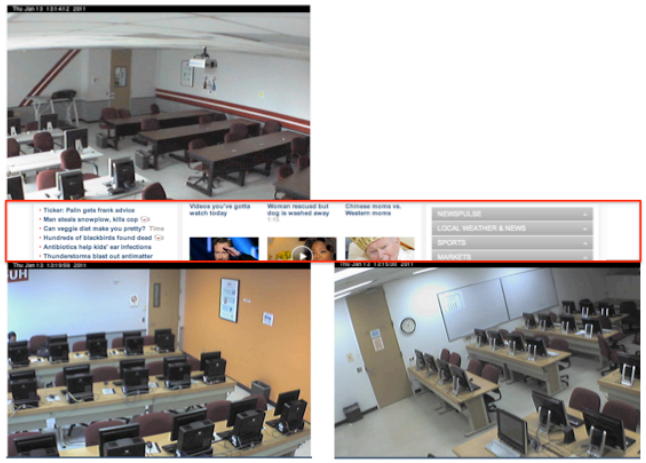

figure 2. Mini web browser tool presented in an open space between the security video feeds

Puzzle Games

We have developed a '*Slider Puzzle*', where the live surveillance video is split into random tile-shaped pieces, and a '*Jigsaw Puzzle*' where the video is split into random jigsaw-shaped pieces. The goal for the player is to rearrange the puzzle pieces, so that s/he recreates a copy of the live security feed that runs on the side. Figure 1 shows an example of the '*Slider Puzzle*' game. Since the puzzle pieces are formed using live video footage, the player inherently pays attention to the monitoring screen.

Mini Web Browser

We provide a mini web browser option for participants, who would like to go through news reading or other online viewing during the monitoring task. The browser is presented between the security video feeds (as shown in Figure 2) to ensure that the participant still pays some attention to the feeds via peripheral vision.

Experimental Results and Discussion

Variable	Mean Diff	T-ratio	P-value	Better with tools?	Statistically Significant?
Correct Identification	0.25	0.39	0.35	NO	NO
False positive	0.75	0.1	0.1	NO	NO
False negative	-0.25	-0.39	0.35	**YES**	NO

Table 1. Paired T-test results for the performance variables

We used subjective feedback survey data to evaluate the participants' enjoyment and performance while performing the task. Table 1 summarizes the test results for the performance variables. It shows that only *false negative* has favorable response with the activity tools, but the difference was not statistically significant with 95% confidence interval. Thus, the participants' performance remained on par in both trials. The symbiotic tools did not degrade performance at all.

Variable	Mean Diff	T-ratio	P-value	Better with tools?	Statistically Significant?
Motivation	-3.5	-2.94	0.03	**YES**	**YES**
Entertainment	-5.25	-6.14	0.004	**YES**	**YES**
Mental Demand	-2.5	-2.4	0.004	**YES**	**YES**
Performance	0.25	0.19	0.43	NO	NO
Effort	1.25	1.46	0.11	NO	NO
Physical Demand	-1.25	-1.21	0.15	**YES**	NO

Table 2. Paired T-test results for the subjective variables

Table 2 summarizes the test results for the subjective variables. It shows that all subjective variables except for *self-reported performance* and *effort* have positive response with the interactive activity tools. One important observation is that the differences were statistically significant in *motivation*, *entertainment*, and *mental demand* with 95% confidence interval (highlighted in yellow color in Table 2). This result shows that the symbiotic tools made the monitoring job more entertaining and mentally engaging and boosted the participants' motivation.

Table 3 summarizes the results for each of the symbiotic activity tools based on participant feedback. For each variable (e.g., *Entertainment*), feedback from all the participants is collected and the arithmetic mean is reported. It can be inferred from the results that the participants found all tools entertaining. An interesting observation is that the participants found the puzzle games to be hardest (higher *difficulty level* values), and hence more mentally demanding (higher *mental demand* values). However, the differences for these variables are not statistically significant with 90% confidence interval. The only variable with statistically significant difference is *time spent for each game* (highlighted in yellow color in Table 3), showing that the participants spent most time on the shooting game and the web-browsing tool –clearly the most popular options in this symbiotic set.

Conclusions

We developed an assortment of symbiotic activity tools that helps to improve users' engagement and entertainment in a monotonous monitoring task. We used as test bed monitoring of live security video footage – a flat out boring task. The tool set comprised two wand-based games and two puzzle games overlaid on top of the security video feeds, as well as a mini web-browsing tool presented between the video feeds. The experimental results confirm our hypothesis that integrating symbiotic activity tools transforms a boring monitoring task by improving operator enjoyment and engagement without sacrificing performance. Heartened by the positive results, we plan to scale-up the experiment, conducting a large-scale field study with an ever0expanding set of symbiotic applications.

Variable	Shooting	Racket	Slider puzzle	Jigsaw puzzle	Web Browsing	P-value	Statistically Significant?
Entertainment	6±2	6±2.82	7.5±0.7	7	5.33±3.21	0.13	NO
Like the activity	5±3.92	3±3.83	3.75±4.35	1.75	5±3.91	0.12	NO
Difficulty level	3.33±2.08	2.5±0.707	5±1.41	6	5.33±2.51	0.26	NO
Mental demand	3.33±1.53	4±1.41	7±2.82	9	5.33±2.08	0.36	NO
Distraction level	5±1.73	5±1.41	4.5±2.12	4	5.66±2.08	0.17	NO
Performance (Balance)	3.33±1.15	3.5±2.12	4±4.24	5	5.33±3.21	0.17	NO
Time for each game	16.25±17.97	2.5±2.89	4±4.24	1.25	30±25.82	0.1	**YES**

Table 3. Paired T-test results for the subjective variables for each of the symbiotic activity tools

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Citations

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