Working With The Television On: An Investigation into Media Multitasking

Abstract
Many people can now bring the office home in the evening and work on a laptop computer while watching television. We conducted a lab-study to investigate the impact that this media multitasking habit has on stress and our ability to stay engaged with the content of a television show. Participants were required to complete a stressful mental arithmetic task, designed to simulate a demanding work-related activity, while watching a segment of a television documentary. To reflect the different ways that people can media multitask, participants were asked either to perform the work task continuously (concurrent multitasking), or during bursts (sequential multitasking). Results show that working on the stressful task was stressful – it did not matter whether the television was on or not, nor did it matter how the tasks were interleaved. There was some evidence that sequentially interleaving tasks allowed participants to remain somewhat engaged with the content of the television show. Overall though the results of this preliminary study suggest that if people want to relax and become engrossed in a television show they should avoid working on a secondary device at the same time.

Author Keywords
Media multitasking; work-life balance; stress; experiment.
ACM Classification Keywords

Introduction
The rise of always-on Internet-connected computing devices is starting to blur the line between work and leisure for many people. While this is enabling flexible working arrangements for some, there are concerns that this is having an impact on work-life balance [3]. Work-life balance generally refers to a healthy level of separation between work and non-work activities. Mobile devices disrupt this balance because they make it easier for people to continue working during periods that were traditionally set aside for rest and relaxation.

Watching television offers a way to relax and relieve stress through escapism [12]. However, recent reports suggest that many people now engage in secondary computing activities while watching television [7]. While some turn to a secondary device for something to do during a commercial break, others use the time keep up on work activities [11]. We find it interesting that some people even claim to enjoy working in front of the television because it feels less like work [1].

The idea that one can work while watching the television seems inconsistent with one of the most robust findings in psychology – attention has a limited capacity [5]. This means that as more attention is given to one task performance improves but this is at the expense of the task that is not being attended to [6]. We might therefore expect that when people work while watching television, there must be consequences for either the quality of the work that is produced or the person’s ability to follow the content of the show. We might also speculate that working on a stressful activity while watching television might eliminate some of the known positive benefits of television watching for relieving stress and enabling post-work recovery [9].

Despite the growing prevalence of media multitasking, to our surprise there have been very few attempts to investigate it systematically. The most notable work on this topic is by Ophir et al. [8], but this focused on whether there are differences in the attentional mechanisms of people who have a tendency to media multitask. In contrast, we investigate media multitasking from the perspective of understanding how working in the front of the television impacts our ability to relax and stay engaged with the content of a show.

In this paper, we report the results of a preliminary study in which we had participants perform a stressful work-like task while watching a television show. To reflect the different ways that people can media multitask, we had participants either perform the work task while the television was on (concurrent multitasking), or only during breaks in the television show (sequential multitasking). This latter sequential condition was designed to mimic the scenario in which someone might do bursts of work during commercial breaks (or while a television show is paused). We were interested in how these different work-patterns would impact the participant’s level of engagement with the television show as well as their level of stress (both self-reported and changes in skin conductance).

Method
Participants. Twenty-four participants (eleven female) with a mean age of 30 years (range 18 - 73) were
recruited from a university participation pool. The participants were split into two groups of twelve (of six and five females each) for each of the between-subject conditions. Participants were paid £5 for their time plus given a chance to win a £20 voucher based on their performance on the work task (described below). All of the participants were regular media multitaskers. None had a history of cardiovascular disease.

Design. A 2x3 (multitasking-type x condition) mixed factorial design was used. All participants did single-task baseline trials (TV-only and Math-only) as well as a dual-task TV+Math trial. For dual-task trials there was a manipulation of multitasking-type (a between-subjects factor), in which participants either performed tasks concurrently or sequentially. The way that this was achieved was by varying the rate at which problems were presented for the secondary math task.

Materials. We wanted to have participants work on a secondary task that would induce a mild-level of stress. After exploring many options (including an email triage task), we settled on a mental arithmetic task. There is a long and well-documented history of mental arithmetic tasks being used to induce stress in laboratory settings. There is also a practical benefit to these tasks: problems can be easy generated for participants to work on continuously over a specific time period. We also needed a task that could be completed using keypresses from a single hand (because the other hand had to be kept still for the skin conductance biosensors to operate normally).

We used a mental arithmetic task that required participants to evaluate whether a given answer to an equation was correct or not. Problems were of the general form: $$(A \text{ op1 } B) \text{ op2 } C = D$$, where, A and B is an integer between 1 and 49, and C is an integer chosen between 1 and 10. There are two operators: \textit{op1} being either add or subtract and \textit{op2} being either multiply or divide. D is either the correct or incorrect value (out by ± 5). E.g., does $(33 + 16) \times 6 = 292$? Problems were randomly generated and displayed on a laptop monitor for a maximum of 5s. Participants had to indicate whether D was correct or incorrect using two keys on the laptop. A counter was displayed so that participants knew how much time had elapsed.

There were two different dual-task TV+Math conditions: sequential and concurrent. In the sequential condition, a new math problem was shown immediately after a response to the previous problem had been given. In the concurrent condition, a new problem was displayed every 10s – this meant that there was a gap of at least 5s between each problem during which the laptop screen was left blank. For both conditions, a television show was played throughout on a separate display.

For the television show, we used an eight-minute segment of an episode from a popular British wildlife documentary. It was presented on a 30-inch display. The show was about tropical marine life and showed fish swimming in the ocean while classical music played and a narration was given. While we did not directly monitor whether participants watched the show, we assessed their level of engagement (or immersion) using a post-viewing questionnaire. The questionnaire adapted and combined questions from tools that have been shown to accurately measure immersion in gaming [4] and narrative engagement [2].
To assess stress levels, we used the State-trait Anxiety Inventory (STAI) Form Y-1 [10]. Physiological data was also gathered to gain a more objective measure of stress. This was captured using a ProComp Infiniti encoder in conjunction with BioGraph Infiniti Software and sensors to measure skin conductance (SA9309M).

**Procedure.** The study took part in a quiet, private office. After reading an information sheet describing the experiment and giving their consent, participants completed Form Y-1 of the STAI to assess their baseline level of stress. Participants were then seated in a comfortable chair and were fitted with the skin conductance biosensors. The sensors were fitted to the fingers of their left hand, and participants were asked to keep that hand as still as possible during the study.

The experiment was divided into three conditions: TV-only, Math-only, and TV+Math. The two single-task baseline conditions always preceded the dual-task condition. However, the order in which participants completed each single-task baseline condition was varied between participants. Each session started with the experimenter explaining what would happen during the session and the participant was free to ask questions. The experimenter then left the room during the study. Before each trial, participants sat quietly for two minutes looking at a fixation point to get a relaxed baseline measurement of skin conductance activity. Once the participant had completed a condition, the experimenter entered the room and gave the participant the appropriate set of questionnaires to complete (depending on the condition). The entire experiment took approximately one hour to complete and participants were debriefed at the end.

**Results**

We first consider participants’ stress levels during each of the experimental conditions. We report changes from baseline (at the start of the study) in self-reported measure of stress from the STAI Form Y-1 [10] as well as a more objective measure based on changes in skin conductance. As can be seen in Table 1, across these two measures, a consistent pattern of results is found: Stress levels were low in the TV-only condition, and were elevated in both the Math-only and the TV+Math condition. For statistical analysis of these stress data, we use a 2x3 (multitasking-type x condition) repeated measures ANOVA. There was a significant main effect of condition on self-reported stress, $F(2,44) = 7.35$, $p = .002$, as well as changes in skin conductance, $F(2,44) = 5.79$, $p = .006$. Pairwise comparisons show that across these two measures there was a significant increase in stress from TV-only to the Math-only condition, and from TV-only to the TV+Math condition. There was no significant difference between the Math-only and TV+math condition. For these non-significant comparisons, the observed effect sizes were very small (for STAI $r = .02$, for EDA $r = -.16$).

To investigate whether there was a difference in stress levels between the concurrent and sequential multitasking conditions we focus in on only the TV+Math condition data (as we would not expect any difference between the other conditions). We do not find a significant effect of multitasking condition for either self-report stress ($M_{con} = 35.75$, $M_{seq} = 34.67$, $t(22) = .24$, $p = .81$, $d = .09$) or skin conductance data ($M_{con} = 0.31$, $M_{seq} = 0.52$, $t(22) = -.39$, $p = .70$, $d = .16$). However, when we consider finer grained moment-to-moment changes in skin conductance levels...

<table>
<thead>
<tr>
<th>Condition</th>
<th>STAI</th>
<th>EDA</th>
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<tbody>
<tr>
<td>TV-only</td>
<td>30.63</td>
<td>-0.50</td>
</tr>
<tr>
<td></td>
<td>(7.37)</td>
<td>(0.72)</td>
</tr>
<tr>
<td>Math-only</td>
<td>35.75</td>
<td>0.12</td>
</tr>
<tr>
<td></td>
<td>(10.38)</td>
<td>(0.65)</td>
</tr>
<tr>
<td>TV+Math</td>
<td>35.21</td>
<td>0.38</td>
</tr>
<tr>
<td></td>
<td>(10.67)</td>
<td>(0.85)</td>
</tr>
</tbody>
</table>

**Table 1.** Mean and standard deviation self-report stress (STAI) and skin conductance (EDA).
over the course of the trial there is some evidence of a difference between these conditions.

Figure 1 shows how skin conductance varied over time: higher values correspond to increased arousal. It can be seen that there is a clear difference between the concurrent and sequential dual-task conditions. In the concurrent condition, skin conductance decreases over time at a steady rate. Whereas in the sequential condition, skin conductance levels oscillate, increasing sharply each time that the math task is started.

Finally, we consider the impact that performing the math task had on the level of engagement that participants had with the content of the television show, in other words, were they paying attention to it? Table 2 shows mean scores from the television engagement questionnaire – higher values reflect a higher level of engagement. For statistical analysis, a 2x2 (multitasking-type x condition) ANOVA was performed (because there was no data from the Math-only condition). It can be seen that participants reported higher levels of engagement in the single-task TV-only condition than in the dual-task conditions, $F(1,22)=19.34$, $p<.001$. While there was no significant main effect of multitasking-type, $F<1$, there was a significant interaction, $F(1,22) = 19.34$, $p<.001$. Follow-up tests of this interaction show that in the concurrent condition engagement scores decreased when participants had to work on the math task while watching the television show, $F(1,11)=27.02$, $p<.001$. In contrast, engagement did not decline in the sequential condition, $F<1$. This result suggests that by working during breaks in a television show, but not during it, people can maintain an active level of engagement with the show.

**Discussion**

Our work seeks to complement existing qualitative investigations into present day media multitasking practices [1,7,11]. By taking an experimental approach, we begin to understand how these practices might be impacting our ability to work and relax. The results of our study suggest that continuing to work on a stressful activity while watching television eliminates the positive benefits of television watching for relieving stress. If people are to maintain a healthy work-life balance they should try and separate stressful work activities from periods of rest and relaxation.
The results of our study also show that media multitasking can reduce the level of engagement that a viewer has with the content of a television show. We found some evidence to suggest that sequential multitasking—in which the secondary task is performed during breaks in the television clip—allowed participants to remain engaged with the show. Given that people often turn to secondary devices during commercial breaks, the challenge for broadcasters is to find new ways to re-engage their media multitasking audiences after commercial breaks.

There are of course limitations to the particular study that was undertaken here. In particular, the secondary task required participants to solve difficult mental arithmetic problems. While people sometimes do stressful and demanding work at home in front of the television, many probably choose to do relaxing, rather than stressful, activities on a secondary device. Hence, future work might consider how our results might have been different had participants been asked to do a less demanding computing task while watching television, such as browsing the Internet to find out what Toronto has to offer to visitors. A second concern is that while every effort was taken to make the study setting as relaxed as possible, it was still not the participant’s home environment, where they would have been more comfortable and had greater freedom to decide what to watch. People also tend to watch television in the company of friends and family. It would be interesting for future research to study the impact that one person’s solitary media multitasking activities have on others who are sitting with them watching television at the same time.

References