The Effects of Chronic Multitasking on Analytical Writing

Danielle Lottridge, Christine Rosakranse, Catherine Oh, Sean Westwood, Katherine Baldoni, Abrey Mann, Cliff Nass
Department of Communication, Stanford University
450 Serra Mall, Stanford, CA 94305-2050
lothridg | being | syoh | seanlw | kbalonis | asm mans | nass @stanford.edu

ABSTRACT
Chronic multitaskers perform worse on core multitasking skills: memory management, cognitive filtering and task switching, likely due to their inability to filter irrelevant stimuli [17]. Our experiment examines effects of chronic multitasking with task-relevant and irrelevant distractors on analytical writing quality. We found a general switch cost and, when controlling for that cost, effects of chronic multitasking habits: heavy multitaskers write worse essays in the irrelevant condition and better essays in the relevant condition. Our study changes multitasking research paradigms in two fundamental ways: it studied a realistic writing scenario including access to both irrelevant and relevant distractors. We found that the effect of chronic multitasking is complex; heavy multitaskers are seduced by unrelated distractors but able to integrate multiple sources of relevant information.

Author Keywords
Multitasking; analytical writing; distractors; chronic multitasking; media multitasking index.

ACM Classification Keywords

INTRODUCTION
Is multitasking good or bad for you? Proponents (including many employers) herald the ability to effectively juggle tasks and pressure workers to respond to messages immediately. Dissenters bemoan constant interruptions, distractions and the inability to get engrossed. Can we improve our ability to multitask? How does multitasking affect our attention span and the quality of our work?

‘Practice makes perfect’—except when it comes to multitasking. Chronic multitaskers perform worse on the core executive functions of multitasking: taking in and releasing items from short-term memory stores (memory management), attending to relevant material and inhibiting irrelevant material (cognitive filtering), and inhibiting the cognitive structures required for one task and activating those required for another task (task switching) [17]. These results suggest a unique and important change in fundamental information processing. Counterintuitively, multitasking does not appear to be a problem of attending to the right things; rather chronic multitaskers’ trouble appears to be the inability to ignore the wrong things.

Multitasking is studied in two main ways: field studies prioritizing external validity (e.g., [6]; what does multitasking look like in the world?) and controlled experiments prioritizing internal validity (e.g., [17]); such experiments tend to follow cognitive psychology standards, often with primary tasks related to basic cognitive function and unrelated distractors. This experiment extends that research in two fundamental ways: first, it studies multitasking experimentally in the realistic domain of essay writing; second, it exposes subjects to information streams that are either relevant or irrelevant to the task at hand.

BACKGROUND
The more people are exposed to media, the more they multitask [9]. High sensation seekers multitask more often [13]. The impact begins at a young age; in a survey of 3,461 North American girls aged 8-12, multitasking was inversely face-to-face communication, feelings of social success, and sleep [19]. When ‘heavy’ (chronic) media multitaskers (HMM) were compared with ‘light’ media multitaskers (LMM), HMM were bad at precisely the tasks at which one would expect them to be good [17]. Habitual and in-the-moment multitasking both hurt cognitive performance. Participants completing three tasks simultaneously performed worse on a subsequent memory test when compared to participants performing the same three tasks serially [26]. Multitasking contributes to cognitive overload through too much information supply and demand, interruptions, and inadequate infrastructure, thus increasing needs for planning, monitoring, reminding, and reclassifying information [14]. A study on word tasks found that people maximized productivity by switching to prioritize a continuous rate of return (an information foraging orientation) and to complete subgoals [18]. Salvucci et al. model multitasking behavior with cognitive architecture, threaded cognition and memory-for-goals theory [23]. Others suggest that people self-regulate their interruptions to maintain a flow state [1].
The type of task (information versus non-information) and individual differences can moderate how tasks are combined for multitasking; for example, higher versus lower order task, difficulty and information carry-over affect impact [12]. If both tasks require the same cognitive framework ('problem state'), it interferes with performance [3]. It was proposed to be more effective to multitask with tasks using different parts of the brain [24]. But fMRI studies reveal that tasks using different parts of the brain (e.g., perceptual encoding and decision-making) suffered from temporary attention limits [25]. These costs appear to increase with age, as older adults direct more attention toward irrelevant stimuli [5].

Field studies reveal that multitasking is associated with poor academic performance [22]. Multitasking students take more time to achieve the same performance as monotaskers [4], or to complete the same task [10]; texting students performed worse on exams than non-texters [7]; and students with open laptops had worse memory for lectures than those without [11]. The present research is however the first to study the causal relationship between multitasking and writing quality.

**METHODS**

The effects of chronic and in-the-moment multitasking on analytical writing quality were investigated with an essay task accompanied by relevant or irrelevant distractors. Undergraduates were granted course credit and categorized using top and bottom quartiles Media Multitasking Index (MMI) scores [17]. 40 HMM and 40 LMM participated; 37 were male. Participants were randomly assigned to the relevant or irrelevant condition. Gender was balanced across MMI score and condition.

Sessions consisted of groups of 5 students using laptops separated by divider boards. The task was a 30-minute GRE-style essay arguing for or against a statement on current events and students with open laptops had worse memory for lectures than those without [11]. The present research is however the first to study the causal relationship between multitasking and writing quality.

**RESULTS**

We observed a switch cost: the more participants switch, the less time participants spend writing (H1a: \( r =-.528, p<.001 \)) and the worse the quality of their writing (H1b: \( r =-.307, p=.006 \)). H1c was not supported. We found that time spent writing correlated with length (\( r=.298, p=.01 \)) and higher complexity (\( r=-.306, p=.006 \)). Length correlated with quality (\( r=.529, p<.001 \)). This suggests that if given more time to write, students would likely produce longer, more complex essays and that those who write more independent of allotted time achieve higher quality essays.

Controlling for number of switches, we found an interaction effect where HMM spent a quarter of their time following irrelevant links (almost 7 min) whereas LMM spent only 16% doing so (approx. 4.5 min.; \( F[1,79]=6.314, p=.01 \), partial \( \eta^2=0.078 \)). In the relevant condition, both LMM and HMM spent about one fifth of their time following links.

When controlling for the number of switches and time spent writing, we observed a significant interaction between media multitasking and condition on writing quality.
In this study, we examined how heavy and light media multitaskers differ in analytical writing behavior when faced with relevant or irrelevant distractors. Our study was designed for external validity with a realistic scenario: writing essays online with access to both relevant and irrelevant information. Our study was unique in reconceptualizing switching as relevance-dependent rather than looking only at the effects of irrelevant stimuli.

Our findings support a multi-faceted view of costs and benefits of multitasking. For both groups, writing quality suffered as a function of the number of switches between writing application and browser. Thus, in-the-moment multitasking carries a cost for writing quality. However, when controlling for switches and time spent writing, this negative effect was dependent on one’s chronic multitasking habits and the type of distractors present. HMM benefited from the relevant condition and had higher writing scores. In the irrelevant condition, LMM were able to easily ignore links and spent more time writing. HMM were seduced by irrelevant content; they spent significantly less time writing and wrote poorer quality essays.

The relationship between complexity and quality is nuanced. Complexity might be sophisticated when paired with high quality but connoted when paired with low quality. Low complexity might mean readable when paired with high quality, simplistic when paired with low quality. Our results suggest complexity is expressed differently by HMM and LMM depending on condition. HMM had high complexity and quality in the relevant condition and low complexity and quality in the irrelevant condition, suggesting that relevance increased sophistication and irrelevancy decreased sophistication. LMM writing did not differ in quality with condition. Lower complexity in the relevant condition suggests simplicity did not affect quality. High complexity in the irrelevant condition suggests intricacy did not improve quality. The relationship between writing complexity and quality continues to be studied (e.g. [2]); our results add to this ongoing discussion.

Our study finds chronic multitaskers have advantages when using multiple streams of task-related content; they appear to have an ability to quickly integrate relevant information. This behavior fits within the theoretical framework of information foraging [20]; HMM may have developed better sampling techniques that are utilized when constrained to relevant material. Yet, as sensation seekers, chronic multitaskers fail to ignore interesting, irrelevant material; they lose time by consuming those media, and their work suffers as a result. As light multitaskers consume fewer media, the condition neither helped nor hurt.

Multitasking is good and bad for you. Our study found that HMM benefit when media streams are relevant and suffer when they are irrelevant. Unfortunately, HMM typically multitask with irrelevant media streams; our finding that students multitask during homework is corroborated by recent research that found students often chat online while writing essays [22]. Therefore, HMM often do not take full advantage of their integration capacity to optimize their performance. Careful construction of a context or digital

**DISCUSSION AND CONCLUSIONS**

In this study, we examined how heavy and light media multitaskers differ in analytical writing behavior when faced with relevant or irrelevant distractors. Our study was...
environment to constrain HMM’s media intake to relevant streams may thus greatly benefit their performance.

ACKNOWLEDGEMENTS
We thank Google for their support, Erina Dubois for her help, Ethan Plaut for editing, and our anonymous reviewers for their generous and constructive critiques.

REFERENCES