Interest level improves learning but does not moderate the effects of interruptions: An experiment using simultaneous multitasking

Maureen A. Conard [a,*], Robert F. Marsh [b]

[a] Department of Psychology, Sacred Heart University, United States
[b] Department of Management, John F. Welch College of Business, Sacred Heart University, United States

ARTICLE INFO

ABSTRACT

It has become common practice for people to multitask with electronic devices in everyday situations. We examined the effects of interrupting participants with instant messages while they watched a video presentation in a situation that resembled commonplace events such as a business meeting, a training presentation, or a classroom lecture. We compared them to participants who were not interrupted. We also investigated how interest in the topics presented affected learning. Results showed that interruptions reduced learning, by a small but statistically significant margin, which is consistent with the findings of similar studies. Importantly, interest level was as strong a predictor of learning as being interrupted, although interest did not moderate the effect of interruptions. Results showed that interruptions are disruptive but perhaps not as much as is commonly believed. The results also highlight the importance of studying individual difference factors, such as interest levels, in conjunction with experimental manipulations, when assessing the effects of multitasking.

1. Introduction

1.1. Overview

Understanding the effects of interruptions or distractions is an important goal of attention researchers, with implications for a wide variety of situations. Interruptions can take many forms. For example, imagine that you received a text or instant message (IM) during a lecture or presentation. Should you attend to it or ignore it? People in a wide variety of occupations and circumstances encounter such situations daily. Although distractions could impact knowledge acquisition, and possibly subsequent performance, people often do attend to such interruptions, perhaps believing in their ability to multitask, or perhaps because the interrupting message is more important than the ongoing presentation.

Understanding the role of individual differences is central in many psychological domains, and is also important to understanding the effects of interruptions. Interest level is one individual difference that could play a role in learning, and could mitigate the effect of interruptions. The present study examined the effects of interruptions and interest level on learning, and investigated whether interest could moderate the effects of interruptions in a simultaneous multitasking situation.

1.2. Theoretical background

Single channel (or resource) theories of working memory and attention postulate that performing two tasks simultaneously will result in a competition for central attentional resources, reducing recall, performance time, and accuracy (Parasuraman, 2011; Tombu et al., 2011). However, theories such as the multiple component theory of attention and working memory postulate that individuals process information through a variety of cognitive components, each with its own functions and workload capacity. In addition, individuals can opt to use a variety of strategies for processing information, some of which are more effective than others (Hambrick, Oswald, Darowski, Rench, & Brou, 2010; Logie, 2011). Similarly, the executive attention theory of working memory postulates that individuals have the ability to keep information "in mind" in a way that is active and easily retrievable, and that working memory is also involved in concentrating attention in order to avoid distractions (Engle, 2002; Meyer & Kieras, 1997). The multiple component and executive attention theories propose that individuals can process, store, and retain information while performing multiple tasks. Any performance deficits due to multitasking would depend on the extent to which those tasks required use of the same channels or cognitive components, as well as the individual's working memory capacity.

Research results across decades have supported both kinds of theories, with some findings of negative interruption effects (Schiffman & Greist-Bousquet, 1992; Schuh, 1978), some findings of negligible effects (O'Conaill & Frohlich, 1995), and some findings of positive and negative effects depending on factors such as task complexity (Burmistrov & Leonova, 2003; Speier, Valacich, & Vessey, 1999; Tétard,

* Corresponding author at: Department of Psychology, Sacred Heart University, 5151 Park Avenue, Fairfield, CT 06825, United States. Tel.: +1 203 365 7505; fax: +1 203 371 7998.

E-mail addresses: conardm@sacredheart.edu (M.A. Conard), marshr@sacredheart.edu (R.F. Marsh).

1999). More recently, Trafton and Monk's (2008) review concluded that interruption complexity, similarity of the primary and secondary tasks, control over interruption engagement, and availability of retrieval cues were the most consistent predictors of disruptiveness. Specifically, simple, brief interruptions were less disruptive than complex, long ones. Dissimilar interruptions were less disruptive than when both tasks were similar. Negotiated interruptions (for which a response could be postponed) were less disruptive than non-negotiated interruptions. The availability of retrieval cues aided recovery time after an interruption, thus making it less disruptive.

1.3. Types of multitasking

In addition to aspects of tasks and interruptions, the type of multitasking also plays a role. Sequential multitasking, also called parallel multitasking and task switching, refers to switching back and forth from a primary to a secondary, interrupting task. Sequential multitasking research results were mixed. Some results sequential multitasking increased the time to perform a task (Conard & Marsh, 2010; Leroy, 2009; Welford, 1952). Other studies showed that brief interruptions (3 to 18 s) increased the time it took to resume a primary task (Hodgetts & Jones, 2006; Monk, Trafton, & Boehm-Davis, 2008; Trafton & Monk, 2008). Altmann, Trafton, and Hambrick (2013) found that interruptions averaging 4.4 s increased response latencies, but interruptions of 2.8 s did not. Importantly, both categories of interruptions considerably increased sequence errors (i.e., resuming the task at an incorrect step in a series of steps) but not other errors. Still other studies found that for simple, boring, or repetitive interruption tasks, participants worked faster after switching back to the primary task, resulting in no net increase in time to complete the primary task (Mark, Gudith, & Klocke, 2008; Ratwani & Trafton, 2006; Speier et al., 1999; Speier, Vessey, & Valacich, 2003).

Simultaneous multitasking differs from sequential multitasking in that it involves performing two tasks at once, such as walking and talking, or listening to a conversation and texting. Single channel theories would predict large deficits in performing these tasks, because it is not possible to truly do two tasks at once. Rather, task performance that appears to be simultaneous is actually task switching at the cognitive level. Alternately, multiple component theories predict that the level of resulting deficits, if any, would depend on the extent to which performing two tasks required shared cognitive components. Conjugate tasks require at least some shared components and more sharing leads to larger deficits. Disjoint tasks don't share components and should have little or no deficit due to simultaneous multitasking. Texting and listening to a conversation are conjugate tasks because both require language processing. Walking and talking are disjoint tasks because they require different cognitive components. Meyer and his colleagues found that simultaneous multitasking with conjugate tasks showed bigger deficits in performance than with disjoint tasks. Practice improved performance for both types of tasks (Meyer & Kieras, 1997).

Many multitasking studies (in non-dangerous situations) were based on purely cognitive tasks such a counting back by threes from 1000, or cognitive and psychomotor tasks such as identifying geometric shapes on a computer screen and pressing a button. Relatively few studied multitasking in everyday tasks. Two studies of sequential multitasking, where participants read a passage and took a comprehension test afterwards, found that participants interrupted with instant messages (IMs) during reading took longer to finish reading than those not interrupted. However, there were no significant differences on test scores (Bowman, Levine, Waite, & Gendron, 2010; Fox, Rosen, & Crawford, 2009).

Conversely, studies employing simultaneous multitasking found differences in grades and test scores. Fried (2008) found a negative correlation between self-reported level of laptop use during classes and final grades. However, Grace-Martin and Gay (2001) found that only long browsing sessions during class were associated with lower final grades. Frequent, short browsing sessions were associated with higher final grades. In a follow-up experiment, Hembrooke and Gay (2003) found that students who were allowed to use laptops during a lecture scored significantly lower on a test than those who did not use laptops, and that the difference was associated with free recall (fill-in) items, not multiple choice items. Although the difference was statistically significant, in practical terms it was equivalent to getting one more item incorrect on the 20 item test, a 5% decrease. Similarly, Rosen, Lim, Carrier, and Cheever (2011) found that participants who received and sent a large number of text messages (more than 16 total received and/or sent, $M = 19$) while viewing a videotaped lecture scored significantly lower on a test than those who received few or no text messages (seven or fewer). In that case, experimenters sent zero, four, or eight text messages. Additional messages were from contacts outside the experiment. Rosen et al. also noted that the size of the difference was equivalent to about one more item incorrect on the 18 item test, a 5.5% decrease. When multitasking required extensive web browsing (approximately 33% of lecture time spent browsing) multitaskers scored 11% lower than non-multitaskers (Sana, Weston, & Cepeda, 2013).

Overall, the evidence from studies using everyday tasks such as reading suggests that sequential multitasking increases time to complete tasks, but does not affect test scores, when completion time was not limited. However, the evidence also suggests that simultaneous multitasking during tasks, such as attending a class or listening to a lecture, there is a small but significant decrease in test scores with brief interruptions (e.g., IMs or text messages), and a somewhat larger deficit with extensive interruptions.

1.4. Interest level

In addition to external factors such as types of multitasking or interruptions, there are internal, individual factors that also merit attention from researchers. Level of interest is one of those individual differences that could affect attention and learning, and has not been explored in the multitasking literature. Interest can be categorized as either individual or situational (Krapp, 2002). Situational interest is specific to a topic or situation, and is positively related to intrinsic motivation to learn, academic achievement and coping, and long-term retention of information, (Müller & Louw, 2004). Nye, Su, Rounds, and Drasgow's (2012) meta-analysis of vocational interests showed that when specific interests matched specific characteristics of academic majors or occupations, (analogous to high situational interest) those interests were substantially correlated with grades and job performance. The Nye et al. findings underscore the importance of situational interest to learning. If situational interest is high, it might motivate the activation of more cognitive resources, particularly in working memory, which could allow the individual to better attend to the content being learned in spite of interruptions. Therefore, it is important to investigate interest and interruptions together.

1.5. The present study

The present study assessed the effects of interruptions and situational interest on learning during simultaneous multitasking with conjugate tasks (Meyer & Kieras, 1997). We operationalized learning as performance on a test of information from a videotaped business presentation. Instant messages (IMs) interrupted participants as they watched the presentation. Half of the interruptions were timed to coincide with information that was on the test, and half were at other times. This method simulates interruptions in everyday situations, which do not always occur at critical times. Further, in addition to comparing mean differences between interrupted and uninterrupted groups, we compared the relative contributions of interruptions and situational interest, and tested whether interest would moderate the effect of interruptions, in a multiple regression framework. The conjugate tasks