RESEARCH QUESTION

I propose to study the impact of various interruptions on the primary task performance of college students. Additionally, I also wish to examine the extent to which the performance deterioration depends on the relative modality between the primary task and the interruption.

BACKGROUND CONTEXT

With the growing sources of information accessible to the average human and increased connectivity, multitasking has become common in our day-to-day lives. Its presence can range from listening to the radio while driving, to being interrupted by a phone call while writing a memo. While multitasking has various forms, the subfield that I am particularly interested in is the process of interruptions and the consequences of having to constantly switch between our interruption and our primary tasks; particularly in the context of college students.

There are various theories as to the way our brain processes information and how various interruptions interact with this process. Firstly we must remember that the primary task and the interruption can occur in different or similar modalities. For example the primary task may be auditory (listening to a lecture) while the interruption might be auditory (a phone call) or visual (text). As such, there are varying theories as to the consequences of these differences or similarities in modality.

At one end of the spectrum we have the Memory for Goals framework (Altman & Trafton, 2002). This framework claims that we have a single processing channel and all activities must be funneled through it, i.e. activities can be processed only one at a time, irrespective of their modality. What determines our capacity to process them is their activation level. Once we are interrupted the activation level of the primary task decays over time, until we resume the primary activity. As expected, it is this decay of activation level that determines the disruptiveness of the interruption, i.e. the time taken to resume the primary activity at the original level of processing depends on the activation level. Studies within this framework that refer to the activation-based model have also shown that interruptions occurring in the earlier phases of the primary task are more disruptive than those in the later phases (Cutrell, 2001). Additionally some studies have shown that the duration of the interruption is more significant than its complexity (Posner, 1966).
The second theory is the *Multiple Resource* Theory (Wickens, 2002), which claims that we have different processing channels for different modalities. Thus if our primary activity is auditory and our interruption is visual then they differ in modality and our ability to process them is not diminished so long as we are within our overall limit to process information. On the other hand a primary and interruption task with the same modality will have a significant negative impact on our information processing capacity. Interestingly enough studies within this school of thought have occasionally been contradictory to the former, in that the similarity of modality and the complexity of the interruption affect the disruptiveness of the interruption while the length of the interruption is irrelevant (Broadbent, 1989).

Given the recent exponential increase in access to information and internet on-the-go with 3G and 4G, the frequency of these interruptions seems to be on the rise. As such, and in conjunction with these two theories, extensive research has been conducted on the implication of interruptions on task performance ranging from the consequences of answering a phone call while driving, to what makes interruptions disruptive (Broadbent, 1989). Particularly relating to my target demographic, there have been many studies conducted recently ranging from the instructional use of IM messaging in a classroom setting (Kinzie, 2005) to understanding whether students can truly multitask (Gendron, 2010).

My project aims to test the effect of interruptions within the context of these two theories with particular emphasis of the consequence of modality difference or similarity. My demographic is college senior students.

**Methods**

Each student participated in two experiments and a control:

1) Visual Primary task + Auditory interruption  
2) Visual Primary task + Visual interruption  
3) Visual Primary task + no interruption (control)

Neutrality of the task was important in order to avoid any unknown and uncontrollable variables influencing the results. Thus three comprehensions from the reading section of SAT tests were used, since studies have already been done to ensure their standardization, in order to avoid any biases or unfair advantages. The participants were given 10 minutes for each test, and asked to answer the comprehension questions (7 multiple choice questions) as accurately as possible while also responding to the interruptions (9 visual and 9 auditory). Irrespective of the modality of the interruption (visual or auditory), all groups were to respond to all interruptions via a visual mode (writing the answers down).

The specific tasks were chosen as a consequence of their similarity to what students encounter on a regular basis.
- **Experiment 1** refers to typing an essay and being interrupted by a phone call.
- **Experiment 2** refers to the same primary task but being interrupted either via a text from a friend or a chat message on one’s cell phone or laptop (given that laptops are permitted in the class, an aspect that institutions are struggling with in terms of embracing the design of smart class rooms).

In order to prevent the experiment results from being skewed due to comprehensions with possible varying levels of difficulty, the participants were divided into three groups. Each group was given the three tests but with varying orders of auditory, visual and no interruptions respectively. The order of the interruptions for each group was as follows:

Group 1: NONE - VISUAL - AUDIO
Group 2: VISUAL - AUDIO - NONE
Group 3: AUDIO - NONE - VISUAL

The results from the control (test with no interruption) were used to establish a base with which to compare the results of tests with interruptions to see the influence of the “interruption” itself as well as the modality of the interruption on the task performance.

**CONCLUSIONS AND OUTCOMES**

The results of the outcome were as following (results in parenthesis is excluding the outliers.)

No interruption: 52.38% (47.62%)
Visual interruption: 40.48% (42.86%)
Audio Interruption: 41.67% (41.27%)

Thus on a pure scoring basis, the results clearly show that performance deteriorates significantly with interruptions. Also, similar modality in the primary task and the interruption has a significant negative impact on the performance however this effect is not as large as the interruption itself.

A detailed summary of the experiment and the results is present in the paper titled ‘The effect of interruption and interruption modality on primary task performance studied using SAT comprehension test performance’ which can be accessed on the EGRS projects’ website.

**Limitations:**
1) The sample size is very small (12). Increasing the size would increases the significance of results and decreases the negative impact of externalities.
2) All the participants were only students from the EGRS 451 class which is not a representative sample of the senior class or Lafayette College. Randomization is necessary in order to be able to draw larger conclusions.

3) There were some participants who did not answer all the questions however it was not possible to determine if these questions were not answered because they did not have time to complete them, because they failed to see the questions or because they did not know the answers. It is important to note that one student answered all the questions for the test without interruptions but left some unanswered on the tests that did have interruptions.

4) The students were to self regulate and spend only 10 minutes based on what the pre-timed presentation told them. However it is possible that they spent extra time going back to previous tests in order to finish questions that they did not finish in the allotted time. This would skew the results and under-report the negative impact of the interruptions. For future references the tests should be offered one at a time with the examiner taking away the exam after the stipulated time.

**Conclusion:**

In the wake of great technological advances within the educational sphere, from smart boards to universal wi-fi, more and more educational institutions are struggling to find the balance between incorporating technology as a useful educational tool while minimizing the negative implications of the distractions available to students as a consequence of the same. Studies have shown that using a laptop during a lecture is in fact detrimental to gaining knowledge from the lecture (Hembrooke, 2003). Our findings complements most of the existing literature stating that interruptions are detrimental to primary task performance particularly when the modality of the two tasks are the same. Furthermore it places it in within the contest of the larger debate as to what role technology should play in the learning experience going forward.

However it is important to remember that these senior college students will soon graduate and leave campus life behind. Once in the real world these distractions and interruptions will be a normal part of these students’ lives. Thus, rather than completely eliminating the occurrence of these distractions it might be more important to teach students the importance of self regulation and finding the middle ground that maximizes the benefits of these resources while minimizing their negative externalities.

**Recommended next steps**
The next step would be to expand the demographic to a greater sample size within the senior class and also possible to other class levels. Also the participants should be selected through random sampling from the Lafayette senior students (or all class years based on what one wishes to study) in order for the participants to be more representative of the population demographic. Furthermore, based on the specified limitations and suggestions, improvements can be made to the experiment to ensure greater accuracy of results.

Further studies should also focus on research conducted on ways to mitigate the negative effects of interruptions and these should be tested on future participants.

### APPENDICES

**Appendix A: Annotated Bibliography.**


Much of the literature on interruptions, within the field of Psychology, has studied the effect of interruptions in recalling the primary task after the delay. However this study goes a step further and examines what makes interruptions disruptive and what are the factors that determine the extent of disruptiveness. The authors find that while the length of the interruption as well as the ability to choose when one is to be interrupted are irrelevant, the similarity of the task to the primary task as well as the level of complexity play a role in determining its disruptiveness. It is relevant to my study because it helps me design my experiment in order to best achieve results that will contribute to my argument. It also helps me understand the existing literature on the broader topic area. It is important to note that the study uses male and female between ages 18 – 45, a range much higher than mine (21 – 23).


This study was part of a larger body of research to investigate the effects of wireless computing and smart – classrooms on learning environments. The authors tested the effect of using a laptop during a lecture on the performance in a test immediately following the lecture involving recall (short answers) and recognition (multiple choice) questions. They found that using a laptop had a significant detrimental effect on the recall and the total scores. More importantly they found that it was the time spent away from the primary task (lecture) that influenced the performance rather that the relevance of the laptop browsing to the lecture. The relevance of this study lies in its emphasis on the effect of multitasking on education and learning. However it does not inspect the effect of interruption and so it can only be used as a context against which to compare my study.

Given the expanding usage of electronic media due to its accessibility and connectivity many studies have been conducted into its effect. This study examines its effects on first year university students’ academic and social behavior using time-diary and survey data. The authors showed that there was a negative correlation between the robust use of electronic media and first semester grades and a positive correlation with face-to-face interactions. The study’s relevance lies in the similarity of trying to examine the effect of electronic media on learning. Although it does not examine interruptions specifically, being constantly ‘wired in’ certainly leads to constant interruptions. The study’s limitations in relation to my study lie in the fact that it examines the effect on education as a whole over the semester rather than immediate effect on learning ability. One also needs to be cautious of reverse causality and inaccuracy of data given that it is survey data and self reported and this could possibly influence the results of the study.


Students constantly multitask while performing school work both in class and outside of it. They believe in their ability to multitask and so do not separate their social lives from school work. This study examines the effect of this behavior by conducting an experiment where three students were asked to read a generic psychology paper and one group was asked not to IM during the task while two others were asked to IM before and during the task respectively. The authors found that the interruption caused the time to read the paper to increase but the test performance remained unaffected. They showed that the students took longer to achieve the same level of performance due to the interruptions. This study is completely synonymous with my study with the only difference being that I hold the time constant; accordingly I should expect the performance to be negatively correlated to the interruptions. Thus it offers a sound basis on which to conduct and assess my experiment. Its limitation however lies in the fact that it does not test the effect of different modalities.


The current generation of students, sometimes referred to as “Information Age” learners, suffer from the lack of ability to focus during class and so often resort to multi-tasking during class room. This study examines if it is possible to channel this into constructive learning and classroom activity via instructionally-related instant messaging. The authors found that 50% of the words used in this process were indeed related to the topic area, however students and instructors were not comfortable using this as a means of discussion simultaneously with lectures. The
The authors further mention that the outcome might be different for sequential rather than simultaneous discussion and the response to this IM based learning might change with time. The relevance of this study lies in its attempt to try and channel this changing environment for the betterment of education, something that I wish to achieve, after studying its negative effects. The limitations however lie in the fact that merely encouraging discussion does not show an improved learning environment and the authors themselves mention that further investigation needs to be undertaken to examine that aspect of the study.


This study examines the effect of multitasking on different measures of performance. Two groups of subjects were given either an ordered sequence of tasks or a group of tasks where they were allowed to discretionally switch between tasks. The authors found an inverted-U relationship between the productivity level and multitasking. On the other hand they found a downward sloping relationship between accuracy and multitasking. This shows that in tasks where inaccuracy has very high opportunity costs multitasking can have a net negative effect. The relevance of this lies in the fact that while in college small errors in task performance do not have significant consequences which might cause students to be complacent and believe that they are good at multitasking. However after graduating when the consequences of errors are much higher they might realize its true negative consequences. Since my demographic is University Seniors, and I wish to draw a relationship to the possible negative impacts after graduation, this study gives me a relevant basis on which I can draw possible conclusions.


The study examines the effects of interruption on primary task given varying levels of difficulty of the interruption. The authors found that the process of forgetting the primary task is irrelevant to the similarity of the ‘interruption’ to the primary task, it is dependent primarily on the duration of the interruption and secondarily on its level of complication. This study relates to my experiment in helping me determine the independent and dependent variables in my study and understanding the differences between correlation and causality of the variables involved. Its limitation lies in the fact that while it studies the effect of difficulty levels of interruptions my study examines the effect of different modalities of interruptions on performance, an aspect that the study does not touch on at all.

Interruptions are part of the day to day life of everyone in the workplace as people are expected to constantly be accessible in order in decrease response time and supposedly increase efficiency. This study examines the effect of these interruptions on the decision-making process and the ability of using different presentation formats to alleviate the negative impacts. The authors find that decision makers are better supported by spatial representations rather than symbolic representations when the primary task is highly computational. This study ties into my study of the consequences of different modalities of primary tasks and interruptions and how it relates to our method of processing information. Its limitation of this study lies primarily in it being a controlled experiment and thus brings into question the ability to generalize to the real world, a limitation that is also relevant to my study.


The continually increasing amount of interruptions in the workplace has caused the implication of interruption on performance to come into close examination. This study examines the effect interruption on task performance as well as workers' psychological state. The primary task was editing a text of moderate complexity and the interruption had two levels of complexity. The authors found that the interruption enhanced the performance of the primary task in terms of speed while maintaining the level of accuracy. On the other hand the psychological state was negatively impacted. This study is particularly significant because it presents a result contrary to majority of the prevalent literature. It reminds one of the significance of the type of primary task on the consequence of multitasking and interruptions and thus exposes the limitation of my study to only one type of primary task.


With the increasing frequency and popularity of instant messaging in both the workplace and one’s personal life, many studies have been conducted to investigate its implications. This study examines the impact of instant messaging on ongoing computing tasks and more specifically the effect of the time of the interruption on the extent of disruption. The authors found that IM interruptions during the early phases of the primary task have a higher impact on the performance rather than the latter phases. The relevance of this study to my study lies in the design of my experiment. It emphasizes the importance of eliminating such design flaws to ensure an unbiased experiment in order to ensure that there are not unknown variables influencing the result of my experiment. As such the interruptions in my experiment will be equally spaced throughout the process of the primary task since my primary goal is to study the effect of different modalities rather than time occurrences of interruptions. The limitation of this study is that it does not examine the different modalities and thus only serves to improve my experiment design.
APPENDIX B: ADDITIONAL SOURCES:


APENDIX C: RESULTS

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