Attention Residue: An Inquiry into Attention Carryover from One Task to the Next in University Students

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Abstract

This article researches the carryover of attention when switching from one task to the next. This is known as attention residue. The primary foci of this paper is to determine the role attention residue plays in learning and working environments, what causes attention residue, and what is understood to help alleviate the negative effects. While much research has been done on multi-tasking, attention residue is different in that tasks are not taking place at the same time, but in sequential order. The study focuses on adolescents and adults with specific attention on university students. This project reviewed literature from psychology, neuroscience and education with primary sources coming from psychology and neuroscience. The findings of the study reveal many negative effects on tasks following previous tasks when attention is carried over from a previous task. This article also discusses studies that have argued to be both effective and ineffective methods of alleviating attention residue.
Attention Residue: An Inquiry into Attention Carryover from One Task to the Next in University Students

This project investigates the carryover of attention from one task to the next. The goals are to first better understand the reasons and science behind this carryover of attention and to find methods to alleviate attention remaining in working memory from the first task so that more attention can be placed on the current task at hand. The age groups primarily focused on will be adolescents and adults. This study is to be used as a foundation in preparation for further research on the effect attention carryover from task switching has on adult English language learning students. If a negative effect is discovered, this will be followed by further research on what methods are and are not effective in alleviating attention carryover in adult English language learners.

Background

Throughout the day people of all ages move from one task to another whether it is at school, work, or during leisure time. During the day, performing multiple tasks either simultaneously or in rapid alternation is required (Rubinstein, Meyer & Evans, 2001 p.763). When switching between tasks, keeping attention on the second task is often very difficult due to attention residue (Leroy, 2007 p.13). Sophie Leroy from the University of Washington defines attention residue in her seminal work “as a type of ruminative thought that is specific to the context of task transitioning and the issue of allocating attention
among activities; specifically, it describes thoughts that relate to a prior task when working on a subsequent task” (Leroy, 2007, p.13).

The Problem

In both the classroom and workplace attention on the current task is needed for learning. Richard Schmidt argues that without attention there is no learning in foreign language acquisition (Schmidt, 1995, p.9). Schmidt further states, “the orthodox position in psychology and cognitive science is that there is no learning without attention” (Schmidt, 1995, p.9). While much research has been conducted on the effects of multi-tasking and attention, research has not looked into how attention from one task impacts subsequent tasks (Leroy, 2007 p.9). Research is needed into the carryover of lingering cognitive load from one task to the next (Leroy, 2009 p.169). Therefore, teachers and trainers in the classroom and workplace need to understand the effect of cognitive load and the amount of mental effort in working memory carried over from one task to the next.

Research Question

This project sets out to determine how, why and to what extent switching tasks leads to attention residue in university students.
Literature Review

Literature Genres

While this paper reviewed scientific magazines, recorded lectures by leading researchers and books such as *Deep Work* (Newport, 2016) to find answers to the project’s research question, the majority of sources referenced are either articles published in peer-reviewed academic journals or doctoral dissertations. These sources come primarily from the fields of psychology, neuroscience and education. While multiple sources were used in researching this project, Sophie Leroy’s seminal work in attention residue resulting from task switching (Leroy, 2007) is referenced heavily. There are three general areas in this literature review and the majority of the sources stem from the fields of psychology and neuroscience.

Psychology

This paper relies heavily on research conducted in the area of psychology. The project thoroughly reviewed a groundbreaking dissertation on attention residue as a result of task switching and its subsequent report in an academic journal in organizational psychology. The studies conducted in this dissertation and journal report explain the types of issues that arise from task switching and describe how time pressure plays a role in disconnecting attention from one task to the next (Leroy, 2007, 2009). The author found that limiting the amount of time available to think attentively on a task to the point of being rushed alleviates attention residue. Conversely, the author found that when attention residue
A study in the field of cognitive psychology analyzed the role cues play in alleviating negative effects on performance in task switching (Chorev & Sapir, 2000). A review of research into external pulls as a result of the use of electronic devices found that these devices contribute to cognitive overload in task switching (Thornton, et al., 2014; Weksler & Weksler, 2012). The consequences of task switching on attention highlight the ability to limit the effects of task switching and the demands on executive function (Brand, 2007). Additionally, there have been studies on affective methods in reducing attention residue from task switching in the genres of organizational psychology and cognitive neuroscience (Dreher, et al., 2001; Leroy, 2007, 2009; Wylie, Javitt, Foxe, 2004).

**Neuroscience**

Relating to the research findings in psychology, this project investigated neuroscience studies using neuroimaging to look into neural activity in task switching (Kieffaber & Hetrick, 2005; Kimberg, Aguirre, D’Esposito, 2000). Similar works also studied the dissolving of residue from task switching in an electrophysiological study (Wylie, Javitt, Foxe, 2004). This paper also collected research from an especially in-depth study using fMRI methods in 2001, where the data on the parts of the brain used in task switching was collected and analyzed to investigate what parts of the brain were in involved in task switching (Dreher, et al., 2001).
Education

Literature researched in the genre of education included traditional classroom education studies, as well as workplace training. One particular research project led to a study in management policy and training that investigated working professionals doing computerized tasks. This article helped the project by providing evidence to support other literature in this project (Bendoly, Swink & Simpson, 2014). In a general overview of the effect attention residue plays in a practical setting on productivity in the workplace, the literature includes the book *Deep Work* (Newport, 2016). Literature on the importance of attention in classroom learning is addressed in this project by including a well-respected paper on consciousness and foreign language learning. (Schmidt, 1995).

Analysis

Details of the Analysis

Evidence from the literature indicates two significant findings. The first finding is the importance of reducing cognitive load from the first task before beginning a subsequent task to alleviate attention residue. The second significant finding is the role external pulls from electronic devices used in a prior task have on the next task.

Reducing Cognitive Load

The literature provided evidence into the importance of ending cognitions, the active conscious thinking happening in the brain from an activity, before moving to another
activity to alleviate attention residue. Attention residue occurs when one has not fully
transitioned attention from a previous activity before starting the next (Leroy, 2007 p.14).
The evidence shows that completion of one task before starting a subsequent task is
effective to varying degrees, but does not guarantee cognitive closure of the first task
(Leroy, 2009). Needless to say, task completion occurs when a task has been completed,
while cognitive closure occurs when someone is no longer thinking about the task. It is
therefore conceivable that a math problem may be solved and the task completed, but the
mind continues to wonder if there were a better way to solve the problem. Therefore
cognitive closure would not take place and attention residue may be present (Leroy, 2009
p.170).

The literature supports two methods to alleviate attention residue between tasks. The
first method is to allow enough time for preparation of the new task (Dreher, et al., 2001;
Kieffaber & Hetrick, 2005; Leroy, 2007, 2009). The amount of time needed to alleviate
attention residue depends on the motivational pull from the first task (Leroy, 2007). The
second method is using time pressure to help with cognitive closure in the completion of a
task. Completing “a task under high time pressure before switching to another will allow
people to free their cognitive resources from the first task” (Leroy, 2009, p. 174). An
example of this is when one takes a test under intense time pressure. When the test is over,
the relative cognitive load is less than if there was no factor of time pressure. If there were
more time to think about answers, there would likely be more cognitive activity thinking
about possible alternative answers that could have been provided. Even though the task would have been completed, there would likely be attention residue when the next task begins. In classroom learning it is important for teachers to know how to vary the methods depending on the dynamic situation. Therefore, if a teacher wants the class to move on to another task, it may be of benefit to use a timer to time-stress the students in completion of the task. Contrarily, if the teacher’s desire is for deep reflection and thought by the students on the task at hand, this time-stressed activity could cause undesirable consequences such as student anxiety and therefore reduced retention (Boaler, 2012).

**External Pulls**

Research from two studies show that external pulls from electronic devices, primarily mobile telephones, play a significant role in attention residue from task switching (Thornton, et al., 2014; Weksler & Weksler, 2012). One study describing scientific literature and in personal observation support the view that the overuse or misuse of electronic devices promotes cognitive overload (Weksler & Weksler, 2012). This cognitive overload can then lead to attention residue when working on a task due to the constant connectivity, continual interruptions and distractions from these devices (Newport, 2016; Thornton, et al., 2014). Research further demonstrates that just the presence of a cell phone can cause distraction to the current task (Rubinstein, Meyer, Evans, 2001; Stothart, Mitchum, Yehnert, 2015; Thornton, et al., 2014).
In the university setting, social networking use has shown to have negative correlation with grade point averages, although cell phone calls do not show the same correlation (Harman & Sato, 2011). In another study, the presence of a cell phone only caused distracting effects in more complex tasks that require more cognitive availability and not in simple tasks that require less (Thornton, et al., 2014 p.485). In the classroom, attention is needed for learning to take place (Schmidt, 1995 p.11). Therefore, the mere presence of cell phones, due to constant connectivity, may cause attention residue and negatively affect learning negatively (Harman & Sato, 2011; Newport, 2016; Thornton, et al., 2014; Weksler & Weksler, 2012). To better understand how attention residue can occur from a social network site such as Facebook, imagine being in an engaging discussion with multiple people where numerous responses are coming in with alerts provided by a mobile telephone. If this discussion was not completed when moving to the next task, attention residue may be carried over and just seeing the mobile telephone could pull attention to the previous conversation on Facebook. Here attention is pulled in two directions with the task at hand competing with the previous task with a constant reminder of the electronic device in view. With smartphones replacing electronic and paper dictionaries in the classroom, this could arguably lead to further distraction away from the current task.
Conclusions

This paper sought to answer the question, “How, why and to what extent does switching tasks lead to attention residue in university students?” The evidence from the literature supports the idea that switching tasks leads to attention residue due to a lack of cognitive closure from the previous task and lingering cognitive load when engaging in a subsequent task (Leroy, 2007 p.10). While the literature details how and why switching tasks leads to attention residue, it does not provide conclusive evidence into what extent switching tasks leads to attention residue in university students.

Literature specifically on attention residue is very limited in the education context and not available in the university context, therefore it is recommended that future studies consider not only the workplace setting, but also that of the classroom. Furthermore, previous studies have not investigated why some individuals hold their attention on a specific task in a classroom filled with attention-pulling devices such as computers and other electronic devices, while others are more easily distracted by external pulls of attention.

Additionally, there is a lack of literature in the area of health and attention residue. This paper focused on an educational setting in the research question, but the majority of the evidence from the literature directly relating to university students was insufficient. That is, while the vast majority of the studies conducted thus far have focused on the workplace or controlled laboratory settings, there is a severe lack of studies centering specifically on university students.
Furthermore, since previous studies found that locations in the brain where task switching occurs contradicted each other, these findings failed to gain support. Therefore, this addition was not considered reliable for use in this study. Due to the number of variables relating to individuals in a university, future studies will likely need to be small and qualitative in nature. However, it may be difficult to make solid claims on the extent of attention residue from task switching on university students in general.

This project helped to identify specific reasons for attention residue from task switching in classroom settings. The literature also provided some insights into what methods help alleviate attention residue. These included time-stressed completion tasks, providing ample time for attention residue from task 1 to dissipate before starting task 2, and completing task 1 and obtaining cognitive closure before starting subsequent tasks.

Additionally, insights from the literature provided evidence of external attention pulling from electronic devices on task 2 used in task 1.

An important part of the research question that the literature was not able to provide answers to, is the extent to which task switching leads to attention residue in university students. Furthermore, the project was not able to provide much specific insight into university students. The lack of specificity on university students is important as gaining insight into the exact connection between attention residue and learning in university students was a core goal of this paper.
While the lack of research available in the literature focusing on the connection between attention residue and learning in university students did not provide conclusive evidence, there is enough evidence from other studied subjects to provide a foundation for further research. The literature researched in this paper and the findings from these studies will be important as a foundation in a planned study on university students learning English in Japan.


