STUDENT PERCEPTIONS AND LEARNING AFTER A COGNITIVE LOAD-BASED INTERVENTION TO REDUCE MULTITASKING BEHAVIORS

By

JESSICA DAWN TSOTSOROS

Bachelor of Science in Occupational Therapy
The University of Oklahoma Health Sciences Center
Oklahoma City, Oklahoma
1999

Master of Science Rehabilitation Sciences
The University of Oklahoma Health Sciences Center
Oklahoma City, Oklahoma
2003

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Oklahoma State University
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STUDENT PERCEPTIONS AND LEARNING AFTER

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Dissertation Approved:

Dr. Penny Thompson
Dissertation Advisor

Dr. Susan Stansberry

Dr. Tutaleni Asino

Dr. Sheri Vasinda

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Abstract: With the influx of educational and personal technologies in the classroom, parents, faculty, and students must find strategies to limit the seductive pull of multitasking. The purpose of this study is to determine if an awareness training and experience using website-blocking software improves learning in a lecture course, and if this experience changes students' multitasking beliefs and planned future behavior with respect to multitasking. This was an experimental study for students in a graduate level occupational and physical therapy program. Students were randomized into two groups. The experimental group received a two-pronged intervention: an education session with awareness exercises on multitasking and a website-blocking software for student use during lectures. Five content knowledge exams were administered and analyzed for group differences in learning. Results: The findings in this study showed that the awareness training and experience using Freedom software did not significantly improve learning in the short-term. Although there was no significant change in student beliefs on their ability to multitask, students reported the amount of time spent multitasking in class decreased across courses, and students reported an increase in the use of strategies to help them maintain attention in class. This finding can be explained using the Theory of Planned Behavior's (Azjen, 1991) predictor of a change of perceived behavioral control by having additional strategies to implement when tempted to multitask which can in turn increase the student's intention to minimize their multitasking behaviors as shown by the decrease in the number of minutes spent multitasking in classes across the curriculum.

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CHAPTER I

"…just as laptops and tablets open up the possibility of bringing the world into the classroom, they also constitute a backdoor through which students may escape" (Aagard, 2015, p. 93).

INTRODUCTION

As a new faculty member to a large university, my first assignment was to learn the curriculum of our graduate program. As part of this experience, I sat in the back of several lecture-based courses to observe. The first 8 a.m. class I observed consisted of 40 graduate students sitting in stadium-style seating in an auditorium listening to a 2-hour slide presentation. I was introduced to the students as a new faculty member who would have them in other classes that same semester. After I observed this class for the first week from the back of the class, I began to notice that all of the students had their laptops open during the lecture. Their cell phones were typically to one side of their laptops or held in their laps on silent. When the lecture began, students had their laptops opened to the professor's lecture slides, or they may be perusing social media, shopping for a wedding dress, or instant messaging friends. This is a common scene in college classrooms; however, it made me wonder: how much are students learning while maintaining this level of multitasking? Can they do two things at once proficiently? Do they feel they need this extra sensory input so they can attend to the lecture?

Technology is embedded into students' lives. Students are typically attached to some type of technology for most hours of the day inside and outside of the classroom (Rideout, Foehr, & Roberts, 2010). In a survey of more than 50,000 undergraduate students in 161 higher education institutions in the U.S., Dahlstrom, de Boor, Grunwald, and Vockley (2015) found that more than 91% of undergraduate

students own a laptop, 92% own a smartphone, 92% own at least two Internet-capable devices, and 64% own three or more mobile devices (p. 12–16). Sixty-one percent of these students said they typically have at least two devices connected to campus Wi-Fi at the same time (Dahlstrom et al., 2015).

The presence of technology in the classroom provides the temptation to multitask. Multitasking, or dividing attention between two tasks, can overload working memory and cause inefficiencies in learning (Schmitz & Voss, 2012). Humans have a long history of engaging in simultaneous tasks, although their abilities to multitask may be limited, depending on the nature of the secondary task (Wei, Wang, & Klausner, 2012). If a secondary task already has a working schema (a structured framework or plan used to organize and store information in the long-term memory), it may be considered an *automatic task*, which requires less attention or cognitive resources. Multitasking with automatic tasks can include actions such as chewing gum while walking, watching television while folding clothes, or running while listening to an iPod. While performing two automatic tasks at the same time seems to be innocuous, multitasking two activities that are not automatic may not be. Tasks such as listening to a college lecture while creating a Facebook post may affect a student's learning.

Background of the Problem

Multitasking is not a new phenomenon exclusive to the digital age. Before digital distractions, students passed notes, tapped pencils, doodled on notebook paper, talked to a friend during class, and studied for other courses—all of which continue to happen, but possibly in digital and less obvious forms (Hembrooke & Gay, 2003). However, the availability of mobile, digital technologies such as smart phones, laptops, and tablets entices students to attempt to multitask using these technologies. Multitasking requires more cognitive energy and time compared to focusing on one task at a time (Junco, 2012). A rapid degradation in learning and productivity takes place when switching tasks from listening to a slide presentation and back to digital technologies in class (Downs, Tran, McMenemy, & Abegaze, 2015; Junco & Cotten, 2012; Junco, 2015; Fried, 2008; Ravizza et al., 2015). *Multitasking* is the term used throughout

this paper to describe completing two or more tasks at the same time that involve digital technologies (Wang & Tchernev, 2012).

While some universities are seeking to ban laptop use in class, some faculty take the opportunity to use laptops, tablets, and smartphones as tools to actively engage students. Active learning activities may include student data collection, student assessment, student self-assessment, student research, simulated experiences, analysis of digitized performances assessing their own or others' skills, student collaboration, and online learning exercises (Weaver & Nilson, 2006). Although these tools can be useful, they can also become a possible distraction during a lecture or while studying if the learning activities are not carefully planned, or if the students lack the ability to limit their own multitasking.

With access to multiple technologies in the classroom and in study sessions outside the classroom, students need to know how to best use educational technologies and focus their attention for learning. Currently, there is little research on effective strategies for college students to limit digital distractions during lecture courses. Students may better retain educational information using these strategies. The majority of multitasking research uses undergraduate students, while very few studies include graduate students as participants. The purpose of this study was to determine if an awareness training and an experience using a website-blocking software improves learning in a lecture course setting and if either or both of those strategies change graduate students' multitasking beliefs and planned future behavior with respect to multitasking.

Research Questions

This experimental study compared beliefs, behavior, and content learning between a randomized control and experimental groups. The experimental group received an intervention to limit multitasking in a lecture course. The intervention for the experimental group consisted of two parts. Part One was an educational session to increase student awareness of the risks of digital multitasking based on the theory of

planned behavior (Ajzen, 1991) and cognitive load theory (Sweller, 2010). Part Two involved the use of website-blocking software, called "Freedom" to limit multitasking during lecture. The following research questions were addressed:

1. What are graduate students currently doing to control their multitasking in a lecture course?
    a. What is the type and extent of multitasking during class?
    b. What strategies, if any, are they currently using to control their multitasking?
2. What are graduate students' current beliefs/attitudes on multitasking in lecture?
    a. What are their perceptions of their own responsibility to maintain attention in class and to limit multitasking?
    b. What are their perceptions of their own ability to multitask effectively?
3. Does an intervention that includes both awareness training and practical strategies change graduate students':
    a. perceptions of responsibility to maintain attention in class to limit multitasking?
    b. perceptions of their ability to multitask effectively?
4. Is there a relationship between graduate students' perceptions of their ability to multitask and their learning as measured by quiz scores?
5. Does an intervention to limit multitasking lead to better graduate student learning as measured by quiz scores?

Importance of the Study

Technology provides multiple benefits for college students, including collaborative work, finding course resources instantly, and facilitating communication with classmates and instructors. However, the pervasive use of technology in the classroom needs to be examined as it relates to student learning outcomes. Faculty, administrators, and others stakeholders interested in student success at all levels of

education, must consider how multitasking can affect student learning inside the classroom, thus affecting performance and learning potential. With the availability and presence of technology increasing and the temptation remaining, it is important to understand how to help not only undergraduate students, but also graduate students control their multitasking in the face of temptation to optimize learning.

Scope of the Study

The term "multitasking" is used in contexts that can include such activities as: texting and driving, watching television while folding clothes, listening to music during studying, and many other types of multitasking. This study will not consider these other types of multitasking. In the context of this study, multitasking encompasses whether or not students use of an Internet-enabled laptop during a graduate lecture course interferes with learning outcomes. The term "multitasking" will be used throughout this paper to describe multitasking that takes place using multiple digital technologies in a classroom at one time.

Theoretical Framework

A theoretical framework provides a structure and a lens to view a research study. Theories used in this study are Cognitive Load Theory (Sweller, 2010), Atkinson and Shiffrin's Working Model of Memory (1968), and the Theory of Planned Behavior (Ajzen, 1998). The Cognitive Load Theory (CLT) and Atkinson and Shiffrin Model of Memory were used together to develop the intervention. The Theory of Planned Behavior helps to explain students' multitasking behaviors.

Cognitive Theories. Atkinson and Shiffrin developed a working model of memory in 1968 (Andiel & Liu, 1994), which is used as a basis for understanding working memory in this paper. Short-term memory is considered the temporary storage container and is assumed to have much more of a limited capacity than the long-term memory (Andiel & Liu, 1994). The long-term memory has an unlimited capacity.

Baddeley (2007) defines working memory as "…a temporary storage system under attentional control that underpins our capacity for complex thought" (p. 1). Learners attend to and take in information through their sensory system and store this in their short-term memory. Each sensory channel (visual and auditory) has a limited capacity for holding pictorial or verbal information. Once this incoming information is detected and the person pays attention the information can be held for a very short amount of time or is otherwise lost (see Figure 1). The learner can then construct a mental model or schema to retain this piece of information in the long-term memory, where it is stored indefinitely.

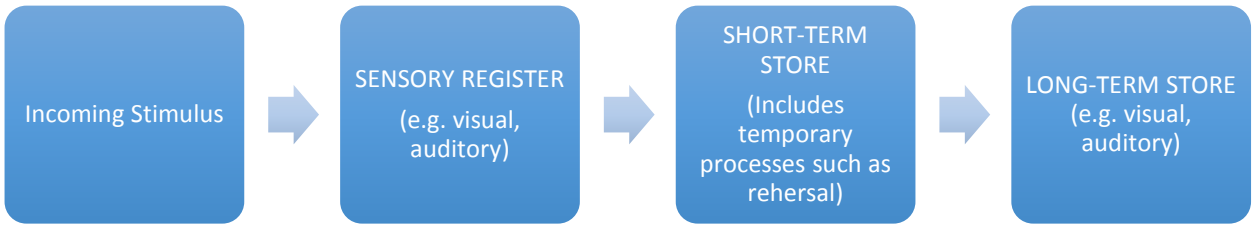

Figure 1: Atkinson and Shiffrin's Working Model of Memory.

Cognitive Load Theory (CLT) builds on the foundation of the working memory model. CLT is a theory of learning and instructional design principles based on assumptions about human cognitive architecture (Sweller, 2004; van Merrienboer & Ayers, 2005). Since the 1980s, educational researchers have applied CLT in their work on issues such as transfer of learning, memory, instructional design, and measurement of cognitive load (Clark, Nguyen, & Sweller, 2006). CLT research has provided evidence-based guidelines for classroom instruction (Clark et al., 2006) and multimedia instruction (Mayer & Moreno, 2003).

Cognitive Load Theory research is primarily concerned with instructional techniques for managing working memory load to facilitate learning (Ayers & Paas, 2012). Learning is defined as a change in long-term memory associated with schema construction and automation, and instruction is defined as the teacher's environmental arrangements for facilitating changes in the learner's knowledge (Mayer, 2008).

CLT is based on three assumptions: the active processing assumption, the dual channel assumption, and the limited capacity assumption (Mayer & Moreno, 2003).

The *active processing* assumption views the learner as actively engaged in the construction of building knowledge (Clark et al., 2006). Knowledge construction includes paying attention to relevant material, mentally organizing material, and integrating material with prior knowledge for learning (Mayer & Moreno, 2003). The *dual coding theory* assumption is based on how the brain processes incoming written and visual information. Learners have two channels, one channel is used for visual information such as pictures or animation and the other channel is used for verbal information such as words, which can be auditory and/or written in text (Pavio, 1986). Both channels have a *limited capacity* and can only process one type of information at a time. When there are excess pieces of information that could be considered redundant, the brain cannot process both pieces in one channel and has the potential to become overloaded. Both channels are used during a typical lecture when students are presented with a slide presentation (visual) and lecture (verbal). When either of these systems is overloaded or asked to process more than one form of information (words and/or pictures) from each channel, this presentation of information can overload the entire processing system, resulting in cognitive overload and decreased capacity to learn (Mayer & Moreno, 2003).

Cognitive Load Theory describes three types of cognitive load presented in instruction (see Figure 2) which impact learning (Sweller, 2010). *Extraneous load* consists of factors that tax working memory without contributing to learning, and arises primarily from how the information to be learned is presented to the learner. *Extraneous load* takes into account how the information to be learned is presented to the learner through instructional design. Good instructional design strategies can minimize extraneous cognitive load, whereas anything that distracts the learner can impose additional extraneous cognitive load.

Intrinsic load comes from the educational information that the learner is to acquire. Intrinsic load can be high or low depending on the complexity of the material presented. The intrinsic load of the

material is fixed for the particular learner and cannot be altered (Sweller, 2010), though it varies for different learners depending on previous knowledge and experience with the subject. Thus, intrinsic load is a function of both the complexity of the information and the learner's previous knowledge. For example, the subject of the circulatory system of the heart is an inherently difficult subject and creates a high intrinsic load for most students. However, if the student had prior knowledge of the heart and previous coursework about the circulatory system, the intrinsic load of this material would be less for that particular student.

Germane load, the third type of cognitive load described by Sweller (2010), encompasses the structures and schemas required to move the information from the short-term memory to the long-term memory (van Merriënboer & Sweller, 2010). The germane load helps the working memory to store the newly learned information in the long-term memory for later use and transfer. The germane load is the most productive of the three types of cognitive load and allows students to connect the new information to previously learned information and make schemas or units of knowledge. To maximize the germane load the instructor must take great effort to decrease the extraneous load when possible and help students build schemas or patterns to use in learning to make connections.

The total cognitive load, therefore, is the sum of intrinsic, extraneous, and germane cognitive load, all contained within the limited capacity of working memory (see Figure 2). If the total cognitive load exceeds the learner's working memory, the processing and learning of new information will be halted, becoming detrimental to learning. Because intrinsic cognitive load cannot be controlled, and germane cognitive load is desirable for learning, the extraneous load must be minimized to increase the likelihood of long-term retention of the material.

Cognitive Load Theory is used as a basis for the intervention provided in this research. The intervention is an effort to bring awareness to students on distractive multitasking and implement a new strategy to decrease the extraneous load during lectures, freeing up the working memory to process and create a schema of the information to move into the long-term memory. Multimedia multitasking puts an

undue stress on memory, due to extraneous cognitive load, and requires the student to continually refocus on the lecture material.

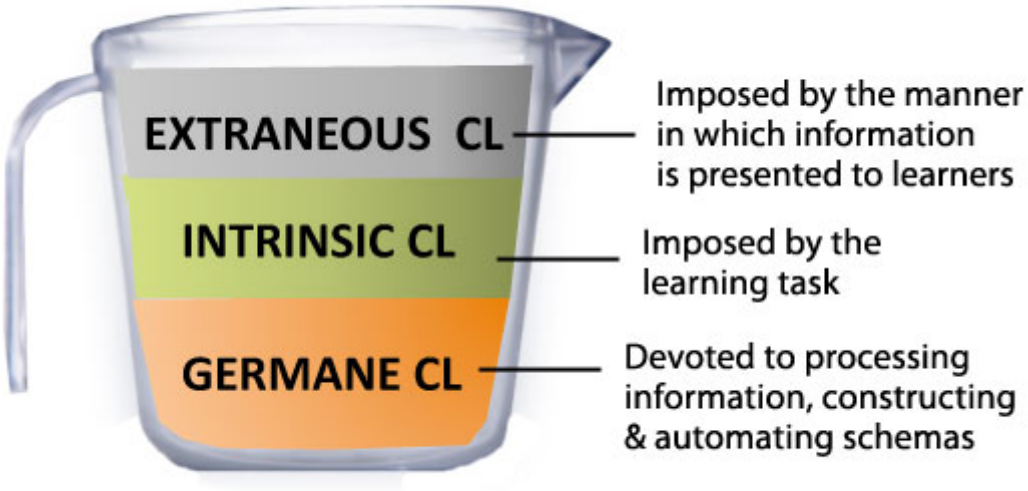

Figure 2: Cognitive Load Theory

Figure used with permission by Connie Malamed at http://theelearningcoach.com/

Theory of Planned Behavior. The Theory of Planned Behavior (TPB) (Ajzen, 1991), shown in Figure 3, is a general model of human behavior based on three constructs that are predictors of behavior: attitude toward the behavior, subjective norms, and perceived behavioral control. The theory suggests that a person's behavior is determined by their intention, which is a function of their attitude, subjective norms and perceived control. *Attitude toward the behavior* is defined by one's evaluation of the behavior, consisting of beliefs and values about the outcome of the behavior and influenced by the control a person believes they have over the behavior (Zemore & Ajzen, 2014). The attitude can be whether the person believes the behavior is enjoyable or not as well as if the behavior is perceived as beneficial or harmful.

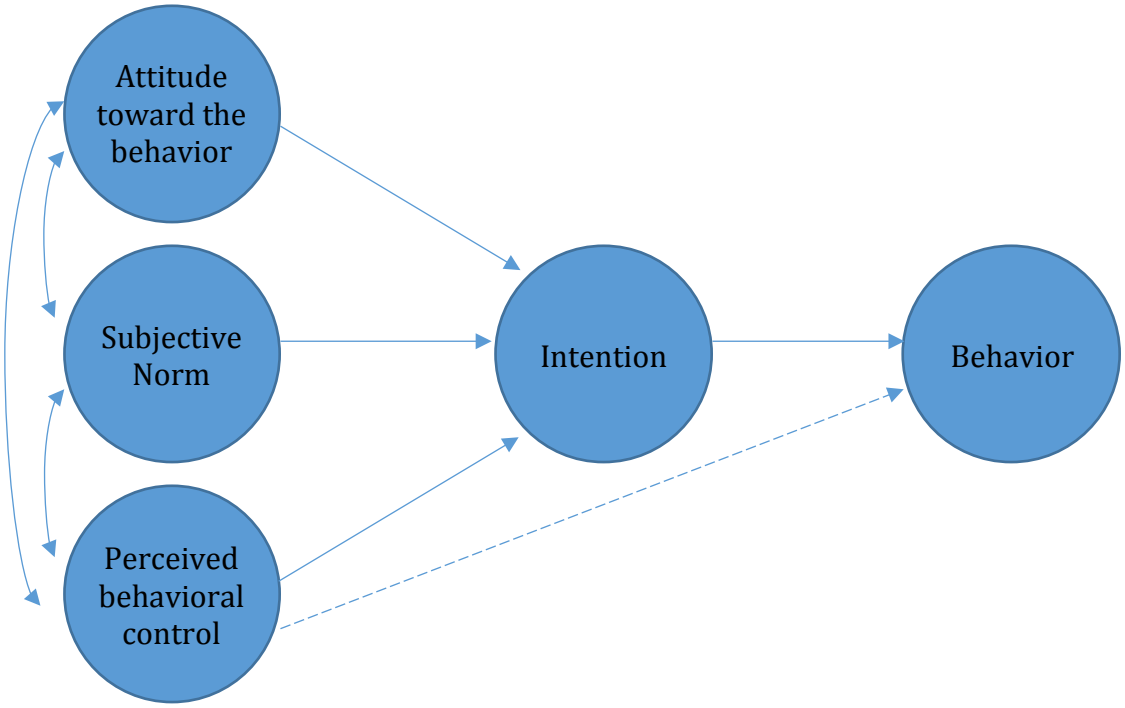

Figure 3: Theory of Planned Behavior

Subjective norms, social norms or beliefs of what other people think a person should do, also impact intention, and ultimately, behavior. This is the influence that others have over a person's behavior. Subjective norms could be students perceiving attitudes and beliefs of instructors or other students around them (Ajzen, 1991). Finally, the Theory of Planned Behavior states that behavior is dependent on *perceived behavioral control* defined as "an individual's perceptions of their ability or feelings of self-efficacy to perform the behavior" (Ajzen, 1991, p. 184).

Attitude towards a behavior, subjective norms, and perceived behavioral control directly act on intention, which leads to the observable behavior. Intentions capture motivational factors that influence the behavior. The stronger the intention for a person, the more likely the person is to act on the behavior (Ajzen, 1991). The stronger the person's perceived behavioral control, or confidence that he or she can complete the behavior successfully, the stronger the probability is that the behavior will come to fruition

(Ajzen, 1991). A person must have the behavior under their control if it is to come to fruition. For instance, a person may have the motivation and intention to be a jockey; however, with a six-foot frame, no amount of intention or motivation will change his or her size to fit into this profession.

There is a direct link between perceived behavioral control and behavior. If two persons have the same intention and strength of intention, the person who has a higher level of confidence (or perceived behavioral control) that he or she can complete the behavior is the one who has the stronger predicted outcome for their behavior. For instance in the jockey example, if one person has a six-foot frame with the exact same strength of intention as a peer that is four feet tall, yet the smaller one has a stronger behavioral control in knowing that he or she can meet the criteria, that person is more likely to pursue this profession. Figure 3 shows this connection by the dotted line.

The Theory of Planned Behavior (Azjen, 1991) was chosen as a framework for the current study to support a change in student's multitasking behaviors as a result of the intervention. The educational session focused on current research related to the detriments of multitasking for college students and an awareness exercise to demonstrate firsthand how difficult it is to concentrate on two activities at one time. Both pieces of the educational session were intended to act upon the student's attitude toward the student's behavior. The student's attitude is influenced by how enjoyable and effective the behavior is for the student. If the student's attitude changed from thinking that multitasking is enjoyable and effective and now understands this behavior as possibly detrimental to learning, this could influence the student's thinking, leading to an increased intention and ultimately the behavioral change of decreased multitasking.

The intervention in this study was expected to change a student's attitude toward multitasking behavior through an experiential exercise of multitasking and discovering the difference in their quiz scores before and after a website-blocking strategy is in place. The Theory of Planned Behavior supports the student's intention of using new strategies for future success in controlling digital multitasking. The strategies in the intervention are based on Cognitive Load Theory and the limited threshold of incoming

verbal and visual information including the addition of student's texting, iMessaging, checking social media or writing an email while listening to the lecture. When students learn new strategies to control their multitasking they may have an increase in their perceived behavioral control, thus increasing their intention and behavior which in turn may limit multitasking.

Definitions of Terms

The following words and phrases are frequently used in the literature to describe multitasking and attention:

Dual Tasking – Attempting to complete two tasks at the same time (Alzahabi & Becker, 2013).

Multitasking or Concurrent Multitasking – the attempt to complete two or more tasks at the same time (Wang & Tchernev, 2012). Junco and Cotton (2012) define multitasking as "divided attention and non-sequential task switching for ill-defined tasks as they are performed in learning situations. (Text messaging a friend while studying)" (pp. 505–506).

Sequential multitasking – Occurs when two or more tasks are being accomplished in a given timeframe, but are never being done at the exact same time. For example, a person can microwave a bowl of soup and make a salad for lunch, both of which can be done in the same time frame, but attentional resources are focused on one task at a time (Downs et al., 2015).

Switchtasking –Sequential tasks where the person is focused on one task at a time (Judd, 2014).

CHAPTER II

LITERATURE REVIEW

Introduction

Students are tethered to the Internet for entertainment, social media, and communication with friends through email and instant messaging for most hours of the day (Dahlstrom et al., 2015). Personal technology ownership continues to increase, and this need for constant connection does not stop at the classroom door (Anderson, 2015). Teens and young adults who have grown up with technology are the heaviest multimedia multitaskers in learning environments (Carrier, Kersten, & Rosen, 2015). College students have a unique need for increased technology to make their studies efficient and portable, moving from class to lab to study environments. The temptation to multitask has increased with each generation of students along with device ownership, putting students in the position to multitask in the classroom as well

(Carrier, Cheever, Rosen, Benitez, & Chang, 2009). With the increased need for technology ownership and earlier required use, technology has become ubiquitous in the lives of students.

This chapter reviews the research related to student learning and multitasking. For an exhaustive search of literature related to multitasking, the researcher utilized ERIC and Web of Science databases. Search terms used were: multitasking, attention, switchtasking, and lecture in psychology experimental and neurosciences. This chapter presents an overview of how multitasking is defined in the literature, along with an explanation as to why multitasking may be detrimental to academic performance. Then, a summary of research on why students are drawn to multitasking and students' perceptions of whose responsibility it is to maintain attention in class is presented. Finally, the Theory of Planned Behavior is presented as a basis for the behavior change expected from the intervention in the study (Azjen, 1991).

Multitasking – What is it?

With the availability of personal and classroom technologies, college students have access to multiple technologies for different purposes. When students enter a traditional lecture class, they may have a phone, a laptop, a smart watch, and possibly a tablet. The college instructor may use additional technologies, such as video, slide presentation, clicker devices, and smart boards. Within the classroom environment, students make decisions about which tool to use for which task and on which tool to focus their attention. Switching back and forth between technologies requires a person to split their attention between two different technologies or multimedia at the same time (Judd, 2013). Multitasking is defined as "performing multiple tasks either simultaneously or in rapid alteration..." (Rubinstein, Meyer, & Evans, 2001, p. 763). Students multitask for different reasons. Internal and external triggers can be the impetus for a student's multitasking behavior during class (Adler & Benbunan-Fich, 2013). Students may have self-interruptions due to internal triggers such as boredom or motivational factors, anxiety, or external interruptions such as instant messages or email notifications on their computer.

Why is Multitasking Counterproductive to Learning?

The human memory is characterized by a limited capacity. According to Atkinson and Shiffrin (1968, as cited in Andiel & Liu, 1994), there are three structural components of memory: the sensory register, short-term memory, and long-term memory (see Figure 4). The *sensory register* is where incoming sensory information is registered through the visual or auditory system. After the sensory information is passed through the sensory register the information is sent to the *short-term store*, and finally it is transferred from the short-term to the *long-term store*. Short-term memory is considered the temporary storage container and is assumed to have limited capacity (Andiel & Liu, 1994). The short-term memory holds five to nine chunks of information (Miller, 1956). The long-term memory has an unlimited capacity for information (Andiel & Liu, 1994).

Learners attend to and take in information through their sensory system and store this in their short-term memory or working memory. While there are subtle differences between the constructs of "short term memory" and "working memory," the terms are frequently used interchangeably in recent educational psychology literature. Baddeley (2007) defines working memory, as "…a temporary storage system under attentional control that underpins our capacity for complex thought" (p. 1). Each sensory system has its own depository where information is held in the working memory through a two-channel system. One channel (Visuospatial Sketchpad) holds and processes visual information and the other channel (Phonological Loop) holds and processes auditory or verbal information (Baddeley, 1986). Each of these channels has a limited amount of capacity for holding pictorial or verbal information. Once this information is processed, the learner can then construct a mental model or schema to retain in the long-term memory. Once a schema is stored in the long-term memory it can be used and retrieved later.

Attention. For the sensory system to register the incoming stimulus, the student has to first attend to the visual or auditory information. With attention as the gatekeeper to memory processing, storing, and retrieving information, learning cannot happen without this sustained attention (Steinmayr, Ziegler, & Träuble, 2010). The ability to focus attention on the incoming stimuli is the first step in the learning process

to produce meaningful learning and to retain information (Baddley, 1986). Students may seem to juggle multiple tasks at one time with ease; nevertheless, long-term learning requires attention to the course material. Students who attend to multiple media devices during a lecture course are subject to distraction, taking their attention away from lecture. If students use social media and email during the lecture or discussion, they must divide their attention. When other activities create a distraction, the learner makes intentional or unintentional choices concerning which source of information to pay attention to for storing and moving to long-term memory. When students become entrenched in social media and email during a lecture, they cannot move lecture information from short-term to long-term memory efficiently (Sweller, 2010), which decreases academic performance (Junco & Cotton, 2012).

In researching competing visual and auditory attention, Kastner, De Weerd, Desimone, & Ungerleider (1998) used functional Magnetic Resonance Imaging (fMRI) and presented participants with sequential or simultaneous pictures. The areas of the brain that process visual information showed a much stronger signal on the fMRI when pictures were presented sequentially rather than when pictures were all presented at the same time. Researchers believe that this finding validates that competition among multiple stimuli may lead to suppression of some images (Kastner, De Weerd, Desimone, & Ungerleider, 1998). When presenting material with competing visual content, one of the sources may be suppressed. Because of what is known about memory and attention, the inference can be made that when students multitask in the lecture, their attention is divided between two or more tasks, decreasing the sustained attention necessary for learning.

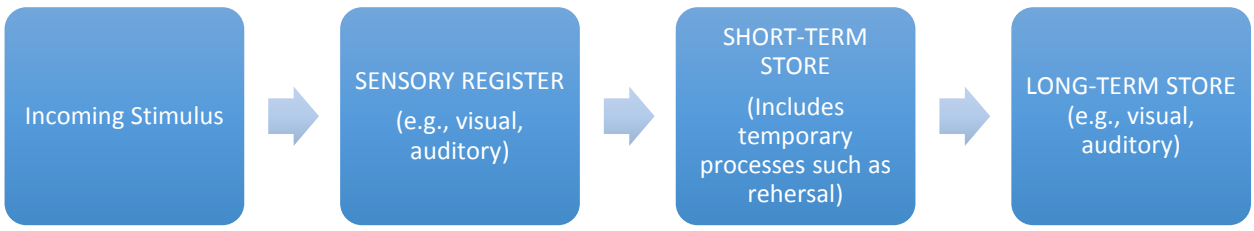

Figure 4: Atkinson and Shiffrin's Working Model of Memory.

Even without students using their personal technologies in a classroom, student attention wanes. Farley, Risko, and Kingstone (2013) explored how the factors of time on task (lecture), fidgeting, and memory affected attention in a lecture class. Their research demonstrated attention to and retention of lecture content (whether in person or on video) decreased during the second half of the class session, while fidgeting increased. Risko, Anderson, Sarwal, Engelhardt, and Kingstone (2012) confirmed these results in a study which focused on the attention of lecture material and mind wandering, finding that attention decreases, as does retention of lecture material, as time increases. Bunce, Flens, and Neiles (2010) used clicker technologies to enable students to self-report when their attention waned during lecture. On average, students reported a lapse in attention during the first 30 seconds of a course, then at 4.5 minutes and then at shorter and shorter segments throughout the lecture. These studies demonstrate that students are prone to mind wandering, which increases the temptation to engage in another form of stimulation or entertainment such as multitasking.

Increased cognitive load. The working memory is where information is processed and stored temporarily in preparation for moving the new information to the long-term memory. Each person has a limited amount of working memory that holds a finite amount of information for a limited amount of time before it is either taken into the long-term memory or forgotten (Baddeley, 1986). Cognitive Load Theory (Sweller, 2010) further explains this working memory bottleneck by defining three types of *cognitive load*, which influence learning: intrinsic load, extraneous load, and germane load.

Intrinsic load is comprised of the information that the learner is to acquire. The intrinsic load can be high or low depending on the complexity of the material presented. The intrinsic load is fixed for the particular learner and cannot be altered (Sweller, 2010). This load is varied for different learners depending on previous knowledge and experience with the subject. Thus intrinsic load accounts for both the complexity of the information and the previous knowledge of the learner.

Extraneous load consists of factors that tax working memory without contributing to learning, and arises primarily from how the information to be learned is presented to the learner. Instructional design strategies can either create or minimize extraneous cognitive load, depending on the design. Anything that distracts the learner and makes the learning process difficult could be considered extraneous. One way of limiting the extraneous load is taking into consideration the dual coding theory (Review, 1991), which suggests each person has two channels to process incoming information. One channel is used for visual information such as pictures or animation and the other channel is used for verbal information such as words, which can be auditory and written in text (Pavio, 1986). Both channels have a limited capacity or threshold and can only process one type of information at a time. Both channels are used during a typical lecture when students are presented with a slide presentation (visual) and a lecture (verbal). When either of these systems is overloaded or asked to process more than one form of information from each channel (words or pictures) this presentation of information can overload the entire processing system, resulting in cognitive overload (Mayer & Moreno, 2003).

Germane load, the third load described by Sweller (2010) in Cognitive Load Theory, encompasses the structures and schemas required to move the information from the working memory to the long-term memory (van Merriënboer & Sweller, 2010). This portion of the load is required for students to connect pieces of new material from their experiences or long-term memory to store the newly learned information in the long-term memory for later use and transfer. Thus, germane cognitive load arises from the necessary work performed by the learner in the learning process.

While all three types of cognitive load tax the limited working memory resources, only germane cognitive load contributes to learning. If the combination of all three types of cognitive load is too high, the germane load present may be limited and the processing and learning of new information may be halted. With the finite capacity of working memory, the extraneous load must be minimized to increase the likelihood of long-term retention of the material.

Mayer and Moreno (2003) address extraneous load in their Cognitive Theory of Multimedia Learning through a concept named “coherence effect.” The coherence effect states "students understand a multimedia explanation better when interesting but extraneous material is excluded rather than included” (p. 48). The instructor has control over multimedia presented in class and should be informed of the cognitive load principles to minimize the extraneous load as much as possible.

While extraneous cognitive load can be minimized by good instructional design, student behaviors and habits of multimedia multitasking during class presentations may impose additional extraneous cognitive load beyond any inherent in the lesson design. Students may open up a website or search through emails while listening to a lecture and following a slide presentation. The increased inputs in the visual channel may increase the extraneous load causing a bottleneck effect or a limit of incoming information that can be processed at one time in the visual system. (Pashler & Johnston, 1998; Carrier, Rosen, Cheever, & Lim, 2015). When students go over this threshold and create a cognitive overload, it becomes more difficult, if not impossible, to retain the new information. Students need to be aware of the impact of multitasking on their available cognitive resources and ultimately their learning.

Demonstrated negative impact of multitasking on academic performance. Research has demonstrated a disadvantageous effect of multitasking on learning outcomes (Downs et al., 2015; Junco & Cotten, 2012; Junco, 2015; Fried, 2008; Ravizza et al., 2015). The majority of experimental studies investigate multitasking during lecture and include university undergraduate students in various multitasking conditions (distracted by Facebook, Instant Messaging, Texting and emails or non-distracted with and without technology) **(**Downs et al., 2015; Wood et al., 2012; Hembrooke & Gay 2003). These experimental studies use a content knowledge exam after the lecture to assess recall of the lecture material. For example in Wood et al.’s study of multitasking in a lecture class with four technology-distracted groups (texting on cell phone, emailing, instant messaging, and Facebook) compared to three control groups (paper and pencil note taking, word processing note taking, and natural use of technology conditions) all control

groups outperformed the technology-distracted groups. The paper and pencil note taking group fared best of all groups on achievement exams. These studies show attempting to attend to lecture material and using digital technologies at the same time can have a detrimental effect on learning (2012).

Although the majority of studies explore multitasking and its effects with undergraduate students there are two multitasking studies include graduate students. One study by Ankit, Dustin, Mullens, & Van Duyn, included 2nd year osteopathic medical students who were administered a survey to identify technology use and influences as well as content knowledge quizzes in 50-minute lecture courses. The researchers found the students' multitasking behaviors were highly influenced by their examination schedule. The weeks that students had exams in other courses were the weeks that the students' multitasking usage increased and quiz scores decreased (Ankit et al., 2014). The second study found pertaining to multitasking and graduate students focused on third year dental students. This study was a quasi-experimental study and was notably underpowered, however results demonstrated that students who reported they were distracted scored one point lower on a quiz score, than the students who reported they were not distracted (Nalliah & Allareddy, 2014). The authors of this study did recommend for universities to consider internet blocking as a strategy to reduce student distraction during lecture (Nalliah & Allareddy, 2014).

Two research studies also used a multitasking efficiency scale to assess students' self-perceptions of their ability to multitask (Downs, Tran, McMenemy, & Abegaze, 2015; Terry, Mishra, & Roseth, 2016). For example, Down's et al., studied undergraduate students in six different classroom environments under various conditions. Students watched a 25-minute novel documentary and most students had laptops open in front of them. Three of the six conditions were unstructured, meaning students could use laptops at will but with added conditions of required interactions of: a) Facebook chat b) taking notes on laptop and c) a combination of both Facebook chat and laptop notes. Two conditions, described as structured, were without laptops or with laptops used only to type notes. The last group is the control group where the

students simply watched the video, with no other technology use, Students took a pretest and a posttest with questions related to their self-assessment of their ability efficiently to multitask, and a 15-item multiple-choice quiz was provided at the end of the documentary. Researchers found that students taking notes by hand or on laptops without any other technology distractions did best on the performance exam, with those taking notes by hand performing slightly above the laptop group. Just behind this group was the control group who only watched the video with no technology. The three groups in the technology distracted conditions using Facebook scored significantly worse than the students taking notes by hand, students with laptops only, and the control group. Scores on the Perceived Multitasking Proficiency Scale revealed a significant difference from the pretest to posttest, with students scoring themselves as less effective multitaskers after the experiment was complete, demonstrating self-awareness through experiential learning (Downs et al., 2015).

Beyond experimental studies, survey studies explore the effects of multitasking in the college lecture hall. Survey research has allowed researchers to explore learning outcomes over the course of semesters and retrospectively through high school GPAs. These studies use measurements including Internet skills, frequency of technology in the classroom, and student report of how they believed using technology in the classroom affected their grade. These studies also confirmed that academic performance degrades as multitasking increases and there is an inverse relationship between multitasking and academic performance, however it should be noted that all of these studies were done with undergraduate participants (Ravizza et al., 2014; Junco, 2012). For example, Junco (2012) studied undergraduate students' multitasking activities in lecture and the effects on grade point average (GPA). The survey measured demographics, frequency, and type of multitasking. Junco found that 34 percent of the students indicated they regularly text in class, 13% use Facebook, 11% email during class and 8% surf non-course related sites during lecture. Using hierarchical linear regression, Junco determined that frequency of Facebook and texting were negatively predictive of the student's GPA (2012).

Although the majority of research studies on multitasking as it pertains to academic performance took place in a classroom setting or through a survey, Rosen, Carrier, and Cheever (2013) conducted an observational study with different levels of students from middle school to university. Two hundred and seventy nine middle school, high school, and university students participated in this study. Students were observed in their typical study or homework environments. A trained observer used a checklist and observed how many times the student was off task with distracting activities while studying. Activities included ranged from texting on the cell phone to Facebooking to the use of Twitter. Even with students knowing they were being observed, the students could only maintain their on-task behavior for an average of six minutes (2013). The switch to off task behavior was due to notifications, having more than one device in the study area, or watching television. There was a negative correlation between the number of times students checked their Facebook during studying and their GPA. As a result of their study Rosen et al. suggest that listening to music does not interfere with studying, allowing students to check into social media or text every fifteen minutes may alleviate the student's anxiety when away from their social network, and encouraging students to use metacognitive strategies such as waiting to check text messages after thirty minutes, turning off Internet, and turning off distracting notifications during the class period could help decrease multitasking behaviors (2013).

With much of the research demonstrating that students are spending at least some time multitasking during the lecture, one study by Hembrooke and Gay explored the different types of Internet browsing and how this affected student learning (2003). The researchers assessed students' comprehension of a lecture under "laptops open" and "laptops closed" conditions. Students browsing behaviors were analyzed for time the students were browsing and whether their browsing was for on-topic or off-topic information. Hembrooke and Gay (2003) found that it did not make a significant difference if the student was searching on- or off-topic information; scores decreased the longer the student spent browsing during the lecture.

Although much of the current research shows that multitasking degrades academic performance, a few studies report no difference or a difference of increased time on task, depending on the secondary task. Bowman, Levine, Waite, & Gendron (2010) assessed students' ability to read a passage of text online while simultaneously responding to instant messaging. The speed of reading was measured and a content knowledge exam was given after the passage was read. The group that read and responded to instant messaging while reading had a significantly increased time on reading; however, no difference was found in the results of the comprehension exam. Cho, Altarriba, and Popiel (2015) replicated the study and again found no significant difference in the comprehension exam and no increase in the amount of time it took students to complete a reading comprehension passage while multitasking.

Through survey research and experimental studies, the majority of studies find that academic performance degrades as multitasking increases (Junco, 2012; Junco, 2015; Fried, 2008; Ravizza et al., 2015). As Junco and Cotten (2012) summarize, students are "aware that divided attention is detrimental to their academic achievement; however, they continue to engage in the behavior" (p. 376).

Student Multitasking Beliefs

While the majority of research demonstrates that student multitasking is not beneficial to educational efforts, students continue to fall prey to digital distractions. Students may believe they can accomplish more this way because they think they are proficient at multitasking or believe that there is no cognitive cost to multitasking. As Junco and Cotten (2012) summarize, students are "aware that divided

attention is detrimental to their academic achievement; however, they continue to engage in the behavior" (p. 376).

Students believe they can multitask effectively. Students believe that they are only somewhat proficient multitaskers, yet continue to multitask. On Downs et al.'s Perceived Multitasking Efficiency Scale 204 undergraduate students scored themselves at the midpoint on a Likert scale of one to five (2015). This score decreased after facing various experimental conditions of multitasking in the lecture course. Undergraduate students in an Introduction to Psychology lecture reported they were dual tasking with technology by surfing the Internet 17 out of 75 minutes of class. The time students spent browsing may indicate that students are not concerned with the content they are missing or believe they can efficiently multitask (Fried, 2008).

Student perceived importance of laptops in the classroom. Students report a mix of messages regarding the utility of laptops in the classroom. Laptops provide students passive and active benefits inside and outside the classroom. Kay and Lauricella (2011) surveyed 156 university students enrolled in communication or teacher education courses to examine their perspective on the passive and active utility of laptops in class and out of class. Students reported both passive and active uses were beneficial. Passive uses include activities such as taking notes, using instructor provided notes, or following a slide presentation on their laptop. Active tasks included collaboration with other students, searching for class related content, using interactive tools, communicating with peers, or using academic software. Despite these perceived benefits, seventy-five percent of the students reported the most challenging aspects of using a laptop during class was the distraction from unrelated course websites, social networking, and instant messaging (Kay & Lauricella, 2011).

In another study on student satisfaction with the use of laptops, researchers found that student satisfaction was not improved. Wurst, Smarkola, and Gaffney (2008) surveyed faculty and students in an honors business college course that implemented college-provided laptops over three years. Researchers

wanted to know how use of the laptops affected student satisfaction, student learning, and course pedagogy. Results of this study indicated that student satisfaction with the class was not improved with laptop use, GPA did not increase, and laptop use was not a catalyst for more constructivist teaching methods. Students perceived the most important benefit of laptop use outside of the classroom was collaborating with other students; however the challenges were again the distraction of web searches, social networking and entertainment websites that allow the student to avoid or procrastinate studying (Wurst et al., 2008).

Students may lack discipline or control strategies. With students believing they can multitask and believing that laptops are beneficial in the classroom, it behooves students to learn and practice discipline or control strategies to limit the temptation to multitask. In a qualitative study, undergraduate students reported that using social media is habitual and a part of their lives and that opting out feels "unnatural." Students in this study felt like social media was a constant temptation in and out of class and had to be "overcome" to stay on task (Flanigan & Babchuk 2015). Zhang (2015) created a theoretical path model based on current literature to find the correlations among learning variables, multitasking behaviors, and academic performance. One hundred seventy-six undergraduate students completed a survey for this study. Zhang hypothesized that all variables would have an impact on student multitasking and student's midterm grades. The path analysis study was broken down into the following variables: intrinsic motivation, extrinsic motivation, self-efficacy, self-regulation, test anxiety, and academic performance. The final path analysis suggests that the strongest correlations are between the student's self-regulation and intrinsic motivators and multitasking. This finding suggests that instead of imposing external regulations, such as banning laptops or faculty dictating class rules, educators and parents have to address the potential negative impact of laptop multitasking through building students' sense of self-efficacy and learning motivations as well as encouraging self-regulation of laptop multitasking behaviors by students themselves (Zhang, 2015).

"Digital Metacognition" a term described by Carrier, Rosen, Cheever et al., (2015), encourages students to think about their own process of thinking and learning and how juggling multiple forms of media could impact learning long-term. Students may choose to stop instant messaging in class or be aware of their own anxiety from being separated from their mobile devices. Students thinking about their own process of learning and what impedes this process may lead to better learning outcomes. Once students are able to identify what is a problem for themselves, they become more self-aware and may be willing to try new strategies.

In an experimental study exploring undergraduate student preferences for multitasking, attitude scale, technology anxiety and metacognitive strategies, researchers administered a comprehensive survey as well as provided a brief intervention to s a subset (117) of the participants (Terry et al., 2016). The researchers divided the students into three groups for one week of intervention. Group one received random fact text messages (not relating to multitasking awareness), group two received a series of informative texts about multitasking and metacognitive strategies, and group three was the control group. Results were inconclusive as measured by a follow up comprehensive technology use, attitude, and metacognitive scale regarding multitasking. Results demonstrated that an awareness intervention alone might not be significant enough to have an effect on multitasking behaviors.

Responsibility to Control Multitasking and Attention

A strong positive correlation was found between a student's self-efficacy and a student's academic performance during multitasking (Zhang, 2015), but some may argue that controlling student multitasking is a faculty responsibility or is a shared responsibility between faculty and students. However, a perception of responsibility has not been studied as it relates to in class multitasking. Regulating a student's off-task and multitasking behaviors may include faculty-induced strategies such as codified rules, strategic redirection, discursive sanctions, or deflection (Cheong, Shuter, & Suwinyattichaiporn, 2016). Codified

rules can include rules in course syllabi, course protocols, or written and signed agreements between the student and the faculty. Strategic redirection is when the instructor use prompts such as "it's time to listen" or when instructors include student technology at appropriate times during the class time. Discursive sanctions are more overt in the classroom such as calling a student out or walking in the back of the classroom and looking at screens and bringing it to the student's attention that the faculty was aware they were off task. Other discursive sanction examples are imposing a disciplinary action or talking with the student in private. Deflection is when faculty are dismissive about student's multitasking in class assuming it is the student's "loss" when they do not pay attention to the material and they will miss information they are later responsible for during a course exam or project (Cheong et al., 2016).

In a qualitative study to exploring teachers' experiences with technology in the classroom eight classroom teachers participated in the study over a six-month period and agreed to be observed in the classroom. The researchers found Facebook constantly running in the background of student computers, laptops with notification alerts frequently posted on the screen, and students often distracted by other content pulling their attention away from the classroom (Aagard, 2015). Aagaard observed common methods faculty used to prevent distraction due to multitasking. These methods included: asking students to close the lid of their laptops, shifting class structure every five to seven minutes to increase attention, including an open/close laptop policy for when students are allowed to use their laptops and when they need to close them, or requiring the students to flip their screens outward so they are not tempted to surf the Internet during a segment of the lecture (2015).

While some of these strategies could possibly cause tension in the classroom between students and faculty because they are all "imposed" on students, it is important to first understand the perception of students and faculty of whose responsibility it is to maintain a student's attention in class. If students believe that it is their responsibility to limit digital distractions and maintain their attention during lecture, they may be more willing to try self-selected strategies to limit multitasking. If students believe it is

faculty's responsibility to set an atmosphere where students are engaged, then students may be more amicable when faculty uses rules and/or active learning strategies to help limit distractions. Currently there is little to no research that explores if the responsibility is perceived to lie with the faculty or the students in this conundrum.

Theory of Planned Behavior

The Theory of Planned Behavior, which serves as the framework for the intervention used in this study, is a general model of human behavior based on three constructs: Attitude toward the behavior, subjective norm, and perceived behavioral control (Ajzen, 1991). The theory suggests that a person's behavior is determined by his/her intention, which is an outcome of three predictors: attitude, social norms, and perceived control.

The Theory of Planned Behavior is a powerful predictive model to explain and change human behavior (Ajzen, 1991; Zemore & Ajzen, 2014). It is widely used in a variety of studies related to health promotion, psychology, business, and drug and alcohol addiction to predict a person's behavior and measure variables of interest (Askew et al., 2014). For example, the TPB has been used to determine the effect of e-cigarette warning labels and college students' intention to use (Lee, Lin, Seo and Lohrmann, 2018); to predict the consumption of sugar-sweetened beverages (Zoellner, Estabrooks, Davy, Chen, & You, 2012); and to predict early adolescent marijuana use (Malmberg et al., 2012).

The Theory of Planned Behavior has also been used in a few studies to examine behaviors related to technology use. For example, TPB was used as a predictor model to study identifying factors that predict a person's intention to respond to their smartphone while driving (Gauld, Lewis, White, Fleiter, and Watson, 2017). Askew et al. (2014) validated the use of TPB use in studying cyberloafing in employees. Askew et

al., explains the term “Cyberloafing” as off-task use of computer or Internet at work that may interfere with work productivity (2014).

Cognitive Load Theory

Cognitive Load Theory was used in this study to develop an intervention to prevent students multitasking in class. When students engage in other tasks not related to the primary learning materials during lecture, learning becomes less effective (Chandler & Sweller, 1991; Sweller, 2003; Woods et al., 2012). Cognitive load theory is commonly used to describe instructional implications and suggestions. It has been used in research studies to examine the use of effective educational videos and e-learning (Homer, Plass, & Blake, 2008; Merkt, Weigand, Heier, & Schwan, 2011; Van Merriënboer & Ayres, 2005).

In recent studies related to multitasking, Cognitive Load Theory is used to either describe the process of what happens while multitasking or used as a theoretical framework (Aagard, 2015; Junco, 2015; Kay & Lauricella, 2011; Farley, Risko & Kingstone, 2013; Fried, 2008).

Cognitive Load Theory has been used in experimental studies to examine the impact of multitasking on academic performance (Kraushaar & Novak, 2006; Van Cauwenberge, Schaap, & Van Roy, 2014; Wei, Wang, & Klausner, 2012).

Conclusion

Previous experimental research has focused on closed environments in natural and artificial contexts with academic performance on exams or grades as the outcomes. Experimental and quasi-experimental research consistently established multitasking is detrimental to student learning (Downs et al., 2015; Junco

& Cotten, 2012; Junco, 2015; Fried, 2008; Ravizza et al., 2015). Correlational and hierarchical regression studies considered variables such as self-efficacy, class rank, technology ownership, frequency of multitasking and believed proficiency of multitasking. Qualitative studies explored faculty and student perceptions using faculty observations and interviews and student surveys (Aagaard, 2015). Numerous studies determined that unstructured, distracted, multimedia multitasking environments are detrimental to learning for college students (Downs et al., 2015; Junco & Cotten, 2012; Junco, 2015; Fried, 2008; Ravizza et al., 2015). Major themes in recent literature address retention of lecture material with various conditions of multitasking and laptop use, multitasking within study environments, and student and instructor perspectives.

A current gap in the literature is research determining effective strategies for college students to use to better control multitasking, in order to better focus attention and retain information in lecture courses while using technology. The majority of research studies have focused on undergraduate students or students from technical school, but very few have studied the needs of graduate students when it comes to multitasking in lecture. Graduate students need to be aware of the effects of multitasking during class and to change their beliefs and perceptions to help them make better choices when facing the temptation of multitasking. In addition, graduate students need strategies to effectively limit their multitasking and attend to lecture. What is lacking in the literature are studies that explore what strategies graduate students currently use to prevent distraction and provide strategies students can voluntarily implement (Zimmerman, 2009). Also lacking in the literature is an exploration of what graduate students see as their responsibility in managing digital distractions. When students see limiting distractions and paying attention as their responsibility, this constitutes a strong subjective norm leading to stronger intentions to eliminate distractions and reduce multitasking behaviors. This study addresses this gap through an intervention to address students' beliefs about multitasking and increase their perceptions of ability to control their own multitasking.

Chapter III

METHODOLOGY

The purpose of this study was to determine if an awareness training and experience using a website blocking software improves learning in a lecture course, and if this experience changes graduate students' multitasking beliefs and planned future behavior with respect to multitasking. This chapter describes the participants, study design, instruments, data collection, and data analysis procedures used to complete this study.

Research Questions

Decisions on the selection of methodology and procedures were made to answer the following research questions:

1. What are graduate students currently doing to control their multitasking in a lecture course?
    a. What is the type and extent of multitasking during class?
    b. What strategies, if any, are they currently using to control their multitasking?
2. What are graduate students' current beliefs/attitudes on multitasking in lecture?
    a. What are their perceptions of their own responsibility to maintain attention in class and to limit multitasking?
    b. What are their perceptions of their own ability to multitask effectively?
3. Does an intervention that includes both awareness training and practical strategies change graduate students':

a. perceptions of responsibility to maintain attention in class to limit multitasking?

b. perceptions of their ability to multitask effectively?

4. Is there a relationship between graduate students' perceptions of their ability to multitask and their learning as measured by quiz scores?

5. Does an intervention to limit multitasking lead to better graduate student learning as measured by quiz scores?

Participants

A convenience sampling of 90 graduate students enrolled in the spring semester of their second year of a Master of Occupational Therapy (OT) or a Doctorate of Physical Therapy (PT) program at a health science center at a Midwestern university was used for this study. Ninety students were enrolled in one section of the required course "Assistive Technology" in the spring of 2017. Students in this study were between the ages of 22 and 43 years with an average age of 24 years and a median age of 25. Approximately two-thirds of the participants were female and one-third of participants were male. To be included in this study, students had to be in good standing with the program and sign the consent form.

This course is taught through simulcast between two campuses 120 miles apart using live synchronous video of the faculty and students in the classroom. Students at Campus A see the course as a live projected video on a large screen in front of the classroom, whereas students at Campus B have the instructor that is on simulcast face to face. Both groups could see each other and had the ability to communicate instantaneously with the other campus instructor and students by pushing a microphone button at their desk in the lecture hall. The number of students enrolled in the course was 60 students at Campus A and 30 students at Campus B.

Campus A and Campus B are considered "one campus" in two locations. Students are aware upon applying to graduate school that they could be assigned to either campus and both receive the same

education through being "virtually" in the same class. There are more face-to-face classes on campus A due to this campus being the larger of the two, therefore having twice the amount of faculty as Campus B.

This 16-week course contains a one-hour lecture and a two-hour lab each week. The course faculty member assigned to this course was not the researcher and is a veteran faculty who has taught the course for over 10 years. In-class lectures from the faculty member consisted of 45-minute lecture with a slide presentation, fill-in-the-blank lecture notes and interactive class discussion with questions posed by the instructor. The course textbook and selected research articles were used to develop the lecture. Students were allowed to use their laptops in class to take notes on the provided slide presentation in class. However, all students adhered to a strict policy of no cell phones turned on in the classroom. This course was one of the last didactic courses the graduate students take before completing 24 weeks of clinic-based work in the community. At the beginning of each class the course instructor read a script to remind students to adhere to the cell phone policy and for the experimental group to turn on their software.

Instruments

Data collected included the participants' scores on the weekly content quizzes delivered through the Desire2Learn online learning management system, and a pre- and post-survey, delivered online via Qualtrics that included the following instruments and items:

1. Student program of study and campus location.
2. "Perceived Multitasking Proficiency Scale" with seven questions by Downs et al., (2015). This scale measures participants' perceptions of their own multitasking ability using a Likert-type scale of 1-5 (1-strongly disagree and 5-strongly agree). Downs et al., (2015), found this scale internally consistent and deemed reliable, with Cronbach's alpha scores ranging from .89 to .92. See Appendix A
3. A modified version of Thompson's (2013) Technology Use Survey - specifying the type and extent of technology used in class. See Appendix B

4. Multiple-choice and open ended questions asking what strategies students currently use to stay focused in a lecture class. See Appendix C

5. An open-ended question asking students what can or does a course instructor do to help them remain focused during a lecture. See Appendix C

6. Responsibility Scale - Students were asked to select how much responsibility they feel they have and how much responsibility the instructor has when it comes to maintaining attention and decreasing distraction during a lecture. The answers were charted on a slider scale with answers ranging from 0% to 100% for each question. See Appendix C

7. Scores on content knowledge quizzes. Students took an in-class quiz with five questions after each week's lectures. Each quiz question related directly to the lecture given that day and content was taken from the slide presentation. Proctored quizzes were given in the Desire2Learn (D2L) learning management system, with the lock-down browser feature enabled. Scores were collected and automatically graded through the D2L software grading system.

Procedures

The first day of the Assistive Technology class the researcher presented the study in the classroom and students were given time to complete the consent forms and pre-survey in Qualtrics, if interested before the lecture began. All consenting students completed the pre-survey with basic demographic information including campus location and program (OT or PT), the Perceived Multitasking Proficiency Scale, Technology Use Scale, open-ended questions on current strategies to control for multitasking, and the responsibility scale contained in the consent survey (see Table 1). After the study was presented to students and they completed the pre-survey, the course faculty began the first lecture of the semester. At the conclusion of the lecture, the students took their first proctored online content quiz in the learning platform Desire2Learn (D2L). This first quiz was used as a baseline for all consenting students before any

intervention was provided. Consenting students had the option to be entered into a drawing for 10, 10-dollar Amazon gift cards and were asked if they would be willing to participate in a focus group if needed.

Table 1

Schedule of data collection spring semester of 2017

Week	Control Group	Experimental Group
1	Consent and Pre-survey Lecture 1, Quiz 1 (Baseline)	Consent and Pre-survey Lecture 1, Quiz 1 (Baseline) All students together - provide intervention, install Freedom software
2	Lecture 2, Quiz 2	Lecture 2, Quiz 2
3	Lecture 3, Quiz 3	Lecture 3, Quiz 3
4	Lecture 4, Quiz 4	Lecture 4, Quiz 4
5	Lecture 5, Quiz 5	Lecture 5, Quiz 5
6	Lecture 6, Quiz 6	Lecture 6, Quiz 6
	Post-survey Completed	Post-survey Completed

After consent was obtained and the pre-survey and first quiz was given on the first day, the researcher randomized consenting students into experimental or control groups using a randomized number generator to minimize bias for location of the lecturer. During the first four weeks of the course, the regular course instructor gave the lectures live on Campus A. The last two lectures were given live from Campus B with a substitute lecturer due to an unexpected absence of the original lecturer. When the instructor was not live on the student's campus, the students saw and heard the lecturer on a large screen at the front of their respective campus classroom. Through all lectures there was a faculty member in the room with students on both campuses.

After the first day of the course, the researcher provided the experimental group with the 45-minute educational session with four specific parts:

1. The researcher presented a summary of current evidence of the effects of multitasking on academic performance (see Appendix D).

2. The participants completed awareness exercises from YouTube https://www.youtube.com/watch?v=BCeGKxz3Q8Q to increase their awareness of their own abilities to multitask. The web activity was a timed activity where the students completed a single task of copying a sentence then writing the numbers 1-20 underneath the sentence. The students then repeated the task by copying the same sentence again, but this time alternating between writing a letter of the sentence with writing a number under the letter, alternating until both the numbers and sentence were complete. Students then compared both instances to see which was more accurate and complete. This exercise was intended to demonstrate the degradation in performance resulting from switch tasking.
3. The researcher demonstrated several website blocking programs and applications that help limit the amount of multitasking that can be done on a laptop or cellphone during a lecture.
4. A two-month subscription of "Freedom," a website blocking software, was downloaded to participants' laptops. During this educational session, instructional technology professionals were on site to assist students in downloading the program.

In an effort to decrease contamination, students in the experimental group were asked not to share information with the control group, discuss the intervention, or talk about the software they were using until after the study was complete. The control group did not attend the intervention session, but did take all of the scheduled six quizzes and completed the post-survey.

The educational session for the experimental group was conducted by the researcher at a time other than class time. The researcher provided students with instructions on how to use strategies such as turning off iMessaging on their phones, laptops, and iPads. Students saw a demonstration of how to put a phone or laptop in "airplane" mode where they are instantly blocked from the Internet connection. In addition, students learned about the "Pomodoro" technique and applications such as 30/30. The Pomodoro technique is a strategy where the person works on a task steadily for 25 minutes, then takes a five-minute break. The

30/30 application applies the technique by allowing the user to create a task list and then sets a timer for 25 minutes specific to one task, then gives the user a short five-minute break before continuing to the next task on the list.

A website blocking software is considered a "productivity" software to help students, writers, researchers, and others eliminate distractions and focus on a single task. There are several commercially available website-blocking products, including LeechBlock, StayFocused, Cold Turkey, SelfControl and Freedom, which were all considered when deciding on the best software for this study. The Freedom software was selected as the most appropriate option for this study. Freedom gives the user the option to schedule sessions to create certain times that freedom blocks the internet or certain websites, and has a locked mode, which does not allow the user to access the Internet a set period of time, whereas other applications are not as robust in their options. Freedom allows users on a Mac or Windows machine to create a list of sites to block or to block all Internet sites. In addition, Freedom can be used with iPhones and iPads as well as laptop and desktop computers. The researcher believed this application would be valuable and affordable for students if they chose to use it in the future. At the time of this writing the cost for Freedom is twenty-nine dollars per year.

At the beginning of each class, the course instructor reminded all students of the course policies on use of cell phones during class and for the experimental group to turn on "Freedom" on their laptops for the next 50 minutes. The experimental group used this software on their laptop for the next five weeks of the course to limit web browsing, searching on social media, and instant messaging during lecture.

At the end of each 50-minute lecture, students had fifteen minutes to take a quiz over course material that was covered in that day's presentation. The quizzes were worth ten points each and were used in lieu of a midterm for a total of 60 points. All quizzes were created by the course instructor and taken directly from previous midterm exams in past years. The quizzes were specific to that day's lecture.

Quizzes were automatically graded by D2L and quiz scores were put in the online grade book. The researcher had access to the course D2L site in order to view student grades and to post links to pre- and post-surveys.

After the final quiz was submitted in class, both experimental and control groups received an email with a link to the follow-up survey, which they were allowed to complete during class time. The post-survey for both groups included the Perceived Efficiency of Multitasking Scale, Thompson's Modified Technology Use Survey, responsibility scale, and planned future use of strategies question. The experimental group had additional questions specific to the educational intervention, use of "Freedom" software, and intentions to use new strategies to limit multitasking.

The researcher attended the class on Campus B during all six lectures to observe and be available for technical issues with either Freedom or the online quiz. Students from Campus B had an instructor onsite to proctor the online quizzes at the end of each class, as is typical in the program when a quiz or exam is given. In order to provide students in the control group with the potential benefits received by the experimental group, the educational session was provided for the control group at the conclusion of the study in an online format, but without the Freedom application.

Data Analysis

Descriptive statistics were used to analyze demographic characteristics of the participants. Week One-quiz scores served as a baseline prior to the intervention to assess for any possible covariates or extraneous variables. A t-test was used to look for significant differences and effect sizes of means between the two groups at baseline (See Table 2). A t-test was then used to identify differences between groups in quiz scores in weeks two, three, four, five, six, to assess for trends over time and to look at the difference in-group means. Descriptive statistics were used with the data gathered from Thompson's Modified Technology Use Survey and the Perceived Multitasking Abilities Survey. Correlations were calculated

between the quiz scores and the Perceived Efficiency of Multitasking Abilities using Pearson correlation coefficient to determine if students quiz scores correlate with their self-assessed multitasking abilities. A paired samples t-test was used to compare the experimental and control groups' perceptions of their ability to multitask before and after the intervention.

Table 2

Research Questions, Measures, and Data Analysis: Student Perceptions and Performance of Multitasking Ability after Cognitive Load Based Intervention

Research Questions	Measures	Data Analysis
RQ 1: What are graduate students ***currently*** doing to control their multitasking in a lecture course? a. What is the type and extent of multitasking during class? b. What strategies, if any are they currently using?	a. Technology use survey (pre-survey) b. Survey of strategies	Descriptive
RQ 2: What are graduate students' ***current beliefs/attitudes*** on multitasking in lecture? a. What are their perceptions of their own responsibility to maintain attention in class and to limit multitasking? b. What are their perceptions of their own ability to multitask effectively?	a. Responsibility slider question on Qualtrics (pre-survey) b. Student Perception of Multitasking Ability survey (pre-survey)	Descriptive
RQ 3: Does an intervention, which includes both awareness training and practical strategies ***change:*** a. perceptions of responsibility to maintain attention in class to limit multitasking? b. perceptions of their ability to multitask effectively?	a. Responsibility slider question on Qualtrics (post-survey) b. Student Perception of Multitasking Ability survey (post-survey)	t-test dependent samples
RQ 4: Is there a *relationship* between students' ***perceptions*** of their ability to multitask and their ***learning*** as measured by quiz scores?	a. Student Perception of Multitasking Ability survey (pre-survey) b. Baseline of quiz scores (weeks 1 and 2)	Pearson Correlation test to look for a correlation

		between the two measurements.
RQ 5: Does an intervention to limit multitasking lead to ***better learning*** as measured by quiz scores?	Comparison of cumulative quiz scores between control and experimental conditions at the end of the data collection period.	t-test

The four open-ended questions on the pre and post survey were analyzed by the researcher and a graduate student who was a first year occupational therapy student who was familiar with the study and has past experience helping other faculty with transcription and analysis. The questions were analyzed using an analysis method described by Chang, Ngunjiri, & Hernandez (2013). In this method of analysis, the researcher took the following steps:

1- Macro Review - In a macro review, the researchers take a broad look over the findings using a "bird's eye view" of the data as a whole. The researchers record their first impressions of the data as a whole, and look for patterns and insights. Using this method, the researcher and the graduate student entered the data into a spreadsheet to look across the answers to the open-ended questions and took general and specific notes over several sessions. Overall notes entailed items such as students aware of their distractions, active engagement in lecture, and students find their own strategies to maintain attention in class.

2- Coding (or Segmenting) – In the coding or segmenting process researchers break the data into very small codes line by line of the data. Chang, Ngunjiri, & Hernandez call this "micro coding" (2013). The researcher and graduate student began the process of coding, breaking the data into segments using a mix of the language of the data itself from students and codes the researchers named. At the beginning of each coding session, the researcher and graduate student reviewed the macro findings and coding from the last session, before beginning to code the next section of the data. This process continued though three sessions until all data was meticulously

coded. The first round of coding was done at an incremental level where all thoughts were captured.

3- Categorization- After finding the codes in the data, codes can then be grouped into manageable pieces of information or "categories." At this stage, the researcher can look back at the macro review to compare findings. The researcher and graduate student put the coded data into agreed upon categories for each of the four open-ended questions. Each of the four questions had from three to fifteen categories that were then placed on a new spreadsheet under each question to later be sorted and collapsed into themes.

4- Themes - A theme can be a few short words or a sentence that describes groups of categories. The researcher and graduate student analyzed the categories from step 3, arranging them into themes. Categories from each question were sorted into similar groups to find the themes that emerged from that particular question. Answers to two of the questions were analyzed together due to the similar nature of the questions. The two questions combined were "What did you think of the Freedom software?" and "Did the Freedom software help you focus or help you in another way?" The two questions "What new information did you learn from the educational session?" and "What can/does a course instructor do to help you remain focused during lecture?" were analyzed separately.

Summary

This chapter explained the specifics of the participants, instruments, procedures, and data analysis for the research study. The graduate students in the experimental group received a three-pronged intervention with a focus on education of the detriments of multitasking during lecture and studying, awareness exercises to simulate multitasking, and specific strategies to limit multitasking. The data analysis used is a mix of

quantitative and qualitative methods to best explain the findings. Further explanation of each research question is in the following chapter.

CHAPTER IV RESULTS

Overview

Chapter IV reviews the purpose of the study, restates the research questions, discusses the research methodology, data collection procedures, demographics, and presents the analysis of the data.

Purpose Statement

The purpose of this study was to determine if an awareness training and an experience using a website blocking software improves learning in a lecture course and if this experience changed **graduate** students' multitasking beliefs and planned future behavior with respect to multitasking.

Research Questions

The following research questions were addressed to support the purpose of the study: methodology and procedures were made to answer the following research questions:

1. What are graduate students currently doing to control their multitasking in a lecture course?
    a. What is the type and extent of multitasking during class?
    b. What strategies, if any, are they currently using to control their multitasking?
2. What are graduate students' current beliefs/attitudes on multitasking in lecture?
    a. What are their perceptions of their own responsibility to maintain attention in class and to limit multitasking?
    b. What are their perceptions of their own ability to multitask effectively?
3. Does an intervention that includes both awareness training and practical strategies change graduate students':
    a. perceptions of responsibility to maintain attention in class to limit multitasking?
    b. perceptions of their ability to multitask effectively?
4. Is there a relationship between graduate students' perceptions of their ability to multitask and their learning as measured by quiz scores?
5. Does an intervention to limit multitasking lead to better graduate student learning as measured by quiz scores?

Research Methods and Data Collection Procedures

The research methods for this study included an experimental design randomizing graduate students into control and experimental groups. All students were given a pre-intervention survey and a post-intervention survey in Qualtrics. The experimental group received an educational session on multitasking and was provided with a two-month subscription for a website blocking software, called "Freedom", to use during lectures for five weeks. At the end of each lecture, students took an online, five-question quiz to assess learning. The quiz scores were compiled from the online learning platform D2L and used in this study.

Demographic Findings

Seventy-four graduate students consented and participated in the pre-survey. Twenty-six students (35.24%) were occupational therapy students and 48 (64.86%) were physical therapy students. Twenty of these students were male and 54 were female. Forty-six students were at Campus A and 28 were at Campus B. The average age of participants was 24 years, ranging from 22 to 43, with a median age of 25 years. All students were in their second year of a three-year graduate program for either a Masters in Occupational Therapy or Doctorate of Physical Therapy. The consent was completed on Qualtrics during the pre-survey. Sixteen students declined participation and 74 students that consented. These students were randomly assigned to a control (n=36) or experimental group (n=38). In the control group, there were 21 students from Campus A and 14 from Campus B. In the experimental group, there were 20 students at Campus A and 18 students at Campus B.

Presentation and Analysis of Data

Before conducting the statistical analyses in this study, the researcher screened the data to ensure that the assumptions for parametric tests were met. An alpha level of .05 was used for all analyses to determine significance.

Research Question 1

In research question 1, the researcher sought to examine what graduates are currently doing to control their multitasking during a lecture course by measuring the type and extent of multitasking during class (if any), and the strategies students are currently using to control it. Descriptive statistics were used to answer this question. Students reported spending an average of 32.23 minutes multitasking in a typical 50-minute lecture course, as shown in Table 3. These minutes represent the cumulative amount of exposure to the different media that were selected in the question (iMessaging, texting, Internet surfing, social media, etc.). It should be noted that students are most likely using these different media concurrently during class. For example, a student may have a tab open for Facebook while also instant messaging a friend about their plans for Friday night. Therefore, the total amount of time spent multitasking may be less than 32 minutes. Students reported spending the greatest amount of time surfing the web unrelated to class (average of 9 minutes) with "surfing the web not related to class" at an average of 8.41 minutes during a 50-minute lecture.

Table 3

Type and Extent of Multitasking from Pre-Survey

Type of Multitasking During Class	Average Number of Minutes Spent on Media in a typical 50-Minute Lecture (n=74)
Checking for updates on social media	9.00
Surfing Web Not Related to Class	8.41
Surfing the Web Related to Class	6.73
Texting	5.64

	3.78
iMessaging	2.74
Posting on Social Media	2.30
Watching Video	.36
Total Average Concurrent Minutes	32.23

All students answered a multiple-choice question in the pre-survey asking what strategies they currently use to help them stay focused during a lecture. The largest segment (48 students) reported controlling for multitasking in class by "placing the phone on silent and in bag." Another strategy used was "closing the laptop when not needed" as show in Table 4.

Table 4

Current Strategies Used to Control Multitasking from Pre-Survey

Strategy	Percent of students (n=74)	Number of times mentioned by a student
Place phone on silent and in bag	64.86%	48
Close laptop when not needed	12.16%	9
Print slide presentation and bring to class	4.05%	3
Turn off Internet	2.70%	2
Leave laptop at home or in bag	1.35%	1
Actively take notes	20.27	15
Read along with slide presentation	14.86	11
Close Internet browser	6.76	5
Make slide presentation full screen	6.76	5

Research Question 2

Research question 2 had two parts. First, the researcher sought to understand the students' current beliefs/attitudes on multitasking during a lecture by examining the students' perceptions of whether it is the instructor or student's responsibility to maintain the students' attention in class. The second part of this research question sought to determine how effective students believe they are at multitasking. To answer the first part, students were asked to select how much responsibility they feel they have and how much responsibility the instructor has when it comes to maintaining their attention during a lecture course. The answers were charted on a slider scale, with answers ranging from 0% to 100% for each question. On average, participants reported that students hold 73 percent of the responsibility and the instructor holds 27 percent when it comes to making sure that they are attentive and focusing on the class lecture.

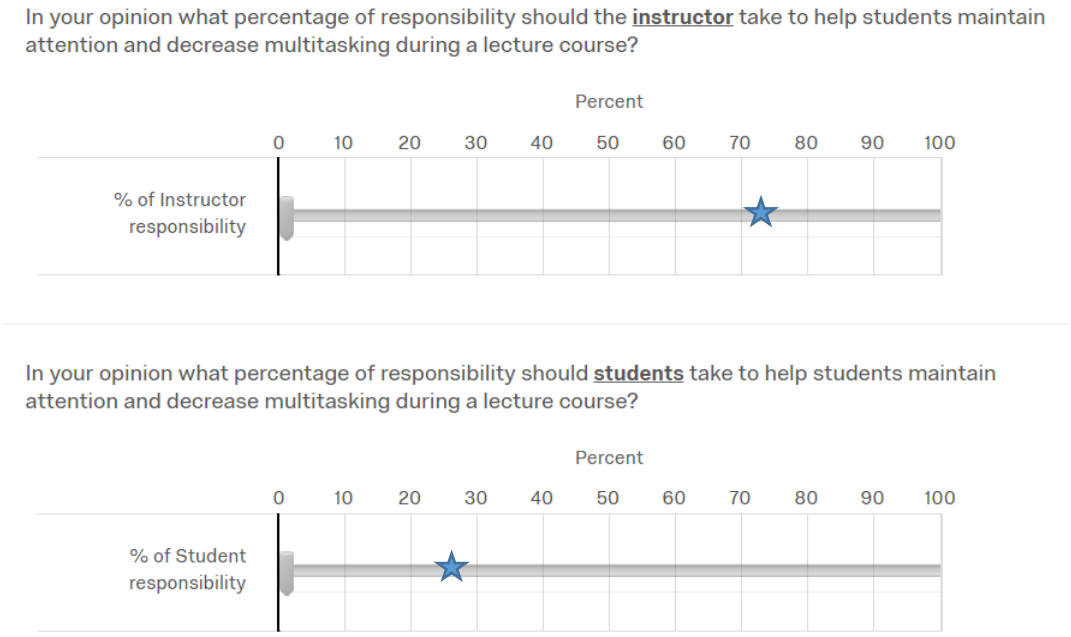

Figure 5. Responsibility Slider Scale

In an open-ended question, students were asked what a course instructor can/does do to help them remain focused during lecture. Qualitative analysis of the open-ended question revealed three overall themes: active engagement, faculty presentation of the materials, and lecture design. Frequent suggestions included active participation in the classroom, instructor using real world examples, keeping the lecture engaging, and not reading directly from the slide presentation. One student answered, "In my opinion, students will not give undivided attention unless they need to, so teacher would need to include blanks in the PowerPoint's, interactive portions, or require participation as opposed to just reading off completed power points." (active engagement, faculty presentation). A student commented on how the lecture design helps keep students engaged, "They make the lecture interesting enough for us to get engaged in the lesson and give breaks as needed for us to be able to pay attention to other things momentarily." One student answered, "using a good pace and presenting novel information at a speed I can keep up with, but not too fast to where I get lost."

To find out how well students believe they can multitask, control and experimental groups completed the Perceived Multitasking Proficiency Scale (Downs et al., 2015) on the pre-survey. Students scored an average of 3.56 on a Likert-type scale (1-strongly disagree and 5-strongly agree), indicating that they fall between "neutral" and "agree" that they are proficient multitaskers. This was a normal distribution.

The researcher conducted a paired samples t-test to determine if there was a change in the number of minutes of total exposure to media that students spent multitasking in a 50-minute lecture class before and after the intervention. There was a significant difference in the experimental group's pre- ($M = 27.45$, $SD = 13.24$) and post-intervention ($M = 20.97$, $SD=14.08$); $t(35)=2.49$ $p = .018$ number of minutes spent in concurrent or overall media use. These results suggest that there was a significant decrease in the amount of time students receiving the intervention reported spending on multitasking in a 50-minute lecture, as

shown in Table 5 below. Surfing the Internet related to course material dropped from an average of 5.18 minutes to 3.75 minutes with a significance of .02.

Table 5

Experimental Group's Pre- and Post-Intervention Minutes Spent Multitasking in typical 50-Minute Lecture

	Pretest Mean n=38		Posttest Mean n=38			
Task Performed	Mean Number of Minutes	SD	Mean Number of Minutes	SD	*t*-value	*p (*two-tailed)
Texting	3.97	3.06	3.83	4.11	.040	.969
iMessaging	3.03	5.45	1.47	2.60	1.35	.184
Checking social media	7.21	7.57	6.13	8.21	.477	.636
Posting on social media	2.03	5.03	1.72	3.09	.444	.660
Surfing Internet ***NOT*** related to course content	7.05	7.29	4.94	4.63	1.70	.098
Surfing Internet related to course content	5.18	4.441	3.75	3.06	2.47	.019
Watching video	.24	.883	.08	.28	1.10	.279
Total	27.45	13.70	20.97	14.08	2.48	.018

Research Question 3

In research question 3, the researcher examined if an awareness training and experience using the website blocking software "Freedom" changed students' perceptions of whose responsibility it is to maintain attention in class or of their ability to multitask effectively.

A paired samples t-test was conducted to compare the experimental group's pre- and post-intervention survey scores on the responsibility scale after receiving the intervention. There was not a significant difference in the means score of the pre (M = 74.32%, SD = 20.42%) and post (M = 74.51%, SD = 20.28%) student responsibility scores; t(37) =-.047 p = .962. No significant changes were found in the perceived responsibility of instructor pre (M = 23.15%, SD = 16.86%) and post scores (M = 26.54%, SD = 21.87%); t(37) = -.816 p = .420. Results suggest that there was no significant change in how the students perceived student or instructor responsibilities to maintain attention in class.

An independent samples t-test was conducted to compare students' perceptions of their own ability to multitask efficiently using the Perceived Multitasking Efficiency Scale (Downs, et. al, 2015) in the control and experimental conditions post-intervention. There was not a significant difference in the control (M = 3.14, SD = .66) and experimental (M = 2.76, SD =.85) conditions; t(68)=.1.65 p = .10. Results suggest students who received the intervention did not have significantly different perceptions of their responsibility to control multitasking, compared to those who did not receive the intervention

A paired samples t-test was conducted to compare the experimental group's pre- and post-intervention survey scores on Perceived Multitasking Efficiency Scale after receiving an intervention. There was not a significant difference in the experimental groups pre (M= 2.96, SD= .77) and post (M= 2.76, SD=.85) scores; t (36) =1.22 p = .23. These results suggest that there was no significant change in how the students perceived their abilities to multitask as a result of the intervention.

Exploratory tests were run to see if the data showed any differences at the item level. Each item showed a decrease from pre- to post-intervention scores; however, a paired samples t-test revealed none of these differences were significant for the experimental group. See Table 7.

Table 6

Perceived Multitasking Proficiency Scale for Experimental Group Pre and Post Means

	Pretest Mean	Posttest Mean
I believe that I am an efficient multitasker	3.11	2.81
I believe that I get more things done when I multitask	2.87	2.78
Multitasking is the only way I get everything accomplished	2.81	2.62
I am good at multitasking	3.18	2.81
Being engaged in multiple tasks is easy for me	2.97	2.76
Multitasking feels natural to me	3.13	2.92
I get things done more quickly when I multitask	2.71	2.62
Total Average	2.96	2.76

Research Question 4

In research question 4, the researcher examined the relationship between students' perceptions of their ability to multitask and their learning as measured by a baseline quiz score. To determine this relationship a Pearson's Correlation was completed. Based on the results of this analysis, students' perception of their ability to multitask and their learning as measured by a baseline quiz score did not have a strong correlation ($r = .012$, $n = 74$, $p = .92$).

Research Question 5

In research question 5, the researcher sought to determine if awareness training and experience using a website blocking software would lead to better learning as measured by five quiz scores. An independent samples t-test was conducted to compare weekly (see Table 8). and overall average quiz scores. There was no significant difference between the control ($M = 9.07$), $SD = .59$)

and experimental (M = 8.9, SD = .85) conditions; t(72) = 1.035. p = .304. These results suggest students who received the intervention did not achieve quiz scores that were significantly different from those who did not receive the intervention.

Table 7

Results of Independent t-tests

	Control (n=36)		Experimental (n=38)			
	Mean	*SD*	Mean	*SD*	*t*-value	*p (*two-tailed)
Quiz 1	9.33	.956	9.16	1.366	.637	.526
Quiz 2	9.39	1.05	9.21	1.277	.654	.515
Quiz 3	9.44	.909	9.05	1.52	1.334	.186
Quiz 4	8.11	1.72	8.05	1.576	.153	.879
Quiz 5	9.11	1.62	9.05	1.60	.152	.880
Average	9.07	.595	8.9	.852	1.035	.304

Notes. p < .05.

Perceived Benefits of Intervention

The experimental group was asked in the post-survey if they found the intervention session to be helpful. Thirty-five students (92.11%) answered, “Yes” and three students (7.91%) answered “No.” Students were asked to select all of the strategies they intended to implement for the remainder of the semester during lecture or studying (see Table 10). When asked what strategies they intended to use during the remainder of the semester, eight students (21%) chose “I do not intend to implement new strategies.” Other strategies the students said they will use the rest of the semester are putting their phone away, printing out the slide presentation, taking notes on paper, using Pomodoro technique, minimizing the browser, and closing browser tabs.

Table 8

Student strategies to use the rest of the semester

	Percent out of 38 students on post-survey	Number of times selected
Purchase Freedom website blocker	5.26%	2
Use other form of website blocker during lecture	18.42%	7
Turn off notification popups for email	18.42%	7
Turn off notification popups for iMessage	23.68%	9
Use airplane mode on phone or laptop	26.32%	10
Turn Internet off after downloading the course slide presentation	15.79%	6
Close laptop when not needed	23.68%	9
Print slide presentation and bring to class	2.63%	1
I do not intend to implement new strategies	21.05%	8
Phone out of site	13.15%	5
Pomodoro Method	2.63%	1

Students were asked in two open-ended questions what they thought of Freedom and how this software helped them focus. Qualitative analysis of the open-ended questions revealed four overall themes: distraction is natural ("Was helpful, but found ways around it to multitask"), increase in self-awareness of multitasking ("It was very helpful in multiple ways. Not only did it decrease my time surfing the internet, but it also decreased the urge to get on when I lose my attention in lecture. Additionally, I felt more focused on the content of the lecture."), technology as help ("I really enjoyed it. I found myself engaged in class a lot more because I didn't have the easy outlet for social media. I would subconsciously go to check

Facebook but then be reminded that I could not access the site."), and self-selected strategies ("It was a great tool to encourage myself to be more present in class.").

Students were asked what new information they learned during the educational session in an open-ended question. Qualitative analysis of the open-ended question revealed three overall themes: increased awareness of the detriments of multitasking, increased self-awareness of own multitasking and learned new strategies to decrease multitasking temptations.

Summary

This chapter presented the findings between graduate students in a control group and an intervention group who received training to bring awareness to the subject of multitasking and used the Freedom software to limit students' multitasking during five lectures. Groups were compared using results of the Perceived Multitasking Proficiency Scale, Technology Use Survey, Responsibility Scale, and five quiz scores. A significant finding showed a decrease in the overall number of minutes the students spent multitasking in a typical 50-minute lecture. Students also reported significantly less multitasking that included searching for content on the web that is related to class. There was a strong correlation in the initial survey regarding a student's Perceived Multitasking Proficiency Scale and their minutes spent multitasking. These findings will be further interpreted and discussed in Chapter 5. No significant findings were noted in research questions three, four, or five.

Analysis of student responses from open-ended questions demonstrates frequent themes in student preferences for course lectures to maintain attention, utility of the awareness training session and Freedom software, and strategies the students will continue to use throughout the semester.

Chapter V

Conclusion

This chapter discusses the research methodology, and presents a discussion of findings organized by research questions, limitations implications, and recommendations.

Research Methods and Data Collection Procedures

The research methods for this study included an experimental design, in which graduate students were randomly assigned to the control and experimental groups. All students were given a pre- and post-intervention survey in Qualtrics. The experimental group received an awareness training on multitasking and were provided with a two-month subscription of a website blocking software, called "Freedom", to use during five weeks of a lecture. At the end of each lecture, students took an online, five-question quiz to assess their learning. The quiz scores were compiled from the online learning platform D2L and used in this study.

Discussion of Findings

The findings in this study showed that the awareness training and experience using Freedom software did not significantly improve student learning in the short-term. Although there was no significant change in student beliefs on their ability to multitask, students reported the amount of time spent multitasking in class decreased across courses, and students reported an increase in the use of strategies to help them maintain attention in class. This finding can be explained using the Theory of Planned Behavior's predictor of a change in the graduate student's perceived behavioral control by having additional strategies to implement when tempted to multitask. This can in turn increase the student's intention to minimize their multitasking behaviors as shown by the decrease in the number of minutes spent

multitasking in classes across the curriculum (Azjen, 1991). Findings are discussed in relation to the Theory of Planned Behavior under each research question (See Figure 6).

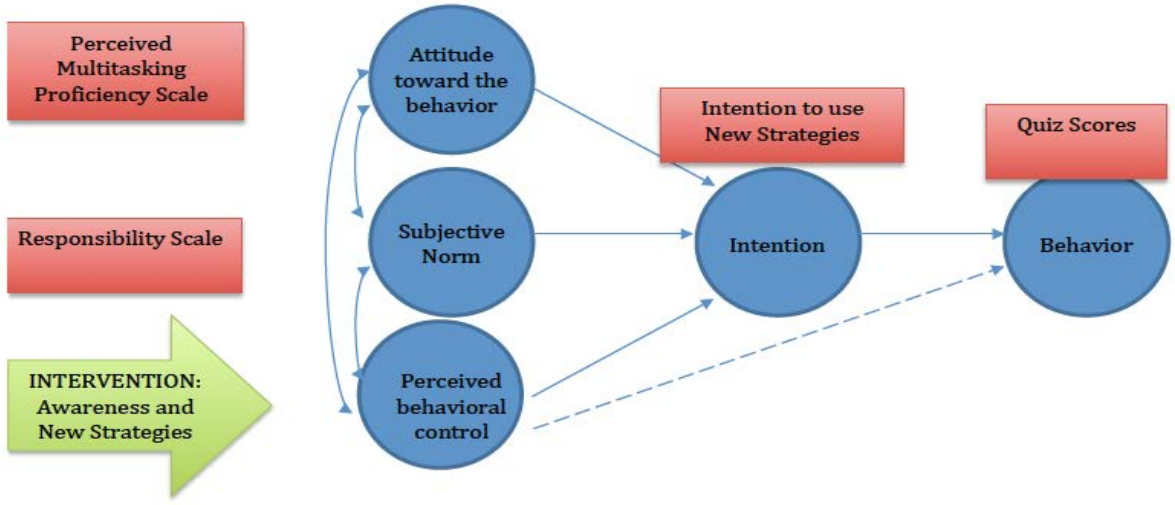

Figure 6: Theory of Planned Behavior, Measurements, and Intervention

Research Question 1: What are graduate students currently doing to control their multitasking in a lecture course?

The first research question in this study examines the type and extent of student multitasking and the current strategies that students use to limit their multitasking while in a lecture course. All 74 graduate students answered a question about their habits and strategies. At baseline, students reported spending more than 32 minutes out of a 50-minute class on a variety of multitasking activities. This time may be total or concurrent exposure to the multitasking activities, having several tabs or applications open at the same time. The most frequently reported activities—checking social media and surfing the web for non-related course information and texting—may indicate that students turn to these activities when their attention wanders (Aagard, 2015). These results confirm findings from Gehlen-Baum and Weinberger

demonstrating that students spend more time on unrelated web surfing instead of course related web surfing (2014). The number of minutes reported in this study is an increase from other reports such as Fried's study (2008), where undergraduate students reported spending 17 out of 75 minutes dual tasking in an Introduction to Psychology course.

In a similar study to the current study, researchers surveyed 2nd year medical students, to identify technology use and influences and administered two content knowledge quizzes in 50-minute lecture courses had similar findings with technology usage (Ankit, Dustin, Mullens, & Van Duyn, 2014). Students reported their media usage as spending 23 minutes studying for another class, 13 minutes on social media and 7 minutes checking email in a 50 minute class period (2014). The researchers found that the student's examination schedule influenced the students' multitasking behaviors. The weeks that students had exams in other courses were the weeks that the students' multitasking usage increased and quiz scores decreased (Ankit et al., 2014).

At the beginning of the present study, students were asked what strategies they currently use to control their multitasking in a lecture course. The most frequently reported strategies to control for multitasking were actively taking notes, reading along with the slide presentation, and putting phones away and on silent. These strategies demonstrate two different categories of strategies. One strategy removes the temptation to multitask (putting away phone), whereas the other two frequent strategies both rely on a student controlling his/her attention with active engagement in the lecture material. Coates (2005, p. 26) defines student engagement as a "constructivist assumption that learning is influenced by how an individual participates in educationally purposeful activities...In essence, therefore, student engagement is concerned with the extent to which students are engaging in a range of educational activities that research has shown is likely to lead to high quality learning." The students in this study reported using strategies (taking notes and following along on the slide presentation) to control for multitasking that require student engagement,

which has been shown to increase learning. Active engagement allows for greater concentration and focus for students during lecture class (Burke & Ray, 2008).

The frequently reported passive strategy of removing the temptation to multitask by turning off and putting away the cell phone does not require active engagement in the learning material, but removes some sources of distraction. Passive or active strategies both require some amount of agency from students (Aagard, 2016). Both strategies can potentially provide a student with an increase in perceived behavioral control leading to stronger intentions to limit digital distractions and maintain attention in the classroom.

Research Question 2: What are graduate students' current beliefs/attitudes on multitasking in lecture?

Research question 2 had two parts. In the first part, the researcher sought to understand the students' current beliefs and attitudes toward multitasking during a lecture by examining their perceptions of whether it is the instructor or student's responsibility to maintain student attention in class and determine how effective students believe they are at multitasking. Exploring the student's perceptions of responsibility provides a glimpse into a student's subjective norms related to multitasking behaviors, which could build on student intentions leading to a student limiting their own multitasking behavior (Ajzen, 1991). Students reported on average that they hold 73% of the responsibility to make sure they are focusing during lecture. This suggests a subjective norm of students limiting their own multitasking behaviors and not relying heavily on faculty to maintain their attention. At the same time, students did provide suggestions of how instructors could better maintain a student's attention in class. Frequent suggestions included the instructor keeping the lecture engaging by using real world examples, not reading directly from the slide presentation, offering scheduled quick breaks, and including active participation and discussion.

In an open-ended question, students were asked what a course instructor can/does do to help them remain focused during lecture. Qualitative analysis of the open-ended question revealed three overall themes: active engagement, faculty presentation of the materials, and lecture design.

Active Engagement

Students in the current study suggested active learning should include engaging lectures with real world examples, class discussions, and active participation. Markwell (2007) echoes this and suggests:

> Lecturers find ways to encourage interaction in large classes as well as in small, and encouraging, even requiring, students to study in groups, and using feedback to encourage engagement; academics finding ways to urge and to stimulate students to work to master thoroughly the material they are studying – to understand fundamental principles, and not simply to memorize the details; academics finding ways that will engage and excite students through connecting their research with their teaching…(p.18).

Classes rich in active learning, part of a constructivist-based course design, may include group discussion, group problem solving, worksheets or tutorials completed during class, personal response systems, and studio or workshop designed courses where students are working collaboratively or individually on projects, have been shown to increase overall grades (Freeman et al., 2014). Comparatively, exposition-centered, "teaching by telling" methods in traditional lectures showed a fail rate of 1.5 times greater than the active learning courses in a study comparing student performance in science, engineering, and mathematics (Freeman et al., 2014).

Faculty Presentation of the Materials

Frequent suggestions included instructor using real world examples to keep the lecture engaging. In the field of occupational and physical therapy clinical examples from the instructor can not only liven up a lecture but demonstrate how the instructor applies and has applied the content from the lecture. Students frequently suggestion the instructor having a "passion" for the subject helps to maintain attention in class. Students would like the information to pertain to them personally and professionally when possible. Students reported that when instructors suggested something would be on an exam it helps them re-engage in the course material. The most frequent suggestion was asking that the instructor refrain from reading the power point slides. Students indicated if this was the method of presentation then there is no reason for them to be sitting in the class. Students said they could read the slides to themselves in the comfort of their own home. Instead, students said it catches their attention when there are fewer words on the slides which allow them to take notes on the slides to stay active and allows for the faculty the freedom to talk about the slides from their own experience.

Lecture Design

Students made suggestions for lecture design such as pacing of the material. Instructors may consider pacing the timing during the lecture to allow enough time for the students to ask clarification questions and pause to process the new information. Students frequently suggested scheduled breaks so that they could better focus on the next segment of the lecture.

In the second part of Research Question 2, students completed the Perceived Multitasking Proficiency Scale (Downs et al., 2015) on the pre-survey to examine how well they believe they can multitask. Students scored an average of 3.56 on a Likert-type scale putting them between the Neutral (3) and Agree (4) categories indicating they believe they are only somewhat proficient at multitasking. Interestingly, students reported multitasking in class 32 minutes during a class, but they did not feel that

they are exceptionally strong multitaskers. This supports the findings by Downs et al. (2015), who found that students believed they were only somewhat efficient, yet continued to multitask.

Froese et al. (2010) had similar findings in their survey and repeated measures experiment with college students, where researchers explored cell phone use and texting and asked students if they believed that texting during a class would lead to a reduction in course points. On average, students believed there would be a 30 percent loss of information if they texted during class and, on average students scored 30 percent less on the quiz, confirming that students knew the disadvantages of multitasking.

Research Question 3. Does an intervention that includes both awareness training and experience using a website blocking software change: perceptions of responsibility to maintain attention in class to limit multitasking and perceptions of the student's ability to multitask effectively?

In the third research question, the researcher sought to determine if awareness training and experience using a website blocking software changes students' perception of whose responsibility it is to maintain attention in class and to limit multitasking. This research question also addressed whether the intervention changed their perceptions of their ability to multitask effectively. Results suggest that there was no significant change in how the students perceived student or instructor responsibilities to maintain attention after the intervention.

Although the results were not significant for this experimental group on the Perceived Multitasking Proficiency Scale overall, at an item level, the mean of all eight questions decreased between the pre- and post-intervention (see Table 6). Although not statistically significant, a downward trend may show that the intervention has the potential to lower the students' perception of how efficient they see themselves, and encourage a more realistic view about the advantages and disadvantages of multitasking. A longer

intervention focused on the students' beliefs and attitudes regarding multitasking may prove to increase the student's intention to limit digital distractions.

Research Question 4: Is there a relationship between students' perceptions of their ability to multitask and their learning as measured by quiz scores?

In the fourth research question, the researcher examined the relationship between students' perceptions of their ability to multitask and their learning as measured by a baseline quiz score. The researcher believed there would be a negative correlation between the students' perceptions of how effective they were at multitasking and their quiz scores. For example, a student may be overconfident in their ability to multitask, therefore continue this habit, resulting in poor quiz scores. Conversely, if students are not overly confident in their ability to multitask and refrain from multitasking, their quiz scores may be higher. This rationale was based on the research reviewed in Chapter 2 showing that academic performance degrades as multitasking increases (Junco, 2012; Junco, 2015; Fried, 2008; Ravizza et al., 2015). As Junco and Cotten (2012) summarize, students are "aware that divided attention is detrimental to their academic achievement; however, they continue to engage in the behavior" (p. 376). However, the relationship between the student perception and quiz score was not significant in this study. This may be due to the students' multitasking proficiency scores being just above average at the beginning of the study and that most students did well on the majority of their quiz scores. That is, there may be no reason to change their habits or perceptions if what they are doing is currently working well enough to produce academic success.

Research Question 5: Does an intervention to limit multitasking lead to better learning as measured by quiz scores?

In the last research question, the researcher sought to determine if awareness training and experience using "Freedom," the website blocking software, would lead to better learning as measured by the average of five quiz scores. The results were not significant; however, this could be due to several limitations that will be discussed later. These results were similar to a pilot study by Nalliah and Allareddy's with third year dental students where 65% reported they were distracted during the lecture, however the results of the recall tests did not have a significant difference. Authors report that there was a one-point difference between the multitaskers and non-multitaskers on a 12-point quiz, which could be significant to the grade in the course. The researchers recommended implementing measures that limit access to wireless Internet (2014).

One possible explanation of why the results were not as expected could be the anxiety that students may have had when they no longer had access to the Internet. Cheever et al. (2014) found that heavy users of wireless devices felt increased anxiety as the time away from their devices increased. With an increase of anxiety in students during the lecture, students may be distracted by this internal anxiety and not be able to fully attend to the lecture information. This could have influenced the experimental group's quiz scores.

In addition, this study tested the student's knowledge right after the lecture was presented in class. If the same quiz or a cumulative exam were provided at the end of the course, students may have scored differently. This is a consideration for the current study where the majority of quiz questions were not application questions but rote memorization that could be recalled through multiple-choice questions. Rubenstein et al. (2001) found that participants were able to multitask and perform rote memorization; however, when the information moved beyond facts and required mental energy to generalize this information, the participants could not do this when multitasking. A possible follow-up to the current study could be to repeat the same procedures but include a test of long-term retention of the lecture material with application questions.

Minutes spent multitasking

Students reported multitasking significantly less after the intervention. Students were given selections on the survey such as minutes spent iMessaging, emailing, searching in the internet related to class and non-related to class and a slider scale to identify the number of minutes they spent on each of these multitasking activities during class. The number of minutes decreased from 32 to 20 minutes of their total exposure to multitasking activities in a typical 50-minute lecture course. The largest and most significant decrease was that students reported surfing the Internet less for class-related material. Using strategies that limit a student's ability to surf the Internet may be a double-edged sword. When students have free use of the Internet, they have the ability to verify information or look up questions during a course lecture about a specific concept. Without clarification through a quick Internet search students may not be able to understand some concepts in the lecture. McCreary (2009) confirmed this as a possible drawback to using laptop free zones in a survey of second year law students. Three-fourths of the students who reported using laptops in class said they did so to help them with understanding a lecture, finding details of a case statute, or accessing course materials which helped them to understand and more fully participate in the class discussion. While another study found that academic performance was not significantly different between students who were browsing during a lecture for on or off topic materials (Hembrooke & Gay, 2003), further research to explore the use of laptops to clarify or enhance lecture materials is needed before any recommendations for use of a website-blocking software during lecture.

Perceived benefits of intervention

Ninety-two percent of the students found the training session helpful. Through this intervention, students reported that they learned about the detriments of multitasking, became more self-aware of their own distractions, discovered new strategies to decrease multitasking, and decreased the temptation to multitask. Some students intend to continue using new strategies they learned, such as turning on airplane

mode on their phone or laptop, using a website blocker such as Freedom, and turning off notifications on their laptop so they do not get the distracting pop up messages. This intention by some of the students reflects the process in the Theory of Planned Behavior (Azjen, 1991), where the students reported they are more aware of the detriments of multitasking, which influences their *attitude toward the behavior* acting upon *intention*. The students also reported that they would continue with these strategies, which demonstrates their *perceived behavioral control* increasing their intention to change their multitasking behavior in the future. Future studies would be needed to see if this behavior change had an effect on class performance over time.

Themes found in "Benefits of Educational Session"

Students reported that the educational session increased their awareness of how multitasking affected learning outcomes and productivity. Students said the educational session helped them realize issues within multitasking and made them recognize areas where they could be distracted and improve on these areas. One student said they learned how "ineffective" multitasking was for them. Students appreciated the new strategies that they learned and practiced during the educational session and throughout the intervention. Students were exposed to the Pomodoro Method, ways to turn off notifications on laptop and phone and various website-blocking software.

Themes Found in "Benefits of Freedom Software"

Students believed that distraction was inevitable. Whether it was due to the course structure or because of internal and external triggers, it cannot be avoided (Adler & Benbunan-Fich, 2013). One student

said, “My mind is going to drift, it’s just that surfing the internet may be the outlet.” If this is a commonplace belief of students, it will be beneficial to address this belief and determine necessary strategies to mitigate the effects of distraction when possible.

Students believed that Freedom helped them become self-aware of their own distractions. Much like leaving a phone at home and then reaching for it throughout the day, only to find out it is not there repeatedly; a website-blocking software can bring the same awareness to students during lecture or studying. Students mentioned throughout the intervention while the website-blocker was on, they would attempt to check their email, surf the internet, or check their iMessage only to remember that this was not possible for the class period.

Students reported that this technology helped them focus on the lecture during class. Students reported using this in and out of the classroom. Students reported that this technology removed the temptation so they are not distracted by the Internet and limited distractions while listening to lecture and studying. Students also liked that they can use this when they feel they need it such as during class or when they choose to while studying. One student said she uses it at home so she does not get on certain websites when she needs to focus on house chores.

Limitations

Limitations to this study include the use of survey self-report. Students may select certain answers on a survey due to social desirability. “Social desirability reflects the tendency on behalf of the subjects to deny socially undesirable traits and to claim socially desirable ones, and the tendency to say things which place the subject in a favorable light” (Nederhof, 1985, p. 264). Social desirability bias may have led students to under-report the amount of multitasking they do or overestimate their abilities to efficiently multitask with media. Another limitation is that participants are in their last year of graduate school and

may already have established habits in academics. Graduate students in this professional program are required to maintain above a 2.5 grade point average in the program, it is reasonable to assume these graduate students have found effective learning strategies. It is possible that the intervention would prompt greater change in younger, less academically experienced students. In addition, administering quizzes immediately after the lecture may motivate students to pay closer attention to the lecture material so they can score well on their quiz in the short-term. Therefore, multitasking might have a measurable negative effect in courses that do not feature regular quizzing after lectures. Data was captured in a six-week period in one course, not inclusive of a final exam where some students may demonstrate increased learning by studying outside of class lectures. Furthermore, long-term retention was not tested in this study, but would be important to assess in future studies. In addition, students who consented to be in the study may have more of an inclination for technology, which was not measured in this study. Students may also have had a "split-attention" affect by being focused on the Freedom software and its effects on their computers while also trying to pay attention to the lecture.

Students from the control and experimental groups were mixed into the same classrooms to maintain ecological validity. Ecological validity refers to the extent to which any piece of a study would generalize to settings typical of everyday life (Schmuckler, 2001). Many empirical studies in multitasking take place in controlled experimental conditions, in an effort to increase reliability, but are also perhaps less generalizable to other populations. The researcher considered the possibility of breaking participants into four different classrooms (a control group and a treatment group on each of the two campuses) to avoid contamination (students sharing information from intervention and website-blocker information); however, it was deemed that the natural environment of the typical classroom would be best for this study.

Implications of the Study

Implications for students.

While significant differences were not found between students receiving or not receiving the interventions, students' responses on open-ended questions indicated they perceived some benefits from training designed to increase their knowledge of the associated risk of multitasking during a classroom lecture. Five weeks of using website-blocking software made students more aware of the distractions in their environment. Students at the graduate and undergraduate level would benefit from an orientation session upon entering college about the pitfalls of digital multitasking and strategies to help them to remain focused in class and while studying. Students could also benefit from self-awareness exercises to demonstrate how effectively or ineffectively they can multitask. Developing awareness and strategies to limit the temptation to multitask and improve a deep focus may prove helpful in students' academic careers.

Implications for faculty.

This study demonstrates the importance of faculty being prepared to address the potential benefits and challenges resulting from the proliferation of technologies in the classroom. Faculty should understand the students' need and temptation for the constant connectedness of social media. In addition, it is important for faculty to know that although students overall believe it is their responsibility to maintain their attention, students believe certain teaching techniques can help them remain focused during a lecture. Findings in this study encourage faculty to use active learning and discussions with real world examples to engage students, and provide frequent short and regular breaks during lecture. Students also suggested that faculty take steps to better organize materials including less text on slides, all which could reduce the extraneous cognitive load for students.

Implications for Administrators and Stakeholders.

Administrators and stakeholders would benefit from the results of this study to assist their students in successfully navigating the difficulties associated with digital multitasking in the classroom. Administrators can provide support to faculty and encourage students to participate in educational seminars

to learn more about multitasking and strategies that decrease this temptation. Administrators could consider providing training to students on strategies including free available apps and specific strategies to encourage students to moderate their digital distractions in the classrooms.

The apps and strategies presented during this intervention may be useful for stakeholders include:

App using Pomodoro strategy - "30/30"

Website blocking apps -

- Focus,
- LeechBlock
- Cold Turkey
- StayFocused
- Freedom

Strategies:

Turn phone and laptop on airplane mode

Turn phone face down

Turn off iMessaging and other notifications in settings

Print off slides or handwrite notes

Recommendations for Further Research

Future research should focus on using a website blocking software and training session with undergraduate students. Undergraduate students spend more time multitasking than graduate students (Judd & Kennedy, 2011); therefore, this type of research study may impact undergraduate students more significantly. This intervention also could be used and assessed for students in a study environment to determine if a website blocking software or Pomodoro method is more effective for learning for students while studying. The same research design could be used in K12 environments where 1:1 computing is used.

Continued research to identify metacognitive or self-regulation strategies that help limit digital distractions could prove useful for students, faculty and administrators. Another relevant area of research is determining the factors that influence student's multitasking behaviors. Learning why students engage in the multitasking behaviors may lead to better strategies or technologies to redirect the student's attention.

Conclusion

Innovative educational technologies provide avenues for students to learn, conduct research, collaborate, and enjoy the enrichment of education. As multitasking has rapidly become a way of life, students, faculty members, researchers and other stakeholders have a responsibility to help students navigate the struggles with the temptation to multitask in the classroom. Research in this area has reported mixed findings and there is still many unknowns about multitasking. As technologies continue to be ubiquitous in the educational environment, researchers and stakeholders should work together to establish a research agenda. The agenda could focus on the impact of: multitasking on student learning, effective technologies to support student attention, and providing resources for faculty development to create an engaging learning environment.

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Appendix A

Perceived Multitasking Proficiency Scale
Downs et al., 2015

Likert Scale (1-strongly disagree and 5-strongly agree).

1. I believe that I am an efficient multi-tasker
2. I believe that I get more things done when I multitask
3. Multitasking is the only way I can get everything I need to do accomplished
4. I am good at multitasking
5. Being engaged in multiple tasks is easy for me
6. Multitasking feels natural to me
7. I get things done more quickly when I multitask.

Appendix B

Original Technology Use Survey

Please estimate how often, on average, you do the following:

	Never	Up to once a month	Up to once a week	Up to once a day	Several times a day	Up to once an hour	Up to once every 15 minutes	More than once every 15 minutes
Send a text message on a cell phone	○	○	○	○	○	○	○	○
Make a voice call on a cell phone	○	○	○	○	○	○	○	○
Use a computer for live chat or instant messaging	○	○	○	○	○	○	○	○
Check for updates on a social networking site (e.g., Facebook, MySpace, etc.)	○	○	○	○	○	○	○	○
Comment on a friend's post on a social networking site (e.g., Facebook, MySpace, etc.)	○	○	○	○	○	○	○	○
Update your own profile on a social networking site (e.g., Facebook, MySpace, etc.)	○	○	○	○	○	○	○	○
Check for updates on a micro-blogging site (e.g., Twitter)	○	○	○	○	○	○	○	○
Update a microblogging site (e.g., Twitter)	○	○	○	○	○	○	○	○

Figure 1: Technology Use Survey

Appendix C

Consent and Survey from Qualtrics

Default Question Block

Q1.

Consent Form
University of Oklahoma Health Sciences Center (OUHSC)
Student Perceptions and Performance of Multitasking Ability after Cognitive Load Based Intervention
IRB# 7353
Jessica Tsotsoros, MS, OTR/L ATP
Assistant Professor, Rehabilitation Sciences
Doctoral Candidate at Oklahoma State University
University of Oklahoma Health Sciences Center (OUHSC)

Penny Thompson, PhD
Assistant Professor, Educational Technology
Oklahoma State University

This is a research study. Research studies involve only individuals who choose to participate. Please take your time to make your decision on whether or not to participate.

Why Have I Been Asked To Participate In This Study?
You are being asked to take part in this trial/study because you are a graduate student at OUHSC.

Why Is This Study Being Done?
This study is to help determine ways students can focus their attention in lecture courses. We hope to learn more and as a result provide strategies to improve learning outcomes.

How Many People Will Take Part In The Study?
About 95 students will participate in this study.

What Is Involved In The Study?
You will be given a pre and a post-survey in your class the first week and in week six. Students will be randomly assigned to a control or experimental group. The experimental group will initially get an extra educational session related to multitasking and the other group will receive the same information after the study is over and all data has been collected. The experimental group will be asked to use productivity software on their laptops during five lectures. Some students may be asked if they will participate in a focus group later this semester.

How Long Will I Be In The Study?
You will be in the study for one semester. You can stop participating in this study at any time. However, if you decide to stop participating in the study, we encourage you to talk to the researcher first.

What Are The Risks of The Study?
There are no foreseeable risks known.

Are There Benefits to Taking Part in The Study?
Potential benefit exists for students to learn about their own habits of learning.

What about Confidentiality?
All student information will remain confidential and data will be DE-identified. The code book to identity will be kept separately from the data in a locked cabinet which only the researcher has access to.
There are organizations outside the OUHSC that may inspect and/or copy your research records for quality assurance and data analysis. These organizations include the US Food & Drug Administration and other regulatory agencies, the University of Oklahoma Health Sciences Center, College of Allied Health, Jessica Tsotsoros, MS OTR/L and Oklahoma State University, Educational Technology Department, Penny Thompson PhD.

The OUHSC Human Research Participant Program office, the OUHSC Institutional Review Board, and the OUHSC Office of Compliance may also inspect and/or copy your research records for these purposes.

What Are the Costs?
There is no cost to you if you participate in this study.

Will I Be Paid For Participating in This Study?
Participants will be entered into a drawing for 10 - 10 dollar gift cards.

What Are My Rights As a Participant?
Taking part in this study is voluntary. You may choose not to participate. Refusal to participate will involve no grade penalty or loss of benefits to which you are otherwise entitled. If you agree to participate and then decide against it, you can withdraw for any reason and leave the study at any time.

Whom Do I Call If I have Questions or Problems?

If you have questions, concerns, or complaints about the study or have a research-related injury, contact Jessica Tsotsoros at 918-660-3282

If you cannot reach the Investigator or wish to speak to someone other than the investigator, contact the OUHSC Director, Office of Human Research Participant Protection, at 405-271-2045.

For questions about your rights as a research participant, contact the OUHSC Director, Office of Human Research Participant Protection at 405-271-2045.

Signature:
By entering your name and clicking on the "next" button you agree to the terms of this study under the conditions described. You have not given up any of your legal rights or released any individual or entity from liability for negligence. [Note: Your name will ONLY be used for you to be entered into the drawing for participating in this study, and if you decide to participate in the focus groups later only the researcher or key personnel will have access to this information.]

Q4. **Multitasking with technology is commonplace. Please consider a typical experience during lecture class and rate your level of agreement with the following statements:**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
I believe that I am an efficient multitasker	○	○	○	○	○
I believe that I get more things done when I multitask	○	○	○	○	○
Multitasking is the only way I can get everything I need to do accomplished	○	○	○	○	○
I am good at multitasking	○	○	○	○	○
Being engaged in multiple tasks is easy for me	○	○	○	○	○
Multitasking feels natural to me	○	○	○	○	○
I get things done more quickly when I multitask	○	○	○	○	○

Q5. **During a typical 50 minute lecture course, how many minutes do you spend...**

	0	5	10	15	20	25	30	35	40	45	50
Sending a text message on a cell phone											
Using your laptop for live chat, instant messaging, or iMessages											
Checking for updates on social networking sites (Facebook, Twitter, Instagram, SnapChat, etc)											

Responding or posting on social networking sites (Facebook, Twitter, Instagram, SnapChat, etc)										
Surfing internet - not pertaining to class										
Surfing internet for resources pertaining to class										
Searching or watching videos (Youtube, TedTalks, Vimeo, etc)										

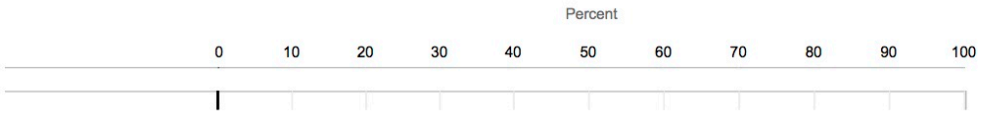
Q6. What strategies do you currently use to help you stay focused on lecture during class?

- [ ] Print Powerpoint and bring to class
- [ ] Leave laptop at home or in bag
- [ ] Place phone on silent and in bag
- [ ] Close laptop when not needed
- [ ] Turn off internet
- [ ] Other

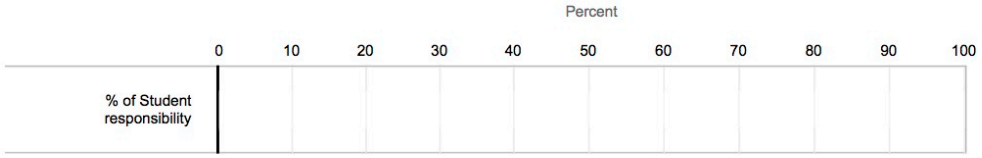
Q7. If you chose "Other" to the question above please describe your strategies here:

Q8. What can/does a course instructor do to help you remain focused during lecture?

Q9. In your opinion what percentage of responsibility should the instructor take to help students maintain attention and decrease multitasking during a lecture course?



Q10. **In your opinion what percentage of responsibility should students take to help students maintain attention and decrease multitasking during a lecture course?**



Q11. **Which campus are you on during the lecture portion of the Assistive Technology course?**

▼

Q12. **Program of Study**

- Occupational Therapy
- Physical Therapy

Block 2

Q13. **Would you be willing to participate in a focus group at the end of this study if needed?**

- Yes
- No

Block 1

Appendix D

(Post-survey from Qualtrics (Experimental Group)

Default Question Block

Q1.

University of Oklahoma Health Sciences Center (OUHSC)
Student Perceptions and Performance of Multitasking Ability after Cognitive Load Based Intervention
IRB# 7353

Jessica Tsotsoros, MS, OTR/L ATP
Assistant Professor, Rehabilitation Sciences
Doctoral Candidate at Oklahoma State University
University of Oklahoma Health Sciences Center (OUHSC)

Penny Thompson, PhD
Assistant Professor, Educational Technology
Oklahoma State University

Thank you for taking the time to participate in this research study. Your participation and input is valuable. Please complete this post survey to help us better understand students and multitasking.

Please enter your name below to help us match your pre and post survey.

Q2. **Multitasking with technology is commonplace. Please consider a typical experience during lecture class and rate your level of agreement with the following statements:**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
I believe that I am an efficient multitasker					
I believe that I get more things done when I multitask					
Multitasking is the only way I can get everything I need to do accomplished					
I am good at multitasking					
Being engaged in multiple tasks is easy for me					
Multitasking feels natural to me					
I get things done more quickly when I multitask					

Q21. **During a typical 50 minute lecture course, how many minutes do you spend...**

	0	5	10	15	20	25	30	35	40	45	50
Sending a text message on a cell phone											
Using your laptop for live chat, instant messaging, or iMessages											

Q1.

University of Oklahoma Health Sciences Center (OUHSC)
Student Perceptions and Performance of Multitasking Ability after Cognitive Load Based Intervention
IRB# 7353
Jessica Tsotsoros, MS, OTR/L ATP
Assistant Professor, Rehabilitation Sciences
Doctoral Candidate at Oklahoma State University
University of Oklahoma Health Sciences Center (OUHSC)

Penny Thompson, PhD
Assistant Professor, Educational Technology
Oklahoma State University

Thank you for completing this research study. We appreciate your participation. Please take the time to answer the following questions to help us understand more about students and multitasking.

Please enter your name so that we can match your pre and post-survey responses.

Q2. **Multitasking with technology is commonplace. Please consider a typical experience during lecture class and rate your level of agreement with the following statements:**

	Strongly Disagree	Disagree	Neutral	Agree	Strongly agree
I believe that I am an efficient multitasker	○	○	○	○	○
I believe that I get more things done when I multitask	○	○	○	○	○
Multitasking is the only way I can get everything I need to do accomplished	○	○	○	○	○
I am good at multitasking	○	○	○	○	○
Being engaged in multiple tasks is easy for me	○	○	○	○	○
Multitasking feels natural to me	○	○	○	○	○
I get things done more quickly when I multitask	○	○	○	○	○

Q3. **Please select all strategies that you plan to use the rest of the semester to stay focused on lecture during class.**

- ☐ Print Powerpoint and bring to class
- ☐ Leave laptop at home or in bag
- ☐ Place phone on silent and in bag
- ☐ Close laptop when not needed
- ☐ Turn off internet
- ☐ Other

Checking for updates on social networking sites (Facebook, Twitter, Instagram, SnapChat, etc)										
Responding or posting on social networking sites (Facebook, Twitter, Instagram, SnapChat, etc)										
Surfing internet - not pertaining to class										
Surfing internet for resources pertaining to class										
Searching or watching videos (Youtube, TedTalks, Vimeo, etc)										

Q3. What did you think of the Freedom software?

Q4. Did the Freedom software help you focus or help you in another way?

Q5. What new information did you learn from the educational session?

Q6. Did you find the educational session helpful?

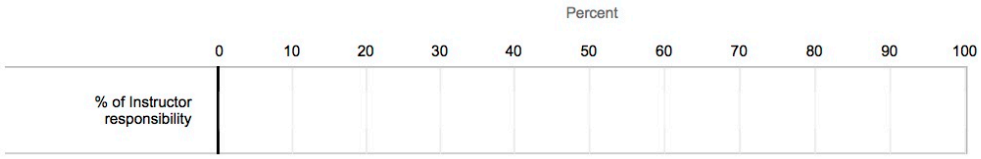
- ○ Yes
- ○ No

Q7. Please select all strategies you intend to implement for the remainder of the semester during lecture or studying?

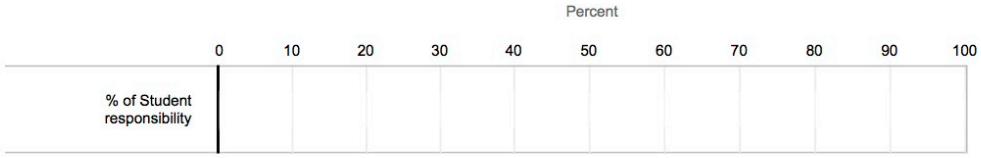
- [ ] Purchase Freedom website blocker
- [ ] Use other form of website blocker during lecture
- [ ] Turn off notification pop ups for email
- [ ] Turn off notification pop ups for iMessage
- [ ] Use airplane mode on phone or laptop
- [ ] Turn internet off after downloading course power point
- [ ] Close laptop when not needed
- [ ] Print Power Point and bring to class
- [ ] I do not intend to implement new strategies
- [ ] Other

Q8. If you chose "Other" please describe

Q10. In your opinion what percentage of responsibility should the instructor take to help students maintain attention and decrease multitasking during a lecture course?



Q11. In your opinion what percentage of responsibility should students take to help students maintain attention and decrease multitasking during a lecture course?



Q12. Which campus are you on during the lecture portion of the Assistive Technology course?

Q13. Program of Study

- ○ Occupational Therapy
- ○ Physical Therapy

Block 2

Appendix E
Post-survey from Qualtrics (Control Group)

Checking for updates on social networking sites (Facebook, Twitter, Instagram, SnapChat, etc)	
Responding or posting on social networking sites (Facebook, Twitter, Instagram, SnapChat, etc)	
Surfing internet - not pertaining to class	
Surfing internet for resources pertaining to class	
Searching or watching videos (Youtube, TedTalks, Vimeo, etc)	

Q3. Please select all strategies that you plan to use the rest of the semester to stay focused on lecture during class.

- ☐ Print Powerpoint and bring to class
- ☐ Leave laptop at home or in bag
- ☐ Place phone on silent and in bag
- ☐ Close laptop when not needed
- ☐ Turn off internet
- ☐ Other

Q4. If you chose "Other" to the question above please describe your strategies here:

Q17. In your opinion what percentage of responsibility should the instructor take to help students maintain attention and decrease multitasking during a lecture course?

	Percent										
	0	10	20	30	40	50	60	70	80	90	100
% of Instructor responsibility											

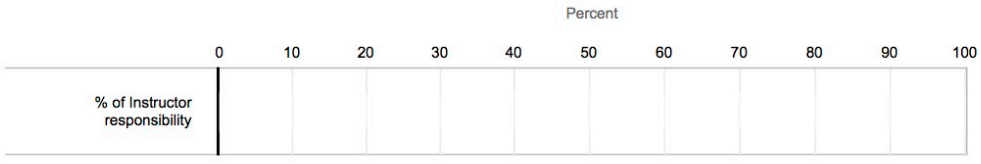
Checking for updates on social networking sites (Facebook, Twitter, Instagram, SnapChat, etc)										
Responding or posting on social networking sites (Facebook, Twitter, Instagram, SnapChat, etc)										
Surfing internet - not pertaining to class										
Surfing internet for resources pertaining to class										
Searching or watching videos (Youtube, TedTalks, Vimeo, etc)										

***Q3.* Please select all strategies that you plan to use the rest of the semester to stay focused on lecture during class.**

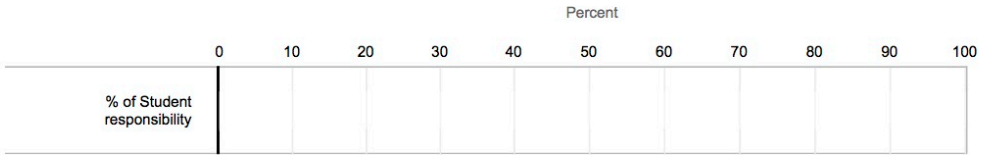
- ☐ Print Powerpoint and bring to class
- ☐ Leave laptop at home or in bag
- ☐ Place phone on silent and in bag
- ☐ Close laptop when not needed
- ☐ Turn off internet
- ☐ Other

***Q4.* If you chose "Other" to the question above please describe your strategies here:**

***Q17.* In your opinion what percentage of responsibility should the instructor take to help students maintain attention and decrease multitasking during a lecture course?**



Q19. **In your opinion what percentage of responsibility should students take to help students maintain attention and decrease multitasking during a lecture course?**



Q5. **Which campus are you on during the lecture portion of the Assistive Technology course?**

▼

Q6. **Program of Study**

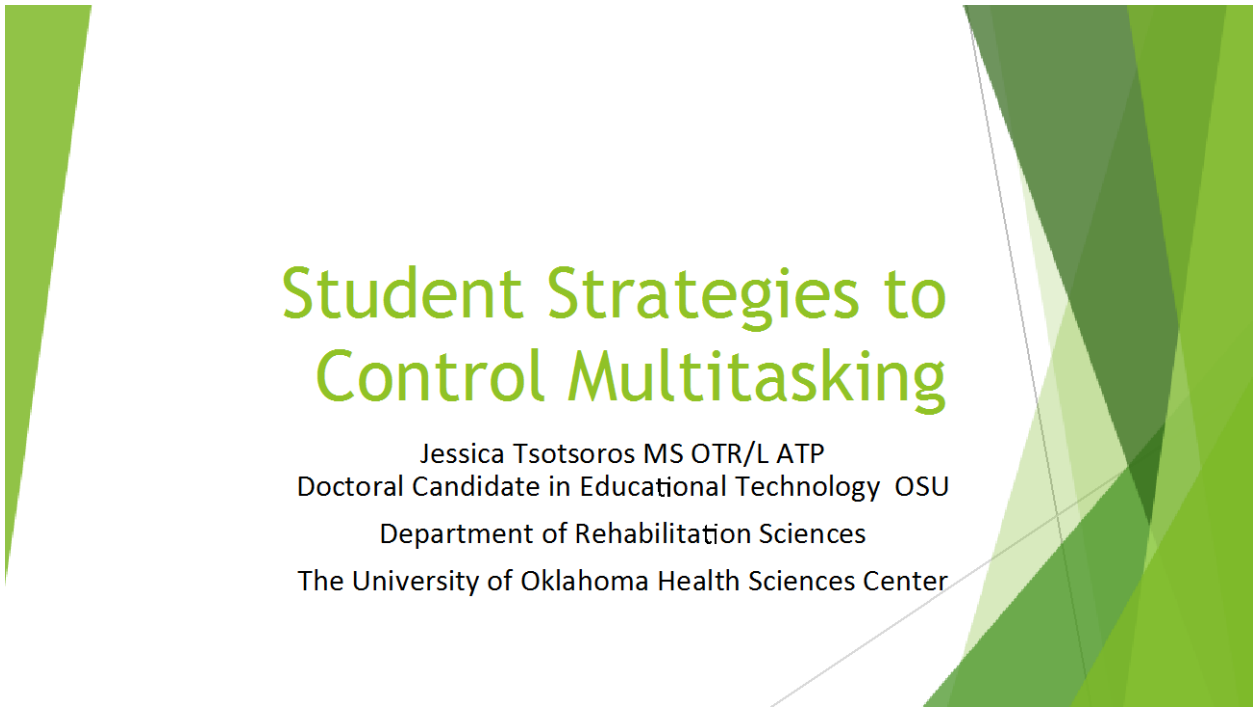
- Occupational Therapy
- Physical Therapy

Block 2

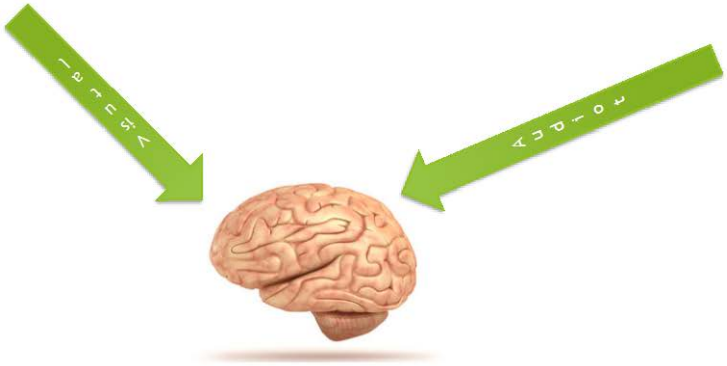
Block 1

Appendix F

Intervention Slides



Dual Channel Theory
Visual / Auditory One way roads



Students watched a 25 minute documentary, 15 item pre and post test. (Downs et al, 2015) - Six Groups

Unstructured	Structured
-Facebook chat	No media - just watched
-taking notes on laptop	laptops to take notes
-FB chat and Notes on laptop	Pencil and paper for notes

Which group do you think did better?

Which group do you think did best? Structured did significantly better

Unstructured	Structured
-Facebook chat	3rd No media – just watched
-taking notes on laptop	2nd laptops to take notes
-FB chat and Notes on laptop	1st Pencil and paper for notes (slightly)

Multitasking Story Experiment

Take out your piece of paper

How to turn off iMessage and other notifications - On iPhone/iPad/iPhone and laptops


Settings


Notifications


Messages


Slide the button from the green/on position to the gray/off position for "Allow Notifications"

Website Blockers

- Focus
- Leechblock
- StayFocusd
- Cold Turkey
- Freedom for both platforms

Pomodoro Technique - use in combination with a website blocker to set up distraction free environment

- Find one task on to do list
- Set timer for 25 minutes
- Break for 3-5 minutes
- After 3-4 sessions take a 30 minute to hour long break

https://ouhsc.qualtrics.com/jfe/form/SV_5mVPqwNNE6ows7z

- Apps
- App store search for pomodoro timer
- 30/30

- Good for your study environment – writing a paper, reading, reviewing etc.

freedom

Freedom.to

Paid Version (Yours is FREE)

Works on all devices (laptop, iPad, Desktop, etc)
Works on all browsers
Works on all operating systems
Can organize blocked sites by list (Social - FB, Twitter, instagram; TV - Hulu, Netflix; Shopping - Amazon)
Scheduled blocks (M-F, 8-5)
Locked mode makes it impossible to alter settings during a session

Instructions for your class time in the next 5 weeks

- Download your Power Point for that day either onto your computer
- Block all websites for the 50 minute class period (not any longer or you can't access the in class quiz)
- Follow cell phone policy

Use of cell phones for texting, surfing or other forms of communication are not allowed in class. Cell phones should be put on silent (no vibration) and put away out of sight in purse or backpack. Students on OKC campus can let family/friends know if there is an emergency they can contact Loretta Ratcliff or Tulsa contact Kathy Campbell who will immediately call the course coordinator or find you in class. Cell phones are not only distracting to students, but those around you. Students will be reminded of this policy at the beginning of each class.

- Download power point prior to class when possible
- After six weeks you will be sent a follow up link to complete a post survey. It is very important that you complete this promptly.

Appendix G

The UNIVERSITY of OKLAHOMA

Institutional Review Board for the Protection of Human Subjects

Initial Submission – Exemption Approval

Date: January 05, 2017

IRB#: 7353
Approval Date: 01/04/2017

To: Jessica Dawn Tsotsoros, MS

Study Title: Student Perceptions and Performance of Multitasking Ability after Cognitive Load Based Intervention

Collection/Use of PHI: No

Exempt Criteria: Exempt Category 1

On behalf of the Institutional Review Board (IRB), I have reviewed the above-referenced research study and determined that it meets the criteria for exemption from IRB review. Study documents (e.g. protocol, survey, etc.) approved for this submission are located on page 2 of this letter. To review and/or access the study submission form (e.g. study application) as well as the study documents approved for this submission, open this study from the *My Studies* option, click to open this study, under *Protocol Items*, click to open/access the current approved *Application*, *Informed Consent*, or *Other Study Documents*.

If this study required routing through the Office of Research Administration (ORA), you may *not begin your study yet*, as per OUHSC Institutional policy, until the contract through ORA is finalized and signed.

As principal investigator of this research study, you are responsible to:

- Conduct the research study in a manner consistent with the requirements of the IRB and federal regulations 45 CFR 46 and/or 21 CFR 50 and 56.
- Request approval from the IRB prior to implementing any/all modifications as changes could affect the exempt status determination.
- Maintain accurate and complete study records for evaluation by the HRPP Quality Improvement Program and, if applicable, inspection by regulatory agencies and/or the study sponsor.

This study meets the criteria for Waiver of Informed Consent and is approved to be conducted without obtaining consent.

If you have questions about this notification or using iRIS, contact the IRB @ 405-271-2045 or irb@ouhsc.edu.

Sincerely,

Martina Jelley, MD, MSPH
Chairperson, Institutional Review Board

VITAE

Jessica Dawn Tsotsoros

Candidate for the Degree of

Doctor of Philosophy in Education

Dissertation: STUDENT PERCEPTIONS AND LEARNING AFTER A COGNITIVE LOAD-BASED INTERVENTION TO REDUCE MULTITASKING BEHAVIORS

Major Field: Education

Biographical

Education:

Completed the requirements for the Doctor of Philosophy in Education at Oklahoma State University, Stillwater, Oklahoma in December 2017.

Completed the requirements for Master of Science in Rehabilitation Sciences at the University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma May 2003.

Completed the requirements for the Bachelor of Science in Occupational Therapy at the University of Oklahoma Health Sciences Center, Oklahoma City, Oklahoma May 1999.

PROFESSIONAL EXPERIENCE:

2013-Present	Assistant Professor and Academic Fieldwork Coordinator for Occupational Therapy The University of Oklahoma Health Sciences Center College of Allied Health/Rehabilitation Sciences