THE EFFECT OF UNRESOLVED INTERRUPTIONS ON PROSPECTIVE MEMORY

By

Joseph Trevor Slayton

Jill T. Shelton
Assistant Professor of Psychology
(Chair)

Amye Warren
Professor of Psychology
(Committee Member)

Preston Foerder
Assistant Professor of Psychology
(Committee Member)

THE EFFECT OF UNRESOLVED INTERRUPTIONS ON PROSPECTIVE MEMORY

By

Joseph Trevor Slayton

A Thesis Submitted to the Faculty of the University of
Tennessee at Chattanooga in Partial Fulfillment
Of the Degree of
Master of Science: Psychology

The University of Tennessee at Chattanooga
Chattanooga, Tennessee

May, 2017

ABSTRACT

I investigated how memory for future intentions (termed prospective memory or PM) was impacted by interruptions, unresolved interruptions, and delays. The PM task was to shop for eight items within an environmental sustainability rating task. A comedy routine appeared after participants had rated several items for both interruption groups, while the delay group viewed the comedy routine before beginning the shopping task. In the unresolved interruption group the comedy routine never reached its conclusion. I predicted that 1) PM performance would be hindered by interruptions with the unresolved group performing worst, 2) that working memory capacity would moderate effects of interruptions on PM performance, and 3) that interruptions would influence gaze patterns such that less information was considered when making consumer decisions relative to delays. Interestingly, delays rather than interruptions negatively impacted PM performance. Working memory capacity predicted PM performance across conditions. No distinct gaze patterns were observed between conditions.

DEDICATION

I dedicate this thesis to any student or individual struggling to become the change they wish to see in the world through loneliness and self-doubt. I also dedicate this thesis to the musicians and artists who throughout this process provided me with encouragement and laughter. Without music, I know that I could not cope with the demands of large-scale data entry and analysis or with the repetition that the science demand. My mother recently told me something that I hope never to forget. She said:

Eventually Jesus called Peter a ‘Rock’ and entrusted him with bringing people closer to God, Trev… but Jesus also called Peter ‘Satan’ once and told him many times to shut his fool-mouth. You may make painful mistakes on the way to learning. The wages of education are mistakes. Those who pursue education and enlightenment operate within an economy of mistakes and often lament their shortsightedness. If you continue pursuing knowledge you will always be astounded by your shortcomings but you will also become more patient with others along the way. You will recognize more readily how difficult learning comes to everyone, not just you. If you have a heart for learning, then you will do what you set out to do and make plenty of mistakes on the way.

Walk in the light you are given, son. Don’t look to the right or the left or worry about whether your light is bright enough or if someone else was given a better light or if your light will soon be extinguished. Just use what light you have while you have it and do the best you can.

Thanks mom.

Glory and thanks be to God for the example set by Jesus Christ who I strive to follow more closely in all my endeavors.

ACKNOWLEDGEMENTS

First, I would like to acknowledge Dr. Jill Shelton for helping me see this thesis to completion from the beginning. I also would like to thank UTC's Office for Equity and Diversity (OED) for funding my graduate assistantship as I pursued my M.S. in Research Psychology. Additional funding was provided by the Provost Student Research Award (PSRA). I express my gratitude to both Dr. Amye Warren and Dr. Preston Foerder for providing timely feedback on my initial proposal and helping me make practical adjustments to my experiment's procedures after pilot studies. I thank with the deepest gratitude my dear friend Sally Swanson who often kept me company as she pursued her own research as a UTC graduate student. I would lastly like to acknowledge two incredibly dependable and enthusiastic undergraduate research assistants, Lydia May and Hannah Allen. Both students gave dozens of hours to running participants in this study and assisting with other studies. I thank you all sincerely.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

NFSC, Need for Situational Closure

NFPC, Need for Psychological Closure

ISE, Intention Superiority Effect

MFG, Memory for Goals

ACT, Adaptive Control of Thought

ACT-R, Adaptive Control of Thought - Revised

AOSPAN, Automated Operation Span Task

SMI, Sensomotoric Instruments®

ANOVA, Analysis of Variance

CI, Confidence Interval

LIST OF SYMBOLS

n, number of cases

$F(\nu_1, \nu_2)$, F distribution with ν_1 and ν_2 degrees of freedom

MSE, Mean Square Error

p, Significance statistic

η^2, Measure of strength of relationship (eta squared)

M, Mean

SD, Standard Deviation

SE, Standard Error

R^2, Multiple correlation squared; measure of strength of association

Δ, Increment of change

β, Regression coefficient value

χ^2, Chi-Square test statistic

ε, Estimate of Sphericity

r, Estimate of the Pearson product-moment correlation coefficient

CHAPTER 1

INTRODUCTION

In 2013, 10% of all fatal vehicle crashes and 18% of all injury-related vehicle accidents involved distractions (Department of Transportation, 2013). Four-hundred and forty-five (14%) of the reported 3,154 distraction-related accidents in 2013 were directly related to drivers using cell-phones. Psychologists have worked diligently for many decades to understand exactly what attributes of an interruption contribute to lapses in attention and failures to retrieve previously encoded intentions. Both Cook, Meeks, Clark- Foos, Merritt, and Marsh (2014) and Hodgetts and Jones (2006a) demonstrated that reinstating a prevailing task context post-interruption significantly impacted interruption recovery and memory for future intentions, the latter concept being referred to more specifically in the literature as prospective memory (Einstein & McDaniel, 2005; Einstein, McDaniel, Manzi, Cochran, & Baker, 2000). Three decades ago, Gillie and Broadbent (1989) investigated variations in prospective memory retrieval relative to interruption length and complexity. Other researchers have investigated how the nature of an interrupted task accounts for variation in post-interruption performance (Jackson, Dawson, & Wilson, 2003; Monk, Boehm-Davis, Mason, & Trafton, 2004). Shelton, Brown, Mason, Gelineau, and Vazquez (2014) demonstrated that interruptions influence purchasing behaviors and prospective memory for shopping intentions. The purpose of the present study is to investigate the impact of interruptions on prospective memory within the context of a shopping task, and to investigate individual difference factors that could modulate the influence of interruptions on prospective memory.

Interruptions and Prospective Memory

Einstein and McDaniel (2005) outlined what is now considered the conventional prospective memory paradigm: First, an experimenter provides instructions and administers practice trials for an ongoing task (e.g., rating presented items using keys on a keyboard). Second, provide prospective memory instructions (e.g., "Click the mouse whenever you see a particular object or word during an ongoing task"). Third, introduce a delay during which participants perform other activities (e.g., complete a Digit Span Task, or count backwards in multiples of a particular number), and, fourth, reintroduce the ongoing task (rating items) without reminding participants of the prospective memory task. Prospective memory targets (e.g. particular items) occur several times in the ongoing task and prospective memory performance is measured by the proportion of times participants remember to make the designated response when the target occurs.

Several researchers have demonstrated that demanding and frequently occurring interruptions negatively impact prospective memory within the aforementioned paradigm (Dodhia & Dismukes, 2009; Einstein, McDaniel, Williford, Pagan, & Dismukes, 2003; Guynn, McDaniel, & Einstein, 1998; McDaniel, Einstein, Graham, & Rall, 2004). What defines an interruption for psychologists may vary in some instances. For example, engaging in an ongoing conversation during another task is not necessarily an interruption but a distraction that requires multi-tasking (Dodhia & Dismukes, 2009), but such distractions have been referred to as interruptions in some studies (Farrimond, Knight, & Titov, 2006). Interruptions are more often generalized as abrupt and unpredictable shifts in task context (Altmann, Trafton, & Hambrick, 2014; Boehm-Davis & Remington, 2009; Nees & Fortna, 2015). For example, being approached by a peer or supervisor for an unexpected chat while writing a report represents a shift in attention from one task to another, or an interruption. If the hypothetical individual who originally interrupted the writing task were to receive a phone call during the interrupting conversation the phone call would represent an interruption to the conversation.

In one study, Einstein et al. (2003) instructed participants to press a slash key when they encountered a specific target cue while performing an ongoing task. Participants were instructed not to press the slash key until they completed the ongoing task. On some trials, after receiving the target cue, but before the ongoing task, participants were interrupted by yet another ongoing task, which they performed until being instructed to return to the original ongoing task. This form of interruption substantially impaired delayed execution of the prospective memory task. In a similar study, McDaniel et al. (2004) found that providing participants with a simple mnemonic strategy or reminder to retrieve their previously encoded intention post-interruption significantly improved performance. Two conclusions can be drawn from both studies: First, retrieving previously encoded intentions amidst demanding interruptions is an effortful process. Second, having contextual cues or reminders available can alleviate the cognitive demands incurred from interruptions.

Dodhia and Dismukes (2009) designed an experiment in which individuals answered multiple choice questions on an SAT completing -style test but were intermittently interrupted by 11 new questions displayed on the computer screen with a different background color. After participants answered the interrupting block of questions, they were taken to a different question from that displayed before the interruption. Dodhia and Dismukes (2009) investigated whether individuals remembered to press a key that would return them to the question they were originally answering after the interruption.

In one experiment, Dodhia and Dismukes (2009) showed participants either a blank screen or an explicit reminder to return to an interrupted task immediately after the interruption took place. In a second experiment, experimental groups received 8-12 second lags of unfilled time after being interrupted. These groups either read “Loading next section.” or, “Loading next section. End of interruption.” Control groups in both experiments experienced all interruptions without lags or messages. Compared to both the control group and the groups given time to pause before being interrupted, the individuals given time to reflect or who received reminders for 8-12 seconds after being interrupted performed significantly better – with the proportion of participants remembering to resume their interrupted question nearly doubling compared to control groups. Dodhia and Dismukes (2009) concluded that when interruptions removed subjects from an ongoing task in which prospective memory cues are embedded, these subjects had significant issues remembering their intentions without reminders or sufficient time to reflect post-interruption.

Hodgetts and Jones (2006a) similarly witnessed faster resumption times after an interruption in the Tower of London disc-sorting task if participants paused 2 seconds prior to the interruption. The Tower of London disc-sort task requires subjects to stacks discs one atop another by size, with smaller discs always being stacked on top of larger discs. Hodgetts and Jones found that an advantage of pausing pre-interruption for later prospective memory performance disappeared when the color of discs changed after the interruption. Both Hodgetts and Jones and Dodhia and Dismukes (2009) studies demonstrated the importance of contextual cue availability in post-interruption recovery.

Cook et al. (2014) demonstrated the importance of context to interruption recovery by demonstratingthe post-interruption prospective memory deficits could be alleviated by giving individuals detailed instructions about the context in which prospective memory targets would occur. Additionally, Cook et al. manipulated ongoing task context for an experimental group in one of their studies so that it was different after an interruption relative to before the interruption, similar to manipulating disc colors after an interruption per Hodgetts and Jones (2006a). When Cook et al. changed the ongoing task context after an interruption participants experienced prospective memory deficits compared to those who returned to a prevailing context. These results suggest that providing detailed prospective memory targets prior to an interruption can alleviate the negative impact of interruptions and that reinstating a prevailing context can further alleviate the impact of interruptions.

Researchers have demonstrated that allowing individuals to negotiate the context in which they experience interruptions may ameliorate anxiety associated with interruptions and improve post-interruption performance (Bailey & Konstan, 2006; Czerwinski, Cutrell, & Horvitz, 2000; Franke, Daniels, & McFarlane, 2002; McFarlane & Latorella, 2002). When humans negotiate interruption context with one another it may take the form of keeping strict office hours or telling others that a person is only available for interrupting conversations under certain circumstances. Humans may be able to negotiate interruption contexts with one another and reach a consensus through dialogue, but negotiating interruption context can be more difficult when humans must negotiate with inhuman and unaware computer systems. There is a burgeoning literature related to interruption negotiation in human-computer interactions. Researchers such as Franke et al. (2002) and Bailey and Konstan (2006) have advocated for attention-aware computer systems and software. An attention aware computer system could be useful for mitigating the disruptive impact of receiving e-mails, which is a common source for interruptions in the work environment (Jackson et al., 2003). Only receiving pop-up alerts for e-mails labeled important is an example of attention awareness in computer systems that can lessen occurrence of interruptions. There are myriad ways in which humans can negotiate interruption context with one another or in a computerized environment and research suggests that these negotiations can make interruptions less of a nuisance. Conversely, researchers have demonstrated that experiencing frequent interruptions at random intervals impairs memory for future intentions and increases reports of frustration and anxiety (Einstein et al., 2003; Zijlstra, Roe, Leonora, & Krediet, 1999).

In sum, pauses, mnemonic strategies, explicit reminders to return to a task, and implicit reminders available via contextual cues all have the potential to aid interruption recovery. In addition, evidence suggests that an inability to negotiate interruption context contributes to anxiety and frustration. The current study aims to further investigate interruption context negotiation, frustration and memory performance

Need for Situational Closure (NFSC)

Humans harbor notions regarding what constitutes completeness and interruptions interfere with one's ability to complete tasks (Wagemans et al., 2012). People tend to have better memory for uncompleted tasks relative to completed tasks(Altmann & Trafton, 2002; Mäntylä & Sgaramella, 1997; Marsh, Hicks, & Bink, 1998). People often get frustrated by interruptions both because they abruptly shift context and because they impede one's ability to complete an interrupted activity (Jhang & Lynch, 2015; Kupor, Reich, & Shiv, 2015; Zijlstra et al., 1999). Zijlstra et al. (1999) observed interrupted individuals becoming frustrated with interruptions primarily when they were unable to control their onset. An experience that might be doubly frustrating could involve being interrupted by a relatively long and passive activity that is itself interrupted just before reaching resolution. In the prospective memory literature, there is a lack of information or findings related to whether desiring closure from a situation interferes with a person's ability to retrieve previously encoded intentions.

Currently, researchers measure a need for situational closure (hereafter abbreviated NFSC) using a 5-item Likert-style questionnaire (see Appendix E) developed by Beike and Wirth-Beaumont (2005). The original intent of the Beike and Wirth-Beaumont was to investigate whether retelling autobiographical events with a bias toward emotionality affected one's reported sense of closure associated with these events. They observed that when participants reported events with more focus on emotional rather than objective details these participants more often reported the event as being a closed book or not comprising unfinished business. Beike and Wirth-Beaumont suggested that one's need for closure could be assessed in real-time using a brief NFSC scale and that need for closure might be altered by how memories are reconstructed.

Kupor et al. (2015) observed that being interrupted during a comedy routine prior to shopping increased individuals' proclivity toward making purchases, ostensibly to achieve closure. Specifically, Kupor et al. either showed participants a comedy routine that they interrupted toward its beginning, end, or not at all before directing participants to an unrelated shopping task. No shopping goals were encoded in the experiment. The dependent variable in this study was the number of products participants indicated they would like to purchase after watching one variation of the interrupted comedy routine. Kupor et al. observed a significant effect of watching the comedy routine interrupted toward its ending and making more future purchasing decisions. In a follow-up mediation analysis, they observed a nonsignificant relationship between condition and purchasing decisions when self-reported NFSC was considered. They observed a perfect correlation (r=1.00) between experiencing the later interruption to the comedy routine and reporting high NFSC. These results suggested that when someone has a strong desire for closure in one domain that they seek out means to achieve closure in unrelated domains.

For nearly a century, cognitive psychologists have observed that uncompleted activities maintain a privileged status in memory compared to completed activities, a phenomenon referred to as the Zeigarnik Effect (Mäntylä & Sgaramella, 1997; Marsh et al., 1998; Zeigarnik, 1938). To date, there are no studies in which retrospective recall, prospective memory performance, and self-reported NFSC are assessed in relation to one another.

Working Memory as a Predictor of Post-Interruption Prospective Memory Performance

Engle (2002) defined working memory as an executive attention system distinct from short-term memory. Kane and Engle (2000) found that most tested subjects could retrieve a list of 10 words from short-term memory after performing a subsequent 16-second filler task. After subjects recalled one list of 10 words, the experimenters presented them with subsequent 10-word lists and demonstrated that working memory capacity predicted whether previously rehearsed lists interfered with memory for newer lists. This finding suggested that many individuals could retrieve information from the recent past by tapping into short-term memory, but that individuals with higher working memory capacities could more easily juggle competing pieces of information in short-term memory without interference. Other researchers have demonstrated that working memory capacity is predictive of both the proactive interference caused by old information competing with new information and of retroactive interference caused by new information interfering with old (Kane & Engle, 2000; Lewis, 1996; Lustig, May, & Hasher, 2001). Ultimately, evidence suggests that working memory capacity generally predicts one's ability to control attentional resources within multiple contexts.

Recently, Foroughi, Werner, McKendrick, Cades, and Boehm-Davis (2016) observed that most interrupted subjects paused after an interruption without any instructions to do so or manipulations that required them to do so per Dodhia and Dismukes (2009). Interestingly, they also observed that working memory capacity predicted the length of post-interruption pauses. This study suggested that individuals with higher working memory capacity are better able to reinstate an interrupted context without external cues or explicit reminders. Research suggests that one's ability to regulate emotions and to focus on what can be achieved in a state of uncertainty are skills more accessible to those with higher working memory capacities (Ashcraft & Kirk, 2001; Hinson, Jameson, & Whitney, 2003; Kidder, Park, Hertzog, & Morrell, 1997; Rose, Rendell, McDaniel, Aberle, & Kliegel, 2010; Schmeichel, Volokhov, & Demaree, 2008). Taken together, the evidence suggests that one's ability to inhibit an emotional response to a situation, such as a desire for closure, and to focus on present activities will be predicted by working memory capacity.

Interruptions and Prospective Memory for Shopping Intentions

The impact of interruptions on decision-making is a popular topic among consumer psychologists. Liu (2008) observed that interrupting subjects lead to their making more purchasing decisions based on desirable characteristics of a product rather than the feasibility of the purchasing decision. Both Kupor et al. (2015) and Liu (2008) drew novel conclusions about the effects of interruptions on shopping preferences but participants did not encode shopping goals prior to making decisions in either study. Both researchers investigated the effect of interruptions on ongoing shopping task decisions without including a prospective memory demand. In contrast, memory researchers have tended toward designing shopping experiments without ongoing tasks that require responses unrelated to the prospective memory task of purchasing items (Farrimond et al., 2006; Shelton et al., 2014).

Much like Liu (2008) demonstrated a tendency to focus on desirability after interruptions during a shopping task, Shelton et al. (2014) demonstrated that individuals using cell-phones while shopping were more likely to make their shopping decisions based primarily on either perceptions related to quality or to price, but were less likely to take both into consideration before making decisions. They also observed decrements in prospective memory that they attributed to dividing attention between cell-phone conversations and searching for targets. Farrimond et al. (2006) interrupted individuals during a virtual shopping task using verbal fluency and semantic fluency tasks they described as being like the naturalistic ongoing task of talking to someone during a shopping task. The latter team did not see decrements in prospective memory performance that could be attributed to the interrupting tasks. In sum, Shelton et al. demonstrated that having a conversation on a cell-phone while shopping for prospective memory targets negatively influenced prospective memory accuracy and that it encouraged unidimensional thinking about purchasing criteria. Farrimond et al. (2006) introduced interruptions believed to simulate conversations in a laboratory-based shopping task and did not observe decrements to prospective memory accuracy.

The discrepancy in results obtained by Shelton et al. (2014) and Farrimond et al. (2006) may be because the former team told participants that they should consider price and quality when making decisions about which item to purchase. Participants had four options of each item and the researchers controlled the price and quality features such that there was always a best (low price, high quality) and worst (high price, low quality) option and two in the middle. Shelton et al. evaluated the price and quality of the purchased items and found that the cell phone group was less likely to consider both dimensions relative to the control group. Farrimond et al. tasked participants with finding items in a virtual marketplace without an additional task of making assessments about these items. There is evidence in the literature to suggest that taxing working memory with higher amounts of information during a shopping task leads to more impulsive shopping decisions (Hinson et al., 2003). This latter finding is especially important to consider if one assumes that having a NFSC contributes to old information interfering with present intentions. To bridge a gap in the literature, I created a shopping-based prospective memory experiment that introduces an unresolved interruption during an ongoing task that is conceptually separated from the prospective memory intention of searching for items and making purchases.

Liu (2008) suggested that interruptions during shopping tasks lead individuals to focus on desirability rather than feasibility of purchasing decisions. It is unclear whether interruptions *per se* drove Liu's effects because in each of her experiments participants were explicitly instructed to stop thinking prior to interruptions. Giving additional instructions in combination with introducing interruptions to experimental groups confounds whether the instructions or interruptions drove Liu's effects. Liu could have witnessed the same behavior observed by Shelton et al. (2014) and Hinson, Jameson, and Whitney (2003). Specifically, Liu may have witnessed a significant relationship between higher working memory loads and impulsive shopping decisions rather than general orientation to desirability.

One way to gather meaningful evidence about the effects of interruptions on information processing during a shopping task is to look at how much and what types of information one gazes at using an eyetracker. Eyetracking software packages generally include an experiment design studio in which slides can be inserted and regions of interest can be delineated. Within these regions, users can calculate gaze proportions and percentages to see whether individuals spend more time looking in one area relative to another.

The control group in prospective memory studies involving interruptions traditionally experience interrupting stimuli as a delay before beginning their ongoing task (McDaniel et al., 2004). Several studies have suggested that experiencing lengthy interruptions do not significantly influence prospective memory performance, but there is still ambiguity regarding the relationship between delay length and prospective memory performance (Hicks, Marsh, & Russell, 2000).

Delays and Prospective Memory Performance

Individuals must often encode intentions and then delay retrieval of those intentions until a later time. Interestingly, the literature surrounding the effect of delays on prospective memory does not currently allow for coherent conclusions to be drawn. Hicks et al. (2000) observed that prospective memory retrieval improved after delays between encoding and retrieval significantly more so if delays comprised numerous task switches rather than singular, unfilled tasks. They suggested that switching tasks during a delay provides opportunities to self-remind about rehearsed intentions. They conversely concluded that engaging in long delays involving a single task reduces opportunities for self-reminding about prospective memory intentions and thus leads to decrements in prospective memory retrieval. Finstad, Bink, McDaniel, and Einstein

(2006) performed a follow-up study and observed improvements in prospective memory relative to task switching only when explicit reminders to perform prospective memory intentions were available during these switches. Schult and Steffens (2013) observed that experiencing delays of increasing length before beginning a task with prospective memory targets embedded concurrently decreased response latencies to these targets Martin, Brown, and Hicks (2011) observed that experiencing longer delays within a prospective memory task interfered more with retrieval than experiencing longer delays in a separate task of equal length of time before beginning their prospective memory task. They suggested that delaying execution within a goal-relevant context for too long might cause otherwise goal-relevant cues to lose their saliency. These findings suggest that experiencing delays between encoding and performing intentions, or during a retention interval, can negatively influence prospective memory when context cues related to prospective memory retrieval lose salience or when these cues are simply unavailable. Additionally, they suggest a complex relationship between type of delay and opportunities for self-initiated reminding.

In the current study, a singular, unfilled activity is introduced either as a delay or an interruption. Whether the unfilled activity represents a delay or an interruption is defined by whether individuals experience it immediately before beginning their ongoing task or briefly after beginning their ongoing task. There is no evidence to suggest that introducing one task as a delay rather than introducing it moments later as an interruption will have a significantly different impact on prospective memory performance. Still, the finding by Hicks et al. (2000) that merely switching tasks more often during a retention interval improves prospective memory performance suggests that switching tasks during an interruption may improve prospective memory. Hicks et al. (2000) suggested that switching tasks improved prospective memory because previously rehearsed intentions maintain a baseline high-level of activation in working memory and are therefore attended to automatically during task switches. Their conclusion has been debated in the literature and more empirical work is needed to inform this controversy.

The Debated Memorial Status of Intentions

Altmann and Trafton (2002) suggested that for several decades, psychologists attempted to explain complex relationships between goal-related memory, interruptions, and individual differences with theories that run counter to empirical evidence. They argued that the intention superiority effect (ISE) is one such theory. Proponents of ISE assumed for many years that goals maintained a baseline highly activated state in working memory and that intentions were protected from unrelated and potentially interfering information in what they referred to as a goal stack (Goschke & Kuhl, 1993; Marsh et al., 1998). They assumed that whichever intentions were last encoded were most activated in one's memory and once these intentions were completed they popped off a cognitive stack and the next goal received attention (Altmann & Trafton, 2002; Anderson, 1983). According to ISE proponents, goals purportedly draw from the same pool of attentional resources as other goal-irrelevant information but can be maintained in memory without strategic rehearsal because of a privileged status (Marsh et al., 1998; Penningroth, 2011; Penningroth, Graf, & Gray, 2012; Schult & Steffens, 2013).

Altmann and Trafton (2003) designed the Memory for Goals (MFG) model to investigate whether goal-directed memories are susceptible to interference from competing, goal-irrelevant stimuli, whether these memories become strengthened if attended to regularly, whether they can be primed via environmental cues, and, ultimately, whether goal-related memories are more highly activated than goal-neutral information in working memory. In opposition to ISE proponents, Altmann and Trafton argued that completed goals are retrieved less readily because they decay while uncompleted goals should continue to be strategically rehearsed until completed. They discarded ideas related to popping mechanism and goal stacks in favor of explanations related to contextual cue availability, decay, interference, and rehearsal. Interestingly, there is empirical evidence to support both ISE and MFG.

Goschke and Kuhl (1993) argued in favor of ISE based on observations that individuals who have rehearsed a script that they are told they will perform later respond to words from that script in a lexical-decision task (LDT) more quickly than they do to words associated with a rehearsed but not to-be-performed script. In one ISE investigation, Penningroth et al. (2012) observed that working memory load did not predict an ISE, suggesting that even when attention is taxed, goals are retrieved more quickly than other information from memory. They additionally observed that individuals were even more likely to respond quickly to goal-related targets if they later reported unawareness about doing so. They interpreted these findings as evidence for a general ISE, independent of individual differences.

Penningroth et al. (2012) argued that the ISE occurring independent of working memory load demonstrated that goals are retrieved effortlessly and automatically from memory compared to neutral material. In an earlier experiment, however, Penningroth (2011) concluded that the ISE is not generalizable but is moderated by gender and whether an individual is action-oriented or state-oriented, as assessed using the prospective and decision-related versus hesitation *(*AOD*)* subscale (Kuhl, 1994). Additionally, Schult and Steffens (2013) observed an ISE only when the task in which intention-related stimuli were embedded presented itself after short rather than lengthy delays. Marsh et al. (1998) observed an ISE even when participants were interrupted during a lexical decision task and concluded that intention-related memories maintain a privileged status despite competition from irrelevant stimuli. The findings of Marsh et al. (1998) were novel but whether they were generalizable becomes debatable considering that a myriad studies have demonstrated that interruptions interfere with one's ability to achieve previously rehearsed intentions (Brumby, Cox, Back, & Gould, 2013; Einstein et al., 2003; Hall, Pedersen, & Fairley, 2010; Loukopoulos, Dismukes, & Barshi, 2001; McDaniel et al., 2004). Whenever goal-related cues are responded to more quickly than goal-irrelevant cues or goal retrieval does not experience interference from interruptions, proponents of ISE have presented these phenomenon as evidence that goals hold a privileged status in memory (Hicks et al., 2000; Marsh et al., 1998; Penningroth et al., 2012). It suffices to say that there is evidence to suggest that goal-irrelevant information can interfere with memory for goals and conversely that in many instances goal-relevant information is more easily accessible compared to neutral material (Altmann & Trafton, 2002; Altmann et al., 2014; Hodgetts & Jones, 2006a, 2006b; Penningroth, 2005, 2011; Penningroth et al., 2012; Trafton et al., 2003)

Interestingly, individuals in both the ISE and MFG camp have yet to pursue investigations in which an individuals' ability to retrieve a rehearsed goal competes with a goal-irrelevant interruption in which participants might anticipate but not receive expected closure. Closure is operationalized here as reaching the logical conclusion of a task when one would expect to do so. For example, the logical conclusion of a joke is its punchline. Listening to the build-up of a joke to its punchline without eventually getting the punchline represents a situation associated with a lack of closure (Kupor et al., 2015). If expected resolution during an interrupting activity is not achieved, then the attentional trace associated with finishing the interruption may remain active and beat out previously rehearsed intentions from short-term memory. This may occur because the contextual features associated with one task ending and another being returned to are unavailable and this lack of contextual cuing may interfere with a person's ability to reorient their attention toward the interrupted goal (Cook et al., 2014; Hodgetts & Jones, 2006a).

Difference Between Need for Psychological Closure and NFSC

Kupor et al. (2015) referred to NFSC as a Need for Psychological Closure (hereafter NFPC), but NFSC should not be confused with NFPC, a construct originally studied by Kruglanski and Webster (1996). Kruglanski and Webster (1996) created a separate need for closure scale to predict a person's generalized desire for closure and this scale has been shown to predict NFPC regardless of situational constraints. Scores on their scale have been empirically related to behavioral inhibition, achievement orientation, and working memory capacity (Czernatowicz-Kukuczka, Jaśko, & Kossowska, 2014; Harlow, DeBacker, & Crowson, 2011). While the NFSC scale has proven useful in predicting a desire for closure in particular situations assumed to induce a high need for closure, it has yet to be related to a person's more generalized NFPC or to working memory capacity (Beike & Wirth-Beaumont, 2005; Kruglanski & Webster, 1996).

Roets and Van Hiel (2011) validated a brief, 15-item NFPC scale after conducting an item analysis of the 42-item scale created by Kruglanski and Webster (1996). Researchers have yet to correlate scores for both the 5-item NFSC scale and the 15-item NFPC scale. Scores from both scales will be collected in the current study to explore whether they are correlated, but no hypotheses are made about a relationship between the two scales.

Proposed Research

The purpose of the proposed research is to test whether individuals who experience unresolved interruptions will exhibit poorer prospective memory performance compared to individuals who experience resolved interruptions or delays. I also predict an interaction between working memory capacity and prospective memory performance post-interruption. Specifically, individuals will have more trouble remembering previously encoded items after an interruption but individuals with higher working memory capacity should have significantly fewer prospective memory failures related to interference from the interruption. Predictions are not made regarding whether need for situational closure will influence prospective memory performance but a relationship between NFSC and working memory capacity will be investigated. The current research specifically aims to investigate whether NFSC is predictive of prospective memory performance beyond working memory capacity. This relationship will be tested within a shopping context, a context for which there is a gap in our understanding of the effects interruptions have on prospective memory. Finally, I will investigate whether interrupted individuals consider less information while making decisions in an ongoing shopping task compared to individuals who experience delays. This is an exploratory prediction in that there is little extant research on whether delays influence later information processing but plenty of evidence to suggest that interruptions influence information processing.

In summary, the hypotheses of the proposed study are as follows:

H_1: Individuals who experience an unresolved interruption are more likely to forget to purchase items from a previously encoded shopping list relative to participants in a delayed group.

H_2: Working memory capacity will moderate the effect of condition on prospective memory performance.

H_3: Individuals in who experience unresolved interruptions will be significantly more likely to fixate on one characteristic of an item (price, quality, or appearance) before rating items in the ongoing task in comparison to individuals in the delay group.

CHAPTER II

METHOD

Participants

Seventy-seven students (63 females and 14 males) at the University of Tennessee at Chattanooga ranging in ages from 17-45 years old, voluntarily participated in this experiment. Participants were randomly assigned to either the delay condition (n = 26), a resolved interruption condition (n = 25), or an unresolved interruption condition (n = 26). A power analysis revealed that the current study had an 95% chance of finding an effect if manipulations caused a large difference.

Apparatus

A SensoMotoric Instruments (SMI) RED250Mobile was used for data collection. It is typically accurate within 0.4 deg and has a resolution of .03 deg. All visual angle metrics are reported in degrees. Visual scan patterns were recorded at a rate of 60 Hz. This portable eyetracking device was positioned at the base of an 18" Dell Latitude E6530 with a screen resolution of 1600 x 900 pixels. The three regions of interest enclosing both ongoing task and prospective memory targets each represent represented 4.7% of the screen and collectively represented 14.1% of the screen. Each region had a visual angle of 2.607°. Participants were seated approximately 60 cm. from the SMI RED250Mobile and laptop screen. Before testing, the eyetracker was calibrated to ensure each participant's eyes could be accurately tracked.

Materials

Need for closure questionnaires. Participants completed a 15-item revised version of Kruglanski's (1990) original 42-item NFPC questionnaire (See Appendix D). This shortened version of the original test was scored using a single average for all 15-items on a 1-6 point Likert scale (Roets & Van Hiel, 2011). In addition, after participants completed their prospective memory/shopping task, NFSC was assessed using the 5-item scale developed by Beike and Wirth-Beaumont (2005). Both the NFPC scale and the NFSC scale were scored by taking the average of responses on a 6-item and 5-item Likert scale, respectively (1= Strongly disagree, 5 and 6 = Strongly agree). The NFSC scale used in this study was identical to that used by Kupor et al. (2015).

Automated operation span task. An Automated Operation Span (AOSPAN) task was administered using E-Prime Professional 2.0 software (Psychology Software Tools, 2012; Unsworth, Heitz, Schrock, & Engle, 2005). During the AOSPAN, participants were presented with a series of simple math problems and then presented with one possible answer and the options to click on "TRUE" or "FALSE". Once participants clicked whether the presented answer was "TRUE" or "FALSE," they were presented for approximately 2 seconds with an uppercase letter. After the letter flashed on the screen another math problem was presented, followed by another possible answer and another letter. This sequence of events repeated itself until participants were presented with 12 different letters beside checkboxes and asked to click boxes next to the letters presented earlier in the order they were presented. Participants were tasked with recalling a maximum seven letters at a time and a minimum three letters. After letters were selected from among the twelve options, participants were shown a percentile value indicating how well they did on the math portion of the test and how many letters they guessed correctly. After seeing their score, a new round of math problems and letters were presented. This test took approximately 15 minutes to complete. The total number of letters recalled in the correct order across the entire task was used to asses working memory capacity

Reliable digit span task. The Reliable Digit Span Subtest of the Wechsler scales was used as a filler task between encoding prospective memory targets and beginning the ongoing task. The Reliable Digit Span required participants to listen to the experimenter recite a series of numbers (minimum 2 numbers and maximum 8 numbers) and then to repeat these numbers in forward order during the first portion of the test and in reverse during its second portion. If participants incorrectly recalled two series of numbers in a row on either portion of the test, the experimenter concluded that portion of the test and tallied the points scored. The Reliable Digit Span task also was included because of its utility as an effort assessment. Axelrod, Fichtenberg, Millis, and Wertheimer (2006) observed that scoring below a 7 for both the forward and backward portion of the test indicated incomplete effort. Any participant scoring below 7 for both portions of the test were to be excluded from the experiment. No participants crossed this threshold so none were excluded because of their Reliable Digit Span scores.

Interrupting comedy routine. The Interrupting comedy routine used during the experiment came from *Late Night with Conan O'Brien*. Six individuals from the research team viewed six separate comedy routines and voted that the chosen routine was most appropriate for the study because it was delivered as a single story with a definite build-up to a punchline rather than as a string of short, funny anecdotes or separate jokes. The comedy routine lasted a total of 3 min. 47 sec. but was cut down to 3 min. 44 sec. for those participants in the unresolved interruption group.

Ongoing and prospective memory task stimuli. Participants viewed 100 different slides during the ongoing task (See Figure 2.1). Images for items were pulled from multiple sources on the internet and both prices and quality ratings (i.e. stars) were cut and pasted from Amazon.com and manipulated to be more easily visible using Microsoft® Paint. Because the items were presented in a series of slides in Eyeworks® Record, all slides were additionally manipulated using Adobe® Photoshop. All items were displayed in the same screen position and were of equal dimensions. The eight items encoded as prospective memory targets were pseudorandomly assigned to slides 9, 22, 33, 45, 58, 67, 77, and 89.

Procedure

Upon entering the laboratory, participants read and signed an informed consent contract (see Appendix B), completed a paper-based 15-item NFC Questionnaire and filled out a brief demographic questionnaire (e.g., age, years of education, ethnicity, gender, native language, and hearing or visual impairments). Next, participants sat down in front of the eyetracker.

After calibration, the experimenter provided instructions for the upcoming ongoing task. The ongoing task involved rating a series of items shown to them for perceived environmental sustainability by pressing A, B, or C keys on the laptop's number pad to indicate their choice of items A, B, or C presented on each slide ("A," "B," and "C" were written on printer labels and stuck to the 4, 5, and 6 keys on the laptop number pad). All slides presented participants with three different criteria for making their ongoing task ratings: appearance, quality ratings, and price (see Figure 2.1). Participants were told explicitly that they could not make correct or incorrect assessments during the ongoing task because their responses were based on perceptions. The experimenter told participants that their only job was to be honest about their perceptions and to consider all the information presented to them before making a choice. The experimenter told participant they might use the information presented in each slide to inform their perceptions using the following instructions:

"Some things you might consider when making sustainability ratings are whether an item appears to have been produced using more or fewer resources, whether you think the item is a necessity or a luxury and is reasonably priced as such, and/or whether you think that an item's quality ratings provide sufficient evidence of their sustainability."

The experimenter then explained that after pressing the A, B, or C keys participants should press the "Next" key to proceed to the next slide ("Next" was written on a printer label and stuck to the Page Down key on the right side of the laptop keyboard). The experimenter instructed participants to only use their right hand during the experiment. Participants practiced performing the ongoing task for six different items.

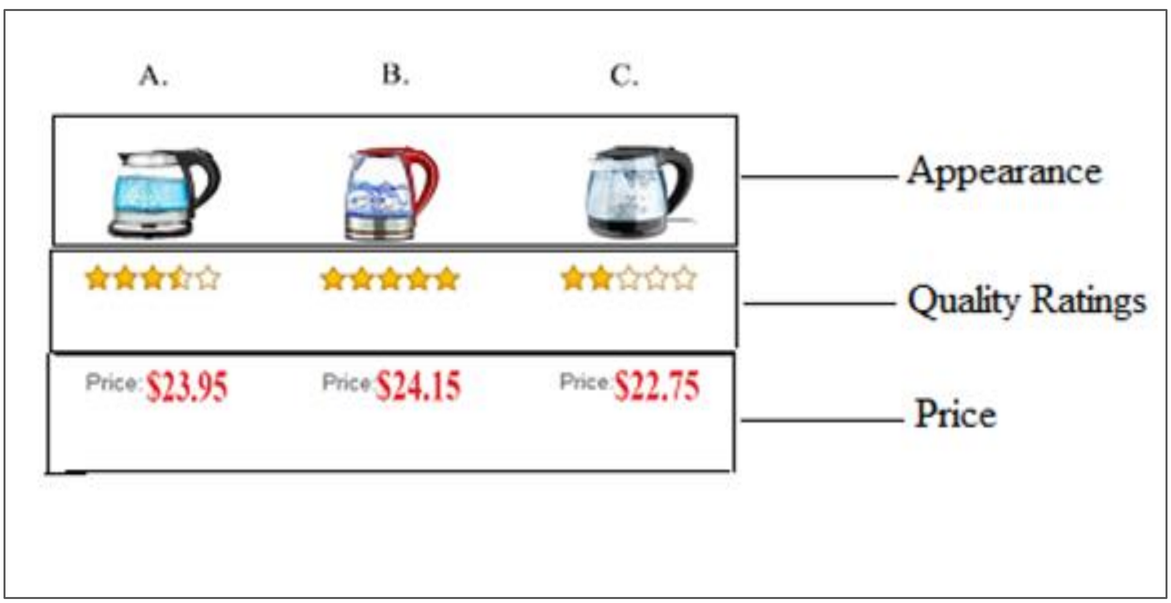

Figure 2.1

Shopping Stimuli Slide Showing Appearance, Quality, and Price Regions

After participants rated six items for environmental sustainability, they practiced the prospective memory task of pressing the space bar to purchase particular items. For the prospective memory practice trials, the experimenter instructed participants to continue rating items for environmental sustainability and additionally to remember to press the space bar to "purchase" two items embedded within six upcoming practice slides (i.e., a baseball glove and an alarm clock). Before they practiced the appropriate prospective memory response, participants rehearsed the names of two target items (i.e. a baseball glove and an alarm clock) and the appropriate prospective memory response aloud to the experimenter. After participants completed practice trials, the experimenter gave them instructions regarding the eight prospective memory targets they should remember to purchase later in the experiment. The experimenter instructed participants as follows:

"Good! You have completed the practice phase of this experiment. When you return to this consumer rating task later in the experiment, in addition to indicating which of the items you think was produced in the most environmentally sustainable way by pressing A, B, or C, you should remember to press *space bar* when you see the following items: vacuum cleaner, flashlight, hairbrush, notebook, umbrella, stapler, lighter, and trashcan. Please repeat the items from the list above aloud to the experimenter before we continue."

Participants repeated the list of eight items to the experimenter, then heard and read the following instructions:

"Pressing the space bar upon seeing any of these items later will represent a purchasing decision. These are the only items you should purchase later in the experiment. It is okay if you forget to press the space bar immediately upon seeing one of the items. You may still press the space bar before one or two additional slides have passed."

The experimenter then directed participants' attention to a word-bank with 16 items, eight of which comprised the rehearsed prospective memory targets and eight of which were distractors that would not be encountered during the experiment. Participants identified which of the 16 items they were supposed to purchase during the experiment and typed these items into a blank space below the word bank. If a participant forgot an item from the encoded list, the experimenter instructed them to move their hands away from the keyboard and then repeated the list aloud to the participant before they asked which item(s) the participant forgot. If a participant added one of the distractor items to their list, the experimenter repeated the list aloud to the participant before asking them "which item does not belong in the list you made?" In both scenarios, the experimenter asked participants to add the item they forgot or to delete any distractor items they added to the list. The experimenter noted how many times it took each participant to relearn the list before he or she successfully typed all eight prospective memory targets. The experimenter then asked participants to say aloud what they were supposed to do in addition to rating items for environmental sustainability by pressing A, B, or C later in the experiment. After participants successfully rehearsed their prospective memory intention, the experimenter told them they would not be reminded of this secondary task later.

The experimenter then instructed participants to focus their attention on a fixation cross in the center of the computer screen. While the participant focused on the screen, the experimenter administered the Reliable Digit Span task. After participants completed the Reliable Digit Span task, the experimenter presented instructions that the trial phase of the experiment would begin soon. Each group received the following set of instructions before beginning the ongoing task:

"Good, you have now completed the first phase of the experiment. You will now begin the trial phase of the experiment. Remember to keep your non-dominant hand in your lap and try to remain still throughout the rest of this experiment. Please put on the headphones beside the laptop now. Please wait for the experimenter to provide you with further instructions."

The experimenter then explained that they would no longer be interacting with the participant until they had completed the following portion of the experiment.

Participants in the delay group clicked continue to leave the final instruction slide and immediately read a message that displayed for four seconds, “Before you begin rating items, you will watch a brief comedy routine.” Participants in the delay group then watched a 3 minute, 52 second comedy routine. Individuals in both interruption conditions began the ongoing task and rated two items before they were interrupted with a similar message: “Before you continue rating items, you will watch a brief comedy routine.” This message was followed by the same 3 minute, 52 second comedy routine. None of the items shown before the interrupting text message were prospective memory targets nor were they semantically related to any of the PM targets per Free Association Norms (Nelson, McEvoy, & Schreiber, 1998).

Individuals in the resolved interruption condition watched the entire comedy routine before continuing the ongoing task while those in the unresolved interruption condition came to the final three seconds of the comedy routine, just before the punchline was delivered, and saw a black screen for those final seconds before returning to the ongoing task.

After viewing the comedy routine, participants in all groups began or continued the ongoing task without further interruptions. After participants viewed all 100 slides in the ongoing task, they completed the 5-item NFSC scale. Participants then typed the prospective memory targets that they remembered encoding earlier. After participants recalled prospective memory targets, they chose from four possible choices the prospective memory response. Participants then were asked to type what they thought the significance of the comedy routine was. Finally, participants rated on a 5-point Likert Scale how they thought they did on both the ongoing and prospective memory tasks and whether they thought the comedy routine was boring or funny. Finally, participants indicated whether they had seen the routine prior to the experiment.

After participants completed these post-test questionnaires, they moved to another computer in the same laboratory to complete three blocks of the Automated Operation Span task. The AOSPAN task took about 15 minutes to complete. After participants completed the AOSPAN, the experimenter debriefed them and concluded the experiment. The full procedure for this experiment is outlined in Figure 2.2.

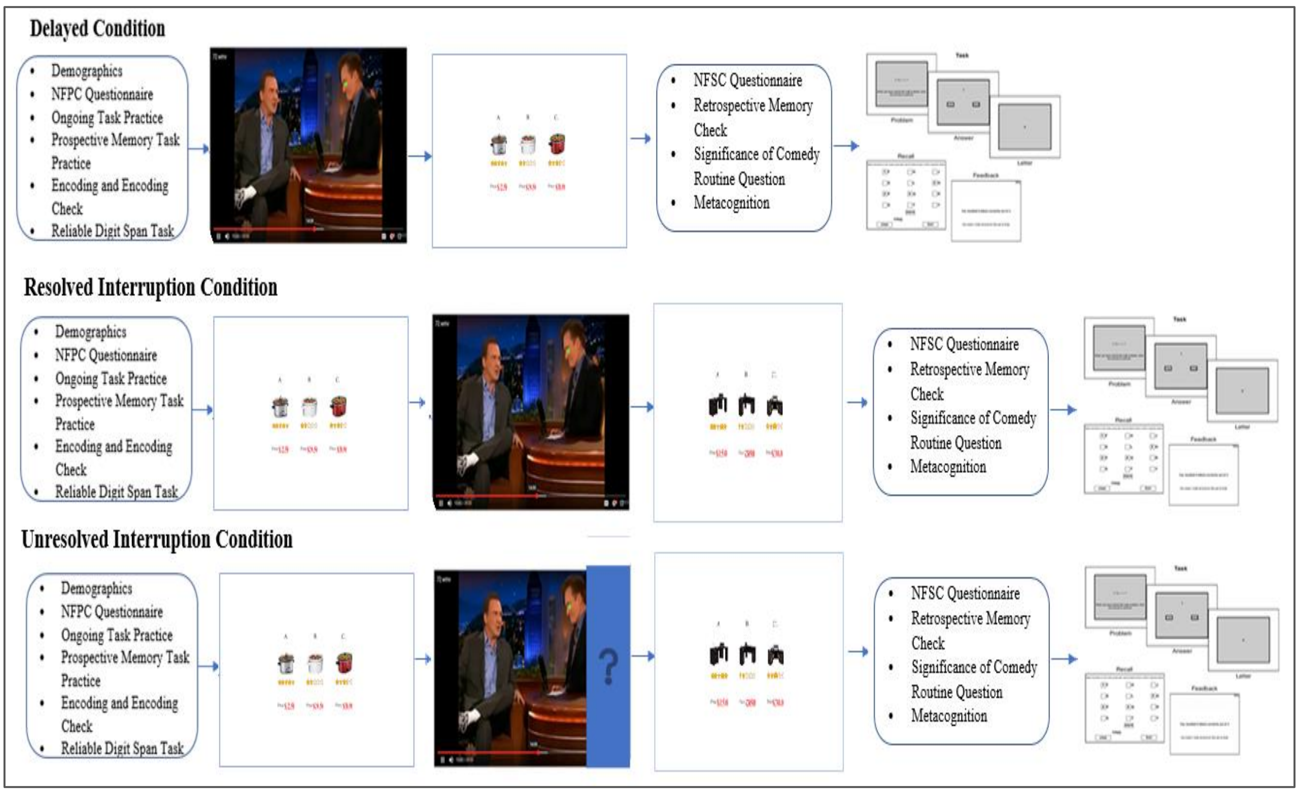

Figure 2.2

Diagram Outlining Experimental Procedure

CHAPTER III

RESULTS

Unless otherwise stated, all results are reported with $\alpha = .05$. The first hypothesis in the present study was that individuals who experienced an unresolved interruption would be more likely to forget to purchase items from a previously encoded shopping list relative to participants in a delay group. A one-way Analysis of Variance (ANOVA) demonstrated statistically significant differences between the three groups, $F(2, 74) = 3.989$, $MSE = .324$, $p = .023$, $\eta^2 = .097$. Levene's test for equality of variances was violated for the present analysis, $F(2,74) = 7.028$, $p = .002$. A Dunnett's T3 Post-Hoc procedure was conducted to determine which differed significantly. The results of this analysis are illustrated in Table 3.1. Participants in the resolved interruption group, $M = .726$, $SD = .204$, had a significantly higher prospective memory accuracy compared to individuals in the delayed condition, $M = .510$, $SD = .371$, but neither of these groups performed at significantly different rates compared to the unresolved interruption group, $M = .674$, $SD = .250$.

Table 3.1

Average Proportion of Prospective Memory Responses in Delayed, Resolved Interruption, and Unresolved Interruption Conditions

Condition	*n*	Mean	SD	SE	95% Confidence Interval for mean	
					Lower	Upper
Delayed	26	0.510	0.371	0.073	0.360	0.660
Resolved Interruption	25	0.726	0.204	0.041	0.641	0.810
Unresolved Interruption	26	0.674	0.251	0.049	0.573	0.775
Total	77	0.636	0.296	0.034	0.568	0.703

The second hypothesis of the study was that working memory capacity would moderate the effect of condition on prospective memory performance. To test the second hypothesis, a hierarchical multiple regression analysis was conducted with proportion of prospective memory targets accurately responded to as the dependent variable, condition entered as the stage 1 predictor, partial scores on the AOSPAN as the stage 2 predictor, and the interaction term entered as the stage 3 predictor. The results of this analysis are illustrated in Table 3.2. Condition contributed marginally significantly to the model, R^2=.052, F(1,75) = 4.142, p = .045, 95% CI [.002, .162]. At stage 2, working memory capacity contributed significantly to the regression model, R^2 = .110, ΔR^2=.058, F(2,74) = 4.571, p=.032, 95% CI[-.007,.004]. The interaction term at stage 3 did not contribute significantly to the regression model, R^2=.116, ΔR^2=.006, F(3,73) = 3.195, p =.480, 95% CI [-.007, .004].

A similar analysis using condition, working memory capacity, and their interaction as predictors of retrospective memory recall during post-test questioning was also conducted.

Condition did not contribute significantly to the regression model, R^2=.034, F(1,75) = 2.628, p = .109, 95% CI [-.009, .603]. At stage 2, working memory capacity contributed significantly to the regression model, R^2 = .093, ΔR^2=.060, F(2, 74) = 3.813, p = .031, 95% CI [.000, .005]. The interaction term at stage 3 did not contribute significantly to the regression model, R^2=.100, ΔR^2 = .006, F(3, 73) = 2.697, p = .476, 95% CI [-.002, .004]. These results are illustrated in Table 3.2.

Table 3.2

Hierarchical Multiple Regression Analyses Predicting Average Proportion Of Accurate Prospective Memory Responses and Average Proportion Of Target Items Accurately Recalled Retrospectively from Condition, Working Memory Capacity, and their Interaction Term

	Prospective Memory		Retrospective Memory	
Predictor	ΔR^2	β	ΔR^2	β
Step 1	0.052*		0.034	
Condition				
Step 2	0.058*		0.06*	
Working Memory Capacity		0.240*		0.244*
Step 3	0.006		0.006	
Condition x Working Memory capacity		-0.346		-0.352
Total R^2	0.116		0.100	
n	76		76	

*p<.05

Another hierarchical multiple regression predicting average proportion of accurate prospective memory responses with condition at stage 1, working memory capacity at stage 2, NFSC at stage 3, and their interaction term stage 4. At stages 1 and 2, condition and working memory capacity contributed to the regression model as shown in Table 3.2. At stage 3, NFSC did not contribute significantly to the regression model, $R^2 = .114$, $\Delta R^2 = .004$, $F(3, 73) = 3.127$, $p = .572$, 95% CI [-.171, .095]. At stage 4, the interaction term did not contribute significantly to $R^2 = .114$, $\Delta R^2 = .000$, $F(4, 74)$, $p = .951$, 95% CI [-.001, .002].

A series of steps were necessary to investigate the third hypothesis that differences in gaze patterns across conditions: First, as shown in Figure 3.1, each slide shown to participants during the ongoing task was broken down into three regions by creating rectangular regions of equal size around images for each item, the quality ratings for each item, and the price for each item. The Eyeworks GazeStats function was used to calculate the percentage of time spent gazing into each region. This percentage was calculated in each region for the 92 slides associated with the ongoing task, including the slide returned to in the interrupted groups (i.e. knife sets). The average proportion of time individuals spent gazing in each region across slides was then calculated.

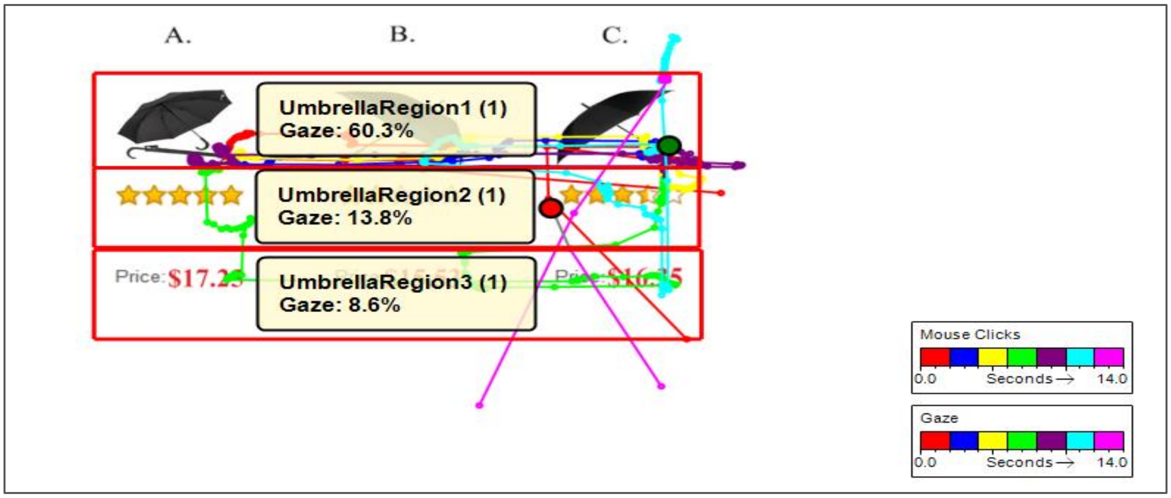

Figure 3.1

Gaze Pattern Statistics Across Regions

A 3 (Condition: delayed/resolved interruption/unresolved interruption) x 3 (Region: Appearance/Quality/Price) mixed-factor ANOVA was used to explore the effect of condition on average gaze proportions in the three regions associated with appearance, quality ratings, and price.[1] Mauchly's Test of Sphericity indicated that the assumption of sphericity had been violated, χ^2 (2) = 70.857, $p < .001$. Therefore, a Greenhouse-Geisser correction was used to raise the critical F value needed to reject the null hypothesis (Greenhouse & Geisser, 1959). The corresponding corrective coefficient was $\varepsilon = .620$.

No main effect of condition was observed, $F(2, 73) = 1.285$, $MSE = 221.132$, $p = 2.83$, $\eta^2 = .034$. A main effect of region was observed, $F(1.230, 75) = 131.156$, MSE =39,310.871, p = .000, $\eta^2 = .642$. There was no qualifying interaction between region and condition, $F(2.460, 73)$ = .809, $MSE = 242.425$, $p = .471$, $\eta^2 = .471$. A Bonferonni Post-Hoc procedure indicated that there

[1] I was unable to obtain gaze data from one participant in the delayed condition because of a technical issue. They were excluded in my analysis of gaze patterns.

was a significant difference between gaze proportions in each region. Average gaze time within regions decreased by an average of 28.3 secs between appearance and quality ratings (*p*<.001) and then decreased by an additional average of 4.7 secs between quality ratings and price (*p* <.001) Descriptive statistics related to gaze patterns are illustrated in Table 3.3.

Table 3.3

Descriptive Statistics for Average Gaze Proportions Based on Region

Region	N	Mean	SD	SE	95% Confidence Interval for Mean	
					Lower	Upper
Appearance	76	42.271	20.443	2.341	37.606	46.937
Quality	76	13.973	8.220	0.954	12.071	15.875
Price	76	9.309	7.394	0.852	7.610	11.008

I additionally performed a correlational analysis between working memory capacity and retrospective recall accuracy, prospective memory accuracy, NFSC, and Likert-Style responses to the statement "I did a good job remembering to respond to all the items I was supposed to purchase" was conducted. Answers to this question will hence be referred to as prospective memory performance evaluations. As shown in Table 3.4, no significant correlation was observed between prospective memory performance and retrospective recall, r = .142, p = .220. There was a marginally significant, positive correlation between prospective memory performance and prospective memory performance evaluations, r = .229, p = .045. There was no significant correlation between retrospective recall and answers to the same question, r = .172, p = .136.

There was also no significant correlation between working memory capacity and answers to this question, r = .187, p = .106. There was a significant and negative correlation between working memory capacity and NFSC, r = -.271, p = .017.

Table 3.4

Correlations Between Three Cognitive Variables, Condition, NFSC, and Self-Evaluation of Prospective Memory Performance

Measure	1	2	3	4	5	6
1. Prospective Accuracy	–					
2. Retrospective Recall	0.145	–				
3. Working Memory	0.252*	0.253*	–			
4. Condition	0.229*	0.184	0.053	–		
5. NFSC	–0.102	0.056	–0.271*	0.106	–	
6. Prospective Memory Performance Evaluation	0.229*	0.173	0.185	0.088	0.064	–

*Correlation is significant at $p < .05$ level (2-tailed)

Finally, I investigated whether there was a significant correlation between NFPC and NFSC. No significant correlation between NFPC and NFSC was detected, r = -.144, p = .219.

CHAPTER IV

DISCUSSION

The objective of this study was to investigate whether unresolved interruptions interfere with memory for previously encoded goals more than resolved interruptions. If supported, this hypothesis would lend credence to the idea that a desire to complete a goal-irrelevant activity can interfere with a previously rehearsed, event-based intention and that goals *per se* do not maintain a privileged state in working memory. This hypothesis was not supported. The only significant difference between groups in the present study was between the delayed group and the resolved interruption group. Working memory capacity significantly contributed to prospective memory performance across groups, but did not moderate the effect of condition on prospective memory performance. Working memory capacity was negatively and significantly correlated with participants' NFSC and need NFSC did not contribute as a significant predictor to prospective memory performance. An analysis of gaze data using an eyetracker did not illustrate significant differences in information processing dependent on one's condition. All participants were likely to focus most of their attention on each items' appearance and then attend to quality, then to price in a top-to-bottom fashion.

Though the difference between the delayed group and the resolved interruption was significant, it is difficult to draw conclusions from these data. Twenty-five percent (*n* = 6) of the participants in the delayed group responded to zero prospective memory targets. Interestingly, none of these individuals scored below average on the Reliable Digit Span effort assessment, the

AOSPAN, nor did they recall any fewer than three of the prospective memory targets in the retrospective memory check. Each of these participants also indicated that they knew space bar was the correct prospective memory response during post-test questioning as well. Eliminating these participants from the current analysis makes the difference between the resolved interruptions and the delayed groups non-significant.

While including these low-scoring individuals in the analysis drives a significant difference between groups, the data do not suggest that these individuals were not trying. The fact that only two other individuals in the study responded to zero targets in the unresolved interruption group and that they also did not score below average on measures related to effort, working memory, or retrospective recall strongly suggests that these individuals failed to make prospective memory responses because of their condition assignment.

Interestingly, these results line up with those obtained by Hicks et al. (2000). They observed long, unfilled delays interfering with prospective memory performance more so than similar-length delays with embedded task switches. Their conclusion was that individuals used task switches during delays as opportunities for self-reminding. In the current study, participants did answer post-test questions about whether they thought the comedy routine was boring or funny, what they thought it signified within the context of the experiment, and whether they thought they performed the prospective memory task accurately. No data were gathered regarding what the participant thought about while they watched the comedy routine or regarding their initial reaction to being interrupted. Individuals in both interrupted groups did switch tasks more often than the delayed group and it is therefore quite possible that they responded to being interrupted with a concerted effort to rehearse their prospective memory intentions. Hicks et al. (2000) did not gather post-test data on whether participants rehearsed their prospective memory tasks during task switches and I did not do so for this study. Given that their findings were not replicated by Finstad et al. (2006), any future studies comparing lengthy delays and interruptions would do well to involve post-experiment self-reports about what participants were thinking immediately upon being interrupted and whether they rehearsed their prospective memory intentions during delays and/or interruptions.

In the current study interrupted individuals experienced task switches within the ongoing task while delayed individuals switched from the Digit Span to the comedy routine and then into the ongoing task. As shown in the Figure 2, the interrupted groups switched tasks more often than the delay group. The group who experienced the resolved interruption may have outperformed the delay group significantly because they used these task switches to self-remind. Even without data regarding self-initiated rehearsal, it is apparent that the task switches here occurred within the intention-relevant shopping context rather than between an irrelevant filler task and the shopping context. Finstad et al. (2006) concluded that task switching negatively impacted prospective memory unless explicit reminders to retrieve prospective memory intentions were available between task switches. Cook et al. (2014) concluded that interruptions did not affect prospective memory performance when a prevailing context was reinstated after an interruption. Given these findings, it is likely that contextual cues aided in self-reminding in the current study.

The current study was not designed with an emphasis on understanding delays compared to interruptions, which is partially why the interruptions were not placed long after the delayed group. The original intention was to investigate whether experiencing an interruption that ended abruptly compared to one that ended smoothly would differentially impact prospective memory. Both interruptions were introduced only two slides into the experiment to eliminate chances that semantically related target items might be introduced pre-interruption and so that the interrupted groups would not receive a substantial amount of time to rehearse their shopping intentions during the ongoing task before being interrupted. From the current study, it does appear that arriving within a goal-relevant context even momentarily before being interrupted promotes later intention retrieval compared to being delayed before arriving within this context. These findings support Cook et al.'s (2014) conclusion that attention allocation policies are rather flexible. In other words, while the current study does suggest that long delays without task switches during the retention interval decrease prospective memory performance, these data also suggest that minimal access to goal-relevant cues before experiencing an unfilled interrupting task supports prospective memory performance. To date, no researchers investigating prospective memory performance after lengthy, unfilled delays and interruptions of similar complexity and length have placed the two so close to one another, let alone observed a significant difference in prospective memory performance.

These data do not provide much information regarding the debated memorial status of intention-relevant memories. These data suggest that delaying retrieval opportunities after encoding causes intention-relevant memories to decay and lose their activation status per the predictions of the ACT-R model (Altmann & Trafton, 2002; Schult & Steffens, 2013). Concurrently, these data suggest that one need only momentary access to goal-relevant information before experiencing an unfilled interruption during the retention interval to prime rehearsal per Cook et al. (2014). These data ultimately support the notion that goals maintain a privileged status in memory in some situations and not in others. Complementary lines of research have demonstrated that prospective memory performance can be improved by reinstating a prevailing context after interruptions (Cook et al., 2014; Hodgetts & Jones, 2006a), by not spending too much time in a goal-relevant context before being given retrieval opportunities (Martin et al., 2011), or by using explicit reminders or using mnemonic strategies (Finstad et al., 2006; McDaniel et al., 2004). The current study suggests that long unfilled delays affect prospective memory performance, but not when intention-relevant information is presented briefly before these delays.

One piece of evidence from the current study does suggest a unique status for event-based intentions in human memory. Specifically, I observed a significant and positive correlation between prospective memory performance and self-evaluations of prospective memory accuracy on a Likert-Style post-test scale. There was not a significant correlation between self-evaluated prospective memory performance and the number of items retrospectively recalled, however. This suggests that individuals who performed their prospective memory intentions accurately knew that they did so afterward without remembering their exact prospective memory targets. Participants gauged their performance accurately but were unable to access information that would informed this assessment. This result suggests something akin to an automaticity and effortlessness associated with memory for intentions per the findings of Penningroth et al. (2012). Where these findings diverge from Penningroth et al. (2012) is that working memory capacity significantly predicted both prospective memory performance and retrospective recall.

The second hypothesis about working memory moderating the effect of condition on prospective memory performance was not supported in this study. In the current study, there were main effects of condition on prospective memory performance and main effects of working memory capacity on prospective memory performance and retrospective recall. That working memory supported both prospective and retrospective memory is not a novel finding in the literature (Anderson, Reder, & Lebiere, 1996; Kidder et al., 1997; Kliegel, Martin, McDaniel, & Einstein, 2002; Rose et al., 2010). An interaction effect would have indicated that working memory capacity might be especially important for post-delay or post-interruption recovery.

What the current research suggests is that prospective memory retrieval is dependent on highly dependent on working memory capacity in situations involving either long, unfilled delays or interruptions. Furthermore, the current research provides further evidence that assessing working memory capacity using the AOSPAN is useful in situations where one hopes to predict either prospective memory accuracy or retrospective recall. The correlations between working memory capacity and both prospective and retrospective memory here were nearly identical (r = .252 and r = .253, respectively).

Kupor et al. (2015) concluded that a high NFSC mediated a significant relationship between their unresolved interruption manipulation and future unplanned product purchases. The current study suggests that when shopping intentions are planned and items/targets rehearsed beforehand, working memory capacity should predict the accurate retrieval of shopping targets and that NFSC related to other intentions does not contribute to the former's predictive power. Given the healthy correlation between both constructs in the current study, and because there is literature to suggest that working memory capacity predicts one's ability to inhibit emotional responses (Schmeichel et al., 2008), to forsake old information and attend to the present (Kane & Engle, 2000), and to recover more quickly from interruptions (Foroughi et al., 2016), these data suggest there may be merit in further investigating a relationship between working memory capacity and self-reported NFSC.

The third hypothesis in the current study was that individuals who experienced unresolved interruptions would be more likely to gaze at fewer regions when making decisions compared to those who experienced delays and/or resolved interruptions. This hypothesis was not supported. All participants spent most of their time looking at appearance compared to quality and/or price. There were limitations to the current study which likely drove the main effect of region regardless of condition

Limitations and Future Directions

Several reviewers have suggested that the main effect of region occurred here because both price and quality varied systematically across slides, which led to there being more predictability associated with these two regions compared to appearance. The assumption here is that participants considered an item's appearance first (which could have changed dramatically from a gas grill to a notebook, for example) and then looked at quality ratings and price. Low or high quality ratings were consistently associated with commensurate low or high prices here, so a decision to choose the highest quality item always meant choosing the highest priced item. Had both quality and price not been so closely associated then a level of unpredictability could have been added and this may have led participants to eschew using one in favor of the other.

Additionally, the current study specifically involved a lengthy, unfilled activity during the delay and the interruption interval. It is possible that leaving a more emotionally salient or cognitively demanding activity unresolved would have led to decrements in prospective memory performance associated with NFSC. Perhaps not receiving closure to an activity during which one has worked hard to make correct responses or to a similarly unfilled activity in which participants are left wondering if, for instance, someone received aid after a life-threatening injury would have contributed to more prospective memory failures than an unresolved comedy routine.

Conclusion

The current study provided support for the notion that experiencing lengthy, low demand delays before beginning an ongoing task negatively impacts prospective memory compared to similar delays experienced during an ongoing task. It appears being interrupted by an unfilled delay can provide opportunities for self-reminding or intention rehearsal. In both situations, one's ability to maintain previously encoded intentions is likely dependent on working memory capacity. Memory for previously retrieved intentions may not necessarily be associated with retrospective recall for intention-related information. NFSC did not interfere with prospective memory here and was significantly and negatively correlated with working memory capacity.

REFERENCES

Altmann, E. M., & Trafton, J. G. (2002). Memory for goals: an activation-based model. *Cognitive Science, 26*(1), 39-83.

Altmann, E. M., Trafton, J. G., & Hambrick, D. Z. (2014). Momentary interruptions can derail the train of thought. *J Exp Psychol Gen, 143*(1), 215-226. doi:10.1037/a0030986

Anderson, J. R. (1983). *The Architecture of Cognition*. Cambridge, MA: Harvard University Press.

Anderson, J. R., Reder, L. M., & Lebiere, C. J. (1996). Working memory: Activation limitations on retrieval. *Cognitive Psychology, 30*(3), 221-256.

Ashcraft, M. H., & Kirk, E. P. (2001). The relationships among working memory, math anxiety, and performance. *Journal of Experimental Psychology: General, 130*(2), 224.

Axelrod, B. N., Fichtenberg, N. L., Millis, S. R., & Wertheimer, J. C. (2006). Detecting Incomplete Effort with Digit Span from the Wechsler Adult Intelligence Scale—Third Edition. *The Clinical Neuropsychologist, 20*(3), 513-523.

Bailey, B. P., & Konstan, J. A. (2006). On the need for attention-aware systems: Measuring effects of interruption on task performance, error rate, and affective state. *Computers in Human Behavior, 22*(4), 685-708. doi:10.1016/j.chb.2005.12.009

Beike, D. R., & Wirth-Beaumont, E. T. (2005). Psychological closure as a memory phenomenon. *Memory, 13*(6), 574-593. doi:10.1080/09658210444000241

Boehm-Davis, D. A., & Remington, R. (2009). Reducing the disruptive effects of interruption: A cognitive framework for analysing the costs and benefits of intervention strategies. *Accident Analysis & Prevention, 41*(5), 1124-1129.

Brumby, D. P., Cox, A. L., Back, J., & Gould, S. J. J. (2013). Recovering from an interruption: Investigating speed−accuracy trade-offs in task resumption behavior. *Journal of Experimental Psychology: Applied, 19*(2), 95-107. doi:10.1037/a0032696

Cook, G. I., Meeks, J. T., Clark- Foos, A., Merritt, P. S., & Marsh, R. L. (2014). The role of interruptions and contextual associations in delayed- execute prospective memory. *Applied Cognitive Psychology, 28*(1), 91-103. doi:10.1002/acp.2960

Czernatowicz-Kukuczka, A., Jaśko, K., & Kossowska, M. (2014). Need for closure and dealing with uncertainty in decision making context: The role of the behavioral inhibition system and working memory capacity. *Personality and Individual Differences, 70*, 126-130.

Czerwinski, M., Cutrell, E., & Horvitz, E. (2000). *Instant messaging and interruption: Influence of task type on performance.* Paper presented at the OZCHI 2000 conference proceedings.

Department of Transportation, N. H. T. S. A. N., NHTSA National Center for Statistics and Analysis. (2013). *Distracted Driving 2013*. (DOT HS 812 132). 1200 New Jersey Avenue SE, Washington DC 20590 Retrieved from https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812132.

Dodhia, R. M., & Dismukes, R. K. (2009). Interruptions create prospective memory tasks. *Applied Cognitive Psychology, 23*(1), 73-89.

Einstein, G. O., & McDaniel, M. A. (2005). Prospective memory multiple retrieval processes. *Current Directions in Psychological Science, 14*(6), 286-290.

Einstein, G. O., McDaniel, M. A., Manzi, M., Cochran, B., & Baker, M. (2000). Prospective memory and aging: forgetting intentions over short delays. *Psychology and Aging, 15*(4), 671.

Einstein, G. O., McDaniel, M. A., Williford, C. L., Pagan, J. L., & Dismukes, R. K. (2003). Forgetting of intentions in demanding situations is rapid. *J Exp Psychol Appl, 9*(3), 147-162. doi:10.1037/1076-898X.9.3.147

Engle, R. W. (2002). Working memory capacity as executive attention. *Current Directions in Psychological Science, 11*(1), 19-23.

Farrimond, S., Knight, R. G., & Titov, N. (2006). The Effects of Aging on Remembering Intentions: Performance on a Simulated Shopping Task. *Applied Cognitive Psychology, 20*(4), 533-555. doi:10.1002/acp.1202

Finstad, K., Bink, M. L., McDaniel, M. A., & Einstein, G. O. (2006). Breaks and task switches in prospective memory. *Applied Cognitive Psychology, 20*(5), 705-712.

Foroughi, C. K., Werner, N. E., McKendrick, R., Cades, D. M., & Boehm-Davis, D. A. (2016). Individual Differences in Working-Memory Capacity and Task Resumption Following Interruptions. *Journal of Experimental Psychology: Learning, Memory, and Cognition*.

Franke, J. L., Daniels, J. J., & McFarlane, D. C. (2002). *Recovering context after interruption.* Paper presented at the Proceedings 24th Annual Meeting of the Cognitive Science Society (CogSci 2002).

Gillie, T., & Broadbent, D. (1989). What makes interruptions disruptive? A study of length, similarity, and complexity. *Psychological Research, 50*(4), 243-250.

Goschke, T., & Kuhl, J. (1993). Representation of intentions: Persisting activation in memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 19*(5), 1211.

Greenhouse, S. W., & Geisser, S. (1959). On methods in the analysis of profile data. *Psychometrika, 24*(2), 95-112.

Guynn, M. J., McDaniel, M. A., & Einstein, G. O. (1998). Prospective memory: When reminders fail. *Memory & Cognition, 26*(2), 287-298.

Hall, L. M., Pedersen, C., & Fairley, L. (2010). Losing the moment: understanding interruptions to nurses' work. *Journal of Nursing Administration, 40*(4), 169-176.

Harlow, L., DeBacker, T., & Crowson, H. M. (2011). Need for Closure, Achievement Goals, and Cognitive Engagement in High School Students. *Journal of Educational Research, 104*(2), 110-119. doi:10.1080/00220670903567406

Hicks, J. L., Marsh, R. L., & Russell, E. J. (2000). The properties of retention intervals and their affect on retaining prospective memories. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*(5), 1160.

Hinson, J. M., Jameson, T. L., & Whitney, P. (2003). Impulsive decision making and working memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 29*(2), 298.

Hodgetts, H. M., & Jones, D. M. (2006a). Contextual cues aid recovery from interruption: The role of associative activation. *Journal of Experimental Psychology-Learning Memory and Cognition, 32*(5), 1120-1132. doi:10.1037/0278-7393.32.5.1120

Hodgetts, H. M., & Jones, D. M. (2006b). Interruption of the Tower of London task: support for a goal-activation approach. *J Exp Psychol Gen, 135*(1), 103-115. doi:10.1037/0096-3445.135.1.103

Jackson, T., Dawson, R., & Wilson, D. (2003). Reducing the effect of email interruptions on employees. *International Journal of Information Management, 23*(1), 55-65.

Jhang, J. H., & Lynch, J. G., Jr. (2015). Pardon the interruption: Goal proximity, perceived spare time, and impatience. *Journal of Consumer Research, 41*(5), 1267-1283. doi:10.1086/679308

Kane, M. J., & Engle, R. W. (2000). Working-memory capacity, proactive interference, and divided attention: limits on long-term memory retrieval. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*(2), 336.

Kidder, D. P., Park, D. C., Hertzog, C., & Morrell, R. W. (1997). Prospective memory and aging: The effects of working memory and prospective memory task load. *Aging, Neuropsychology, and Cognition, 4*(2), 93-112.

Kliegel, M., Martin, M., McDaniel, M. A., & Einstein, G. O. (2002). Complex prospective memory and executive control of working memory: A process model. *Psychological Test and Assessment Modeling, 44*(2), 303.

Kruglanski, A. W. (1990). Lay epistemic theory in social-cognitive psychology. *Psychological Inquiry, 1*(3), 181-197.

Kruglanski, A. W., & Webster, D. M. (1996). Motivated closing of the mind: 'Seizing' and 'freezing.'. *Psychological Review, 103*(2), 263-283. doi:10.1037/0033-295X.103.2.263

Kuhl, J. (1994). Action versus state orientation: Psychometric properties of the Action Control Scale (ACS-90). *Volition and personality: Action versus state orientation, 47*, 56.

Kupor, D. M., Reich, T., & Shiv, B. (2015). Can't finish what you started? The effect of climactic interruption on behavior. *Journal of Consumer Psychology, 25*(1), 113-119. doi:10.1016/j.jcps.2014.05.006

Lewis, R. L. (1996). Interference in short-term memory: The magical number two (or three) in sentence processing. *Journal of Psycholinguistic Research, 25*(1), 93-115.

Liu, W. (2008). Focusing on desirability: The effect of decision interruption and suspension on preferences. *Journal of Consumer Research, 35*(4), 640-652.

Loukopoulos, L. D., Dismukes, R. K., & Barshi, I. (2001). *Cockpit interruptions and distractions: A line observation study*. Paper presented at the Proceedings of the 11th international symposium on aviation psychology.

Lustig, C., May, C. P., & Hasher, L. (2001). Working memory span and the role of proactive interference. *Journal of Experimental Psychology: General, 130*(2), 199.

Mäntylä, T., & Sgaramella, T. (1997). Interrupting intentions: Zeigarnik-like effects in prospective memory. *Psychological Research, 60*(3), 192-199. doi:10.1007/BF00419767

Marsh, R. L., Hicks, J. L., & Bink, M. L. (1998). Activation of completed, uncompleted, and partially completed intentions. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 24*(2), 350.

Martin, B. A., Brown, N. L., & Hicks, J. L. (2011). Ongoing task delays affect prospective memory more powerfully than filler task delays. *Canadian Journal of Experimental Psychology/Revue canadienne de psychologie expérimentale, 65*(1), 48-56. doi:http://dx.doi.org/10.1037/a0022872

McDaniel, M. A., Einstein, G. O., Graham, T., & Rall, E. (2004). Delaying Execution of Intentions: Overcoming the Costs of Interruptions. *Applied Cognitive Psychology, 18*(5), 533-547. doi:10.1002/acp.1002

McFarlane, D. C., & Latorella, K. A. (2002). The scope and importance of human interruption in human-computer interaction design. *Human-Computer Interaction, 17*(1), 1-61.

Monk, C. A., Boehm-Davis, D. A., Mason, G., & Trafton, J. G. (2004). Recovering from interruptions: Implications for driver distraction research. *Human Factors: The Journal of the Human Factors and Ergonomics Society, 46*(4), 650-663.

Nees, M. A., & Fortna, A. (2015). A comparison of human versus virtual interruptions. *Ergonomics, 58*(5), 852-856. doi:10.1080/00140139.2014.990934

Nelson, D. L., McEvoy, C. L., & Schreiber, T. A. (1998). The University of Florida word association, rhyme, and fragment norms. Retrieved from http://www.usf.edu/FreeAssociation/

Penningroth, S. L. (2005). Free recall of everyday retrospective and prospective memories: The intention-superiority effect is moderated by action versus state orientation and by gender. *Memory, 13*(7), 711-724.

Penningroth, S. L. (2011). When does the intention-superiority effect occur? Activation patterns before and after task completion, and moderating variables. *Journal of Cognitive Psychology, 23*(1), 140-156.

Penningroth, S. L., Graf, P., & Gray, J. M. (2012). The effect of a working memory load on the intention-superiority effect: Examining three features of automaticity. *Applied Cognitive Psychology, 26*(3), 441-450. doi:10.1002/acp.2817

Psychology Software Tools, I. (2012). [E-Prime 2.0]. Retrieved from http://www.pstnet.com

Roets, A., & Van Hiel, A. (2011). Item selection and validation of a brief, 15-item version of the Need for Closure Scale. *Personality and Individual Differences, 50*(1), 90-94. doi:10.1016/j.paid.2010.09.004

Rose, N. S., Rendell, P. G., McDaniel, M. A., Aberle, I., & Kliegel, M. (2010). Age and individual differences in prospective memory during a" Virtual Week": the roles of working memory, vigilance, task regularity, and cue focality. *Psychology and Aging, 25*(3), 595.

Schmeichel, B. J., Volokhov, R. N., & Demaree, H. A. (2008). Working memory capacity and the self-regulation of emotional expression and experience. *Journal of Personality and Social Psychology, 95*(6), 1526.

Schult, J. C., & Steffens, M. C. (2013). Tuned for the future: Intentions are only accessible when a retrieval opportunity is near. *Memory & Cognition, 41*(8), 1252-1260.

Shelton, J. T., Brown, N. L., Mason, A. M., Gelineau, J., & Vazquez, O. G. (2014). *I forgot to buy the bread, but I bought the bagels!* Paper presented at the The 4th International Conference on Prospective Memory, Naples, Italy.

Trafton, J. G., Altmann, E. M., Brock, D. P., & Mintz, F. E. (2003). Preparing to resume an interrupted task: Effects of prospective goal encoding and retrospective rehearsal. *International Journal of Human-Computer Studies, 58*(5), 583-603.

Unsworth, N., Heitz, R. P., Schrock, J. C., & Engle, R. W. (2005). An automated version of the operation span task. *Behavior research methods, 37*(3), 498-505.

Wagemans, J., Elder, J. H., Kubovy, M., Palmer, S. E., Peterson, M. A., Singh, M., & von der Heydt, R. (2012). A century of Gestalt psychology in visual perception: I. Perceptual grouping and figure–ground organization. *Psychological Bulletin, 138*(6), 1172.

Zeigarnik, B. (1938). On finished and unfinished tasks. In W. D. Ellis (Ed.), *A source book of Gestalt psychology.* (pp. 300-314). London, England: Kegan Paul, Trench, Trubner & Company.

Zijlstra, F. R., Roe, R. A., Leonora, A. B., & Krediet, I. (1999). Temporal factors in mental work: Effects of interrupted activities. *Journal of Occupational and Organizational Psychology*, *72*(2), 163-185.

APPENDIX A

IRB APPROVAL

THE UNIVERSITY of TENNESSEE UT CHATTANOOGA

Institutional Review Board
Dept. 4915
615 McCallie Avenue
Chattanooga, TN 37403-2598
Phone: (423) 425-5867
Fax: (423) 425-4052
instrb@utc.edu
http://www.utc.edu/irb

MEMORANDUM

TO: Trevor Slayton, Jessica Hacker, Tyronne James, Dr. Noelle Brown (US Naval Research Lab), Dr. Jill Shelton — **IRB # 16-016**

FROM: Lindsay Pardue, Director of Research Integrity; Dr. Amy Doolittle, IRB Committee Chair

DATE: April 27, 2016

SUBJECT: IRB #16-016: Measuring the Effects of Working Memory Capacity, Need for Closure, and Unresolved Interruptions in Shopping-Based Prospective Memory Task

The Institutional Review Board has reviewed and approved the following changes for the IRB project listed below:

- The letter-number sequencing working memory test has changed to an operation span working memory test.
- The list of items to memorize has changed.

You must include the following approval statement on research materials seen by participants and used in research reports:

The Institutional Review Board of the University of Tennessee at Chattanooga (FWA00004149) has approved this research project # 16-016.

Please remember that you must complete a Certification for Changes, Annual Review, or Project Termination/Completion Form when the project is completed or provide an annual report if the project takes over one year to complete. The IRB Committee will make every effort to remind you prior to your anniversary date; however, it is your responsibility to ensure that this additional step is satisfied.

Please remember to contact the IRB Committee immediately and submit a new project proposal for review if significant changes occur in your research design or in any instruments used in conducting the study. You should also contact the IRB Committee immediately if you encounter any adverse effects during your project that pose a risk to your subjects.

For any additional information, please consult our web page http://www.utc.edu/irb or email instrb@utc.edu

Best wishes for a successful research project.

Page 1 of 1

APPENDIX B

INFORMED CONSENT

Informed Consent

Principle Investigator: Dr. Jill Talley Shelton *Phone number: 423-425-5246*

The research in which you are about to participate is sponsored by the UTC Psychology Department.

Research conducted by the UTC Psychology Department has been recognized around the world. It is helping make UTC a university known internationally as a place where cutting edge research is being conducted. Ultimately, projects like this may help you by increasing the name recognition of the university from which you will graduate. You may benefit from the fact that a prospective employer knows of the reputation of the university.

Your involvement in this research project is voluntary, and you may choose to end your participation in this study at any time without penalty. You must be 18 years of age or older to participate in this study. If you are not 18, please contact Trevor Slayton at 423-618-5069 for further instructions.

The information collected as part of this research project will be stored in a secure electronic database. Information from that database – without names or other information that could connect it to any individual – will be provided to researchers only for projects that have met the approval of the UTC Institutional Review Board (IRB). The information will be provided and coded only with an arbitrarily assigned digital code, not related in any way to your name, student ID, or any other identifying information.

We anticipate that your participation in this project should last no more than an hour.

All information that you provide in this study will be used only in a summary fashion. At no time will your individual responses to the questionnaire items in SONA or to the tasks in this experiment be published or made available to anyone. We are interested only in statistical summaries of the data. No one will disclose any personal information regarding you or any other participants in this study.

This test is being conducted by Trevor Slayton, a graduate student in the Psychology Department at the University of Tennessee at Chattanooga. This project has the approval and authorization of both the UTC Psychology Department and the UTC Institutional Review Board (IRB). If you have any questions about the study, please contact Trevor Slayton at 618-5069. If you have any questions concerning your rights as a participant, please contact IRB Chair Dr. Amy Doolittle at 423-425-5563.

Participant Agreement: I have read the information above.

I willingly volunteer to participate in this study under the conditions outlined above.

____________________________________ ________________________________

Participant Printed Name *Participant Signature if responding on paper*

Participant Student ID ____________________ *Date___________________________*

APPENDIX C

DEMOGRAPHICS QUESTIONNAIRE

Participant Information

Ethnicity: __ African American

__ Pacific Islander/Alaskan Native

__ Caucasian

__ Hispanic/Latino

__ Native American

__ Asian

__ Other

Gender: __ Male

Female

Year: Freshman

__ Sophomore

__ Junior

__ Senior

How many years of formal education have you *completed* (1st grade through 12th grade is 12 years, plus number of years in college)?

Age:

Native language ________ ____

Do you have any hearing impairments? __ Yes __ No

Do you have any visual impairments? Yes No

If yes, do you have the corrective hearing aids and/or visual aids necessary to participate in this study (i.e. contacts/glasses, hearing aids, etc.)? ___ Yes No

APPENDIX D

15-ITEM REVISED NEED FOR PSYCHOLOGICAL CLOSURE (NFPC) QUESTIONNAIRE

1.........strongly disagree
2....moderately disagree
3...........slightly disagree
4................slightly agree
5.........moderately agree
6.............strongly agree

1. I don't like situations that are uncertain.

1 2 3 4 5 6

2. I dislike questions which could be answered in many different ways.

1 2 3 4 5 6

3. I find that a well ordered life with regular hours suits my temperament.

1 2 3 4 5 6

4. I feel uncomfortable when I don't understand the reason why an event occurred in my life.

1 2 3 4 5 6

5. I feel irritated when one person disagrees with what everyone else in a group believes.

1 2 3 4 5 6

6. I don’t like to go into a situation without knowing what I can expect from it.

1 2 3 4 5 6

7. When I have made a decision, I feel relieved

1 2 3 4 5 6

8. When I am confronted with a problem, I’m dying to reach a solution very quickly.

1 2 3 4 5 6

9. I would quickly become impatient and irritated if I would not find a solution to a problem immediately.

1 2 3 4 5 6

10. I don't like to be with people who are capable of unexpected actions.

1 2 3 4 5 6

11. I dislike it when a person's statement could mean many different things.

1 2 3 4 5 6

12. I find that establishing a consistent routine enables me to enjoy life more.

1 2 3 4 5 6

13. I enjoy having a clear and structured mode of life.

1 2 3 4 5 6

14. I do not usually consult many different opinions before forming my own view.

1 2 3 4 5 6

15. I dislike unpredictable situations.

1 2 3 4 5 6

APPENDIX E

NEED FOR SITUATIONAL CLOSURE (NFSC) QUESTIONNAIRE

1.........strongly disagree
2.........disagree
3.........somewhat agree
4.........agree
5.........strongly agree

1. I just wish I could watch more of the comedy clip.

   1 2 3 4 5

2. The comedy clip is unfinished business for me.

   1 2 3 4 5

3. The comedy clip seems like ancient history to me.

   1 2 3 4 5

4. The comedy clip is a “closed book” to me.

   1 2 3 4 5

5. I have put the comedy clip completely behind me.

   1 2 3 4 5

VITA

Trevor Slayton was born in Chattanooga, Tennessee to the parents of Clinton and Rhonda Slayton. He is the younger brother of Daniel Bailey Slayton. He attended Shades Cahaba Elementary in Birmingham, Alabama and continued to Chattanooga High School: Center for the Creative Arts. After graduating he attended the University of Tennessee at Chattanooga (UTC) where he became interested in the environmental and cartographic sciences. He pursued a Bachelor of Science in the Environmental Sciences with a concentration in the cartographic sciences under the guidance of Dr. Thomas P. Wilson. As an undergraduate he proudly served as the President of UTC's Golden Key International Honor Society and in his senior year was awarded the Environmental Science Award and the Outstand Senior Award. He worked internships for both the City of Chattanooga Water Quality Division and the Tennessee Valley Authority's Geographic Information Sciences Division. After graduating UTC, he worked for Chattanooga's Regional Planning Agency for two years before accepting a graduate assistantship in UTC's Research Psychology program. Trevor graduated with a Master of Science in Research Psychology May 2017.