TESTING THE EXISTENCE OF UNCONSCIOUS THOUGHT

THROUGH A MEMORY PERSPECTIVE

by

Erin Rachelle Yosai

A thesis submitted in partial fulfillment
of the requirements for the degree

of

Master of Science

in

Psychological Science

MONTANA STATE UNIVERSITY
Bozeman, Montana

April, 2012

©COPYRIGHT

by

Erin Rachelle Yosai

2012

All Rights Reserved

APPROVAL

of a thesis submitted by

Erin Rachelle Yosai

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citation, bibliographic style, and consistency and is ready for submission to The Graduate School.

Dr. Ian M. Handley

Approved for the Department of Psychology

Dr. Colleen Moore

Approved for The Graduate School

Dr. Carl A. Fox

STATEMENT OF PERMISSION TO USE

In presenting this thesis in partial fulfillment of the requirements for a master's degree at Montana State University, I agree that the Library shall make it available to borrowers under rules of the Library.

If I have indicated my intention to copyright this thesis by including a copyright notice page, copying is allowable only for scholarly purposes, consistent with "fair use" as prescribed in the U.S. Copyright Law. Requests for permission for extended quotation from or reproduction of this thesis in whole or in parts may be granted only by the copyright holder.

Erin Rachelle Yosai

April 2012

ACKNOWLEDGEMENTS

I would like to thank my thesis committee, Dr. Handley, Dr. Hutchison, and Dr. Meade for their support and instruction. I also extend my thanks to the members of the Mad-Pal Psychology Lab and my graduate cohorts for their input and aid. Special thanks to Janine Jackson for her patience and her assistance with statistical analyses, and to Katya Numbers for her editing assistance and feedback.

TABLE OF CONTENTS

1. INTRODUCTION 1

Conscious and Unconscious Thought 4
Consciousness Explanations for the Unconscious Thought Effect 9
Does the Sophisticated Unconscious Exist? 14
Working Memory Capacity 15
The Current Project: Working Memory within the Unconscious Thought Paradigm 17
Experiment Overview 19
Predictions and Hypotheses 21

2. METHOD 26

Design and Participants 26
Procedure 27
Independent Variables 28
Task Difficulty 28
Thought Conditions 29
Dependent Variables and Manipulation Checks 30
Preference Ratings 30
Car Evaluation 30
Car Rank 30
Composite Preference Rating 31
Trait Recall 31

3. RESULTS 33

Factorial ANOVA 33
Multiple Regression Analyses 36
Correlations 37
Attribute Recall 39

4. GENERAL DISCUSSION 41

Interpretation of Null Results 46
WMC 47
Memory vs. Unconscious Processing 50
Future Directions 54

5. CONCLUSION 57

REFERENCES CITED 58

TABLE OF CONTENTS CONTINUED

APPENDICES 63

APPENDIX A: Car Traits for the Complex Difficulty Condition.....64
APPENDIX B: Car Traits for the Simple Difficulty Condition 67

LIST OF TABLES

Table Page

1. WMC as a Predictor Of Car Choice Across Thought Conditions 37

2. Correlations between Car Choice, OSPAN score, and Condition 39

3. Repeated Measures ANOVA: Proportion of Participants' Accurate Car Recall within Thought and Difficulty Conditions 41

ABSTRACT

Research indicates that engaging in unconscious thought processes may aid individuals in making optimal decisions (e.g. Bos et al., 2008, Bos et al., 2011, Dijksterhuis, 2004; Dijksterhuis & Nordgren, 2006) when conscious processing capabilities are limited. Experiments within this domain have dubbed the result of optimal complex decision making after delay in which conscious thought is distracted, relative to no conscious distraction the 'Unconscious Thought Effect' (Strick et al., 2011). However, skeptics of unconscious thought processes assert that the 'unconscious thought effect' may be an artifact of conscious or memorial-based processing (e.g. Lassiter et al., 2009; Reyna, 2003). The current experiment hypothesized that measuring individuals' working memory capacity (Unsworth et al., 2005), or attentional control, would clarify whether controlled memorial processes or unconscious thinking produces this effect. Namely, the control and effortful direction of attention influences conscious processes, but unconscious thought processes do not require attention (Dijksterhuis & Nordgren, 2006). Specifically, it was hypothesized that individual WMC would moderate decisions within conditions where conscious thought processes and attention were necessary to car evaluations. This thesis' specific interest is the 'unconscious thought condition.' Results indicating that individual WMC moderates car evaluation following a distraction period would support a memorial-based explanation for unconscious thought effects. Conversely, results indicated no effect of individual WMC on object evaluations following a distraction period would support the existence of independent, sophisticated unconscious thought processes (e.g. Dijksterhuis & Nordgren, 2006). Although this experiment failed to clearly support either hypothesis regarding WMC, several possible explanations of the null and inconsistent results were identified. Attending to experimental issues and theoretical inconsistencies in future research may improve the understanding of the existence and boundarit.es of unconscious thought

INTRODUCTION

Individuals often receive contradictory recommendations when they are faced with important and difficult decisions. Some suggest that consciously considering information and deliberating on the pros and cons of each possibility will generally produce optimal decisions. Indeed, decades of psychological research back this idea, as periods of effortful conscious activity often do allow individuals to form good judgments, make good decisions, and solve complicated problems (e.g. Dewall, Baumiester, & Masicampo, 2008). Yet, others suggest that simply gathering information and then "sleeping on it" (i.e., not consciously thinking about that information) will generally produce optimal decisions (see Bos, Dijksterhuis, & van Baaren, 2008). That is, some people suggest that after taking the weight of a complex decision off of conscious processes, a correct decision will present itself in due time. This idea implicates the existence of unconscious processes that can consider complex information and make good judgments and decisions independent from conscious thinking processes. In the recent past, psychologists moved this anecdote from lore to laboratory as they began researching the possibility that humans can use unconscious thought processes to make complex decisions. Much of this new literature suggests that individuals can unconsciously process complex information and produce judgments that are often as good as, if not better, than those formed through conscious thinking processes (e.g. Bos et al., 2008; Bos et al., 2011; Dijksterhuis, 2004; Dijksterhuis & Nordgren, 2006; Handley & Runnion, 2011; Mintzberg & Westley, 2001; Strick et al., 2011).

Research on unconscious thought typically follows a paradigm established by Dijksterhuis (2004). In this paradigm, experimenters present participants with information regarding several objects, like apartments or cars. Importantly, each object is associated with an equal amount of information that is mostly positive, mostly negative, or balanced. Thus, there is a best and worst object. After participants receive this information, they report their evaluations of the objects either immediately (allowing for minimal conscious or unconscious thinking), after several minutes designated to the conscious consideration of the object information, or after engaging in a distracting task for several minutes (arguably preventing conscious thinking, but allowing unconscious thinking about the information). In many of these experiments, participants prefer the best object to the worst object to a greater extent if they were distracted following the information presentation than if they reported their preferences immediately or after thinking consciously about that information. Many researchers interpret these results to mean that individuals can think unconsciously about information while conscious thinking processes are distracted, and this unconscious thinking often produces optimal judgments.

Of course, the above interpretation of such results is as controversial as it is intriguing. Several authors and theorists offer alternative explanations for the finding that individuals often make good judgments following a period of conscious distraction (e.g. Lassiter, Lindberg, Gonzalez-Vallejo, Bellezza, & Phillips, 2009; Strick, Dijksterhuis, & van Baaren, 2010). These alternative explanations are subtly different, but converge on the idea that conscious thinking processes produce judgments of objects *while*

information is presented and after the information is presented. Further, the judgments participants make while information is presented are generally better, and are likely reported even after a period of distraction. Thus, these explanations suggest that the good judgments reported following distraction resulted from conscious thinking processes that occurred while information was presented, not from an unconscious thinking process that occurred after. The results of several experiments are inconsistent with these alternative explanations (e.g., Bos et al., 2008; Handley & Runnion, 2011; Strick et al., 2011). However, these consciousness explanations are not without merit. Thus, the possibility that results obtained in unconscious thought research may be a result of conscious or memory-based processes must be further considered.

An examination of individual working memory capacity (WMC) adds a novel element to the current conscious/unconscious thought debate. WMC is the ability to control attention and maintain important information within memory in the face of distraction (Baddeley & Hitch, 1994; Kane & Engle, 2003). Research shows that individual WMC affects a plethora of processing outcomes during complex cognitive tasks. Tasks affected by individual WMC include the ability to encode new information, resist distraction, comprehend reading material, and learn a new language (e.g. Barrett, Tugade, & Engle, 2004; Engle, 2002; Kane & Engle, 2003). Essentially, the ability to control attention is key to an individual's WMC. Thus, using a WMC test to examine individual differences within the established unconscious thought paradigm may provide additional evidence for or against the existence of unconscious thought. Further, Dijksterhuis and Nordgren (2006) posit that controlled attention is necessary to conscious

processes, but unconscious thought processes are thought *without* controlled attention. As such, using a WMC measure within an unconscious thought experiment may help illustrate if people who are better able to control their attention outperform participants who are not able to control attention. Unconscious thought research aims to determine whether an independent, intelligent, goal-motivated unconscious processes enables individuals to output good decisions after distracting themselves (diverting attention away) from conscious processing (e.g. Bos et al., 2008; Dijksterhuis & Nordgren, 2006). Thus, combining a working memory task with an unconscious thought task may establish whether an individuals' WMC can influence judgments and decisions during an unconscious thought task. Specifically, if individual WMC influences judgments within the conscious processing thought condition, but not in the unconscious thought condition, it would appear that a sophisticated unconscious processing mechanism exists independently from both conscious thought and memorial processes.

Conscious and Unconscious Thought

This thesis adopts the definitions of conscious and unconscious thought offered by Dijksterhuis and Nordgren (2006). According to these researchers, conscious thought processes are "cognitive and/or affective task-relevant processes of which an individual is aware while attending to a task" (e.g., an individual making a pros and cons list to help him or her decide which doctoral program to select). Alternatively, unconscious thought processes "are cognitive and/or affective task-relevant processes of which individuals are *not* aware" (Dijksterhuis & Nordgren, 2006, pp. 96) These processes are detectable while

conscious attention is directed elsewhere; for example, while writing a grocery list, unconscious processes can still consider doctoral program options. Although important, research shows that conscious thought has a very limited processing capacity. For instance, some researchers estimate that individuals can consciously process 40-60 bits of information (about one short sentence) per second (Norrentranders, 1998; Wilson, 2002). Further, individuals can only consciously hold in short-term memory about 7 +/- 2 units of information at any given time (Miller, 1956). In contrast, the overall processing capacity of the human brain is vast (Dijksterhuis, 2004; Wilson, 2002), due primarily to the existence and operation of unconscious processes. For example, it is clear that the visual cortex alone processes an enormous volume of information every second to create perceptions of objects, distance, movement, color, etc.; all unconsciously. Thus, most of the processing capacity in the human brain is thought to occur in more automatic or unconscious ways.

Humans often face decisions that require the elaboration, integration, and weighting of large volumes of information. In such cases, conscious thinking processes may result in suboptimal decisions due to limited processing capacity. Yet, individuals often do make reasonable judgments even within such contexts. Given this, and recognizing the enormity of unconscious processing capacity, Dijksterhuis (2004) proposed that individuals might posses sophisticated unconscious processes that can engage in task-directed mental activity to produce information-based judgments, even while conscious thought (the spotlight of human attention) is directed elsewhere. In fact, Dijksterhuis and colleagues suggest that, in some cases, unconscious-thinking processes

may output better decisions from complex information than conscious processes (Bos et al., 2008; Dijksterhuis, 2004; Dijksterhuis & Nordgren, 2006). As such, individuals output better decisions following a period of unconscious thought relative to periods of conscious thought or extremely limited unconscious or conscious thought. This effect is demonstrated in the common unconscious thought paradigm, generally modeled after Dijksterhuis' (2004) research.

Unconscious thought research typically follows a paradigm established by Dijksterhuis (2004). In this paradigm, participants are presented information about objects (i.e. different apartments or cars) about which they are asked to form an impression. Most often, four different objects are associated with an equal amount of information that is weighted as positive, negative, or neutral. One of the four objects has a majority of positive attributes assigned to it, two of the objects have an equal amount of positive and negative attributes assigned to them, and one object has more negative attributes assigned to it. Thus, there is a best and worst object. For example, a participant may be presented with information regarding four different apartments. Each apartment is assigned twelve weighted attributes. One apartment is weighted positively (possessing 8 positive attributes and 4 negative attributes), two apartments are weighted in a neutral way (possessing an equal amount of positive and negative attributes), and one apartment is weighted negatively (possessing 4 positive attributes and 8 negative attributes). Objectively then, one apartment is the best option, whereas one apartment is inferior. In Dijksterhuis' (2004) experiments, participants were randomly exposed to forty-eight attributes, twelve for each apartment, for 4 s each. Next, participants reported their

evaluations of the apartments either immediately (hindering both conscious and unconscious thinking), after 3 min of thinking deliberately about the information (conscious thought), or after engaging in a highly distracting task for 3 min (arguably allowing unconscious thinking to process the information while conscious processing capabilities were hindered). Results showed that participants in the distraction condition (unconscious thought) chose, or rated more favorably, the positively versus negatively weighted apartment significantly more than participants in the immediate decision and unconscious thought conditions. Many researchers interpret this result as indicating that unconscious processes enable participants to sort and organize information while conscious processes are distracted (e.g., Dijksterhuis, 2004; Dijksterhuis & Nordgren, 2006; Strick et al., 2011).

In the years since the original Dijksterhuis (2004) experiments, research on unconscious processing has grown rapidly. Current research indicates that unconscious thought processes excel at processing subjective information, but not rule-based or mathematical functions (Payne et al., 2008). Further, active unconscious processes enable individuals to cluster and polarize information (Dijksterhuis, 2004; Dijksterhuis & Nordgren, 2006) and weight information by importance (Bos et al., 2011). As such, unconscious thought processes integrate information, and are able to sort and weight the information in a way that outputs an optimal decision. Periods of unconscious thinking also enable the formulation of more creative alternatives than conscious thinking (Dijksterhuis & Muers, 2006; Zhong, et al., 2008), may facilitate moral decision-making

(Ham, van den Bos, & Doorn, 2009), and affect attitudes towards persuasive arguments (Handley & Runnion, 2011).

Importantly, unconscious thinking is goal-directed (Bos et al., 2008). That is, unconscious thinking does not occur unless individuals have a goal to process information for a judgment task. For instance, Bos et al. (2008) presented to participants information on two different types of objects (i.e. cars and roommates). Next, the researchers told participants that they were only going to report their judgments about one of the types of objects: cars or roommates. In doing this, the researchers manipulated participants' goal to form a judgment using only a subset of the presented information. After this, participants engaged in a distracting *n*-back task (see Jonides et al., 1997) for three minutes. Finally, participants were instructed to make surprise attitude ratings regarding *both* information sets. Participants made more accurate attitude ratings *only* for the set of information they were given a goal to think about. As such, participants were better able to distinguish between the best and worst alternative choices for the objects (e.g. roommates) that they were specifically asked to think about. Importantly the objects they were not directed to think about did not show this same boost in decision making accuracy; suggesting that without a goal to process information for a later output, unconscious thought processes did not occur. Thus, they concluded that unconscious thought is a goal-dependent process.

Nonetheless, many researchers find the idea that unconscious processes think about complex information and output rational judgments controversial. In fact, many are convinced that the decisions being made within the unconscious-thought paradigm are a

product of conscious processes (e.g. Dewall et al., 2008; Lassiter et al., 2009). Some of these alternative explanations to Unconscious Thought Theory question the existence of separate unconscious thought processes, and posit rather that the judgments in the unconscious thought experiments are a product of memory-based processing.

Conscious Explanations for the Unconscious Thought Effect

Two main alternative accounts assert that a conscious process can explain the experimental results obtained using Dijksterhuis' (2004) unconscious-thought paradigm. First, Lassiter et al, (2009) asserted that the differences observed in conscious and "unconscious" thought conditions actually result from different conscious processes. More specifically they postulate that individuals form "on-line" impressions of objects as they receive information. Further, because individuals update these impressions based upon incoming information, these impressions reasonably reflect the actual object qualities (i.e., are reasonable bases for judgments). Lassiter and colleagues suggest that if individuals engage in a distraction task after the presentation of information, they will simply retrieve this on-line impression when asked to form a judgment later on. Yet, if participants receive instructions to think about the information following the information presentation, individuals will infer that they should consider information they can remember and will therefore form a "memory-based" impression (see also Hastie & Park, 1986). Importantly, individuals can only remember subsets of the information provided, and thus memory-based judgments are generally poor. As such, Lassiter et al. suggest that if individuals consciously think about the presentation of information, they will form memory-based impressions, and report poor judgments later.

However, this idea does not fully account for unconscious-thought phenomena. According to Lassiter et al.'s account, individuals form memory-based judgments when they are prompted to think consciously and infer that they should consider recalled information. Given this, individuals in immediate and unconscious thought conditions, who do not receive this prompt should report comparable on-line judgments. Yet, researchers regularly report differences between these two conditions in unconscious-thought experiments. Specifically, participants in distraction conditions report more positive evaluations for the positively weighted items relative to participants who report their evaluations immediately (Dijksterhuis, 2004; Strick et al., 2010).

Fuzzy-Trace Theory (Brainerd & Reyna, 1990) represents a second alternative explanation for unconscious-thought effects through a memory perspective. This theory states that individuals encode multiple representations of information in parallel, as the information is presented. These parallel representations consist of verbatim (word-for-word) details for the presented information as well as "gist" representations. That is, while encoding information, individuals commit verbatim details into their working memory, in addition to formulating patterns and meanings from the information—therefore extracting a *gist* of the information. Verbatim details are often rehearsed in an individual's working memory for a short period of time. Importantly, as the time delay between encoding and recall increases, verbatim details decay more rapidly than gist memories. This differential memory decay forces an individual to rely more upon their "fuzzy trace" or gist impressions of the information as time elapses (Brainerd & Reyna, 1990; Reyna & Brainerd, 1995). Therefore, if an individual is questioned about

information they encoded after a long-enough delay, that individual will rely more on their gist representation of the information when forming a response. For instance, imagine reading a story about attending a friend's birthday party. Over time, the verbatim details of the story that was read fade away. Consequently, one begins to rely on their already established ideas of what a birthday party represents to guide retrieval. As such, details of the birthday party that are inconsistent with previous memories of a birthday party will be forgotten, and what one can recall is merely a gist representation of what is individually representative of birthday parties. This phenomenon of memory and forgetting has been well established since Bartlett (1932; see Reyna & Brainerd, 1995), and may account for why unconscious thought conditions may make better preference decisions. Namely, participants in the unconscious thought conditions may be relying on the overall gist impressions of the information they can remember when asked to make preference decisions. As such, they may recall their feelings about the information and subsequently experience memories or gist impressions from prior experiences that were had when considering specific objects and how they came to prefer one to the other. Thus, engaging gist impressions and prior knowledge in tandem to make a preference choice may lead to better for performance.

Consequently, given Fuzzy-Trace theory (FTT), what some psychologists call unconscious thought phenomena, others may classify as the forgetting process of human memory. As memory performance is based on the retrieval of both verbatim and gist traces (Brainerd & Reyna, 2002), results in unconscious thought paradigms may be explained via a memory perspective. According to FTT, individuals are likely to report

judgments based on gist and verbatim recall. Often individuals struggle to recall all the verbatim information for these judgments, leading to a suboptimal decisions or evaluations. This is consistent with findings from the unconscious thought paradigm in which participants in the immediate and conscious thought conditions often render poor judgments, particularly when the information is complex. Further, over time and without information rehearsal, individuals forget verbatim information and more heavily rely on gist impressions and schemas to report judgments. This might explain why individuals in unconscious thought experiments that are distracted after information presentation (introducing time and inhibiting rehearsal) commonly report better judgments.

However, Fuzzy-Trace theory cannot account for several findings born from the unconscious thought paradigm. For instance, there is evidence that unconscious thought is a goal-directed process (Bos et al., 2008), and without a goal to process specific information, unconscious thought processes are not engaged. As discussed earlier, Bos et al. (2008) conducted an experiment in which all participants received the same information about cars and roommates. But, after they were presented the information, participants were instructed to process only the attributes of the cars or the attributes of the potential roommates prior to distraction. After distraction, participants made a preference rating regarding *both* cars *and* roommates. As such, participants were better able to distinguish between the best and worst alternative choices for the objects (e.g. roommates) that they were specifically asked to think about. The object they were not directed to think about did not display any distinction in attitude ratings. Hence, without a goal to process information for a later output, unconscious thought processes did not

occur. If FTT's gist extraction processes were driving decision-making in the unconscious thought condition, participants would have shown the same ability to recall their gist feelings about the information regardless of instruction to form judgments about a certain set of details (for either cars or apartments). Currently, Fuzzy-Trace theory makes no mention of gist-maintenance as being goal-dependent, and would need this modification to fully explain some unconscious processing results (e.g. Bos et al., 2008). Due to this inconsistency, the goal-directedness of unconscious processing does not adhere to the framework of FTT, a passive process of judgment making based on forgotten verbatim details and subsequently defaulting to gist representation.

Furthermore, Handley and Runnion (2011) show that unconscious thought effects seemingly occur even when memory is comparable across conditions. In their study participants were presented with rapid (220 words per minute) auditory persuasive messages that contained either strong or weak arguments. Next, participants reported their attitudes and argument recall following no delay, three minutes of conscious thought, or three minutes of distraction. Only participants in the distraction condition reported more favorable attitudes if they heard strong as compared to weak arguments, indicating that they processed those arguments while distracted (Handley & Runnion, 2011). More importantly for the current discussion, results demonstrated no significant difference in argument recall across conditions, indicating that all participants were recalling comparably little information at the time of rating the arguments. A fuzzy-trace explanation, and arguably, most memory-based research would predict that participants in the distraction conditions should recall fewer attributes of the arguments due to time

and an inability to rehearse information. As a result, these participants may rely more on gist impression to report attitudes. Yet, the uniform recall across conditions is inconsistent with that prediction. As such, in this experiment, the authors likely saw a floor effect in that memory was poor for everyone due to quickly presented information. Further exploration is needed to support whether this finding lends itself to the possibility that unconscious processing produced the attitude differences reported by Handley and Runnion (2011).

Does the Sophisticated Unconscious Exist?

All in all, there is plentiful research that suggests unconscious thought exists (e.g. Bos et al., 2008; Bos et al., 2011; Dijksterhuis, 2004; Dijksterhuis & Muers, 2006; Dijksterhuis & Nordgren, 2006; Strick et al., 2010; Strick et al., 2011). As previously established, there is nonetheless a debate in the literature as to whether the effects interpreted as unconscious processing are actually due to conscious thought. Although Dijksterhuis and numerous colleagues (Bos et al., 2008; Bos et al., 2011; Dijksterhuis, 2004; Dijksterhuis & Muers, 2006; Dijksterhuis & Nordgren, 2006; Strick et al., 2010; Strick et al., 2011) assert that the phenomena of unconscious thought processes are separate from any conscious memory phenomena, more concrete results need to be established to rule out memory-based explanations. The purpose of this thesis is to extend the research and to explore the dissociation between unconscious thought explanations and competing memory explanations for the unconscious thought effects. Namely, the current experiment uses a measure of working memory to examine whether individual

preference making within the unconscious thought paradigm is the result of memorial processes and can thus be moderated by an individual's working memory capacity.

One way to establish this is to pit the predictions of conscious memory and unconscious thought processes against one another. To do so, a workable memory theory will be used to further investigate the possibility that memory-based processes moderate object preferences in the unconscious thought paradigm. Research regarding cognitive working memory capacity (WMC) is a well-established framework of conscious, controlled, memory-based processing. An individual's WMC can significantly affect the ability to process information and maintain a goal during a complex task.

Working Memory Capacity

According to Baddeley & Hitch (1994), working memory is defined as a tripartite memory system composed of two storage systems (the phonological loop and the visuo-spatial sketch pad) and the central executive system. The central executive system is a mental process that holds information within conscious attention in an active state, facilitates the information held in attention towards processing, and makes connections between long-term memories, retrieval, and subsequent actions. This 'active memory' is like a limited capacity workspace that is split between storage and processing demands. Engle and colleagues (see Kane & Engle, 2003; Engle 2002) have since focused their research on the central executive system as the component of working memory responsible for the variation between individuals' WMC and higher order cognition. Engle (2002) asserts that working memory is not just short-term memory (which as discussed earlier, is the memory store that can retain information temporarily without

rehearsal), but also the capacity to control attention that is essential to performance during complex tasks. Important to an individual's WMC is the ability to hold and maintain information within the conscious spotlight of attention, as well as to shield that information from interference and distraction from internal and external sources. This relationship between the ability to control attention and the amount of information that is kept 'active' in short-term memory characterizes individual WMC (Engle, 2002).

Operationally, Barrett, Tugade, and Engle (2004) define WMC as the number of items one can keep in mind for later recall during a complex memory task. WMC is tested through a variety of higher-order cognitive tasks that are correlated with fluid intelligence, reading comprehension, and complex learning and reasoning abilities (Engle, 2002; Kyllonen & Christal, 1990). Generally, WMC tasks expose participants to information for later recall while engrossing them in another attention-demanding task. The individual ability to engage in focused processing while suppressing or inhibiting external distractions results in good task performance. Such *attentional-control*, or the ability to keep attention focused on the task rather than other internal or external information, is one of the main contributors to an individual's level of WMC (Barrett et al., 2004; Engle, 2002). Individuals with a higher WMC are better able to focus attention, and are more successful at enacting controlled, goal-directed, processing relative to those with low WMC who allow less appropriate or undesired responses to emerge during task performance (Barrett et al., 2004). For example, a person with low WMC is more likely captured by internal thoughts about their upcoming vacation while completing a college midterm, arguably a complex task. Such thought intrusions make the individual more

vulnerable to lapses in focused attention and leads to more overall errors or delayed reaction time during a task.

Essentially WMC, and within that, attentional control, are factors that are integral to the efficiency and success of conscious processing (for an extensive review, see Barrett et al., 2004). Individuals higher in WMC have numerous attentional and processing advantages over those with lower WMC. Thus, WMC could be a contributing factor to participants' performance in a number of paradigms outside of memory research, including the unconscious processing paradigm introduced by Dijksterhuis (2004). Specifically, individuals' WMC differences may moderate decision-making performance within the conscious processing conditions. In the common unconscious thought paradigms (e.g. Dijksterhuis, 2004), participants are asked to consciously deliberate on presented information to output a judgment. Arguably, individual WMC may affect output judgments within unconscious thought experiments. Globally, if memory and attention are responsible for the effects seen in unconscious thought research, individual WMC should relate to the quality of judgments across thought conditions. This finding would indicate that the unconscious thought effect could be more succinctly explained thought memory-based processes.

Current Project: Working Memory within the Unconscious Thought Paradigm

As previously mentioned, conscious memory-based processes may account for the unconscious thought effect, challenging the notion that there exists independent unconscious processing of complex information. The current research must find a way to

provide solid evidence that unconscious processing and memory events are independent. The purpose of the present experiment is to pit the two possible explanations of unconscious processing against each other. Specifically, this experiment is designed to uncover evidence supporting either unconscious-processing or memory-based explanations when looking at results within the standard unconscious processing paradigm (e.g. Bos et al., 2011, Dijksterhuis & Nordgren, 2006; Dijksterhuis, 2004).

Dijksterhuis and Nordgren (2006) posit that "*attention* is the key to distinguishing between conscious and unconscious thought. Specifically, conscious thought is thought *with* controlled attention, and unconscious thought is thought '*without* controlled attention'" (pp. 96; or with controlled attention directed elsewhere). Further, as noted above, attentional control is a key component of WMC, a measureable individual difference. Therefore, following Dijksterhuis and Nordgren's logic (2006), individual WMC will affect judgments formed through conscious processes (conscious thought conditions), whereas the quality of judgments formed through unconscious processes (i.e., in distraction conditions) should not relate to WMC level. Specifically, when the task is complex, individual WMC level should have a negative relationship with preference rating when they think consciously (or make immediate decisions), but no relationship in unconscious thought (distraction) conditions. However, if the judgments made in distraction conditions result from a conscious, memory-based process rather than unconscious thought, the quality of judgments in this condition should also be affected by individual WMC.

The purpose of the current experiment is to examine individuals' working memory capacities *within* the unconscious thought paradigm. As mentioned previously, WMC and the ability to control attention is a key component to directing conscious processing (Barrett et al., 2004; Engle, 2002; Kane & Engle, 2003). Unconscious thought experiments engage participants in a very complex task (i.e. presenting 48 pieces of information in succession). Thus, individual WMC may affect judgments within such experiments. Specifically, WMC may affect judgments in the conditions that engage conscious processing (the immediate and conscious thought conditions). Arguably then, if unconscious processes are separate from conscious processing or memory events, there should be no difference in preference ratings in the 'unconscious thought' condition due to individual differences in WMC. However, if WMC relates to judgment quality within each of the separate thought conditions, perhaps a theory such as Fuzzy-Trace Theory (Brainerd & Reyna, 1990; Reyna & Brainerd, 1995) could more concisely explain the results obtained within the unconscious thought paradigm.

Experiment Overview

Participants in the current experiment first completed the computer-automated operation span (OSPAN) task (Unsworth, Heitz, Schrock, & Engle, 2005), which is a valid and reliable indicator of WMC. Next, participants received information about four differently weighted cars (see, e.g., Bos et al., 2008). Independently, participants were randomly assigned to receive either a large amount of information about each car (12 attributes) or a moderate amount of information about each car (4 attributes). Participants

were also randomly assigned to report preference judgments about the cars either immediately, after 3 min of conscious thought, or after 3 min of distraction.

As mentioned previously, working memory can only hold a limited amount of information at a time (Miller, 1956). Thus, providing participants with 48 pieces of information in succession undoubtedly hinders their conscious processing efforts. However, when the task is less complex (i.e. 16 pieces of information and 4 cars), conscious thought processes will be less overwhelmed and result in a more optimal decision. For example, using similar shortened information, Dijksterhuis and Nordgren (2006) found that participants' object ratings in the conscious thought condition were much improved in contrast to the complex paradigm's conscious thought condition. Participants were presented 16 attributes assigned to four different cars. After information presentation, participants were assigned to one of the three thought conditions. In this shortened paradigm, individuals in the conscious thought condition made optimal apartment preferences, over the other two conditions. This finding is opposite to the findings in the original length paradigm. Dijksterhuis and Nordgren (2006) assert that conscious thought is hindered by its small capacity, and therefore can only account for a small subset of information at a time, whereas unconscious thought processes can process a much larger amount of information, and in the face of distraction. Thus, under very complex circumstances, conscious thought is hindered, and unconscious process may excel at making the best decision. Conversely, when tasks are simple enough for CT to handle, unconscious thought processes are not needed for judgments (but can still take place). Hence, using conscious thought will lead to more accurate decision-making than

unconscious thought processes, when the task is *simple* (Dijksterhuis & Nordgren, 2006; Strick et al., 2011).

As such, including a less complex task in the current experiment will provide a 'control' condition against which to compare participants' output in the complex task. Exposing participants to only sixteen pieces of information and asking them to hold it in working memory is a much more feasible task than holding 48 pieces in working memory at once. Thus, a shortened task may also mirror a memory task that is significantly moderated by WMC, and show a positive relationship between individual WMC and preference choice. Simply, individuals with higher WMC will make better preference choices than their counterparts when the task is simple. Consequently, if the current results show a moderating effect of WMC in the simple paradigm but not in the complex paradigm, this would be further evidence that the large amount of information presented within the original paradigm is outside the control of attention, lending additional support to possibility that separate, non-memorial processes are at work within the unconscious thought experiments.

Predictions and Hypotheses

The goal of the current experiment is to pit two possible explanations for the unconscious thought effect against each other. Experimentally testing a memory theory and an unconsciousness theory in the same experiment will help to further define (or rebut) the existence of unconscious thought. As attentional control is a vital contributor to both individual WMC and conscious processing within the unconscious thought

paradigms, testing individual attentional differences will elucidate individual performance within the three separate thought conditions. As such, pitting the two theories against each other leads to the formulation of specific hypotheses and predictions.

Hypothesis 1: Experiment results will replicate prior unconscious thought research. Specifically, when participants receive complex information, they will form more positive evaluations and preferences about the positively versus negatively weighted car to a greater extent in the distraction conditions relative to the immediate and conscious thought conditions. However, when participants receive simple information they will form more positive evaluations and preferences about the positively versus negatively weighted car to a greater extent in the conscious thought conditions relative to the immediate and unconscious thought conditions.

As previously mentioned, Dijksterhuis & Nordgren (2006) state that conscious thought is hindered by its small capacity, and therefore can only handle small amounts of information at a time. On the other hand, unconscious thought processes can handle a much larger amount of information, even while conscious processes are distracted. Thus, under very complex circumstances, conscious thought is hindered, and unconscious process may excel at making the best decision. Conversely, when tasks are simple enough for conscious thought to handle, unconscious thought processes are not needed to integrate the information. Hence, the engaging in conscious thought will lead to more accurate decision-making than unconscious thought processes, when the task is *simple*

(Dijksterhuis & Nordgren, 2006; Strick et al., 2011). As such, it is predicted that the current experiment will replicate these results.

Hypothesis 2: Memory-based explanations and WMC within the paradigm: As the immediate decision and conscious thought conditions are reliant on attention-controlled processing, it is predicted that individual WMC will moderate car choice within these conditions. Additionally, it is predicted that WMC will moderate these conditions in some way regardless of task difficulty.

Hypothesis 2.1: Within the immediate and conscious thought conditions, higher levels of WMC will relate to better car judgments when participants receive simple information.

Research shows that higher WMC individuals are better at suppressing unwanted thoughts (Rosen & Engle, 1998) and inhibiting mind wandering during complex tasks than are lower WMC individuals (McVay & Kane, 2009). Thus, higher WMC capacity individuals are better at keeping external and internal distractions at bay, making verbatim details easier to retain (Rosen & Engle, 1998). Hence, car judgments should improve as participants' WMC increases, when the task is simple. Also, prior research shows that lower WMC individuals are prone to give up at holding information in their working memory more quickly than are individuals with higher WMC (Heitz, Schrock, Payne, & Engle, & 2007). Essentially, lower WMC individuals are more easily overwhelmed during information presentation and give up on the task at hand sooner than do higher WMC individuals. Thus, lower WMC participants may not focus on recalling and rehearsing traits as participants with higher WMC do. Instead, lower WMC participants may 'give-up' trying to encode and rehearse the car traits as they are

presented and rely on making car judgments on their overall feeling or impression of the information.

As previously discussed, higher levels of WMC are associated with better thought suppression and higher levels of concentration and short-term memory retention. Thus, when participants have time to consciously think about modest amounts of information and use their WMC, they can retain and use most of the information in forming judgments, resulting in good memory-based judgments. Thus, within the simple information conditions, a positive relation between individual WMC and car judgments is expected in the immediate and conscious thought conditions. As such, individuals with higher WMC should make better car judgments than their lower WMC counterparts.

Hypothesis 2.2:Within the immediate and conscious thought conditions, higher levels of WMC will relate to poorer car judgments when participants receive complex information.

When participants have time to consciously think about and rehearse large amounts of information, they can retain and use little of the overall information to forming judgments. It is not possible to hold 48 items of information in working memory. Ironically, individuals with higher WMC may attempt to retain more specific details of the presented information, but due to the volume of that information only remember a small amount of it. Consequently, higher WMC will result in the use of degraded recall to form judgments, leading to poor judgments. However, individuals with lower WMC attempt to retain complex information in memory for a shorter duration, and are less likely to rely on degraded recall when forming preferences. As a result, lower WMC should result in better preferences formed using gist impressions.

Hypothesis 2.3: Within the distraction conditions, participants' level of WMC will relate with the quality of their car judgments.

Unconscious Thought Theory (Dijksterhuis & Nordgren, 2006) posits that the unconscious thought process that occur after information presentation do not rely upon attention, a key facet of WMC. However, WMC research posits that, even in the face of distraction, individuals higher in WMC should outperform lower WMC participants when the task is simple. Thus, it is predicted that individual WMC will positively relate with car judgments in the simpler condition. On the other hand, when the task is complex, a memory-based explanation would predict that participants would perform comparably to the participants in the immediate and conscious thought conditions. As such, higher WMC and car choice will have a negative relationship.

Hypothesis 3: Unconscious Thought and WMC: WMC will moderate car evaluations in each immediate and conscious thought condition as predicted by FTT (see Hypotheses 2.1 and 2.2). However, contrary to hypothesis 2.3, WMC will *not* moderate car evaluations in the unconscious thought conditions.

Hypothesis 3.1: Within the distraction conditions, participants' level of WMC will not relate to the quality of their car judgments, regardless of whether they received complex or simple information.

Of central focus in this experiment are the car preferences within the unconscious thought condition. Even if an unconscious processing explanation was supported by the experimental data, the conscious processing predictions for unconscious thought theory and a memory-based theory remain the same. As such, it is expected that individual

WMC will moderate results in the conditions that utilize conscious processing: the immediate and conscious thought conditions. However, since unconscious thought is arguably separate of controlled attention, individual WMC should not predict car preferences within the unconscious thought conditions. Specifically, Unconscious Thought Theory (Dijksterhuis & Nordgren, 2006) posits that the unconscious thought processes that occur after information presentation do not rely upon attention, a key facet of WMC. Thus, if unconscious thought exists, participants' WMC (and by virtue their ability to control and use attentional processes) should not relate to their car judgments. Thus, there should be no relation between individual WMC and car preference within the distraction conditions, regardless of difficulty.

Method

Design

The current experiment is a 2 (information: complex vs. simple) X 3 (thought condition: immediate decision vs. conscious thought vs. unconscious thought condition) between-subjects design including automated operation span (OSPAN) score, a measure of WMC, as a continuous predictor variable.

Participants

Three hundred and seven introductory psychology students from Montana State University participated in this experiment for partial course credit. Due to experimenter or computer errors, 60 participants were missing OSPAN scores or preference ratings. Complete data was therefore collected from 56 additional participants. Further, following

Unsworth, Heitz, Schrock, and Engle (2005), 43 participants who committed more than 15 math errors (85% accuracy criterion) on the Automated OSPAN task were excluded from analysis. Therefore, the data from 260 participants were analyzed overall.

Procedure

Participants completed the experiment on computers at individual workstations. Participants first provided informed consent and then began the automated OSPAN task. The automatic OSPAN engages participants in a complex task that quickly presents the participant with a math problem that they have to answer as true or false. After giving their answer, the computer flashed a letter to remember for a string of 3-7 trials. This process is repeated for a total of 75 trials, and takes 20-25 minutes to complete (Unsworth et al., 2005). After completing the OSPAN, participants notified the experimenter who then started them on the next computerized task. Individuals were informed that they were participating in an experiment that examined impression formation. They were then told that they would see a series of attributes concerning 4 different cars: The Hatsdun, the Kaiwa, the Dasuka, and the Nabusi. The participants were then advised to read each attribute carefully (e.g. The Dasuka has poor highway stability; The Hatsdun has a sunroof, The Kaiwa gets very good gas mileage, etc.) until the next attribute appeared. Participants were informed that after the presentation was complete they would answer a series of questions regarding the four different cars.

According to condition, participants then were randomly presented the car attributes (48: Complex or 16: Simple), at an interval of four seconds per attribute. Subsequently, participants were randomly assigned to evaluate the cars either

immediately (immediate decision condition), after being instructed to ‘think hard’ about and seriously consider the information they received for three minutes (conscious thought condition), or after being distracted (unconscious thought condition) by an attention-demanding *n*-back task (Jonides et al., 1997) for three minutes. The purpose of the *n*-back task is to distract the participants from the car information that was presented. The *n*-back task is designed to focus conscious processing elsewhere, ideally allowing unconscious processing to take over digesting the information about the cars.

Participants rated each car on positivity, and also rank ordered the cars from most to least preferred. Participants were also asked to recall the attributes for each car as well as they could. After this attribute recall was completed, individuals rated each attribute (e.g. good gas mileage) on importance and relevance. This measure ensured that the positive and negative trait manipulation within the experiment was effective. Finally, participants were fully debriefed and thanked for their participation.

Independent Variables

Task Difficulty

Participants were randomly assigned to a complex- (i.e., original, per Dijksterhuis, 2004) or simple-information condition. The complex condition contained 48 pieces of information about the four different cars (12 each), whereas the simple condition contained 16 pieces of information about the four different cars (4 each). One car, the Hatsdun, was weighted as the best car, possessing eight positive attributes and four negative attributes or three positive attributes and one negative attribute according to

difficulty condition. The Nabusi was weighted as the most negative car, assigned eight negative attributes and four positive attributes or three negative attributes and one positive attribute according to difficulty condition. The Kaiwa and Dasuka were neutrally weighted, possessing either 6 positive and negative attributes or two positive and negative attributes according to condition. Car attributes were presented at random during the encoding to reduce order effects. Attributes were not counterbalanced across cars, consistent with the experiments that this thesis borrowed from (Bos et al., 2008).

Pre-testing conducted at Montana State University established that all car names were evaluated equally. Individuals (n = 32) participating in a separate experiment were presented the car names without any attributes assigned to them and then asked to evaluate each car and rank the cars by preference. A repeated-measures ANOVA was conducted on the dependent variable, showing no significant effect of car name on car ranking, $F < 1$. This result indicates that the attributes assigned to each of the four cars affect subsequent car choice.

Thought Conditions

Independently from the information participants received, they were randomly assigned to one of three thought conditions. In the Immediate Decision condition, participants were asked to *immediately* evaluate the cars. In this case, participants had little time to process the information consciously or unconsciously. In the Conscious Thought condition, participants were asked to think *deliberately* and concentrate hard on the information about the cars for three minutes. After three minutes, participants in this condition evaluated the cars. Finally, in the Unconscious Thought condition, participants

were immediately directed into a *distracting n*-back task. This task is highly demanding and requires the participants' full attention. Specifically, the 2-back task was used. Participants were presented a sequence of numbers one at a time. Every time the currently presented number was presented two numbers previously (e.g., 6…2…4…2), participants were told to press the spacebar on the computer. This task is designed to occupy working memory and prevent participants from consciously thinking about the car attributes that they were just presented (Dijksterhuis, 2004). After three minutes of the *n*-back task, participants were directed to the car-ranking task.

Dependent Measures and Manipulation Checks

Preference Ratings

Car Evaluation After receiving all of the information about the cars, participants were asked to evaluate each car. Participants completed the following four evaluation items using 9-point scales: "What is your overall attitude regarding the Hatsdun?" (1= *+25 very positive* to 9 = *- 25 very negative*), "What is your overall attitude regarding the Kaiwa?" (1= *+25 very positive* to 9 = *- 25 very negative*), "What is your overall attitude regarding the Nabusi?" (1= *+25 very positive* to 9 = *- 25 very negative*), and "What is your overall attitude regarding the Dasuka?" (1= *+25 very positive* to 9 = *- 25 very negative*),

Car Rank Secondly, participants rank-ordered the cars from 1 (being their top preference) to 4 (being their least preferred). Specifically, the four car names were

presented in text boxes at random on the computer screen and participants were asked to drag the text boxes into the order they preferred the cars. After dragging the text boxes into an order on the screen, participants were asked to confirm that this was the order they preferred the cars, the top car being the first choice, the second car being their second choice, until reaching the fourth car, their last choice, accordingly.

Preference Ratings Preference ratings for the car evaluations were calculated consistent with prior unconscious thought research (e.g. Bos et al., 2008; Dijksterhuis, 2004; Dijksterhuis & Nordgren, 2006). The car evaluation scale measure for the car with the most negative attributes, in this case the Nabusi, was subtracted from the car evaluation for the car with the most positive attributes, the Hatsdun. The rank order dependent variable was dummy coded to assign arbitrary weights to the car that was ranked as the top choice and the car that was ranked as the last choice. Specifically, the Hatsdun was assigned a weight of one, the Dasuka and Kaiwa were assigned weights of zero, and the Nabusi was assigned a weight of -1. Then, consistent with prior research (e.g. Dijksterhuis, 2004), The weighted score for the participants' top ranked car was subtracted from the weighted score for the last ranked car. A more positive score indicated the more accurate car ranking choice.

A Pearson's correlational test was conducted to assess the correlational strength between the evaluation and ranking dependent variables. These two dependent measures were significantly correlated, $r(258) = .468$, $p < .001$. Therefore, the two dependent variables were standardized into a *z*-score. A composite dependent variable score was used for all further analysis.

Trait Recall

Finally, participants were asked to recall as many traits about the four specific cars as possible. Participants were provided a separate text box into which they could type recalled attributes for each car. Two research assistants coded trait recall as either being “Correct Trait Recall” or “Incorrect Trait Recall.” Further, a “Total Traits Recalled” column was included. Recall scores across difficulty conditions were adjusted according to proportion. This recall measure examines potential differences in recall between thought conditions. Prior research (Handley & Runnion, 2011) demonstrated no significant differences in information recall across immediate, conscious, and unconscious thought conditions. Therefore, if this effect is replicated in the current research; it may add supportive evidence towards Unconscious Thought Theory. Specifically, if participants were simply relying on degraded memory or gist representations while choosing a car in the unconscious thought condition, individuals would arguably be able to remember less traits than participants in the immediate or conscious thought conditions. Thus, if there were evidence of degraded recall within the unconscious thought condition; results would add supportive evidence towards a memory-based explanation of results. However, if there is no difference in recall across thought or difficulty conditions, evidence supporting prior research (Handley & Runnion, 2011) contributes to the theory that there is an active process handling the information while consciousness is distracted. This unconscious process would arguably still be outputting better car decision regardless of uniform recall.

RESULTS

Factorial ANOVA

The composite preference measure was entered into a 2 (Difficulty: Complex paradigm vs. Simple paradigm) x 3 (Thought: immediate vs. conscious vs. unconscious) between-subjects ANOVA. There was no significant main effect of difficulty, $F < 1$. Interestingly, participants in the complex and simple paradigms performed comparably well.

There was a marginal effect of thought condition, $F(260, 2) = 2.728$, $p = .067$, indicating a trend for participants in the unconscious thought condition to form the normatively best car preferences. Finally, the predicted interaction between Thought and Difficulty conditions was not significant, $F(260,2) < 1$. This finding is not consistent with prior research (Dijksterhuis & Nordgren, 2006; Strick et al., 2011) which displays an effect of decision quality as a function of complexity in the conscious thought condition, with the complexity of the task (the number of attributes presented) not bearing affect upon the unconscious thought condition. Nonetheless, planned comparisons were conducted to test specific predictions based off of previous unconscious-thought research and specific *a priori* hypotheses.

The precise nature of the predicted interaction between task difficulty and thought condition was tested using planned comparisons. These comparisons were designed to determine predicted differences in car preference between thought conditions within complex and simple information conditions. First, the differences in car ranking between

thought conditions within the complex paradigm were explored. Specifically, complex unconscious-thought condition were assigned a weight of 1, complex immediate-decision conditions were assigned a weight of -1, and all other conditions were assigned a weight of zero. This comparison demonstrated that, within the complex paradigm, participants in the unconscious thought condition preferred the best versus worst car to a greater extent that participants in the immediate condition, $t(253) = 2.492$, $p = .013$. This replicated prior findings in the unconscious thought literature involving the presentation of complex information (e.g. Bos et al., 2008; Bos et al., 2011; Dijksterhuis, 2004; Strick et al., 2011), and suggests that participants are processing information unconsciously while they are distracted after information presentation. A similar comparison tested the difference between the complex unconscious thought condition and the complex conscious thought condition. This comparison indicated a marginally significance difference between these conditions, $t(253) = 1.8$, $p = .07$, such that participants in the unconscious thought condition demonstrated a greater preference for the best versus worst car. This marginal difference is also consistent with a recent meta-analysis that indicates a small difference between these conditions that sometimes does, and sometimes does not, reach significance within individual experiments (see Strick et al., 2011). Lastly, a similar comparison tested the difference between the complex immediate thought condition and the complex conscious thought condition. There was no significant difference between the two conditions, $t(253) < 1.20$, $p > .05$. This comparison indicates that participants are not making significantly different car ratings in the two complex conscious thought conditions. This finding is also consistent with recent meta-analysis, indicating that the

differences in decisions within the immediate and conscious thought conditions do not differ from each other (see Strick et al., 2011). Overall, these planned comparisons indicate that participants in the complex conditions generate better preferences/decisions in the unconscious thought conditions than in the immediate thought condition, and maybe than individuals in the conscious thought condition.

Next, similar planned comparisons were used to explore the specific differences between thought conditions within the simpler paradigm. None of these comparisons indicated significant differences across the thought conditions, all ts < 1.7, all ps > .05. These contrasts indicate that participants in the simpler paradigm make comparable car choices regardless of condition. Thus, it seems as if only those participants in the complex (original) paradigm are showing effects consistent with prior unconscious thought research (e.g. Bos et al., 2008; Dijksterhuis & Nordgren, 2006; Strick et al., 2011). This null result is not consistent with prior research that indicates conscious thought performs well when the information is simple (Dijksterhuis & Nordgren, 2006). It may be that the information presented was not simple enough for conscious processing to demonstrate an advantage over unconscious thought processes. However, the basic unconscious thought effect was replicated in the current experimental data. Subsequently, the next task is to analyze the current experiment's results with WMC (automated OSPAN) included.

Multiple Regression:
Unconscious Thought and WMC

The preference measure was also analyzed with a hierarchical regression in which WMC, in addition to thought and difficulty conditions, served as predictor variables. In the first step of this analysis, difficulty and thought conditions (dummy coded) and WMC (WMC; centered) were regressed onto the preference measure. In the second step, the 3 two-way interactions between thought and complexity, thought and WMC, and difficulty and WMC were entered as predictors. In the third step, the three -way interaction between thought, complexity, and WMC was entered. The results of the regression analyses indicated that WMC was not a significant moderating factor of car preference ratings (see Table 1) within the thought and difficulty conditions.

As seen in Table 1, within the multiple regression analysis, there was a marginal main effect of thought condition in Step Three, β =-.150, p = .089. Additionally, there was a marginal interaction between Difficulty and WMC, β =-.150, p = .086. This findings indicates a possible positive relationship between car choice and WMC when the information is simple and a negative relationship under complex information. However, WMC does not interact with the different thought conditions (immediate, conscious thought, or unconscious thought). Therefore, it is likely that individual WMC did not moderate the results reported in the factorial ANOVA. However, correlations were conducted to examine if individuals' WMC was an indicator of performance within the specific thought conditions.

Table 1. WMC as a Predictor of Car Choice in Thought and Complexity Conditions

		B	Std. Error	β	F	Sig. (*p*)
Step Three	(Constant)	-.047	.075		.384	.536
	Thought	.155	.091	.150	2.923	.089
	Complexity	.066	.107	.039	.385	.535
	WMC	.003	.005	.063	.525	.470
	Thought x Complexity	-.021	.129	-.014	.026	.871
	Thought x WMC	-.006	.006	-.094	1.150	.285
	Complexity x WMC	-.011	.007	-.150	2.977	.086
	Thought x Complexity x WMC	-.003	.008	-.032	.138	.711

*Note: Dependent Variable: composite Car Choice; *p* < .05.

Correlations

Despite the null results of the regression analysis, correlation coefficients were computed between WMC and the car preference measure for each condition in the thought x difficulty factorial (see table 2). As predicted, individual WMC was positively correlated with car preference in the simpler conscious thought condition, $r(51)=.280$, $p < .05$. Also, there was no significant correlation between WMC and preference in the

complex conscious condition. Together, these results are consistent with unconscious thought effect findings (Strick et al., 2011). This finding suggests that individuals with higher WMC in the simpler conscious thought condition are making better car choices than their lower WMC counterparts. Thus, to an extent, this result supports the prediction that working memory will moderate car choice in the simpler paradigm.

Contrary to both unconscious thought and memory-based predications, higher WMC did not moderate car choices in the immediate decision condition, regardless of number of attributes presented, all *p*s > .100. Thus, higher WMC has no significant influence on car choices when asked to immediately evaluate each of the four cars. Interestingly, there was a significant negative correlation between WMC and car choice in the complex unconscious thought condition, $r(44)=-.351$, $p < .02$, but not in the simple condition, $p > .05$. This finding suggests that the *lower* WMC participants are making better car choices in the complex unconscious thought condition. This finding is opposite to both of the unconscious thought and memory-based predictions. Unconscious processing theories would assume that WMC would have no effect on car choice. Further, memory-theories would assume that higher WMC individuals would have made better choices than lower WMC participants, due to those individuals' ability to maintain information across distraction and thus output more quality judgments (e.g. Barrett et al., 2004).

Table 2.Pearson Correlation's between Car Choice and WMC as a function of thought condition and difficulty of task.

	Thought Condition		
Difficulty of Task	**Immediate**	**Conscious**	**Unconscious**
Shortened	-.151, *n* = 40	.280*, *n* = 51	.056, *n* = 41
Original	-.129, *n* = 42	-.008, *n* = 42	-.351*, *n* = 44

Note: Means with * are significant at the *p*< .05 level

Exploratory Analysis: Recall Measures

Attribute recall was first analyzed using repeated measures ANOVA. Factors included in this analysis included Car Name, Thought Condition, and Difficulty condition. There was a significant Difficulty x Car interaction, $F(2)= 3.546$, $p < .05$. This interaction indicates that recall for each car changed depending on the difficulty level of the task. However, this was the only significant effect (see Table 3). Secondly, the factor of WMC quartiles was added in to the repeated measures ANOVA analysis. This analysis revealed no significant effects, all *F*s < 2.25, *p*s >.05. This finding indicates that individual WMC had no moderating effect on number of car attributes recalled, regardless of thought condition or paradigm difficulty. To investigate this finding further, Pearson's correlation tests were conducted to examine the correlation between the WMC and car trait recall for the Hatsdun (the best car), the Nabusi (the worst car) and an adjusted proportion of recall score for the two neutral cars combined. Individual WMC did not significantly correlate with any car trait recall, all *rs* < .30, all *p*s > .05. As such,

this finding is confounding. Memory research would be predict that individuals with higher WMC would be able to recall more car traits than their lower WMC counterparts. However, null findings that recall is not affected by thought condition is consistent with prior research reported by Handley and Runnion (2011), and may implicate that the preferences formed via unconscious thought are separate from (explicit) memory processes. Namely, there may be a process distinct from recall occurring during distraction that enables participants to make better car preferences than participants in the other conditions.

Table 3. Repeated Measures ANOVA: Proportion of Participants' Accurate Car Recall within Thought and Difficulty Conditions

Effect	*MS*	*df*	F	*Sig. (p)*
Car Name	.011	2	.497	.609
Car x Thought	.025	4	1.065	.373
Car x Difficulty	.082	2	3.546	.030*
Car x Thought x Difficulty	.036	4	1.554	.186
Error	.023	490		

*Note: * indicates significance at* $p < .05$.

GENERAL DISCUSSION

This thesis experiment is one of both replication and novelty. The purpose of the experiment was to pit the predictions of Unconscious Thought Theory (Dijksterhuis & Nordgren, 2006) and conscious thought explanations against one another. First, this experiment aims to replicate the unconscious thought effect within the Dijksterhuis (2004) paradigm. Prior unconscious thought research posits that individuals possess a sophisticated thought process entirely separate of conscious processes that enables them to sort, weight, and polarize subjective information while their attention is focused elsewhere (Dijksterhuis & Nordgren, 2006; Payne et al., 2008). However, some argue that there are not sophisticated and integrative thought processes that occur unconsciously, and that the effects observed in the unconscious thought literature may actually be the result of conscious information processing (Dewall et al., 2008; Lassiter et al., 2008). Fuzzy-Trace theory (Brainerd & Reyna, 1990) provides a viable memorial explanation for unconscious thought effects that results from attention (but see Bos et al., 2008; Handley & Runnion, 2011 for discussion). Therefore, adding the additional variable of WMC to the unconscious processing paradigm was predicted to shed light on the debate over conscious and unconscious processes that currently exist in the literature.

More specifically, extrapolating from Fuzzy-Trace theory and other conscious explanations, individuals higher in WMC should outperform those lower in WMC in all of the three thought conditions, when the task is simple. However, when the task is more complex, lower WMC participants should outperform their higher WMC counterparts. On the other hand, unconscious thought theory would suggest WMC would not affect car

choice in the unconscious thought conditions. The current experiment tested these rival predictions by examining individuals' car preference across immediate, conscious and unconscious thought conditions for complex and simple tasks (see Dijksterhuis, 2004). Further, this thesis examined whether WMC moderated these preferences. In light of the specific, but diverging predictions outlined above, inclusion of this novel predictor variable allows this study to explore the existence of unconscious thinking in a unique way.

The present research used Dijksterhuis' (2004) paradigm in which participants evaluated cars (see, e.g., Bos et al., 2008). Further, this experiment used the automated OSPAN introduced by Unsworth and colleagues (2005) to measure the WMC of individual participants. Additionally, this experiment used two difficulty conditions to further examine WMC as a predictor of car choice. Namely, participants in the original paradigm were presented 48 pieces of information regarding the cars. Alternatively, participants assigned to the simpler paradigm received only 16 car attributes. Arguably, the shortened paradigm mimics a memory test, as the succinct nature of conscious thought can lead participants to output judgments equally as well as participants assigned to the unconscious thought condition (see Dijksterhuis & Nordgren, 2006). Thus, it was predicted that individuals assigned to the shortened paradigm would be more likely to exhibit effects of individual WMC on car choice. Conversely, participants in the original paradigm that were assigned 48 car attributes were at a conscious processing disadvantage. As such, it was predicted that within the complex condition, individuals with higher WMC might make worse car choices than lower WMC participants in the

immediate, conscious, and unconscious thought conditions. Conversely, in the simple task, higher WMC would outperform their lower WMC counterparts across conditions. Further, predictions asserted that if unconscious processes were separate from a memory-based process, WMC would not moderate car choices in the unconscious thought condition. In sum, if participants' WMC moderated car choice in the unconscious thought condition, results would lend support to a memory-based explanation of decision-making within this paradigm.

Hypothesis 1 predicted that the current experiment would replicate prior unconscious thought research that has manipulated the complexity of information (e.g. Dijksterhuis & Nordgren, 2006). Specifically, participants in the complex condition would make significantly better decisions if they were distracted from thinking after the information presentation than if they provided evaluations immediately following the information. Planned comparisons showed a significant difference in car evaluations between the unconscious thought and immediate decision conditions. This finding indicates that after delay, participants made significantly better car evaluations than those who assessed the cars immediately. Comparisons between the conscious and unconscious thought conditions showed a marginally significant effect. As such, participants are making slightly better car ratings after delay than after thinking hard about the information for the allotted time. These results are in accord with prior research, and this finding is reliably obtained in unconscious thought effect research (for a complete meta-analysis see Strick et al., 2011). Arguably then, this experimental result defines the unconscious thought effect. Further, it was predicted that participants receiving simple

information would form more positive evaluations and preferences about the positively versus negatively weighted car to a greater extent in the conscious thought conditions relative to the immediate and unconscious thought conditions. Planned contrasts within the simple information condition showed no significant effect of thought condition on car evaluation. This result indicates that participants did not make significantly different car assessments regardless of thought conditions when the task was simple. This null result does not corroborate prior research (Dijksterhuis & Nordgren, 2006; Strick et al., 2011) that indicates that participants in the conscious thought conditions render better evaluations than participants in the other thought conditions when information is simple. Finally, the omnibus interaction between thought condition and complexity was not significant. Unlike Dijksterhuis and Nordgren's (2006) findings, it did not matter how many pieces of information the participants encoded, car rankings did not significantly vary across task difficulty. As such, the interaction between thought condition and complexity was not replicated. It is possible that the procedures used in the current experiment were ineffective for various reasons further discussed shortly.

Memory-based explanations predicted that participants completing the shortened task would demonstrate a positive relationship between car choice and WMC regardless of thought condition. Specifically, it was expected that higher WMC participants would make better car choices than lower WMC participants when the task is simple. However, results from the regression and correlational analyses do not fully support this prediction, showing little relation between individual WMC and car choice. Specifically, within the shortened paradigm, WMC level moderated car choice only in the conscious thought

condition. As such, participants with higher WMC made better car evaluations in the conscious thought condition, but WMC did not relate to car evaluations in the immediate and unconscious thought conditions. Additionally, memory explanations predict that within the complex difficulty conditions, higher levels of WMC would relate to poorer car choices regardless of thought condition. Individual WMC did not have an effect on car evaluation in the conscious and immediate decisions conditions; only significantly moderating car evaluation within the unconscious thought condition. Specifically, individuals with lower WMC made significantly better car evaluations than higher WMC participants after a period of distraction. However, memory-explanations predict that individual WMC would moderate car choice not *only* in the simpler conscious thought and complex unconscious thought conditions, but also across all thought conditions.

Lastly, unconscious thought predictions assert that WMC should moderate car preferences cogent with memory-based predictions. Specifically, WMC will moderate car evaluations in the immediate decision and conscious thought conditions, regardless of complexity. Specifically, as previously discussed, when the task is simple higher WMC and car evaluations will be positively related. Conversely, when the task is difficult, higher WMC and car evaluations will be negatively related. The key difference however, is that Unconscious Thought Theory predictions posit individual WMC should have no relationship to car choice regardless of task complexity within the distraction conditions. Aligned with these predictions, there was no relationship between individual WMC and car choice in the shortened task in the distraction condition. However, there was a *negative* relationship between WMC and car choice in the complex task, distraction

condition. This relationship indicates that the lower WMC an individual has, the better car choice they will make when the information is complex. However, this is the only significant result in the entire complex-task condition. Thus, explanations of the obtained results remain speculative.

Interpretation of Null Results

Interestingly, the current experiment replicated aspects of prior unconscious processing research (e.g. Bos et al., 2008; Bos et al., 2011; Dijksterhuis, 2004; Handley & Runnion, 2011). Namely, participants who received complex information in the current research formed normatively better preferences in the unconscious thought condition than in the immediate thought condition (and marginally better preferences than participants in the conscious thought condition). However, that is where the replication ends and the novelty begins.

Surprisingly, the current experiment did not show a significant effect of task difficulty or an interaction between task difficulty and thought condition. At best, the ANOVA results for the preference measure indicated a marginal overall main effect of thought condition (indicating that participants in the unconscious thought condition generated better decisions). The number of attributes the participants received did not affect decision-making quality. There are a number of possibilities that could explain this result. The most concise explanation is that the shortened paradigm used in this experiment was not as effective as the shortened paradigm that was used in prior research (e.g. Dijksterhuis & Nordgren, 2006). For instance, perhaps the null result could have resulted from differences in the presented information. In this thesis, car traits were

selected from the complex list of forty-eight car traits. However, it is not clear which specific attributes were used in previous research, so it is not clear how much this thesis' information may differ from that used in prior research. Another possible explanation for null results in the shortened paradigm is that sixteen attributes were chosen in the shortened paradigm without trait rotation or accounting for the usage of all of the car traits through counterbalancing. That is, the pieces of information that were presented to the participants in the simpler paradigm could have been overall less effective or extreme than the information in the complex condition. Overall, clarifying the specific traits used in prior research and properly counterbalancing the trait rotation in future research may clarify this null effect.

Working Memory Capacity

Contrary to predictions, individuals' WMC had little effect on car evaluation within the current experiment. As an exception, participants' car preferences in the simple-information/conscious-thought condition were indeed positively related to WMC. Specifically, higher levels of WMC related to better car preferences. Further, higher levels of WMC related to *worse* car preferences within the complex-information/unconscious-thought condition. That is, participants with lower WMC made better evaluations regarding the quality of the presented cars than the participants with higher WMC. Firstly, this finding is contrary to the proposed predictions of Unconscious Thought Theory. The unconscious thought condition was predicted to show no effects of WMC on preference ratings. However, this result is cogent with memory-based predictions. Specifically, when the information is complex, lower WMC participants will

be better at evaluating cars than their higher WMC counterparts.

Prior research on WMC (e.g. Barrett et al., 2004; Unsworth & Engle, 2007) establishes that higher WMC participants often outperform those with lower WMC. Those with lower WMC have a reduced ability to inhibit external and internal distractions, essentially lacking ability to control their attentional as efficiently as individuals with higher WMC. As such, those with lower WMC may form a reliance on already developed heuristics and pre-learned information (Unsworth & Engle, 2007) to make more efficient decisions. Commonly then, decision –making is guided by feelings of intuition, familiarity, or gist. Therefore, in the current experiment, low WMC participants in the unconscious thought condition may simply be better at drawing upon their intuition after 3 minutes of delay/distraction, thus allowing them to make an optimal decision. Contrary to memory-based theories, Dijksterhuis and Nordgren (2006) posit that unconscious processing is separate of making a decision based on a feeling of intuition. However, they also posit that intuition choices should not be distrusted if an individual has all the information they need, and has engaged in long periods of unconscious processing. As such, it is difficult to separate when an individuals' evaluations may be based on intuition, and which evaluations may be based on independent unconscious thought processes. This thesis experiment did not explore the dissociation between participants using unconscious thought versus using memory-based intuition. Further, such dissociation may be very difficult to establish experimentally. As such, it is difficult to fully conclude which theory better explains this finding.

Further, research asserts that people with lower WMC initially exert as much

effort on complex tasks as do those with higher WMC. However, lower WMC individuals tend to give up on complex tasks more quickly once the complexity of the information becomes overwhelming (Heitz et al., 2007; Unsworth & Engle, 2007). This process of giving up may be analogous to relying on unconscious processing or a gist extraction mechanism to make a better judgment (at least when attention is distracted). If this were true, the current experiment should have shown a negative correlation between individual WMC and car choice in all of the complex-information conditions. However, the only significant negative correlation was within the unconscious thought condition. Thus, the three-minute distraction is aiding lower WMC participants in making a better car-choice, while higher WMC participants are making degraded choices. Arguably, unconscious thought might account for this data. Specifically, Dijksterhuis (2004) posits that unconscious processes are processes without controlled attention. As such, participants who are unable to control attention (lower WMC individuals) are making better decisions. Arguably then, relying on unconscious thinking processes by not consciously paying too close of attention to the presentation of car attributes leads to better car choices. Theoretically, sophisticated unconscious processes may be taking over and processing the large amount of car information while participants are distracted. Further, lower WMC participants are better able to let this process take over than higher WMC participants, who may be fixated on degraded memory traces more so than lower WMC participants. However, all data considered, support for unconscious thought or memory-based processing is speculative due to the lack of consistent, robust findings.

Memory Versus Unconscious Processing

Recent Fuzzy-trace theory literature may add more insight to the argument that the unconscious thought effect is memory-based. Fuzzy-trace theory posits that reasoning processes are independent of memory (Reyna, 2003). The independence of memory and reasoning processes may be due to the fact that correct responses to memory tests require only verbatim representations, especially for recall and recognition tasks. Alternatively, reasoning tests *may* draw upon verbatim traces, but it is more likely that people rely heavily on gist representations. Within this dual-process model of memory and reasoning, WMC is not a highly important factor in reasoning decisions (Reyna, 2003). Therefore, within the common unconscious thought paradigm, which is arguably both a memory and reasoning task, WMC is not exhibiting moderating effects on car judgments. As such, participants within this experimental paradigm must rely both on memory and reasoning processes in the immediate and conscious thought conditions. Further, three-minutes of distraction in the unconscious thought condition induces participants to forget verbatim details and to rely solely on reasoning judgments. Given this, higher WMC individuals who excel at verbatim tasks, may rely too much on recalling verbatim car details to make a choice about complex information within the unconscious thought condition. Further, individuals with lower WMC may rely more on fuzzy-trace processes to form preferences based off of complex information in the unconscious thought conditions. Hypothetically, the task of encoding 48 car attributes in order to output later decisions may be too taxing on verbatim memory processes. Therefore, participants may switch perspectives and begin treating the task as a reasoning exercise, particularly if they have lower WMC.

Subsequently, this mindset switch enables participants' reliance on gist representations and intuition when choosing a car, when assigned to the unconscious thought condition, leading to an evaluation advantage for lower WMC individuals. However, lower WMC individuals are only showing significant reasoning advantages in the unconscious thought condition. If lower WMC participants were simply switching mindsets to process the task as a reasoning exercise while their counterparts were not, they should also significantly outperform higher WMC participants in the immediate and conscious thought conditions as well. Ergo, the lone significant result in the distraction condition may suggest that reasoning processes are indeed occurring unconsciously while participants are distracted.

In sum, it is difficult to draw conclusions about the relationships between WMC and the unconscious thought effect. It is possible that Fuzzy-Trace Theory (e.g. Brainerd & Reyna, 1990; Reyna, 2003; Reyna & Brainerd, 1995) and the Unconscious Thought Theory (Dijksterhuis, 2004) account for the same process. Both theories posit that human reasoning involves complex processes. Specifically, according to Fuzzy-Trace Theory, multiple information representations are encoded simultaneously. When it comes time for an individual to make a decision, the right gist or reasoning principle is extracted, retrieved, or executed to output a decision or judgment. Thus, relying on gist representations is akin to relying on intuition to make reasoning decisions (Reyna, 2003). Similarly, within Unconscious Thought Theory, human reasoning includes complex processes. Essentially, the brain needs time to organize, sort, polarize, weight, and cluster information to output a reasonable decision (e.g. Dijksterhuis, 2004; Dijksterhuis & Nordgren, 2006). Taking time to step away from the presented information supposedly

enables an individual to make the optimal decision at a later time. Interestingly, Dijksterhuis and Nordgren (2006) posit that unconscious processing is separate of making a decision based on a feeling of intuition. However, Dijksterhuis and Nordgren (2006) also posit that intuition choices should *not be distrusted* if an individual has all the information they need and have engaged in long periods of unconscious processing. Essentially, Dijksterhuis and Nordgren (2006) endorse relying on intuition *after* a period of delay. Thus, engaging in unconscious thought processes and *then* relying on intuitive output may lead to better decision-making, as doing so allows time for unconscious thinking to take place. Although speculative, it is feasible that Fuzzy-Trace and Unconscious Thought theories may be describing the same reasoning and decision-making processes, under the guise of different, catchy titles.

That said, Fuzzy-trace theory still cannot account for some of the established Unconscious Thought research. As such, research regarding the goal-directedness of unconscious thought (Bos et al., 2008) is not cogent with the current boundaries of Fuzzy-Trace theory. As previously discussed, participants are better able to distinguish between the best and worst alternative choices for the objects (e.g. roommates and cars) that they were specifically given a goal to think about. Essentially, the objects they were not directed to think about did not show the same boost in decision-making accuracy that the goal directed objects did; suggesting that without a goal to process information for a later output, unconscious thought processes did not occur.

Further, Fuzzy-trace explanations posit that verbatim and gist representations selectively encode information, but are not mediated by processing goals. Arguably then,

finding that individuals' verbatim representations were uniform across conditions may support unconscious processing theories. Specifically, there would be no need for participants to only rely on their gist representations to make car evaluations only in the unconscious thought condition. However, participants in the complex unconscious thought condition are consistently making better evaluations than are individuals assigned to the immediate or conscious thought decision, suggesting that individuals who are distracted have some sort of processing advantage (Strick et al, 2011). Therefore, examining trait recall consistent with prior research (Handley & Runnion, 2011), was necessary to further explore individual differences within this experiment. This thesis experiment demonstrated that information recall was non-variably degraded across thought conditions. In Fuzzy-Trace terminology, these results suggest that participants' verbatim traces of the given information are similar, regardless of thought condition. This may not be the case, as individuals are different in the way that they encode, selectively process, and forget information. In the present experiment, attribute recall was coded for amount of car traits correctly recalled. Although recall was coded for correct recall, further analysis of the recall data (i.e. looking at the proportion of positive to negative trait recall, coding reported memory intrusions) may help further establish support for a memory-based or unconscious thought explanation of results.

In conclusion, according to the present data, it is difficult to rebut current unconscious thought research through a memory-based theoretical perspective. Although the experimental data does not elucidate the existence of separate, sophisticated unconscious processing, the current experimental results do not clearly deny it either. In

sum, the replication of the unconscious thought effect in this experiment is consistent with much unconscious thought research (see Strick et al., 2011 for meta-analysis). Further, uniform exploratory recall data across thought conditions corroborates prior unconscious thought research (Handley & Runnion, 2011) show no evidence of goal-directed forgetting. These findings together lend support to the existence of separate unconscious thought processing.

However, WMC did moderate car choice within the simpler conscious thought condition. Further, individual WMC moderated car choice in the *unconscious* thought condition (within the complex paradigm). Although lower WMC individuals outperforming their counterparts is currently confounding, this result is motivation for further formulation of research questions, experimental design, and research.

Future Directions

There are potential limitations to the current experiment. In retrospect, the simpler paradigm, consisting of 16 attributes should have been presented in numerous rotations. Only having one possible version of the simpler cars paradigm may have skewed the obtained results. Future investigation should include four different simpler paradigms to properly balance for order-effects.

Secondly, the distractor task within the unconscious thought condition may have been too cognitively taxing. Participants in the unconscious thought condition engaged in the *n*-back task (e.g. Jonides et al., 1997). *N*-back tasks are commonly considered a working memory measure, although it's validity has recently come into question (Kane, Conway, Miura, & Colflesh, 2007). Thus, it is feasible that participants in the

unconscious thought condition received *two* complex working memory tasks (the automated OSPAN *and* the n-back) within the duration of the experiment. The two tasks may be cognitively exhausting the participants, leading them to make different decisions than they would under the same cognitive load as the other participants. One way to balance cognitive load across thought conditions is to have all of the participants participate in the *n*-back task. Specifically, participants in the immediate decision and conscious thought decisions conditions could engage in the *n*-back task prior to information presentation, while participants in the unconscious thought condition would receive it directly after information presentation, as in prior research (see Dijksterhuis, 2004). Alternatively, future research could include a full battery measurement of WMC in a session separate from the decision task so that participants are not cognitively depleted when they engage in the decision task. This may provide a more reliable, well-rounded measure of working memory tasks and attentional control. An attentional control battery (see Hutchison, 2007) could include such tasks as the OSPAN (Turner & Engle, 1989), the anti-saccade task (Unsworth, Shrock, & Engle, 2004), and the Stroop task (Kane & Engle, 2003). Dividing the experiment into two parts would prevent the cognitive overload of participants, and possibly allow for more valid results. Specifically, in prior unconscious thought research, participants completed only the unconscious thought paradigm (i.e. the Cars Task). However, in this thesis research, participants had to complete a 25-minute long, cognitively taxing task (the automated OPSAN) before engaging in the unconscious thought task. Therefore, to achieve consistency with prior research, it is feasible that the working memory task and unconscious thought task should

be separated in future research. Thirdly, using a different distractor task could affect future experimental results. Meta-analysis shows that unconscious thought effects were much more prominent when word search puzzles were the distractor task (Strick et al., 2011). All in all, future research should take overall cognitive load into consideration when re-running the experiment.

In closing, establishing solid experimental evidence of a separate unconscious processing mechanism is difficult, given the results reported in this experiment. However, it is also challenging to apply a memory-based explanation for the result from much prior research in the Unconscious Thought Theory literature. The experimental results reported here lead to more questions than answers. As the existence and limits of unconscious thinking have yet to be wholly defined and understood, further research must extend and elucidate the findings presented in this thesis experiment.

CONCLUSIONS

This experiment attempted to further examine the existence of unconscious thought. Previous research indicates that engaging in unconscious thought processes may aid individuals in making optimal decisions (e.g. Dijksterhuis, 2006; *for extensive review see* Strick et al., 2011) over more limited conscious processes. However, skeptics of unconscious thought processing assert that the reported unconscious thought effect might simply be an artifact of conscious or memory-based processing (e.g. Lassiter et al., 2009; Reyna, 2003). The current experiment hypothesized that using a measure of WMC (Unsworth et al., 2005) to examine individual differences within the common unconscious thought paradigm (e.g. Bos et al., 2008) would help to establish or discredit the theory of unconscious thought. Specifically it was hypothesized that if individual WMC moderated decision-making performance within 'unconscious thought conditions,' a memory-based explanation for unconscious thought research may suffice. Conversely, it was further hypothesized that if there was a significant effect of WMC within the conscious thought conditions, but *not* the unconscious thought condition, results would further support Unconscious Thought theory (Dijksterhuis & Nordgren, 2006). Although this experiment failed to support either general hypothesis unambiguously, several possible explanations of the null results were identified. Attending to experimental issues and theoretical inconsistencies in future research will conceivably improve the understanding of the existence and boundaries of unconscious thought processes.

REFERENCES CITED

Baddeley, A.D., & Hitch, G. J. (1994) Developments in the concept of working memory. *Neuropsychology, 8,* 485-493.

Barrett, L., Tugade, M., & Engle, R. (2004). Individual differences in working memory capacity and dual-process theories of the mind. *Psychological Bulletin, 130,* 553-573.

Bos, M., Dijksterhuis, A., & van Baaren, R. (2008). On the goal-dependency of unconscious thought. *Journal of Experimental Social Psychology, 44,* 1114-1120.

Bos, M.W., Dijksterhuis, A., & van Baaren, R. B. (2011). The benefits of "sleeping on things": Unconscious thought leads to automatic weighting. *Journal of Consumer Psychology, 21,* 4-8.

Brainerd, C. & Reyna, V. (1990). Gist is the grist: Fuzzy-trace theory and the new intuitionism. *Developmental Review, 10,* 3-47.

Brewer, W. & Nakamura, G. (1984). The nature and function of schemas. In R.S. Wyer & T.R. Sroll (Eds.), *Handbook of Social Cognition.* Vol. 1 pp. 119-160. Hillsdale, NJ, Erlbaum.

Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. *Journal of Verbal Learning and Verbal Behavior, 11,* 671-684.

Dewall, N., Baumeister, R., & Masicampo, E.J. (2008). Evidence that logical reasoning depends on conscious processing. *Consciousness and Cognition, 17,* 628-645.

Dijksterhuis, A. (2004). Think different: The merits of unconscious thought in preference development and decision-making. *Journal of Personality and Social Psychology, 97,* 586-598.

Dijksterhuis, A., & Bos, M. W. (2005). *I am thinking about you…when I shouldn't: The dangers of conscious thought during impression formation.* Manuscript submitted for publication.

Dijksterhuis, A. & Nordgren, L. (2006). A theory of unconscious thought. *Perspectives on Psychological Science, 1,* 95-109.e

Dijksterhuis, A. & Muers, T. (2006). Where creativity resides: The generative power of unconscious thought. *Consciousness & Cognition, 15,* 135-146.

Engle, R. (2002). Working memory capacity as executive attention. *Current Directions in Psychological Science, 11,* 19-24.

Fiske, S., & Linville, P. (1980). What does the schema concept buy us? *Personality and Social Psychology Bulletin, 6,* 543-557.

Ham, J., van den Bos, K., & Doorn, E. (2007) Lady justice thinks unconsciously: unconscious thought can lead to more accurate justice judgments. *Social Cognition, 27,* 509-521.

Handley, I. M., & Runnion, B. C. (2011). Evidence that unconscious thinking influences persuasion based on argument quality. *Social Cognition, 29*(6, Unconscious Thought), 668-682.

Hastie, R. & Park, B. (1986). The relationship between memory and judgment depends on whether the judgment task is memory-based or on-line. *Psychological Review, 93,* 258-268.

Heitz, R., Schrock, J., Payne, T., & Engle, R. (2007). Effects of incentive on working memory capacity: Behavioral and pupillometric data. *Psychophysiology, 44,* 1-11.

Hutchison, K. (2007). Attentional Control and the relatedness proportion effect in semantic priming. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 33,* 645-662.

Jonides, J., Schumacher, E.H., Smith, E., Lauber, E., Awh, E., Minoshima, S., & Koeppe, R. (1997). Verbal working memory load affects regional brain activation as measured by PEY. *Journal of Cognitive Neuroscience, 9,* 462-475.

Kane, M. & Engle, R. (2003). Working memory capacity and the control of attention: The contributions of goal neglect, response competition, and task set to stroop interference. *Journal of Experimental Psychology: General, 132,* 47-70.

Kane, M., Conway, A., Miura, T., & Colflesh, G. (2007) Working memory, attention control, and the *n*-back task: A question of construct validity. *Journal of Experimental Psychology, 33,* 615-622.

Kyllonen, P. & Christal, R. (1990). Reasoning ability is (little more than) working memory capacity? *Intelligence, 14,* 389-433.

Lassiter, G. D., Lindberg, M., Gonzalez-Vallejo, C., Bellezza, F., & Phillips, N. (2009). The deliberation-without-attention effect: Evidence for an artifactual interpretation. *Psychological Science, 20,* 671-675.

McVay, J., & Kane, M. (2009). Conducting the train of thought: Working memory capacity, goal neglect, and mind wandering in an executive-control task. *Journal of Experiment Psychology: Learning, Memory, and Cognition, 35,* 196-204.

Miller, G.A. (1956). Information theory. *Scientific American, 195,* 42-46.

Mintzberg, H., & Westley, F. (2001). Decision making: It's not what you think. *MIT Sloan Management Review,* 89-93.

Norrentranders, T. (1998). *The user illusion: Cutting consciousness down to size.* New York: Viking.

Payne, J., Samper, A., Mettman, J., & Luce, M. (2008). Boundary conditions on unconscious thought in complex decision-making. *Psychological Science, 19,* 1118-1123.

Strick, M., Dijksterhuis, A., & van Baaren, R. (2010). Unconscious-thought effects take place off-line, not on-line. *Psychological Science, 21,* 484-488.

Strick, M., Dijksterhuis, A., Bos, M., Sjeordsman, A., van Baarren, R., & Nordgren, L. (2011). A meta-analysis on unconscious thought effects. *Social Cognition, 29,* 738-762.

Reyna, V. & Brainerd, C. (1995). Fuzzy-trace theory: Some foundational issues. *Learning and Individual Differences, 7,* 145-162.

Reyna, V. (2003). How people make decisions that involve risk: A Dual-process approach. *Current Directions in Psychological Science,* 13, 60-66.

Rosen, W., & Engle, R. (1998) Working memory capacity and suppression. *Journal of Memory and Language, 39,* 418–436.

Turner, M. L., & Engle, R. W. (1989). Is working memory capacity task dependent? *Journal of Memory & Language,* **28,** 127-154.

Tversky, A. & Khaneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science, 185,* 1124-1131.

Unsworth, N., & Engle, R. (2007). The nature of individual differences in working memory capacity: Active maintenance in primary memory and controlled search from secondary memory. *Psychological Review, 114,* 104-132.

Unsworth, N., Heitz, R., Schrock, J., & Engle, R. (2005). An automated version of the operation span task. *Behavior Research Methods, 37,* 498-505.

Unsworth, N., Schrock, J. C., & Engle, R. W. (2004). Working memory capacity and the antisaccade task: Individual differences in voluntary saccade control. *Journal of Experimental Psychology: Learning, Memory, & Cognition,* **30,** 1302-1321.

Wilson, T. (2002). *Strangers to ourselves: Discovering the adaptive unconscious*. Cambridge, MA: Harvard University Press.

APPENDICES

APPENDIX A:

CAR TRAITS FOR THE COMPLEX DIFFICULTY CONDITION

The Hatsdun:

The Hatsdun has good mileage
The Hatsdun has good handling
The Hatsdun has a large trunk
The Hatsdun is very new
The Hatsdun is available in many colors
The Hatsdun comes with excellent service
The Hatsdun has poor legroom
The Hatsdun has poor highway stability
The Hatsdun has cup holders
The Hatsdun has a sunroof
The Hatsdun is relatively good for the environment
The Hatsdun has a poor sound system

The Kaiwa:

The Kaiwa has fairly good mileage
The Kaiwa has poor handling
The Kaiwa has a large trunk
The Kaiwa is available in many colors
The Kaiwa has excellent service
The Kaiwa has plenty of legroom
The Kaiwa has good highway stability
The Kaiwa has no cup holders
The Kaiwa has no sunroof
The Kaiwa is fairly good for the environment
The Kaiwa has a poor sound system
The Kaiwa is old

The Dasuka:

The Dasuka has poor mileage
The Dasuka has fairly good handling
The Dasuka has a small trunk
The Dasuka is available in very few colors
The Dasuka has poor service
The Dasuka has little legroom
The Dasuka has good highway stability
The Dasuka has cup holders
The Dasuka has a sunroof
The Dasuka is not very good for the environment
The Dasuka has a good sound system
The Dasuka is new

The Nabusi:

The Nabusi has poor mileage
The Nabusi has poor handling
The Nabusi has a small trunk
The Nabusi is available in many colors
The Nabusi has poor service
The Nabusi has plenty of legroom
The Nabusi has poor highway stability
The Nabusi has no cup holders
The Nabusi has a sunroof
The Nabusi is not very good for the environment
The Nabusi has a poor sound system
The Nabusi is old

APPENDIX B:

CAR TRAITS FOR THE SIMPLER DIFFICULTY CONDITION

The Hatsdun:

The Hatsdun has good mileage
The Hatsdun has good handling
The Hatsdun is very new
The Hatsdun has poor highway stability

The Kaiwa:

The Kaiwa has good mileage
The Kaiwa has poor handling
The Kaiwa is fairly good for the environment
The Kaiwa is old

The Dasuka:

The Dasuka has poor mileage
The Dasuka has good handling
The Dasuka has good highway stability
The Dasuka is not very good for the environment

The Nabusi:

The Nabusi has poor mileage
The Nabusi has poor handling
The Nabusi is not very good for the environment
The Nabusi has plenty of legroom