THE RELATIONSHIP OF WORKING MEMORY TO JOB PERFORMANCE AND INNOVATION WITH STRESS AND EFFORT AS MODERATORS

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Title of Study: THE RELATIONSHIP OF WORKING MEMORY TO JOB PERFORMANCE AND INNOVATION WITH STRESS AND ON-TASK EFFORT AS MODERATORS

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Abstract: The present study investigated working memory capacity and the affect it has on employees to perform their job and to be innovative. The study also considered moderation of effort and stress to the relationship of working memory capacity to job performance and innovation. As cognitive ability has a strong relationship with working memory, this study aimed to determine if working memory is a stronger predictor of job performance and innovation than intelligence. This study did not find that working memory was statistically significant with job performance or innovation. Support was also lacking in any significant relationship with the moderation of effort or stress.

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CHAPTER I

INTRODUCTION

Working memory is a well-defined cognitive process that takes observed inputs and merges that with long-term memory using the central executive to translate them into a valid perception. As such, research demonstrates that working memory is correlated with multi-tasking (Logie, Trawley, & Law, 2011), learning of foreign languages (van den Noort, Bosch, & Hugdahl, 2006), analytical problem solving (W. E. Williams & Seiler, 1973), remaining focused during challenges (Kane et al., 2007), and other benefits. However, we have little empirical data that has examined the impact of working memory on job-related performance in a normal population. Based on existing theory, working memory should be a strong predictor of both job performance and innovation at work. Prior investigations of working memory have remained almost entirely within the realm of cognitive psychology. Therefore, this current study examines the relationship between working memory and job performance in a sample of employees across industries.

RQ1: To what extent does working memory affect a person's ability to perform their job?

Innovation includes the conception, development, and implementation of new products, processes, or behaviors (Damanpour, 1991). In reviewing competencies on performance appraisals from multiple industries, it was suspected that innovative skills would not be as prevalent as some other competencies, such as teamwork or communication skills. However, in a study involving multiple technical industries, innovative behavior was found to have a positive relationship with job performance (Afsar, Badir, & Khan, 2015).

Although it may not be required for all roles, leaders should appreciate innovation or at least an innovative mindset. Since working memory explains cognitive processes linked to innovation such as attending to environmental cues, avoiding distraction, sorting through connections in long-term memory, and processing new solutions, working memory should be a critical link for improving innovative performance. To date, limited research is available on the relationship between working memory and innovation (Vandervert, Schimpf, & Liu, 2007). Therefore, the current study assesses the following research question.

RQ2: To what extent does working memory affect a person's innovative behavior?

Understanding the relationship of working memory to job performance and innovation can provide value in the selection of job candidates and in the development of personnel. Although companies may use standardized assessments such as personality, ability, and interviews, person-job fit is occasionally misaligned. This results in high turnover costs, loss of productivity, and delays in getting the right person in place. Hester (2013) estimated a cost of turnover from 30% of annual salary for entry-level job candidates to 250% for high demand positions. If working memory does have a positive relationship to job performance and to innovation, it may provide an option to reduce the misalignment of candidates to jobs as part of the screening process. A positive relationship between working memory and job performance and innovation may also be instrumental in retention of employees through career development with training to improve working memory, thereby improving experience for employees.

Once the job candidates become employees, it is important to provide an environment where they can be as productive as possible. Research on working memory suggests that distractions may exist that impact the advantages of working memory (Pyysiäinen, 2006). It has also been found that stress has increased in the workplace from 1983 to 2009 (Cohen & Janicki-Deverts, 2012). Therefore, the present study examines how stress may potentially disrupt the relationship between working memory and job performance and innovation.

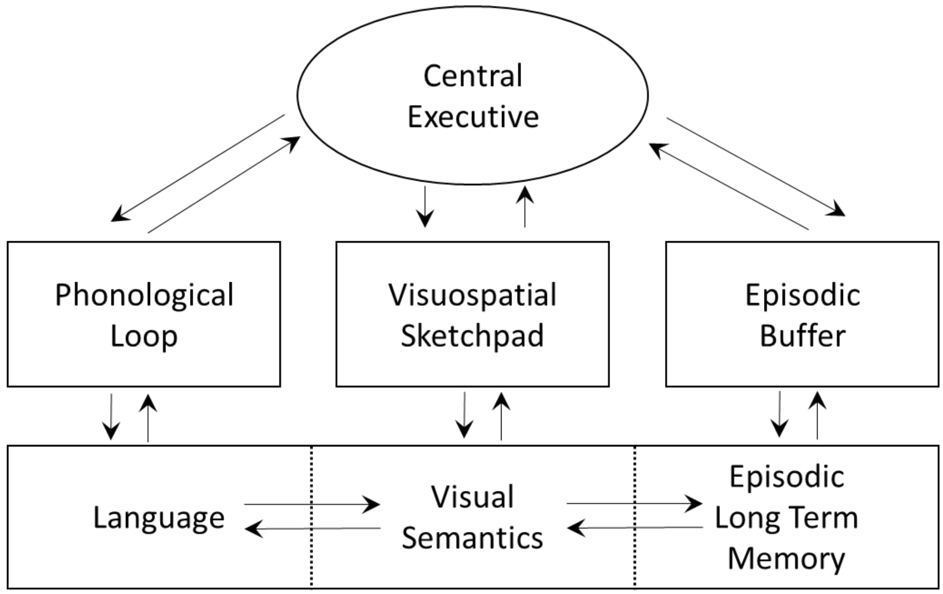
In addition to the impact of stress, the present study will research the impact of effort on the relationship of working memory and innovative behaviors. A quotation attributed to many is "hard work beats talent when talent fails to work hard." Indeed, O'Reilly and Chatman (1994) found that MBA students that were smarter and worked harder had greater success in their early careers. Even if a person has lower levels of working memory than others, effort may moderate the relationship between working memory and job performance and innovation.

Although the present study is focused on working memory, cognitive abilities, or "g", is also considered an antecedent to job performance (Nelson, 2003). Several studies on working memory and cognitive abilities indicate a strong correlation with working memory (A. Baddeley, 1992; Wu, Parker, & de Jong, 2014; Zook, Davalos, DeLosh, & Davis, 2004) with research by Lépine, Barrouillet, and Camos (2005) revealing a correlation of 0.70. Ackerman, Beier, and Boyle (2005) conducted a meta-analysis with eighty-six samples relating working memory capacity to "g" and discovered the correlation to be less than unity ($\hat{p}$ = .48). With strong correlation between working memory and cognitive abilities and the fact that cognitive ability is a significant predictor of job performance, this research measures cognitive ability to investigate the relationship between working memory and job performance and innovation beyond that of the more established relationship with cognitive ability.

Working Memory

Baddeley and Hitch (1974) outlined the three component models of working memory. Baddeley (2000) modified the model later to include a fourth component — the episodic buffer. The four components of working memory include: the phonological loop, the visuospatial sketchpad, the episodic buffer, and the central executive, as illustrated in Figure 1.

Figure 1. *Working Memory Model (Baddeley, 2000)*



According to Brooks and Shell (2006, p. 17), "Working memory is where we 'think' as we learn." Cowan (1999) provides the following definition of working memory, which is consistent with definitions from other working memory researchers. Working memory refers to cognitive processes that retain information in an unusually accessible state, suitable for carrying out any task with a mental component. The task may be language comprehension or production, problem solving, decision making, or other thoughts (Cowan, 1999, p. 62).

Working memory combines inputs from multiple senses and joins that information with long-term memory to form our perception of the world. The phonological loop is responsible for transitory storage of verbal or written information. The visuospatial sketchpad is responsible for transitory storage of how things appear: the visual or spatial information. The episodic buffer is the portion of working memory that links the phonological loop and visuospatial sketchpad together and serves as a buffer that models the information, separate from long-term memory. The central executive provides coordination between the other three components, retrieves the information from long-term memory, and stores the information into long-term memory.

A theorized situation that demonstrates the use of working memory can involve the use of a complex task like a chess game. Looking at the chess pieces on the board, the visuospatial sketchpad can capture the location of the pieces. The phonological loop hears your opponent say, “Check”. The central executive is coordinating the processing of this information into the episodic buffer and is retrieving from long-term memory the prior experiences that may be useful. The episodic buffer ties audible and visual information along with the recalled knowledge into a model and uses this information to decide what reaction, or move, to make based on experience. The decision to concede or make a move uses analysis of visual and audible information, along with an assessment from long-term memory regarding which outcome is likely to occur in each case.

Working Memory and Job Performance

Working memory capacity is similar to cache on a computer. Computer cache pulls information from the hard drive, or long-term memory, and retains information in a transitory manner, making it available for faster processing. Adding more RAM to a computer or changing to a better processor increases the amount of cache in a computer so some computers have higher levels of cache than do others. A person with a higher level of working memory capacity has the ability to retain more information in short-term memory and process that information in a more efficient manner than does a person with a lower level of working memory capacity.

Indeed, Webster, Edwards, Franco-Watkins, and Tubré (2014) hypothesized that improved learning resulted from higher working memory capacity, which was supported by their research. Meanwhile, Bosco, Allen, and Singh (2015) suggest that executive attention, a function of the central executive function, positively relates with job performance. Working memory should relate to job performance because of learning and the central executive function. Working memory relates to learning because of rehearsal and storage of new information into long-term memory. The central executive is important for job performance, especially those job tasks that require analysis of information, complex decision-making, and reasoning. The central executive incorporates information in the environment with elements from long-term memory which helps him/her to solve problems or make decisions. In addition to improved learning, job roles include a number of other competencies where research indicates a higher working memory capacity has a positive effect. For example, employees with higher working memory capacity have an improved ability to control emotional responses (Schmeichel, Volokhov, & Demaree, 2008), increased problem solving capabilities (Wiley & Jarosz, 2012), and better focus (Brewin & Beaton, 2002). With many competencies that are useful in performing job roles it is reasonable to expect that people with higher levels of working memory capacity will perform better in their jobs. Therefore, working memory relates to job performance via multiple avenues—learning, central executive, task focus, and emotional control. As such, I propose that increased working memory capacity will result in improved job performance.

H1: Working memory capacity will be positively related with job performance.

Working Memory and Innovative Behavior

Innovation is important to most, if not all, corporations for introduction of new products, ideas, services, and adaptation to changing circumstances (Kitchell, 1995). Innovation requires the development of creative thought and translating it into a functioning product or service (Amabile, Conti, Coon, Lazenby, & Herron, 1996). Hammond, Neff, Farr, Schwall, and Zhao (2011), in a meta-analysis, found that independent differences like personality traits, education, and tenure; motivation; job factors including tenure and autonomy; and contextual factors including climate and supervisor support are antecedents for innovative behavior. For the purposes of this study, I use an accepted definition of innovative behavior as "the intentional creation, introduction and application of new ideas within a work role, group or organization, in order to benefit role performance, the group, or the organization" (Janssen, 2000, p. 288).

Working memory explains how the central executive, visuospatial sketchpad, phonological loop, and episodic buffer process information and generate solutions to complex tasks. Because innovation is a complex cognitive task and requires attention, concentration, and novel solutions, we expect working memory capacity to provide value as a predictor in the ability to generate creative or innovative solutions. Indeed, Vandervert et al. (2007) reported a positive relationship between working memory and innovation based on neuroimaging and biographical data. Another study of children between 5 and 8 years old found that executive functions, including working memory, failed to predict innovation (Beck, Williams, Cutting, Apperly, & Chappell, 2016). This study was conducted with a small sample size and with children, so while worth tracking future efforts, the relevance to the present study may be limited. Innovation requires observation, identifying needs, processing options, and identifying solutions (Perry, 1995). As opposed to the cited research (Beck et al., 2016; Vandervert et al., 2007), the present study collected survey data from employees of multiple companies across industries on working memory capacity and innovative behavior. Another key innovative behavior is to eliminate suboptimal options, stay focused, and screen irrelevant information (Gergin, 2012). The more working memory capacity you have, the more likely you are to process increased amounts of meaningful inputs in the central executive resulting in a valid, implementable solution.

H2: Working memory capacity will be positively related with innovative behavior.

When considering how working memory affects job performance and innovative behavior, the research should consider conditions that may strengthen or weaken the relationship. With limited published research on the question of how working memory affects job performance and innovation, two possible constructs were chosen that already linked to job performance and should also place limits on working memory capacity—stress (Hunter & Thatcher, 2007; Jamal, 1984) and task effort (Christen, Iyer, & Soberman, 2006; Katerberg & Blau, 1983).

Working Memory to Performance and Innovative Behavior: The Moderating Role of Work Stress

Similar to the distracting affect that the irrelevant sound effect has on working memory and the ability to recall (RepovŠ & Baddeley, 2006), intrusive thoughts can consume some of the resources from the central executive that manage attention. Eysenck and Calvo (1992) posits that worry and distracting thoughts compete for working memory resources. Because stress and anxiety can be distracting (Bertrams, Englert, Dickhäuser, & Baumeister, 2013), job stress may consume working memory capacity. Job stress is defined as the harmful physical and emotional responses that occur when the requirements of the job do not match the capabilities, resources, or needs of the worker (Park, 2008).

Activation theory suggests that employees require some stress to engage (W. E. Scott, Jr., 1966). Activation theory is not central to the hypothesis proposed in the present study but it remains important in understanding the effects of stress. Activation theory presents a curvilinear model that shows that when there is no stress, the employee does not engage and does not perform as well as when a low to moderate amount of stress exists. Activation theory assumes that the optimal amount of stress is a moderate amount that is high enough to challenge or engage the employee but not so high that stress is a hindrance, which prevents employees from coping with the stress (Ursin & Eriksen, 2004). Partially aligned with the activation theory, there is a classification of stress into challenge stress and hindrance stress (Cavanaugh, Boswell, Roehling, & Boudreau, 2000; Webster et al., 2014; Yuan, Li, & Lin, 2014). This is consistent with activation theory since challenge stress engages the individual while hindrance stress requires an individual's cognitive processes to deal with coping mechanisms, instead of focusing on more productive activities.

Attentional control theory and processing efficiency theory suggest an explanation for decreased cognitive performance when anxiety is high (Derakshan & Eysenck, 2009). Attentional control theory refines the processing efficiency theory introduced by Eysenck and Calvo (1992). The central executive is the primary concentration component of working memory for the attentional control theory, which is an important part of the theoretical basis of the present study. Researchers identify multiple functions of the central executive (Fournier-Vicente, Larigauderie, & Gaonac'h, 2008), including shifting, updating, and inhibition functions (Miyake, Friedman, Emerson, Witzki, & et al., 2000). Shifting is the ability to cognitively change focus between various tasks or states of mind. Updating is the addition or modification of the information within working memory.

Inhibition is the ability to avoid irrelevant stimuli (Eysenck & Derakshan, 2011). The attentional control theory posits that anxiety has a negative impact on shifting and inhibition.

A study, based on attentional control theory, used adolescents to assess the impact of anxiety on cognitive test performance and found that the interaction of anxiety and working memory capacity had an impact on performance that varied, depending on the level of working memory capacity, resulting in a curvilinear relationship (Owens, Stevenson, Hadwin, & Norgate, 2014). Specifically, if an individual has a lower working memory capacity, indicating fewer cognitive resources to apply to tasks, an increase in anxiety consumes more of the limited resources while an individual with higher working memory capacity has adequate cognitive resources even with increased anxiety.

As innovation and job performance involve cognitive processes, I propose that high levels of stress will interfere with the relationship of working memory to job performance and to innovative behavior. Working memory provides resources beneficial for increased job performance. The central executive is a key component of working memory with the ability to remain focused. Stress introduces distractions, such as intrusive thoughts, that consume resources and reduce the amount of attention available for performing the task at hand. A study of associations with anxiety and performance on working memory indicated that increased anxiety lowered performance, (Coy, O'Brien, Tabaczynski, Northern, & Carels, 2011). LePine, LePine, and Jackson (2004) found that hindrance stress has a negative impact on performance within learning environments. This same study (LePine et al., 2004) showed that hindrance stress and challenge stress were positively related to exhaustion ,and exhaustion had a negative impact on learning performance.

Adding to the theories on anxiety, worry, and stress negatively affecting cognitive functions that may affect job performance, there are some studies specific to innovation. I propose that the attention control theory affects innovative behavior in the same manner as with job performance. If an individual is applying cognitive resources to solving a problem and implementing that innovative solution, increased available attention is beneficial. Higher levels of stress introduce distractions that reduce the amount of resources available to focus on the objective. Ambiguity in definition of roles, coupled with lower organization support introduces stress and has been found to have a negative relationship with self-rated and supervisor-rated innovative performance (Leung, Huang, Su, & Lu, 2011). Another study found that the negative affect of higher stress was associated with lower innovative climates (Länsisalmi & Kivimäki, 1999).

Research referenced has focused on two theories—attentional control theory and processing efficiency theory (Derakshan & Eysenck, 2009). Stress, anxiety, worry, and intrusive thoughts can all require working memory resources, reducing the capacity available to apply to job performance or innovation. The present study assumes that differences in working memory capacity affect job performance and innovation, and that stress reduces the amount of working memory capacity available to apply towards job performance or towards innovation. Therefore, I propose the following two hypotheses.

H3: Stress will moderate the relationship between working memory and job performance such that higher levels of stress will weaken the positive relationship between working memory capacity and job performance.

H4: Stress will moderate the relationship between working memory and innovative behavior such that higher levels of stress will weaken the positive relationship between working memory and innovative behavior.

Working Memory to Performance and Innovative Behavior: The Moderating Role of Effort

A common belief, expressed in various quotations, is that if someone works hard they can achieve much. Therefore, it is not surprising that multiple studies identified a positive relationship between effort and performance (Harkins, 2006; Katerberg & Blau, 1983; O Reilly & Chatman, 1994). Performance research often considers effort and motivation as similar constructs (Dysvik & Kuvaas, 2013; Goodman et al., 2011; Porter, 1968; W. E. Williams & Seiler, 1973).

Mental effort is about remaining focused on the task at hand. Mental effort is the consumption of energy in the pursuit of achieving cognizant objectives (Fairclough & Houston, 2004). With the executive-attention view of working memory capacity, individuals with higher levels of working memory capacity remained more focused and applied more consistent mental effort than did individuals with lower levels of working memory capacity (Kane et al., 2007) .

Lack of effort interferes with attention by allowing distractions to consume working memory capacity. Effort, in this context, is the amount of concentration and focus that an individual applies to tasks that contribute to job performance or innovation (Bettman, Johnson, & Payne, 1990). Building on attentional control theory and processing efficiency theory (Wilson, 2008), if an individual increases their concentration and focus they are blocking intrusive thoughts that may consume working memory capacity. With job performance and innovation being defined as having cognitive aspects, I propose the following two hypotheses.

H5: Effort will moderate the relationship between working memory and job performance such that higher levels of effort will strengthen the positive relationship between working memory and job performance.

H6: Effort will moderate the relationship between working memory and innovative behavior such that higher levels of effort will strengthen the positive relationship between working memory and innovative behavior.

Cognitive Ability and Working Memory

Cognitive ability is the ability to learn (Schmidt, 1992) and is often referred to as general intelligence or general cognitive ability or "g". Although multiple tests of intelligence exists (Prokosch, Yeo, & Miller, 2005), *g* is the factor that measures the common shared variance among those tests.

In their study on working memory and intelligence, Colom, Flores-Mendoza, and Rebollo (2003) found that working memory is a single cognitive resource and supports the model that working memory is different from intelligence. Colom et al. (2003) also supports the high correlation between working memory and intelligence. In one study, Colom, Rebollo, Palacios, Juan-Espinosa, and Kyllonen (2004) claim that the latent variable, working memory capacity, predicts cognitive abilities better than other measures. Ackerman et al. (2005), in a meta-analysis, agrees that working memory capacity is a predictor of cognitive ability and reinforces that working memory capacity differs from cognitive ability, although having strong correlation.

One difference between cognitive ability and working memory is that cognitive ability, also known as *g*, explains inter-individual differences in cognitive abilities (Mackintosh, 1998) whereas working memory capacity explains intra-individual differences in the ability to process information (Baddeley, 1992). Cognitive ability is the more general term that explains and measures shared variance among more specific abilities such as verbal, quantitative, and mechanical reasoning. In contrast, working memory has a more precise theoretical foundation as it explicitly defines the cognitive mechanism that retains and processes information (Colom, Martinez-Molina, Shih, & Santacreu, 2010). There is no specific cognitive mechanism implicated in the definition of cognitive ability. Cognitive ability is measured by the overlap among specific cognitive abilities, and the shared variance is therefore used to define *g*. Measures of working memory capacity directly measure executive control and attention. Similar to cognitive ability, working memory manifests in different domains, as there are measures of reading span, operation span, and symmetry span, which tap different functions of working memory. Therefore, working memory and cognitive ability are both domain-general cognitions.

Cognitive ability is one of the most widely studied predictors of job performance (Côté & Miners, 2006; Horn & Noll, 1997; Kuncel, Rose, Ejiogu, & Yang, 2014; Nelson, 2003; Ree, Earles, & Teachout, 1994). Cognitive ability is the ability to learn and therefore those higher in cognitive ability will learn more job knowledge, which translates into higher levels of job performance (Oakes, Ferris, Martocchio, Buckley, & Broach, 2001). Although this current study's primary objective is to explore the relationship between working memory and job performance, working memory and cognitive ability are highly correlated and both are cognitive tasks. In addition, an investigation of the relationship between working memory and performance would require a comparison of this relationship to that of the more widely studied cognitive ability. Although the relationship between cognitive ability and job performance is well established, the following hypothesis is tested:

H7: Cognitive ability will be positive related with job performance.

Any study of innovation introduces challenges with the lack of standard, accepted measures and definitions. Some studies continue to treat innovativeness and creativity as isomorphic. While the present study considers innovation and creativity to be separate, it considers innovation to include the creative germ, through the ideation, and to the implementation of a product or process. Since innovation involves cognitive activities, it is reasonable to expect that individuals with higher levels of cognitive ability will be stronger innovators. Cognitive abilities positively correlate to learning (Chamorro-Premuzic & Furnham, 2008). With higher levels of cognitive abilities leading to increased learning, cognitive abilities should positively relate to innovation.

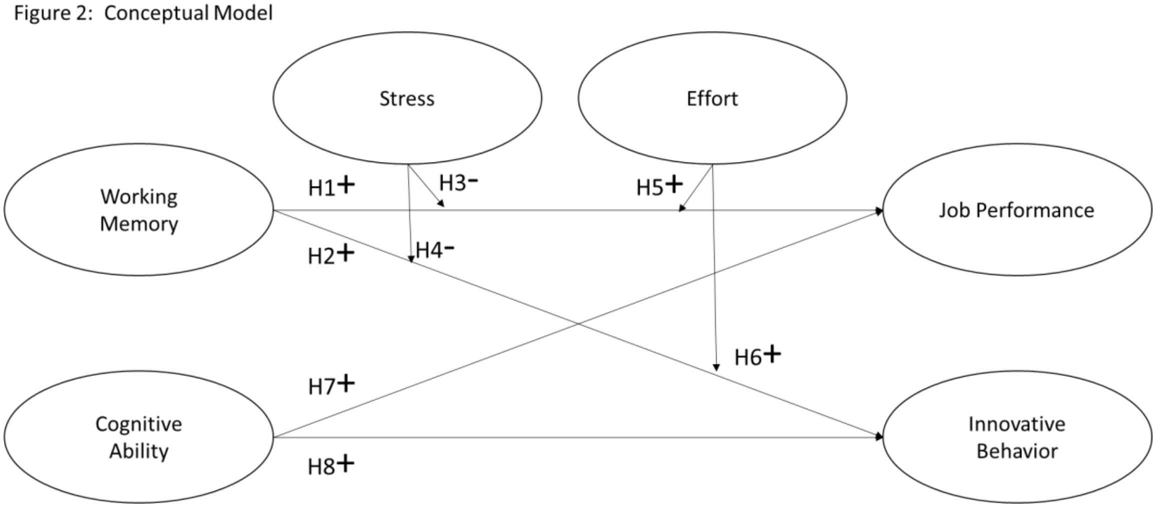
While researchers have separately studied cognitive abilities and innovation extensively, there are limited published studies that assessed the relationship between the two constructs. With their study, Squalli and Wilson (2014) claim to provide the first empirical test of the intelligence-innovation hypothesis. Using data at the geographical level of the states in the United States to measure innovation and intelligence, the study buttressed a positive relationship (Squalli & Wilson, 2014). In support of this hypothesis, a study on cognition and innovative behavior by Wu et al. (2014) found a positive relationship with the need for cognition and innovative behaviors.

Innovation involves creativity so while limited studies may exist between intelligence and innovation, studies do exist that have investigated the relationship between intelligence and creativity. Jauk, Benedek, Dunst, and Neubauer (2013) investigated the threshold hypothesis, which establishes a threshold of IQ that results in increased creativity above that threshold. Their study supported a threshold of an IQ equal to 100 for ideation origination and a threshold of an IQ equal to 120 for creative potential. In contrast, Batey, Chamorro-Premuzic, and Furnham (2010) found that cognitive ability only accounts for 4% of the variance in ideational behavior. For more support of a positive relationship between cognitive abilities and innovation, in a meta-analysis, Kim (2005) found that the relationship between intelligence did exist, although it was modest with r = .17. Faullant, Schwarz, Krajger, and Breitenecker (2012) also obtained evidence for a relationship between cognitive style and creativity. Research by Finke, Ward, and Smith (1992) and Cusack (1994) include findings on the impact of cognitive processes to creativity. The research by Guastello and Fleener (2011) on creative behavior found a relationship between cognitive abilities and creative behaviors. Thus, since the ability to learn is important to innovation and with the definition of cognitive ability including the ability to solve problems and the fact that innovation is solving problems, the following hypothesis is proposed.

H8: Cognitive ability will positively relate with innovative behavior.

Figure 2 reflects the model of the proposed hypotheses.

Figure 2: Conceptual Model



CHAPTER II

METHOD

Participants

An invitation was sent to contacts at 38 United States companies of various sizes and in multiple industries including call centers, staffing agencies, technology sales and services, and food distribution. Of the 38 companies, 16 agreed to participate in the research study. All 16 companies provided a list of names and email addresses to distribute the survey link to potential participants. Participants were rewarded $10 or $15 in exchange for their participation; although, some companies declined payment to their employees.

With one food distribution company, data on working memory and cognitive ability were collected five months earlier for a different, related research effort. I was granted access to these individuals' working memory and cognitive ability data, and conducted surveys among a set of employees to gather data on other measures. The food distribution company also granted permission to survey employees' supervisors to provide ratings of effort, job performance and innovative behaviors. The rationale for using earlier scores on working memory and cognitive ability was that these were stable individual difference constructs that would not change over three to six months.

Two hundred fourteen individuals (214) completed the individual survey from sixteen companies. One hundred thirteen (113) of the individual participants were male and the average

age of all participants was *M* = 37 (*SD* = 12). Education level varied from 16 participants that had not completed high school to 88 participants with a bachelor's degree. Table 1 presents the breakdown of the sample population's gender, race, age, and education.

Table 1

Participant Demographics

Table 1: Participant Demographics

Gender	N	Race	N	Age	N	Education	N
Female	101	White/Caucasion	149	18 - 30	77	No high school degree	16
Male	113	African-American	7	31 - 40	50	High school degree	23
		Hispanic	49	41 - 50	54	Vocational Training	12
		Other	9	51 +	32	Some college, no degree	34
						Associate or Bachelor	106
						Post graduate degree	9

An email invitation was sent to the supervisors of the teams that were authorized to participate with a link to the supervisor survey that measured innovation, effort, and job performance. Supervisor ratings were provided for 170 individuals. These supervisors were from fourteen companies in multiple industries.

Measures

Working Memory Capacity

The working memory measure developed by Franco-Watkins, Edwards, and Wallace (2014) uses the operation span task to measure working memory. Operation span (ospan) tasks were initially developed by the Engle laboratory (Turner & Engle, 1989; Unsworth & Engle, 2005). In a separate pilot study, the operation span task created by Franco-Watkins et al., correlated strongly (*r* = .58) with the operation span task created by Unsworth and Engle (2005). The operation span task requires participants to maintain information in memory such as letters, words, or numbers while processing a distractor task–math equations. As part of the exercise, participants were given training exercises on the operation span prior to the actual tests.

Operation span used a set of simple mathematical operations paired with letters. As the number of pairs in the set increased, it was anticipated that the participant would find it increasingly difficult to retain the sequence of the letters in memory. Test participants solved the math problems while retaining the letters in working memory until queried for recollection of the letters in the presented sequence. The number of correctly recalled letters evaluates working memory in the correct sequence while trying to solve the mathematical operations with a high degree of accuracy—at least 85%. Conway and colleagues (2005) determined the reliability of the operation span using the described scoring method of 0.81.

Job Performance

Following accepted practice (Facteau & Craig, 2001), supervisors rated subordinates on job performance, and employees rated their own job performance. Employees and supervisors rated job performance using the seven-item scale from Williams and Anderson (1991). Items included: “This employee meets formal employment requirements of the job” and “This employee adequately completes assigned duties.” Responses used a 5-point scale (1 = “strongly disagree”, 5 = “strongly agree”). However, the four items measuring task performance was used in this study. One omitted item measured perceptions of performance evaluation and the other two omitted items were reverse-coded which adversely impacts measurement properties.

Job performance scores were obtained by taking the average of the item ratings. Supervisor ratings are considered more accurate ratings than self-ratings (Holzbach, 1978). Therefore, supervisor ratings were the primary dependent variable. However, there were some participant entries without supervisor ratings. As such, I collected self-report ratings of performance and ran a parallel set of analyses using self-ratings as the dependent variable. Collections of these data were for illustrative purposes as more powerful tests in the event that low response rates were received from supervisors. To help boost response rates from supervisors, I offered payment of $15 to participate and kept the survey short (only 7 items).

With one company that had already participated in an earlier research effort, the individuals were not asked to rate their job performance due to concerns of time and to encourage participation. Therefore, participants did not self-rate performance in this company and the overall sample size for self-ratings of performance was smaller. The smaller number of scores on self-rated job performance may have contributed to lower internal consistency in scores for the self-rated job performance ($\alpha = 0.56$). The supervisor rated job performance scores demonstrated strong internal consistency ($\alpha = 0.94$).

Innovative Behavior

Participants answered a six-item scale on innovative behavior (Scott & Bruce, 1994). Supervisors rated subordinates and participants rated themselves using a five-point Likert-type scale with responses ranging from 1 (never) to 5 (very often). Sample items include "generate creative ideas" and "promote and champion ideas to others." Internal consistency was high for scores on innovative behavior (Supervisors: $\alpha = 94$; Individuals $\alpha = 0.82$).

The mean of the six-item scores provide an overall score of innovative behavior. Supervisor ratings were the primary dependent variable. However, there is often a loss of data when supervisors do not provide ratings. As such, I collected self-report ratings of innovative behavior and ran a parallel set of analyses using self-ratings as the dependent variable. Collections of these data were for illustrative purposes as meaningful tests in the event that low response rates were received from supervisors. To help boost response rates from supervisors, I offered an incentive to participate and kept the survey short (only six items).

Stress

Stress varies from person to person thus participants answered the 11-item scale measuring challenge stress and hindrance stress from Cavanaugh et al. (2000) as a self-rated measure. The 11 items asked the participants to respond on the level of stress using a 5-point scale (1 = "produces no stress"; 5 = "produces a great deal of stress"). Sample items included

"Time pressures I experience" and "The amount of red tape I need to go through to get my job done." The primary variable was perceived hindrance stress. Internal consistency was strong for scores in the present study: challenge stress α = 0.94; hindrance stress = 0.84.

Effort

Similar to job performance, supervisors are often more unbiased and the more capable person to determine who provides the most effort in performance of their job. Therefore, supervisor and self-ratings of on-task effort was obtained by using the 10-item scale from Kanfer, Ackerman, Murtha, Dugdale, and Nelson (1994) to assess effort and attention to the task (e.g. "I paid close attention to the kind of errors I was making") using a 5-point scale (1 = strongly disagree; 5 = strongly agree). The present study obtained effort scores by taking the average of the item ratings. Higher scores indicated higher levels of on-task effort. Internal consistencies for scores on employee ratings of effort (α = 0.92) and supervisor rating of effort (α = 0.95) were strong.

Cognitive Abilities

The ability test consists of 60 multiple choice questions (Arthur Jr., 2014) measuring basic vocabulary, grammar, geometry, logic, arithmetic, and problem solving. Participants had ten minutes to complete as many questions as possible. The measure was scored by summing the number of correct answers.

Procedure

Two computerized surveys were created using Qualtrics; one survey to collect self-rated measures and another survey for supervisor-rated measures. See Appendix B for the email template sent inviting participants to complete the survey. The email was tailored to agreed-upon company terms and dates. After receiving the email, participants were given two to three weeks to complete the survey and a reminder was sent to the participants. The email included a short description of the study with a link to the survey, along with any compensation agreement.

Individuals willing to participate opened the survey, provided consent, and responded to the items. Questions in the survey used a 5-point Likert-type scale, unless otherwise noted. The expectation was that the survey items would take approximately 45 minutes to complete.

Participating companies sent a separate email to the supervisors (see Appendix C) with a description and the link to the supervisor-rated survey. A Qualtrics panel was created from the data provided by the participating company linking subordinates to supervisor by email address. Supervisors rated their subordinates on performance, effort, and innovative behavior. Surveys were optional for supervisors and they were not informed if their subordinates completed the employee survey. The instructions to supervisors explained that we were obtaining performance scores for their subordinates who may or may not participate in the study but if they do participate then performance scores would link to participant scores.

Once the data were collected, the next process included merging the files, scoring the ability test, and examining all responses. Merged files contained data from the working memory test, the self-rated employee survey, and the supervisor-rated survey. A unique key code was tied to each individual. A confirmatory factor analysis was performed to confirm that the items loaded on the correct factors, which involved evaluating the means, standard deviations, and inter-factor correlation on all measures. Due to the use of multiple dependent variables, a structural equation modeling was conducted to assess the hypotheses whereby job performance and innovative behaviors were regressed onto working memory and cognitive ability.

Moderation was assessed by creating the interaction of effort and stress with working memory. The measures used in the interaction were mean-centered prior to creating the interaction term. The hypothesis was that stress would negatively moderate the relationship between working memory and job performance and innovative behavior. I expected the relationship between working memory and performance and innovation to be weaker with higher levels of perceived stress. Another hypothesis was that effort would positively moderate the relationship between working memory and the two variables, job performance and innovation. I expected the relationship between working memory and job performance and innovation to be weaker with lower levels of effort.

CHAPTER III

RESULTS

Results from this current study are presented herein. Table 2 below contain the means, standard deviations, and correlations, which are the estimated values based on full information maximum likelihood with 214 observations.

Table 2

Means, Standard Deviations, and Correlations

Table 2: Means, Standard Deviations, and Correlations

	Variable	Mean	SD	1	2	3	4	5	6	7	8	9	10
1.	WM	36.96	10.47	1.00									
2.	self-innov	3.64	0.68	0.03	1.00								
3.	self-effort	4.51	0.50	**0.21**	**0.43**	1.00							
4.	challenge	2.89	0.91	0.12	0.05	-0.02	1.00						
5.	hindrance	2.55	0.98	0.05	-0.11	-0.08	**0.60**	1.00					
6.	self-perf	4.70	0.50	**0.24**	**0.28**	**0.65**	0.04	0.00	1.00				
7.	cog-ability	27.76	9.85	**0.23**	-0.08	-0.05	**0.26**	**0.32**	-0.03	1.00			
8.	sup-innov	3.09	1.05	0.03	**0.28**	**0.15**	**0.23**	-0.03	**0.18**	0.08	1.00		
9.	sup-effort	4.26	0.60	-0.05	0.12	0.13	0.01	**-0.14**	**0.18**	0.10	**0.46**	1.00	
10.	sup-perf	4.40	0.70	-0.03	0.04	**0.14**	-0.06	-0.12	0.07	**0.16**	**0.37**	**0.81**	1.00

N=220 with blanks replaced using maximum likelihood.
Items in bold have correlations ≥ 0.14 with $p < .05$ indicating significance

Variable	Definition
WM	Working memory capacity
self-innov	Self-rated innovative behavior
self-effort	Self-rated work effort
challenge	Challenge stress
hindrance	Hindrance stress
self-perf	Self-rated job performance
cog-ability	Cognitive ability
sup-innov	Supervisor rated innovative behavior
sup-effort	Supervisor rated work effort
sup-perf	Supervisor rated job performance

Three relationships have strong correlations: self-rated performance with self-rated effort, hindrance stress with challenge stress, and supervisor-rated performance with supervisor-rated effort. Moderate correlations were obtained for the relationships between hindrance stress and cognitive ability, the relationships of innovative behavior with work effort at both the self-rated measures and the supervisor-rated measures, and the relationship of supervisor-rated performance with supervisor-rated innovative behavior.

The correlations between employee and supervisor ratings reflect potential issues with validity as one would expect that supervisor-rated innovation, effort, and job performance would have moderate-to-strong correlations with self-rated innovation, effort, and job performance given that the questions were the same for the same target behaviors. Harris and Schaubroeck (1988) found that although self-ratings and supervisor ratings are not strong, the correlation obtained in the present study between self- and supervisor-rated performance (r = 0.05) is substantially less than the r = .35 reported by Harris and Schaubroeck (1988). Another study by Abubakr Mohyeldin Tahir (2003) documents that self-ratings of performance was correlated in the low-to-moderate range with supervisor ratings.

Possibly, even more concerning, is the correlation between the working memory capacity measures and cognitive ability. Most reported research demonstrates these measures to have a strong relationship (e.g., r = .45; (Ackerman et al., 2005; Colom et al., 2003) but I obtained a correlation of only r = .23.

Confirmatory factor analyses (CFA) were conducted using Mplus on the independent variables and the dependent variables for both the self- and supervisor-rated variables to check model fit and factor loading. The CFA on self-rated independent variables included the measurement models for challenge and hindrance stress and effort. Self-rated dependent variables included the measurement models for job performance and innovative behavior. The CFAs for supervisor-rated independent variable included the measurement model for effort. The supervisor rated dependent variables included job performance and innovative behavior.

Table 3: CFA Results

CFA	# of Observations	χ^2	DF	RMSEA Estimate	RMSEA 90% CI		CFI	TLI	SRMR
Individual IV	198	396.6	186	0.076	0.065	0.086	0.92	0.91	0.05
Supervisor IV	170	163.2	35	0.147	0.125	0.170	0.92	0.89	0.04
Individual DV	199	71.7	34	0.075	0.050	0.099	0.96	0.94	0.05
Supervisor DV	170	119.8	34	0.122	0.099	0.146	0.95	0.93	0.04

Because task performance was the primary objective of the performance measure, I chose to use only the first four items for both the self-rated and supervisor-rated job performance, consistent with research by Huang and You (2011).. One of the other three performance items excluded referred to the performance appraisal process (and not job performance itself) and the other two excluded items were reverse-scored. Based upon the results of the CFA, there was some consideration of whether to use self-rated measures or supervisor-rated measures. Concerns existed over the self-interested bias associated with self-reports or leniency bias associated with supervisor-rated measures. A decision was made to use the supervisor rating for innovative behavior and performance because supervisors were a separate source by which to check the self-ratings of stress and effort and also because supervisors are often considered a less biased source for performance ratings (Harris & Schaubroeck, 1988; Khalid & Ali, 2005). After preliminary analysis, a decision was made to use the self-rating of effort to mitigate the risk of common source bias (Kammeyer-Mueller, Steel, & Rubenstein, 2010).

Table 4

SEM Results with Supervisor Rated DV

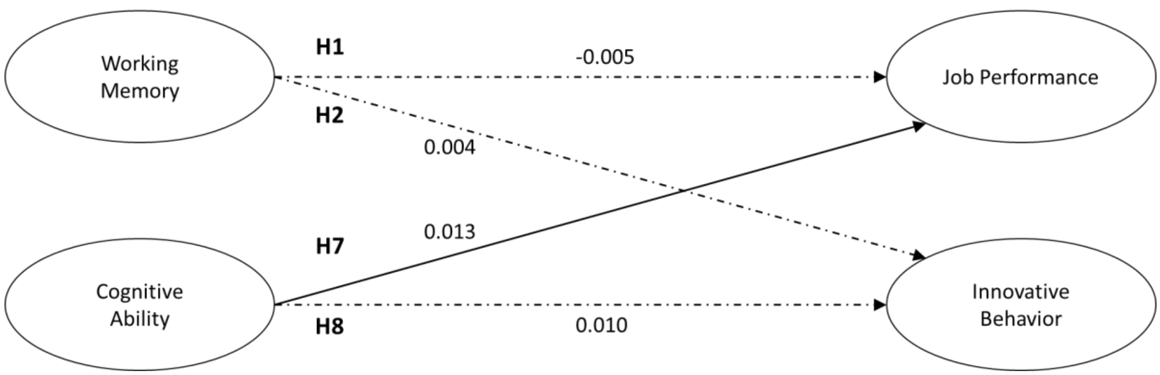
Table 4: SEM Results with Supervisor Rated DV

SEM Model	N	χ^2	p <	DF	RMSEA Estimate	RMSEA 90% CI		CFI	TLI	SRMR	r^2 Perf	r^2 Innov
1	208	127.99	0.00	50	0.087	0.068	0.105	0.96	0.94	0.04	0.03	0.01
2	213	136.92	0.00	66	0.071	0.054	0.088	0.96	0.95	0.04	0.09	0.06
3	212	141.62	0.00	66	0.074	0.057	0.090	0.96	0.95	0.04	0.09	0.03
4	212	150.86	0.00	66	0.078	0.062	0.094	0.95	0.94	0.04	0.04	0.04

Model fit of structured equation models were assessed, using Mplus, with the chi–square statistic and several other fit indices, such as the root mean square error of approximation (Steiger, 1990), Tucker–Lewis index (TLI) (Tucker & Lewis, 1973), and comparative fit index (CFI) (Bentler, 1990). The CFI and TLI assess the relative improvement in fit compared to the independence model and are resistant to errors associated with sample size. Satisfactory models yield CFI and TLI values greater than .90 (Hu & Bentler, 1999). The RMSEA is a parsimony–adjusted index that accounts for model complexity and was used to assess lack of model fit. RMSEA values less than .05 indicate close approximate fit, values between .05 and .08 indicate a reasonable error of approximation, and values greater than .10 suggests a poor fit (Browne & Cudeck, 1992).

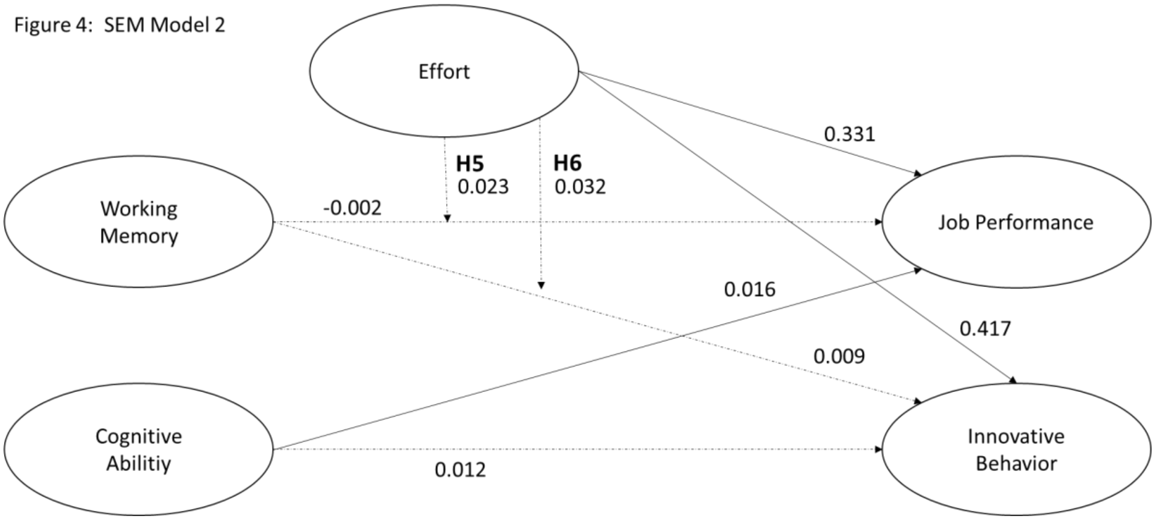
Figures 3 to 6 present the unstandardized path coefficients. Solid lines indicate a statistically significant relationship ($p < .05$), whereas dashed lines indicate a non-significant relationship.

Figure 3: SEM Model 1



The first structural equation model (Model 1) evaluated hypotheses 1 and 2, which predicted a positive relationship between working memory and job performance (H1) and innovative behavior (H2). Hypotheses 7 and 8 were also modeled which predicted positive relationships between cognitive ability and job performance (H7) and innovative behavior (H8). Model 1 included working memory and cognitive ability as independent variables with supervisor-rated innovative behavior and supervisor-rated job performance as dependent variables. Model 1 was a moderate fit for the data; $\chi^2(50) = 127.99$, $p < .05$, RMSEA = .09, CFI = .96, TLI = .94. A significant relationship was obtained between cognitive ability and job performance (β = 0.013), providing support for hypothesis 7. Three percent of the variance in job performance and 1% of the variance in innovative behaviors were explained by the model.

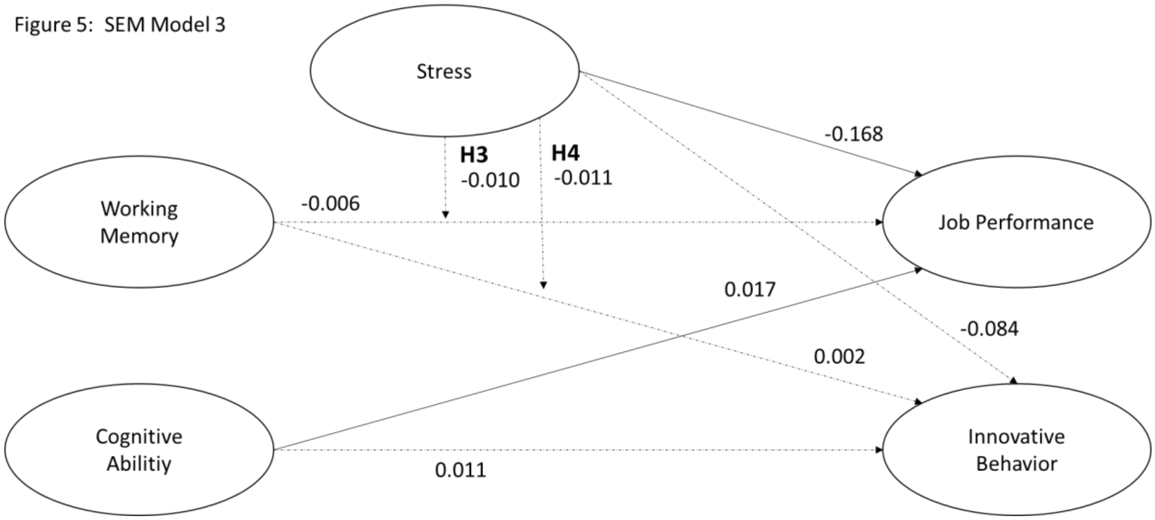
Figure 4: SEM Model 2



The second structural equation model (Model 2; see Figure 4) was a test of hypotheses 5 and 6, which predicted that effort would moderate the relationship between working memory and job performance (H5) and innovative behavior (H6). I regressed supervisor-rated job performance and innovative behaviors onto working memory and cognitive ability, self-rated work effort and the interaction between effort and working memory and ability. Effort and working memory were mean-centered prior to creating the interaction. Model 2 fit the data reasonably well $\chi^2(66) = 157.25$, $p < .05$, RMSEA = .10, CFI = .94, TLI = .92 and explained 10% of the variance in supervisor-rated job performance and 7% of the variance in supervisor-rated innovative behavior. Support does not exist for hypothesis 5 because the interaction between effort and working memory was not related to performance ($\beta = .02$, n*s*). There was also no support for hypothesis 6 because the interaction between effort and working memory was not related to innovation behavior ($\beta = .03$, *ns*).

Model 3 (see Figure 5) assessed hypotheses 3 and 4, which posited that work stress would moderate the relationships between working memory and job performance (H3) and innovative behavior (H4).

Figure 5: SEM Model 3



I regressed supervisor-rated job performance and innovative behavior onto working memory and cognitive ability, hindrance stress and the interaction between hindrance stress and working memory. Hindrance stress and working memory were mean-centered prior to creating the interaction. The model was a moderate fit to the data $\chi^2(66) = 165.43$, $p < .05$, RMSEA = .11, CFI = .93, TLI = .91 and explained 10% of the variance in job performance and 5% of the variance in innovative behaviors. Hypothesis 3 was not supported ($\beta = -.01$, *ns*). There was also no support for hypothesis 4 in that there was no interaction between hindrance stress and working memory for innovative behavior ($\beta = -.01$, *ns*).

Although hindrance stress was operationalized as job stress, challenge stress was also measured and I replicated the previous model replacing hindrance stress with challenge stress (see Model 4; Table 4) using challenge stress. As seen in Table 4, model 4 was a moderate fit to the data but the interaction was not statistically significant.

Failing to find support for the theories based upon the supervisory ratings of job performance and innovation, structured equation models were performed using self-rated job performance and innovation. Since the posited hypotheses assumed that supervisor rating of performance and innovation was more accurate, this information is included for thoroughness. While the results varied from the models based on supervisory rated variables it does not significantly alter the findings.

Table 5

SEM Results with Self-Rated DV

Table 5: SEM Results with Self-Rated DV

SEM Model	N	χ^2	p <	DF	RMSEA			CFI	TLI	SRMR	r^2	
					Estimate	90% CI					Perf	Innov
5	205	89.09	0.00	50	0.062	0.040	0.082	0.95	0.94	0.05	0.07	0.01
6	214	107.03	0.00	66	0.054	0.034	0.072	0.95	0.94	0.05	0.13	0.04
7	205	114.25	0.00	66	0.060	0.041	0.078	0.94	0.93	0.05	0.07	0.04

Because I also collected self-rated job performance and innovative behaviors, I replicated my analyses with self-ratings as the dependent variables. Model 5 evaluated hypotheses 1 and 2, which predicted a positive relationship between working memory and job performance (H1) and innovative behavior (H2). Hypotheses 7 and 8 were also modeled which predicted positive relationships between cognitive ability and job performance (H7) and working memory (H8). Model 5 included working memory and cognitive ability as independent variables with self-rated innovative behavior and self-rated job performance as dependent variables. Model 5 was a reasonable fit for the data. A significant relationship was obtained between working memory and job performance ($\beta = 0.11$), providing support for hypothesis 2. Seven percent of the variance in job performance and 1% of the variance in innovative behaviors and was explained by the model.

Model 6 was a test of hypotheses 5 and 6, which predicted that effort would moderate the relationship between working memory and job performance (H5) and innovative behavior (H6). I regressed self-rated job performance and innovative behaviors onto working memory and cognitive ability, supervisor-rated work effort and the interaction between effort and working memory and ability. Effort and working memory were mean-centered prior to creating the interaction. Model 2 fit the data reasonably well $\chi^2(66) = 107.03$, $p < .05$, RMSEA = .05, CFI = .95, TLI = .94 and explained 13% of the variance in self-rated job performance and 7% of the variance in self-rated innovative behavior. Support does exist for hypothesis 5 given that the interaction between effort and working memory was significantly related to performance ($\beta = .02$). There was no support for hypothesis 6 because the interaction between effort and working memory was not related to innovation behavior ($\beta = -.01$, *ns*).

Model 7 assessed hypotheses 3 and 4, which posited that work stress would moderate the relationships between working memory and job performance (H3) and innovative behavior (H4). I regressed self-rated job performance and innovative behavior onto working memory and cognitive ability, hindrance stress and the interaction between hindrance stress and working memory. Hindrance stress and working memory were mean-centered prior to creating the interaction. The model fit the data reasonably well with $\chi^2(66) = 114.25$, $p < .05$, RMSEA = .06, CFI = .94, TLI = .93 and explained 7% of the variance in job performance and 4% of the variance in innovative behaviors. Hypothesis 3 was not supported (β = -.001, *ns*). There was also no support for hypothesis 4 in that there was no interaction between hindrance stress and working memory for innovative behavior (β = -.01, *ns*).

CHAPTER IV

DISCUSSIONS/CONCLUSION

The primary objective of the present study was to assess how working memory capacity of a professional affects job performance and innovative behavior. The importance of these research questions lies in the premise among most professionals that cognitive ability is the strongest predictor of task and training performance. However, cognitive psychologists have observed that working memory is correlated with several performance-related outcomes such as multi-tasking, learning of foreign languages, analytical problem solving, and remaining focused during challenges. However, we have no empirical data that examined the impact of working memory on job-related performance in a normal population. Theories of working memory would suggest that because it is the central executive responsible for processing information, attention, and memory that working memory should be a strong predictor of both job performance and innovation at work.

Despite the strong theoretical link between working memory and job performance, the results of this study demonstrated that working memory was not related to job performance or innovative behaviors. In addition, minimal support was found for the relationship between cognitive ability and performance, and no support for the relationship between cognitive ability and innovative behaviors.

In addition, minimal support was found for the relationship between cognitive ability and performance, and no support for the relationship between cognitive ability and innovative behaviors. Furthermore, the predicted interactions were not significant so there was no support for my hypotheses that effort or stress moderated the relationships between working memory and job performance and innovative behaviors. It is worth noting that the path coefficients were in the predicted direction. And, enough data was collected to yield sufficient power as per an a priori power analysis. I also collected self-rated job performance and innovative behaviors.

Although no support was found for hypotheses 1–6, hypothesis 7 was supported in the bivariate relationships and in the structural equation models. There was a statistically significant positive relationship between cognitive ability and job performance. The relationship between cognitive ability and innovation performance was small-to-moderate but not statistically significant at the bivariate level or in the structural equation models. Thus, hypothesis 8 was also not supported.

Table 6

Summary of Hypotheses

	Hypothesis	Supported?
H1	Increased working memory capacity will positively relate with job performance.	No
H2	Working memory capacity will positively relate with innovative behavior	No
H3	Stress will moderate the relationship between working memory and job performance such that higher levels of stress will weaken the positive relationship between working memory capacity and job performance.	No
H4	Stress will moderate the relationship between working memory and innovative behavior such that higher levels of stress will weaken the positive relationship between working memory and innovative behavior.	No
H5	Effort will moderate the relationship between working memory and innovative behavior such that higher levels of effort will strengthen the positive relationship between working memory and job performance.	No
H6	Effort will moderate the relationship between working memory and innovative behavior such that higher levels of effort will strengthen the positive relationship between working memory and innovative behavior.	No
H7	Cognitive ability will be positive related with job performance.	Yes
H8	Cognitive ability will be positively relate with innovative behavior.	No

Implications

No prior research was found examining the relationship between working memory and job performance or innovative behavior in a sample of working adults. The findings in this current study were not consistent with published studies using college students. Based on the findings reported in the present study and contrary to my expectations, cognitive ability was a stronger predictor of job performance than working memory. Effort and stress did not moderate the relationships between working memory and the two outcomes. Therefore, none of my data supported prior research, which calls into question the validity of the measures, validity of the research design, or both. An assumption is made that there is an issue with the data from the present study but more research is needed.

Limitations and Direction for Future Research

There is prior research indicating that ability and working memory are strongly related to each other and to performance (Colom et al., 2004; Süß, Oberauer, Wittmann, Wilhelm, & Schulze, 2002). The lack of a moderate to strong relationship with cognitive ability to job performance was inconsistent with existing research. Because I was unable to replicate the results of past research, there are some concerns regarding the validity of the performance measure. I investigated several potential reasons for the lack of replication. First, the data was cleansed and re-processed multiple times to verify that mistakes were not made in the processing of the data. Second, outlier analyses revealed the existence of several outliers with regard to companies with three or fewer respondents. However, the removal of these outliers did not markedly change the pattern of results.

One conclusion from the lack of validity data is that there may have been problems with the measurement of cognitive ability, working memory, performance, or all three. Because validated measures were used for cognitive ability and working memory, there exists the possibility that job performance was invalid. Some evidence for this conclusion is that the relationship between supervisor- and self-rated performance was quite low. Because performance data was collected from supervisors for the purposes of the study and there was little motivation to provide accurate ratings, performance scores may be invalid. Although the correlation between supervisor-rated job performance and self-rated job performance is lower than other studies, there are research findings with low correlations between the two measures (Harris & Schaubroeck, 1988).

Based upon issues identified, queries were made to supervisors of four of the companies to validate their reviews. A single question was posed, "Could you go through this list of individuals and quickly provide to me a single value of '1' for low performance to '5' for high performance?" Based on the willingness of people at the four companies, three companies had the same supervisors rate the same subordinates. In company 1, a supervisor other than the one who provided the initial ratings rated the individuals. Table 6 indicates that the reassessment had changes in the supervisory rating of performance. Although the sample size is too small to draw many conclusions, it is suggestive that for at least these four companies that the performance measures may have been inaccurate. It is also important to note that between two and three months had passed between the initial assessment and the reassessment but it does appear that leniency bias may have provided a factor to the validity concerns (Gonsalvez & Crowe, 2014).

Table 7: Reassessment of Job Performance

	Initial Assessment			New Assessment			Mean Δ of Rating
	N	Mean	SD	N	Mean	SD	
Company 1	12	4.56	0.84	12	3.54	1.27	1.02
Company 2	15	4.52	0.44	28	3.86	0.89	0.45
Company 3	13	4.33	0.87	21	4.43	0.60	-0.48
Company 4	7	4.29	0.49	7	4.79	0.37	0.50

While the most likely issue with data validity is with the job performance measures, there is the potential for issue with the validity of the working memory measure. Lacking the strong correlation between working memory capacity and cognitive ability led me to believe that an issue with validity may exist in one of these two measures. The more probable of the two measures to have validity issues is with the working memory based on the fact that ability is a timed test and it is difficult to cheat. The working memory test was not timed or proctored. It is possible that working memory test-takers noted the letter combinations, on paper or electronically, to aid them in scoring higher with working memory. There was some evidence for this theory in that several participants scored high on working memory but low on ability.

More evidence for problems with the way in which the working memory measure was delivered came from comparing one company that used a slightly different methodology to the other companies in the study. Information for the food distribution company was from a similar research effort that used proctored surveys. The data for this company had similar correlations between job performance and working memory as the aggregated data but a stronger correlation existed between cognitive ability and job performance at $r = .40$ and between working memory and job performance at $r = .30$.

A question was included in the demographic section of the survey to measure the industry or role for each respondent's job. These roles are listed in Appendix E. After conclusion of the study, I contacted human resource experts to rate these roles/industries as low complexity, mid-level complexity, or high complexity. Five human resource professionals responded. Using the average of those five responses, I applied the level of complexity to the individual and only considered individuals with a role that was rated greater than between mid and high level complexity, resulting in 61 records. The hypothesized relationships were not supported but the results did vary from the model with all participants. Working memory was significantly related to innovative behaviors. Without more controls and larger sample size of roles with higher complexity, I would not want to rely on this limited information but it may provide some potential for the theories to be tested based on role complexity.

Based on the reading that led to this research, I believe the attentional control theory continues to be an important contributor to the benefits of working memory (Eysenck & Derakshan, 2011; Wilson, 2008). Attentional control theory served as the foundation of most of the hypotheses in the present study. More research is needed with working professionals to understand the true impact of working memory and how its benefits would interact with other constructs like effort and stress. With most of the hypotheses not supported in the present effort, questions are raised as to whether increased levels of working memory have a positive relationship with improved attention to cognitive tasks. With the potential measurement issues, my conclusion was that the present study was not an adequate test of the hypotheses and that future research is needed to effectively test the hypotheses presented herein.

Conclusion

It is logical that the theories of working memory and attentional control would yield positive relationships between working memory and job performance and innovation, as both results are often related with higher levels of cognition. Unfortunately, there are times when what is logic is not what is found, as is the case in the present study.

Lacking confidence in the validity of the performance measures has, unfortunately, cast a cloud over any findings presented by this study. Going into the study, the opportunity to add to the body of research of this important area of working memory and the potential of attentional control theory was stimulating. If the measures in the study are valid then the potential of attentional control theory are not as significant as had been hoped. Most of the studies with working memory and attentional control theory are with students so there is some possibility that the benefits do not generalize to the professional field. My conclusion was to question the validity of my results and suggest additional studies with stronger structure around the data collection protocol. I hope that the failure of this study to find significant relationships between working memory and job performance will challenge other researchers to continue investigating the role of working memory and job performance.

REFERENCES

Abubakr Mohyeldin Tahir, S. (2003). Self and supervisor ratings of performance: Evidence from an individualistic culture. *Employee Relations, 25*(4), 371-388.

Ackerman, P. L., Beier, M. E., & Boyle, M. O. (2005). Working memory and intelligence: The same or different constructs? *Psychological Bulletin, 131*(1), 30-60.

Afsar, B., Badir, Y., & Khan, M. M. (2015). Person-job fit, person-organization fit and innovative work behavior: The mediating role of innovation trust. *Journal of High Technology Management Research, 26*(2), 105.

Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the work environment for creativity. *Academy of Management Journal*, *39*(5), 1154-1184.

Arthur Jr., W. (2014). Development of an internet-administered general mental ability test. College Station, TX.

Baddeley, A. (1992). Working memory: The interface between memory and cognition. *Journal of Cognitive Neuroscience*, *4*(3), 281.

Baddeley, A. (2000). The episodic buffer: A new component of working memory? *Trends in Cognitive Sciences, 4*(11), 417-423.

Baddeley, A. D., & Hitch, G. J. (1974). Working memory. In G. H. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory, Vol. 8*. New York; London: Academic Press.

Batey, M., Chamorro-Premuzic, T., & Furnham, A. (2010). Individual differences in ideational behavior: Can the big five and psychometric intelligence predict creativity scores? *Creativity Research Journal, 22*(1), 90.

Beck, S. R., Williams, C., Cutting, N., Apperly, I. A., & Chappell, J. (2016). Individual differences in children’s innovative problem-solving are not predicted by divergent thinking or executive functions. *Philosophical Transactions of the Royal Society B: Biological Sciences, 371*(1690), 20150190.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107*(2), 238.

Bertrams, A., Englert, C., Dickhäuser, O., & Baumeister, R. F. (2013). Role of self-control strength in the relation between anxiety and cognitive performance. *Emotion*, *13*(4), 668-680.

Bettman, J. R., Johnson, E. J., & Payne, J. W. (1990). A componential analysis of cognitive effort in choice. *Organizational Behavior and Human Decision Processes, 45*(1), 111-139.

Bosco, F., Allen, D. G., & Singh, K. (2015). Executive attention: An alternative perspective on general mental ability, performance, and subgroup differences. *Personnel Psychology, 68*(4), 859-898.

Brewin, C. R., & Beaton, A. (2002). Thought suppression, intelligence, and working memory capacity. *Behaviour Research and Therapy, 40*(8), 923-930.

Brooks, D. W., & Shell, D. F. (2006). Working memory, motivation, and teacher-initiated learning (Vol. 15, pp. 17-30). New York: Springer.

Browne, M. W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods and Research, 21*(2), 230-258.

Cavanaugh, M. A., Boswell, W. R., Roehling, M. V., & Boudreau, J. W. (2000). An empirical examination of self-reported work stress among U.S. managers. *Journal of Applied Psychology, 85*(1), 65-74.

Chamorro-Premuzic, T., & Furnham, A. (2008). Personality, intelligence and approaches to learning as predictors of academic performance. *Personality and Individual Differences*, *44*(7), 1596-1603.

Christen, M., Iyer, G., & Soberman, D. (2006). Job satisfaction, job performance, and effort: A reexamination using agency theory. *Journal of Marketing*, *70*(1), 137-150.

Cohen, S., & Janicki-Deverts, D. (2012). Who's stressed? Distributions of psychological stress in the United States in probability samples from 1983, 2006, and 20091. *Journal of Applied Social Psychology, 42*(6), 1320-1334.

Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior, 24*(4), 385-396.

Colom, R., Flores-Mendoza, C., & Rebollo, I. (2003). Working memory and intelligence. *Personality and Individual Differences, 34*(1), 33-39.

Colom, R., Martinez-Molina, A., Shih, P. C., & Santacreu, J. (2010). Intelligence, working memory, and multitasking performance. *Intelligence, 38*(6), 543-551.

Colom, R., Rebollo, I., Palacios, A., Juan-Espinosa, M., & Kyllonen, P. C. (2004). Working memory is (almost) perfectly predicted by g. *Intelligence, 32*(3), 277-296.

Conway, A. R. A., Kane, M. J., Bunting, M. F., Hambrick, D. Z., & et al. (2005). Working memory span tasks: A methodological review and user's guide. *Psychonomic Bulletin & Review, 12*(5), 769-786.

Côté, S., & Miners, C. T. H. (2006). Emotional intelligence, cognitive intelligence, and job performance. *Administrative Science Quarterly, 51*(1), 1-28.

Cowan, N. (1999). An embedded-processes model of working memory. In *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 62-101). New York: Cambridge University Press.

Coy, B., O'Brien, W. H., Tabaczynski, T., Northern, J., & Carels, R. (2011). Associations between evaluation anxiety, cognitive interference and performance on working memory tasks. *Applied Cognitive Psychology, 25*(5), 823-832.

Cusack, J. R. (1994). Creative cognition: Theory, research, and applications. *The American Journal of Psychiatry, 151*(5), 777.

Damanpour, F. (1991). Organizational innovation: A meta-analysis of effects of determinants and moderators. *Academy of Management Journal, 34*(3), 555-590.

Derakshan, N., & Eysenck, M. W. (2009). Anxiety, processing efficiency, and cognitive performance: New developments from attentional control theory. *European Psychologist, 14*(2), 168-176.

Dysvik, A., & Kuvaas, B. (2013). Intrinsic and extrinsic motivation as predictors of work effort: The moderating role of achievement goals. *British Journal of Social Psychology, 52*(3), 412-430.

Eysenck, M. W., & Calvo, M. G. (1992). Anxiety and performance: The processing efficiency theory. *Cognition and Emotion, 6*(6), 409-434.

Eysenck, M. W., & Derakshan, N. (2011). New perspectives in attentional control theory. *Personality and Individual Differences, 50*(7), 955-960.

Facteau, J. D., & Craig, S. B. (2001). Are performance appraisal ratings from different rating sources comparable? *Journal of Applied Psychology, 86*(2), 215-227.

Fairclough, S. H., & Houston, K. (2004). A metabolic measure of mental effort. *Biological Psychology, 66*(2), 177-190.

Faullant, R., Schwarz, E. J., Krajger, I., & Breitenecker, R. J. (2012). Towards a comprehensive understanding of lead userness: The search for individual creativity. *Creativity and Innovation Management, 21*(1), 76-92.

Finke, R. A., Ward, T. B., & Smith, S. M. (1992). *Creative cognition: Theory, research, and applications*. Cambridge, MA: The MIT Press.

Fournier-Vicente, S., Larigauderie, P., & Gaonac'h, D. (2008). More dissociations and interactions within central executive functioning: A comprehensive latent-variable analysis. *Acta Psychologica, 129*(1), 32-48.

Franco-Watkins, A., Edwards, B. D., & Wallace, J. C. (2014). Working Memory Test

Gergin, D. (2012). Patterns of user innovation: Using pattern language for managerial knowledge management. *International Journal of Technology, Knowledge and Society, 8*(3), 121-134.

Gonsalvez, C. J., & Crowe, T. P. (2014). Evaluation of psychology practitioner competence in clinical supervision. *American Journal of Psychotherapy, 68*(2), 177-193.

Goodman, S., Jaffer, T., Keresztesi, M., Mamdani, F., Mokgatle, D., Musariri, M., . . . Schlechter, A. (2011). An investigation of the relationship between students' motivation and academic performance as mediated by effort. *South African Journal of Psychology, 41*(3), 373-385.

Guastello, S. J., & Fleener, M. J. (2011). Chaos, complexity, and creative behavior. *Nonlinear Dynamics, Psychology, and Life Sciences, 15*(2), 143-144.

Hammond, M. M., Neff, N. L., Farr, J. L., Schwall, A. R., & Zhao, X. (2011). Predictors of individual-level innovation at work: A meta-analysis. *Psychology of Aesthetics, Creativity, and the Arts, 5*(1), 90-105.

Harkins, S. G. (2006). Mere effort as the mediator of the evaluation-performance relationship. *Journal of Personality and Social Psychology, 91*(3), 436.

Harris, M. M., & Schaubroeck, J. (1988). A meta-analysis of self-supervisor, self-peer, and peer-supervisor ratings. *Personnel Psychology, 41*(1), 43-62.

Hester, J. (2013, May/Jun). The high cost of employee turnover and how to avoid it. *Nonprofit World, 31*, 20-21.

Holzbach, R. L. (1978). Rater bias in performance ratings: Superior, self-, and peer ratings. *Journal of Applied Psychology, 63*(5), 579.

Horn, J. L., & Noll, J. (1997). Human cognitive capabilities: Gf-Gc theory. In *Contemporary intellectual assessment: Theories, tests, and issues* (pp. 53-91). New York: Guilford Press.

Hu, L.-t., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*(1), 1-55.

Huang, C.-C., & You, C.-S. (2011). The three components of organizational commitment on in-role behaviors and organizational citizenship behaviors. *African Journal of Business Management, 5*(28), 11335-11344.

Hunter, L. W., & Thatcher, S. M. B. (2007). Feeling the heat: Effects of stress, commitment, and job experience on job performance. *Academy of Management Journal, 50*(4), 953-968.

Jamal, M. (1984). Job stress and job performance controversy: An empirical assessment. *Organizational Behavior & Human Performance, 33*(1), 1-21.

Janssen, O. (2000). Job demands, perceptions of effort-reward fairness and innovative work behaviour. *Journal of Occupational and Organizational Psychology, 73*, 287-302.

Jauk, E., Benedek, M., Dunst, B., & Neubauer, A. C. (2013). The relationship between intelligence and creativity: New support for the threshold hypothesis by means of empirical breakpoint detection. *Intelligence, 41*(4), 212-221.

Kammeyer-Mueller, J., Steel, P. D., & Rubenstein, A. (2010). The other side of method bias: The perils of distinct source research designs. *Multivariate Behavioral Research, 45*(2), 294-321.

Kane, M. J., Brown, L. H., McVay, J. C., Silvia, P. J., Myin-Germeys, I., & Kwapil, T. R. (2007). For whom the mind wanders, and when: An experience-sampling study of working memory and executive control in daily life. *Psychological Science, 18*(7), 614-621.

Kanfer, R., Ackerman, P. L., Murtha, T. C., Dugdale, B., & Nelson, L. (1994). Goal setting, conditions of practice, and task performance: A resource allocation perspective. *Journal of Applied Psychology, 79*(6), 826-835.

Katerberg, R., & Blau, G. J. (1983). An examination of level and direction of effort and job performance. *Academy of Management Journal, 26*(2), 249-257.

Khalid, S. A., & Ali, H. (2005). Self and superior ratings of organizational citizenship behavior: Are there differences in the source of ratings. *Problems and Perspectives in Management, 4*, 147-153.

Kim, K. H. (2005). Can only intelligent people be creative? A meta-analysis. *Prufrock Journal, 16*(2-3), 57-66.

Kitchell, S. (1995). Corporate culture, environmental adaptation, and innovation adoption: A qualitative/quantitative approach. *Journal of the Academy of Marketing Science, 23*(3), 195-205.

Kuncel, N. R., Rose, M., Ejiogu, K., & Yang, Z. (2014). Cognitive ability and socio-economic status relations with job performance. *Intelligence, 46*, 203-208.

Länsisalmi, H., & Kivimäki, M. (1999). Factors associated with innovative climate: What is the role of stress? *Stress Medicine*, *15*(4), 203-213.

LePine, J. A., LePine, M. A., & Jackson, C. L. (2004). Challenge and hindrance stress: Relationships with exhaustion, motivation to learn, and learning performance. *Journal of Applied Psychology, 89*(5), 883-891.

Lépine, R., Barrouillet, P., & Camos, V. (2005). What makes working memory spans so predictive of high-level cognition? *Psychonomic Bulletin & Review, 12*(1), 165-170.

Leung, K., Huang, K.-L., Su, C.-H., & Lu, L. (2011). Curvilinear relationships between role stress and innovative performance: Moderating effects of perceived support for innovation. *Journal of Occupational and Organizational Psychology, 84*(4), 741-758.

Logie, R. H., Trawley, S., & Law, A. (2011). Multitasking: multiple, domain-specific cognitive functions in a virtual environment. *Memory & Cognition, 39*(8), 1561-1574.

Mackintosh, N. J. (1998). *IQ and human intelligence.* New York: Oxford University Press.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., & et al. (2000). The unity and diversity of executive functions and their contributions to complex “frontal lobe” tasks: A latent variable analysis. *Cognitive Psychology, 41*(1), 49-100.

Nelson, L. C. (2003). *Working memory, general intelligence, and job performance.* (Doctoral dissertation), University of Minnesota, Ann Arbor. Retrieved from ProQuest Dissertations & Theses global database, #3076329.

O Reilly, C. A., III, & Chatman, J. A. (1994). Working smarter and harder: A longitudinal study of managerial success. *Administrative Science Quarterly, 39*(4), 603.

Oakes, D. W., Ferris, G. R., Martocchio, J. J., Buckley, M. R., & Broach, D. (2001). Cognitive ability and personality predictors of training program skill acquisition and job performance. *Journal of Business and Psychology, 15*(4), 523-548.

Owens, M., Stevenson, J., Hadwin, J. A., & Norgate, R. (2014). When does anxiety help or hinder cognitive test performance? The role of working memory capacity. *British Journal of Psychology*, *105*(1), 92-101.

Park, J. (2008). Work stress and job performance. *Perspectives on Labour and Income, 20*(1), 7-19,11.

Perry, T. S. (1995). How small firms innovate: Designing a culture for creativity. *Research Technology Management, 38*(2), 14.

Porter, L. W. (1968). *Managerial attitudes and performance*. Homewood, IL: R.D. Irwin.

Prokosch, M. D., Yeo, R. A., & Miller, G. F. (2005). Intelligence tests with higher g-loadings show higher correlations with body symmetry: Evidence for a general fitness factor mediated by developmental stability. *Intelligence, 33*(2), 203-213.

Pyysiäinen, I. (2006). Does meditation swamp working memory? *Behavioral and Brain Sciences, 29*(6), 626-627.

Ree, M. J., Earles, J. A., & Teachout, M. S. (1994). Predicting job performance: Not much more than g. *Journal of Applied Psychology, 79*(4), 518-524.

RepovŠ, G., & Baddeley, A. (2006). The multi-component model of working memory: Explorations in experimental cognitive psychology. *Neuroscience, 139*(1), 5-21.

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

Scott, S. G., & Bruce, R. A. (1994). Determinants of innovative behavior: A path model of individual innovation in the workplace. *Academy of Management Journal*, *37*(3), 580-607.

Scott, W. E., Jr. (1966). Activation theory and task design. *Organizational Behavior & Human Performance, 1*(1), 3-30.

Squalli, J., & Wilson, K. (2014). Intelligence, creativity, and innovation. *Intelligence, 46*, 250-257.

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioral Research*, *25*(2), 173-180.

Süß, H.-M., Oberauer, K., Wittmann, W. W., Wilhelm, O., & Schulze, R. (2002). Working-memory capacity explains reasoning ability—and a little bit more. *Intelligence, 30*(3), 261-288.

Tucker, L. R., & Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis (Vol. 38, pp. 1-10).

Turner, M. L., & Engle, R. W. (1989). Is working memory capacity task dependent? *Journal of Memory and Language, 28*(2), 127-154.

Unsworth, N., & Engle, R. W. (2005). Working memory capacity and fluid abilities: Examining the correlation between Operation Span and Raven. *Intelligence, 33*(1), 67-81.

Ursin, H., & Eriksen, H. R. (2004). The cognitive activation theory of stress. *Psychoneuroendocrinology, 29*(5), 567-592.

van den Noort, M. W. M. L., Bosch, P., & Hugdahl, K. (2006). Foreign language proficiency and working memory capacity. *European Psychologist, 11*(4), 289-296.

Vandervert, L. R., Schimpf, P. H., & Liu, H. (2007). How working memory and the cerebellum collaborate to produce creativity and innovation. *Creativity Research Journal, 19*(1), 1-18.

Webster, B. D., Edwards, B. D., Franco-Watkins, A. M., & Tubré, T. (2014). *The promise of working memory for learning and task performance.* Paper presented at the 29th annual meeting of the Society for Industrial and Organizational Psychologists, Honolulu, Hawaii.

Wiley, J., & Jarosz, A. F. (2012). Working memory capacity, attentional focus, and problem solving. *Current Directions in Psychological Science, 21*(4), 258.

Williams, L. J., & Anderson, S. E. (1991). Job satisfaction and organizational commitment as predictors of organizational citizenship and in-role behaviors. *Journal of Management, 17*(3), 601-617.

Williams, W. E., & Seiler, D. A. (1973). Relationship between measures of effort and job performance. *Journal of Applied Psychology, 57*(1), 49-54.

Wilson, M. (2008). From processing efficiency to attentional control: A mechanistic account of the anxiety-performance relationship. *International Review of Sport and Exercise Psychology, 1*(2), 184-201.

Wu, C.-H., Parker, S. K., & de Jong, J. P. J. (2014). Need for cognition as an antecedent of individual innovation behavior. *Journal of Management, 40*(6), 1511-1534.

Yuan, Z., Li, Y., & Lin, J. (2014). Linking challenge and hindrance stress to safety performance: The moderating effect of core self-evaluation. *Personality and Individual Differences, 68*, 154-159.

Zook, N. A., Davalos, D. B., DeLosh, E. L., & Davis, H. P. (2004). Working memory, inhibition, and fluid intelligence as predictors of performance on Tower of Hanoi and London tasks. *Brain and Cognition, 56*(3), 286-292.

Appendix A: Invitation to Companies

Dear [Recipient Name]:

I am writing to request your assistance in gaining approval for your company to participate in an academic study. This study is part of my dissertation as I pursue my Ph.D. in Business at Spears School of Business, at Oklahoma State University.

The study investigates the relationship of working memory to job performance and innovation. The research also considers the impact of stress and effort on the relationship between working memory to job performance and innovation.

The study has two parts. The first will be individuals that will provide information, using a computerized survey, on a number of measures including cognitive ability, working memory, stress, effort, and innovative behavior. Expectations are that the individual survey will take about 45 minutes.

The second portion of the study will be a survey for supervisors that will rate their subordinates on job performance, effort, and innovative behavior. Time required will vary depending upon the number of subordinates but each subordinate should not require more than 5 minutes.

An institutional review board has reviewed survey items to check that the study has taken appropriate actions to protect privacy information and protect the participants.

I look forward to hearing from you.

Sincerely,

Bill Periman

Ph.D. Candidate at Oklahoma State University

Appendix B: Email to Participants

Company Name

To:	[Recipient names]
From:	[Your name]
Date:	[Pick the date]
Re:	Academic Study Participation

Comments: Good Morning.

Your company has approved your voluntary participation in an academic study about working memory and job performance. This study involves the collection of data using a computerized survey tool. The study anticipates this survey will require between 30 minutes and 45 minutes.

The study takes measures to protect any information that would identify you as part of this study.

Each participant in the study receives $10.
If you choose to participate, please click on this link, ____________________, prior to dd mon yy.

Thank you for your assistance.

If you have questions, please email bill.periman@okstate.edu.

Appendix C: Email to Supervisors

Company Name

To: [Recipient names]

From:

Date: [Pick the date]

Re: Academic Study Participation

Comments: Good Morning.
Your company has approved your voluntary participation in an academic study about working memory and job performance. This study involves the collection of data using a computerized survey tool. The study anticipates this survey will require approximately 5 minutes for each subordinate.

The study takes measures to protect any information that would identify you as part of this study.

Each participant in the study receives $10.

If you choose to participate, please click on this link, ____________________, prior to dd mon yy.

Thank you for your assistance.

If you have questions, please email bill.periman@okstate.edu.

Appendix D: Survey Questions

Individual participants were asked the following categories from the perspective that the item applied to them. Supervisors were asked the following items in Innovative Behavior, Work Effort, and Job Performance from the perspective of rating their subordinate and the wording was slightly modified to reflect "The individual" instead of "I".

Innovative Behavior

I search out new technologies, processes, techniques, and/or product ideas

I generate creative ideas.

I promote and champion ideas to others.

I Investigate and secure funding needed to implement new ideas.

I develop adequate plans and schedules for the implementation of new ideas.

I am innovative.

I do not give up quickly when something does not work well.

I really do my best to get my work done, regardless of potential difficulties.

When I start an assignment I pursue it to the end.

I do my best to do what is expected of me.

I am trustworthy in the execution of the tasks that are assigned to me.

Work Effort

I really do my best to achieve the objectives of the organization.

I think of myself as a hard worker.

I really do my best in my job.

I put a lot of energy into the tasks that I commence.

I consistently work hard during the execution of my job.

I really do my best to achieve the objectives of the organization.

I think of myself as a hard worker.

I really do my best in my job.

I put a lot of energy into the tasks that I commence.

I consistently work hard during the execution of my job.

Challenge Stress

The number of projects and or assignments I have.

The amount of time I spend at work.

The volume of work that must be accomplished in the allotted time.

Time pressures I experience.

The amount of responsibility I have.

The scope of responsibility my position entails.

Hindrance Stress

The degree to which politics rather than performance affects organizational decisions.

The inability to clearly understand what is expected of me on the job.

The amount of red tape I need to go through to get my job done.

The lack of job security I have.

The degree to which my career seems "stalled."

Job Performance

You adequately complete assigned duties.

You fulfill responsibilities specified in your job description.

You perform tasks that are expected of you.

You meet formal performance requirements of the job.

You engage in activities that will directly affect your performance evaluation.

You neglect aspects of the job you are obligated to perform.

You fail to perform essential duties.

Appendix E: Roles

- Agriculture/Farming (1)
- Arts/Broadcasting/Entertainment (2)
- Clerical (3)
- Education (4)
- Engineer (5)
- Financial/Insurance (6)
- Human Resources (7)
- Hotel or Food Service (8)
- Laborer (9)
- Legal Services (10)
- Manufacturing (11)
- Medical (12)
- Military (13)
- Operations (14)
- Other -- Non-technical (15)
- Other -- Technical (16)
- Real Estate (17)
- Religion (18)
- Retail (19)
- Sales -- Non-technical (20)
- Sales -- Technical (21)
- Software Developer (22)
- Technical Support (23)
- Transportation/Logistics (24)

VITA

William Cecil Periman

Candidate for the Degree of

Doctor of Philosophy

Thesis: THE RELATIONSHIP OF WORKING MEMORY TO JOB PERFORMANCE AND INNOVATION WITH STRESS AND EFFORT AS MODERATORS

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Completed the requirements for the Doctor of Philosophy in Business Administration at Oklahoma State University, Stillwater, Oklahoma in 2016.

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