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Ask a Busy Person? A Reexamination of Cognitive Performance Under Load

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Walden University
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Abstract

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BS, University of Phoenix, 2003

Dissertation Submitted in Partial Fulfillment

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Abstract

A longstanding folk belief suggests that “busy” people possess the ability to get more done than others. *Busyness*, defined as the demands of everyday life, has been shown to generate cognitive load, which has been called “cognitive busyness.” Although most cognitive theory would deny the possibility that cognitive load may enhance performance, some recent research may support the possibility. Cowan's 1988 information-processing model was used to study how measures of everyday busyness correlated with performance on cognitive tasks. The research question addressed whether any combination of such measures, in combination with working memory, could predict performance on such tasks. 92 participants, paid workers with Amazon Mechanical Turk, engaged in an online process, starting with completion of a validated self-report instrument to measure busyness. They then participated in 2 activities, structured as games and designed to measure working memory and cognitive performance. Multiple regressions, linear and nonlinear, were used to identify significant predictors of performance. Results of the analyses did not reveal any evidence for significant relationships between the variables. Additionally, “volitional busyness” did not appear to enhance, or even affect, performance on a planning task. Further research exploring the effect of these variables on a working memory-based task may be worthwhile, if only to confirm the present findings. This project might benefit linguists tracking semantic change, showing how a term may adopt an entirely different meaning and suggesting further refinement in identifying such shifts over the years; psychologists exploring cognitive load and its effects; and social psychologists interested in making corrections to popular perceptions of the value of tradition gender-associated tasks.

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This dissertation has taken (it seems) forever, and along the way I have been grateful for the support of many people, sometimes at times when I doubted I could ever finish. At the top of that long list would be my wife, Valentina, and my daughter, Lara, who for years have put up with me disappearing "downstairs" for hours or days—sometimes emerging even more drained and dejected than ever, and sometimes with the Eureka expression of one who had a long and creative bath.

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Chapter 1: Introduction to the Study

Introduction

There is an old popular belief that some people are identifiably "busy" as a quality or trait, and that such people derive certain advantages from that condition. Typically, this has been expressed in terms of ability to take on more tasks and perform them more efficiently than most.

I first became aware of this concept through the somewhat-serious *Parkinson's law*, perhaps the first popular book on management theory (Parkinson, 1957). The book opens with the statement, "Work expands to fill the time available for its completion" (Parkinson, 1957, p. 2), dubbed "Parkinson's first law." Although the thesis is facetiously stated in the beginning, Parkinson wrote from knowledge and experience, as a military officer, naval historian, and university professor (Rogers, 1993). Subsequent research (Aronson & Gerard, 1966; Aronson & Landy, 1967; Brannon, Hershberger, & Brock, 1999) substantiated the presence of the "Parkinson Effect." Discovering that Parkinson's thesis had some merit led me to look more closely at Parkinson's supporting statement for the law, offered as an exception: The "law" did not apply to busy people. Indeed, asserted Parkinson (1957), using a classic statement of the belief, "It is the busiest man who has time to spare" (p. 2). The apparent implication, on which Parkinson expanded, is that busy people get more done.

This prevalent and longstanding piece of folk wisdom—busy people have extraordinary abilities to take on and complete even more work than they already have, and to complete it more efficiently than others who are less busy—is repeated in management science (Gutierrez & Kouvelis, 1991; Reimann, 1979). However, according to most cognitive theorists, being occupied by many simultaneous tasks should consume cognitive resources, thereby increasing cognitive load or *cognitive busyness* (Gilbert and Osborne, 1989) and degrading general cognitive abilities (Baddeley & Hitch, 1974). This dissertation examined whether the folk belief persists in the absence of evidence, or if there is any evidentiary basis for the assertion.

Background of the Study

Many observers have commented on the effects of cognitive load on task performance. Early researchers suggested the effect was unquestionably deleterious (e.g., Baddeley & Hitch, 1974), in that increasing cognitive load (e.g., by attempted performance of simultaneous tasks) would reliably degrade performance. Later researchers built on this assertion, repudiating, for example, the existence of support for cognitive multitasking (Tombu & Jolicœur, 2004). Others, however, questioned the assumption, including those revisiting their own earlier work (Baddeley, 2003). In recent years, researchers noted that cognitive load may even enhance performance in certain task types or in certain task areas . Some noted the adoption of strategies that appeared to mitigate the otherwise-deleterious effects of cognitive load; strategies that typically required reduced amounts of (at that point, scarce) cognitive or working memory resources (Beilock & DeCaro, 2007; Hoffmann et al., 2013). Among such noted strategies were the adoption of similarity-based rather than rule-based decision making (Hoffmann et al., 2013); the reduction of the number of strategies used in decision making; and increased adoption of automatic over controlled processing (Jaeggi et al., 2007).

However, researchers have not studied cognitive load in a positive light, and noninduced load has hardly been studied at all. So far, such research and theoretical work on cognitive load have been experimentally based (with rare exceptions, e.g., Milgram's [1974] "urban overload" hypothesis), using induced cognitive load and assuming adverse effects. Those who have noted environmentally related load viewed it, typically, through the lens of deleterious effects on cognitively demanding tasks, including social interaction and relations (Milgram, 1974), learning (Sweller, 1988), and compliance with medication regimes (Martin & Park, 2003; Whitbourne, Neupert, & Lachman, 2008). Atypically, some researchers have noted that a degree of cognitive load could be advantageous (Hoffmann et al., 2013; Kim et al., 2005; Pontari & Schlenker, 2000) or mentioned in passing some circumstances in which they observed anomalous, apparently positive effects (Bryan & Harter, 1897).

The standard practice in research requiring the presence of cognitive load is to induce it in standard fashion where needed, such as by imposing simultaneous dual-task operations (Oberauer, Lange, & Engle, 2004; Süß, Oberauer, Wittmann, Wilhelm, & Schulze, 2002), imposing dual memory and processing tasks (Barrouillet, Bernardin, Portrat, Vergauwe, & Camos, 2007; Cowan et al., 2005; Unsworth, Heitz, Schrock, & Engle, 2005), or distracting by requiring processing of an unrelated input (Darowski, Helder, Zacks, Hasher, & Hambrick, 2008). However, researchers employing such methods have also commented on the relation to the load induced by environmental demands, such as being around other people (Hoffmann et al., 2013; Milgram, 1974). Gilbert and Osborne (1989) even asserted that such induction is no more than a replication of environmentally related load: "[B]usyness-inducing tasks … are merely experimental mimics of the many resource-consuming tasks of ordinary life" (p. 940). Everyday tasks and activities, the overhead of daily living, make their own demands on cognitive resources (Martin & Park, 2003). The product of such "environmental demands" (Martin & Park, 2003, p. 77) is cognitive load. (Indeed, recognizing this, Gilbert and Osborne used the term *cognitive busyness* for cognitive load, to link it more closely to the increased load level generated by increased activity.)

Research participants therefore enter the laboratory with a preexisting level of cognitive load. I have, however, identified no studies in which continuing cognitive load has been incorporated into experimental work. Rather, researchers seem to assume that environmentally related cognitive load may be ignored, discounted, or should be minimized in the laboratory. Thus, although cognitive load is much studied (Kirschner, Ayres, & Chandler, 2011) and anomalies in expected results have been noted (Hoffmann et al., 2013; Kim et al., 2005; Pontari & Schlenker, 2000), few researchers have explored the possibility that cognitive load derived from environmental demands might have a positive effect in certain circumstances or for a subset of people. The studies reported in this dissertation are notable exceptions. I surmised that the standard practice of inducing cognitive load and ignoring any preexisting, environmentally generated load may be attributed to one or more of three strictures.

Measurement Conventions

It is common practice to measure simple binary states of cognitive load (on/off) or at least low/medium/high (Hoffmann et al., 2013). This practice tends to promote the use of induced cognitive load, as it offers the experimenter greater control over both presence and strength.

Instrumentation Deficits

Before 2001, most instruments for the measurement of environmentally based cognitive load were variously incomplete or complicated to administer, focusing on isolated aspects of environmental or everyday demands rather than taking a holistic view (Martin & Park, 2003). However, all shared the assumption that such environmental demands influence the ability to perform cognitive tasks, as suggested by Gilbert and Osborne (1989).

Concerns About Validity

The validity of measurement amidst the possible “noise” implicit in correlational research is a standard design concern. The controlled nature of experimentally induced cognitive load leads to greater certainty—confidence— that the variable being studied is the independent variable leading to changes in the dependent variable. Correlational research has more “noise”—that is, more extraneous variables—that may lead to less confidence. Such concerns led to the near-exclusion from cognitive research of an important influence on the performance of tasks in everyday lives: environmentally generated cognitive load.

Problem Statement

Everyday activities create cognitive load, introducing the possibility of conducting research using participants in the very condition of cognitive load that artificial methods of load induction seek to screen out and then replicate (Gilbert & Osborne, 1989). The notion of “state busyness”—a level of environmentally induced, little-varying, background cognitive load—may now be introduced into the research process.

However, the level of environmental busyness as it happens to exist in participants’ lives, by virtue of having a job, family, friends, and acquaintances, may be inflated by accidents of family demands, economic position, or employment necessities. A more useful study might consider the effect of busyness beyond the regular, enforced demands of life and including an element of choice or adopted lifestyle—such as that presumably experienced by those individuals perceived as “busy people,” noted in management theory and popular wisdom. That inclusion would encompass the difference between the regular demands of looking after a family and the voluntary addition of the duties of being the neighborhood “soccer mom/dad” or multisport coach. In another sphere, the comparison would be between the regular demands of a job, plus running the office fantasy football league, social calendar, or union activities. The level of such “volitional busyness” might offer a better measure of the level of environmentally induced cognitive load taken on by an individual over and above the needs of daily survival.

Additional environmental demands will add to cognitive load (Gilbert & Osborne, 1989), and cognitive theory states that cognitive overload/busyness diminishes cognitive performance (Baddeley & Hitch, 1974; Lieberman, 2000). Lieberman (2000) attributed the deleterious effects of cognitive load on processing to its impact on working memory. The impact of reduced working memory on cognitive performance is an important and accepted part of cognitive theory (Baddeley & Hitch, 1974; Miller, 1956). However, established exceptions show performance actually improving. These improvements may be demonstrated empirically. Accordingly, I hypothesized that some people keep themselves in a condition of high environmental demands—acquire a self-induced level of structural cognitive load—because they perceive the consequent additional cognitive load brings them cognitive advantage. People acquire the additional task-load (i.e., cognitive load) gradually as they learn it enables them to function better. The drivers to the behavior (the gradual acquisition of additional "structural" cognitive load) may include an enhanced sense of self-efficacy at getting more done than others, better problem-solving or judgment skills, or better thinking or processing ability (possibly in defined areas, e.g., Jaeggi et al., 2007). One important factor to be considered was how the impact of such load varies with differing levels of working memory. For example, is the effect more pronounced with low innate working memory, or is it perhaps an adaptive mechanism to compensate for low working memory by making better use of available resources? Or is increased self-induced cognitive load perhaps related to high working memory, again attempting to make greater use of resources otherwise underused?

This additional load may be considered "volitional," because it is not essential to the performance of routine or structural daily tasks but exists in excess of such requirements and is adopted as a strategy by an individual. This volitional addition of cognitive load may create an advantage, akin to the ability to multitask (found in about 2.5% of participants—Watson & Strayer, 2010), or to function under very high levels of cognitive load (Jaeggi et al., 2007). The level of "volitional busyness" creating the additional load might offer a better measure of the level of an individual's "adopted" environmentally induced cognitive load.

Purpose of the Study

This quantitative correlational study identified and described the cognitive performance of a group of people whose levels of volitional busyness differed. Specifically, I sought to identify, if they exist, subgroups of people whose cognitive performance improved—rather than deteriorating or remaining unchanged—with greater volitional busyness.

Research Questions

For this project, I gathered data to test the hypothesis that in addition to working memory, the level of volitional or self-induced busyness, as derived from the two Martin & Park Environmental Demands Questionnaire (MPEDQ) measures Busyness and Routine, is also a predictor of performance on a cognitive task.

Therefore, the overall research questions were the following:

RQ1: Is busyness related to performance on a cognitive task?

Null Hypothesis 1: Busyness is unrelated to performance on a cognitive task.

Alternative hypothesis: Busyness is associated with performance on a cognitive task.

RQ2: Is routine related to performance on a cognitive task?

Null Hypothesis 2: Routine is unrelated to performance on a cognitive task.

Alternative hypothesis: Routine is associated with performance on a cognitive task.

RQ3: Is working memory related to performance on a cognitive task?

Null Hypothesis 3: Working memory is unrelated to performance on a cognitive task.

Alternative hypothesis: Working memory is associated with performance on a cognitive task.

RQ4: Do busyness, routine, and working memory predict performance on a cognitive task?

Null Hypothesis 4: None of the independent variables busyness, routine, and working memory predict performance on a cognitive task.

Alternative hypothesis: At least one of the variables busyness, routine, and working memory predict performance on a cognitive task.

Theoretical Framework

Working Memory and Cognitive Load

Researchers offered the first descriptions and models of the mechanisms for "normal human information processing" (Baddeley & Hitch, 1974, p. 47) in the 1950s (Cowan, 1988). In 1974, Baddeley and Hitch proposed that the "tasks of reasoning, comprehension and learning" (p. 49) took place in a system combining various proposed information stores, collectively termed *working memory (WM)*. The researchers also studied the ability of the system to carry out more than one task. Notably, Baddeley and Hitch observed that when the system was tasked with performing two operations simultaneously—in this case, "reasoning and recall"—full performance in one was only achieved at the cost of poor performance in the other. They described the effect of such dual-task challenges as *cognitive load.* This research, with subsequent refinements (notably, Baddeley, 2001; Bayliss, Jarrold, Gunn, & Baddeley, 2003) formed the basis of theory on such information processing in subsequent decades.

Working memory capacity limitation. The level of cognitive load becomes important in a working memory system that has only limited capacity, as it will limit the cognitive processing capacity that remains available. The proposition of such a limitation is generally attributed to Miller (1956), although that work itself references Miller's own and others' work from preceding years. Miller discussed "channel capacity" for making judgments on a single factor. Based on a meta-analysis of research on a range of variables and stimuli (including saltiness of a solution, pitch of a musical note, and loudness of a sound), Miller concluded that people have an inbuilt limitation on the number of values they can retain. (However, Miller also noted Pollack's study, in which people with absolute pitch could identify many times the average number detected by those without such a facility, although Miller demurred on considering why this should be so.)

Miller's estimate for this inbuilt limitation of working memory capacity, expressed in terms of distinguishable alternatives, was a mean of about 6.5 categories.

One standard deviation includes from four to 10 categories, and the total range is from 3 to 12 categories. “Considering the wide variety of different variables that have been studied, I find this to be a remarkably narrow range” (Miller, 1956, p. 86). Miller (1956) proposed that this constituted what he called the “span of absolute judgment” (p. 90). Cowan (2001) and Cowan, Morey, Chen, Gilchrist, and Saults (2008) further explored the concept of such a limitation, concluding that the limit was closer to four categories or simultaneous representations.

Definition of Terms

Cognitive busyness/Cognitive load: The term *cognitively busy* was apparently first used by Gilbert and Krull (1988) to describe subjects under cognitive load from a standard dual-task induction—undertaking a second task while working on a primary task. It was further explained by Gilbert and Osborne (1989), and their explanatory footnote bears full reproduction:

> We use the term *cognitive busyness* rather than the more familiar *cognitive load* because (a) busyness describes a mental state rather than the activity that gives rise to that state, and (b) load lends itself rather comically to use as an adjective (e.g., “The loaded subjects were unable to locate their fingers during the power failure”). (Gilbert & Osborne, 1989, Footnote 1, p. 940)

Later, Lieberman (2000) defined cognitive busyness as “effects on task A when working memory is being used to complete task B” (p. 484).

Gilbert and Osborne (1989) made one further observation that lies at the heart of this research. Their study reflected the effect of induced load, but they commented that such “busyness-inducing tasks (Gilbert, 1989) … are merely experimental mimics of the many resource-consuming tasks of ordinary life”(Gilbert & Osborne, 1989, p. 940).

Environmental demands: “The many resource-consuming tasks of ordinary life” (Gilbert & Osborne, 1989, p. 940) are themselves a significant source of cognitive load—so much so that load induction in experimental situations merely imitates the effects of such daily tasks. Gilbert and Osborne (1989) were primarily concerned with cognitive busyness as generated by social interactions and the self-regulation—the continuous process of self-monitoring and self-correction through which people maintain interpersonal identities and objectives—involved in such social interaction. Milgram (1974) alluded to similar concerns in the “urban overload” hypothesis. However, the demands of daily life may differ, often substantially, from person to person. Some lives may be organized around social interaction, others around directly cognitive tasks (e.g., management of an enterprise, a household, or a family; or diagnosis and repair of malfunctions in humans or machinery). Others may be engaged in primarily creative endeavors (e.g., writing, painting, or designing). The list could readily be expanded.

Park et al. (1999) and Park and Hall Gutchess (2000) reported that such demands of daily living interfered with cognitive performance in older adults. Park and Hall Gutchess also noted that routine tasks become automatic and as such require little cognitive processing for their completion. Martin and Park (2003) posited that such life demands could be quantified largely by frequency or density, as well as by the degree to which the tasks were familiar or novel. Responding to their perception of a need for a different type of instrument, one that both comprehensively surveyed aspects of everyday life and took into account these characteristics of task performance, Martin and Park designed the Martin and Park Environmental Demands Questionnaire (MPEDQ), specifically related to the cognitive demands of daily living. They asserted that data generated on the Busyness scale were significantly associated with the ability to perform a cognitive task (in this case, adhering to a medication regime) and formed a more reliable predictor of that ability than working memory or aging. Martin and Park quantified the demands using two variables—Busyness (the density of demands of daily tasks) and Routine (the degree to which daily tasks are familiar, and thus less demanding; Park et al., 1999; Park & Hall Gutchess, 2000)

Volitional busyness: The degree to which an element of busyness, over and above the structural demands of the individual's daily life, has been adopted by an individual. I suggest that by comparing the two scales of the MPEDQ, it may be possible to differentiate between those who perceive themselves to be busy in their daily lives (and who indeed remain at a fairly constant level of task loading), those who maintain a personal perception of busyness that is not supported by data, those who are actually overwhelmed by their daily burdens, and those who are actually busy but evidently able to perform as needed.

Assumptions and Limitations

In general, I assumed participants would understand the questions posed in this study and answer them truthfully. I assumed no participants would submit duplicate entries. I accepted Miller and Park's description of the age group on which their study was validated, as well as their statement that other factors such as education level did not significantly affect the results generated by the instrument.

External Validity

The MPEDQ was initially designed for and tested with a population of individuals with rheumatoid arthritis. Although the instrument designers (Martin & Park, 2003) pointed out the extension of the applicable population by validation, the instrument would seem specialized and not readily generalizable. It has been used in one large-scale study (Soubelet & Salthouse, 2010; $N = 2{,}257$) of adults who were not selected by health status or specific age. The study reported coefficients of reliability for Busyness and Routine of .88 and .81, respectively, with a correlation between the scales of -0.31.

Additionally, the instrument only accounts for busyness arising from task-based, perceived demands and not directly for cognitive busyness arising from other sources (e.g., social interaction, the need to make constant assessments of others, neuroticism, etc.). However, the instrument does offer a base-level measure of busyness that is represented in the resultant data.

Construct Validity

Whether cognitive busyness is a valid construct for cognitive load is a debate that reaches back to Gilbert and Osborne (1989), who simply stated that it was so. The study offered the possibility of extending that concept and demonstrating that the difference between life-determined (or structural) task load and overall task load can be considered self-imposed. I do not intend this construct to imply that task load is consciously adopted or imposed; rather, I intend it to indicate that it is attributable to the adopted lifestyle of the individual.

Significance of the Study

This project sits at the intersection of two contemporary social concerns. The first involves the focusing of attention on the performance of cognitive tasks. With both education and employment becoming more demanding of concentration at a fine level, and with diagnosed attentional disorders currently at an incidence of 4-12% in children (Getahun et al, 2013) and averaging 3.4% in adults (Fayyad et al, 2007), any cognitively based scheme offering the possibility of conscious refining of attention (i.e., more efficient use of working memory) could offer clear benefits both individually and societally. Just as one example, one standard classroom accommodation for youths with attentional disorders is seating placement away from "distracting stimuli"—a move to a quieter place. (I am commonly involved, professionally, with the specification of such schemes.) In fact, there is a general impetus to keep classrooms hushed and "un-distracting." What would it suggest for the design of classrooms if it were found that additional environmental demands, in the form of multiple inputs and/or social demands, could actually assist concentration and cognitive processing? We may see some of this in informal implementation where students choose to study with multiple media inputs, or in libraries or study halls with a high degree of interpersonal interaction rather than in the quiet of a dorm room. Another indicator may be offered by the work being done by Cook et al. (2015) and Helps et al (2014) incorporating the use of white noise in the didactic environment for attentionally challenged youth.

Directing more cognitive resources toward processing core cognitive tasks may be viewed as increasing the efficiency of processing resources. If such a process could be demonstrated in cognitive processing, then it would suggest an ability to improve cognitive efficiency. The assertions of Colom, Rebollo, Palacios, Juan-Espinosa, and Kyllonen (2004) regarding the close association between *g*—a measure of general intelligence which, as Colom et al. note, is "common to all tests of ability" (p. 278)--and working memory would suggest that a boost in working memory efficiency would be a boost to *g* as well. The existence of a process under the control of the individual to enhance working memory would offer a new dimension to discussions of the malleability of intelligence and the way in which information is processed.

Looking at the reverse implications of an upheld hypothesis, what of those individuals who have been taking advantage of additional environmental demands to improve their cognitive performance, only to lose those environments? Unemployment, sickness, promotion, relocation—any of these could place an individual, suddenly, in a nonoptimal environment. When such an event occurs, how can an individual adapt and maintain cognitive abilities at the former level? For those suddenly unemployed, for example, would they preserve or regain their environmental-demand-boosted abilities sufficiently to demonstrate them in the next job interview or examination? There might be suggested a danger that individuals used to the attentional boost derived from external demands, once deprived of them, may be unable to regain a situation in which those demands are available—may be unable to demonstrate competence in the very occupations or positions that provided them with that boost, because of inability to demonstrate their former levels of cognitive competence.

In the event the primary hypothesis is not upheld, the place of rationality and science in society is well-served by the debunking of an unfounded myth, especially one such as this, which has made its way into established management theory.

Regardless of the outcome of the research, the data acquired would form a contribution to accelerating research on cognitive capacity and performance under load, a field receiving increasing attention in recent years (see the summary in Kirschner et al., 2011). Additionally, a well-constructed study performs a useful social purpose—the reinforcement of scientific research based upon curiosity, upon those moments when someone says, “Now, that’s odd,” or “Why should that be?” In a society where irrationality and unreason become increasingly powerful, reinforcing the foundations of science is social change in itself.

Summary

It has long been suggested that “busy” people may be more efficient task performers than others not so perceived. Conventional thinking on cognitive task processing has contradicted that idea, holding instead that increased task load must necessarily degrade cognitive performance. However, a thread of inconsistency runs through cognitive research, with exceptions to the general rule appearing through the years, as cognitive load appears to assist rather than inhibit or obstruct task performance. In particular, recent work on multitasking and on performance under high cognitive load has suggested that some individuals have abilities well beyond predicted cognitive performance under such circumstances, suggesting an ability to perform better than others who are (theoretically) not so encumbered.

Alongside these apparent anomalies runs my interest in cognitive load occasioned not by laboratory induction, but by environmental demands—dealing with a busy social or work life, handling social interactions. Combining these two interests raises a question: Is some of the apparent task overload in so-called "busy" people a means of using some of the suggested advantages of high cognitive load? In effect, they would be using such load to make themselves perform better, whether or not they were conscious or aware of that.

As a first stage in exploring the possible phenomenon outlined above, I explored whether any such advantage might be identified in people with an identifiable high level of "busyness" in their daily lives. Chapter 1 outlined the development of the research questions and hypotheses, and offered an outline of the theoretical background, including historical hints at the existence of the deliberate use of cognitive load to increase the efficiency of goal-oriented cognitive processing.

Chapter 2 comprises a comprehensive review of the literature on working memory and cognitive load, expanding on gaps in the literature and theory. I then consider, in greater detail, more recent work that shows the existence of performance beyond prediction in other areas involving cognitive load and task performance. Chapter 3 contains descriptions of the research design and methodology, instruments, and data analysis.

Chapter 2: Literature Review

This review of the literature provides a brief overview of the concept of busyness, which has been defined as “the environmental demands of day-to-day events with which [persons] cope” (Martin & Park, 2003, p. 77), and offers a description of the positive and negative effects of busyness on response to cognitive load. Working memory (WM) and cognitive overload inform the theoretical framework of this study. Information on intelligence as related to WM and attention span is also provided, along with information on the impact of distraction on intelligence. A review of the literature on strategies and instruments to measure WM and cognitive load is included, with a description of the Martin and Parks Environmental Demands Questionnaire.

There are eight main sections within this review of the literature. Each section of the literature review builds upon the next in order to better define the objectives of this research study, which explored *volitional busyness* and cognitive efficiency. The first describes WM primarily through the research of Baddeley (1992, 2000, 2001, 2003, 2011; Baddeley & Hitch, 1974; Bayliss, Jarrold, Gunn, & Baddeley, 2003) with support from many others. The review also explores contemporary theoretical models of short-term memory and WM. The next section defines WM’s role in cognitive load theory, followed by a section on working memory capacity (WMC). A section on perceptual load theory follows the discussion of WMC, describing the measurement of cognitive load and defining automaticity. These sections provide a solid foundation for the subsequent sections on busyness, volitional busyness, multitasking, and learned cognitive strategies.

Keywords

Key terms used to search the literature included *volitional busyness*, *theory of cognitive overload*, *working memory*, *Parkinson's law*, *busiest man*, *ask a busy man*, *environmental busyness*, *busyness*, *cognitive busyness*, *cognitive control*, *cognitive ability*, *cognitive processes*, *attention*, *attentional control*, and *perceptual load*.

Literature Search Strategy

The literature compiled for this review was obtained through the use of comprehensive online library search methods. A librarian was used for assistance in determining the best search methodology and to help generate ideas regarding keywords to search. Among the journal databases searched, those generating the most applicable results were JSTOR, EBSCO, PubMed, Science Direct, Wiley, and Elsevier. A multitude of other databases were also searched in the process. Prior to generating the returns, the "peer reviewed" feature was selected, ensuring that all of the literature generated would fit this designation.

I reviewed current literature containing empirical research in the relevant areas, which appeared in a wide range of publications, from journals of general psychology (*American Psychologist*), experimental psychology (*Journal of Experimental Child Psychology*), and neuroscience (*Neuropsychology*) to journals on cognitive science (*Applied Cognitive Psychology, Cognition, Cognitive Neuropsychology, Intelligence*) and social psychology (*Journal of Social Psychology, Journal of Applied Social Psychology, Journal of Personality and Social Psychology*). Articles were identified through searches conducted through the Walden University Library; through Google Scholar with a preference for peer-reviewed journals; and through Internet search engines such as Google and Scirus, with a filter applied for peer-reviewed journals. Additionally, once key authors had been identified in this way (e.g., Lavie, Baddeley, Sueller, Colom, Engle), the corpus of their work was reviewed for other relevant research, and other works cited by those authors were similarly reviewed. Similarly, I reviewed identified journals for other relevant work, especially in specifically themed issues.

Working Memory (WM)

Within cognitive sciences, it is generally agreed that thinking—the consideration of problems, issues, and the weighing and assessing of non-perceptual inputs—takes place within a system known as *working memory* (Baddeley, 1981, 1992, 2001; Baddeley & Hitch, 1974; Bayliss et al., 2003). The term itself is attributed by Baddeley (2003) to Miller, Galanter and Pribram, and it was adopted by Baddeley and Hitch (1974) in their proposal of the initial multicomponent model to differentiate between it and the earlier models based on short-term memory (STM). More than 40 years later, the model has seen significant development, through the significant revision offered by Baddeley (2001) and continuing work since (e.g., Baddeley, 2003, 2011; Barrouillet et al., 2007; Colom et al., 2004; Cowan et al., 2008; Süß et al., 2002). Over three decades of contributing research, the term went through several varying and inconsistent permutations before being defined as referring to the system or systems involved in the temporary maintenance and manipulation of information (Baddeley, 2001; McCabe, Roediger, McDaniel, Balota, & Hambrick, 2010).

Working Memory Models

While the basic WM concept was broadly accepted early on, Barrett, Tugade, and Engle (2004) noted that there was little initial agreement on the definition or even components of the model. For example, Colom and Shih (2004) asserted strongly that WM was simply a storage facility, although comprising “a highly integrated ensemble of cognitive functions” (Colom, Shih, Flores-Mendoza, & Quiroga, 2006, p. 811). Opinion was sharply divided on the issue, with other studies (Mackintosh & Bennett, 2003; Shah & Miyake, 1996) suggesting at least partial fractionation. However, there was broad agreement upon certain characteristics of the conceptualized WM system. Particularly, it was seen to play a central role in controlling attention—balancing the various calls upon working memory capacity (WMC) at any given moment—and integrating calls and information transfer between inputs, short-term memory, and long-term memory (LTM; Oberauer & Hein, 2012; Paas & Sweller, 2012). There were, however, competing schools of thought on WM structure and function, offering different theoretical models on how WM functions (Logie, 2011).

Unitary Model

The earliest modern theories of STM were rooted in the observation that when humans are presented with a series of items to be recalled, they are able to recall very few of them (Sperling, 1960). As implied by the terminology, such iconic memory (Neisser, as cited in Gegenfurtner & Sperling, 1993) was considered to be based on visual imagery and considered to have only a very small capacity—typically, about four items—for only a short time (Cowan, 2001; Sperling, 1960; Zhang & Luck, 2011). Experiments involving the short-duration display and subsequent recall of visual data suggested that information was held in memory only for a small fraction of a second (di Lollo & Dixon, 1988). The hypothetical area of STM responsible for immediate processing of data was known as the *short-term store* and was also theorized to be the controller and allocator of memory resources for processing of immediate data such as speech and the transfer of information into LTM (Baddeley & Hitch, 1974; Atkinson & Shiffrin, as cited in Baddeley & Hitch, 1974) . This era saw the beginnings of the conceptualization of WM as a system containing various stores and working modules, with a central coordinating system (Baddeley & Hitch, 1974).

The Three-Component Model

In a summary of the state of research and theory on WM, Baddeley (1981) pointed out the limitations of a theory based purely on a single STM store, noting research demonstrating its lack of predictive value. Baddeley (1981) noted particularly Baddeley and Hitch's (1974) prediction that in a unitary system with limited capacity, once the memory being used for both storage and processing is moderately challenged by simultaneous processing and storage tasks, performance should be impaired. This was indeed demonstrated, with reasoning speed and item recall both adversely affected by the introduction of two or more additional items into STM (Baddeley & Hitch, 1974). However, the noted effect was far from that expected by the researchers. In what might be seen as foreshadowing many such results to follow (e.g., Jaeggi et al., 2007; Watson & Strayer, 2010), while the researchers expected the "near-span digit load ... should have almost totally occupied STM," it failed to do so (Baddeley, 1981, p. 17). The effect was so far from predictions that it led Baddeley and Hitch to a revised conceptualization of the mechanisms of WM, which has since come to form the basis of models of WM—even of those apparently in contest with it (Baddeley, 1981, 2003; Baddeley & Hitch, 1974). Baddeley and Hitch described a structure that included not just a single short-term memory but two—one handling essentially auditory or language-based information (the phonological loop) and one handling essentially visual or spatially-based information (the visuo-spatial scratch pad). These two data stores were seen to be administered by a *central executive*, which combined elements of a verbal memory store and a controller—essentially, an administrator and allocator—of attentional resources.

Such a model would accord with Gilbert and Osborne's later (1989) general observations on cognitive deterioration under load, which implicitly allowed for a simultaneous-processing or resource-sharing model: "When people do too many things at once, they often do some of them badly…" (p. 946). Clearly, while the effect of cognitive load (described by Gilbert and Osborne as "cognitive busyness" [1989, p. 940]) on cognitive processing was becoming substantiated by research, there were some exceptions to the expected degradation. Gilbert and Osborne expanded on this with a number of observations on responses and reactions to cognitive busyness, including automatic process responses.

By extension to the three-component theory, and as similarly theorized with the unitary model, once the "pool" limit of WM was reached, probably at four or more items (Cowan, 2001), there would be no resources left for any other processing. As such, when too many calls were made on attention simultaneously—increasing cognitive load—WM should reach its capacity and become unable to allocate more resources to some tasks (Wickens, as cited in Watson & Strayer, 2010). However, and once again, experiments conducted by Jaeggi et al. (2007) found that when considered as a group, participants' WM was affected as predicted by Wickens, yet there were individuals able to maintain WM and attention-related tasks beyond predicted capacity limits.

Such inconsistencies between predictions and observations were noted by Kirschner, Ayres, and Chandler (2011). In their survey of the present state of knowledge on cognitive load, they noted the continuing dearth of consistent and replicated research in the area. Notably, they drew attention to a lack of correlation between reported cognitive load and associated measures of performance—implying, however, the effect was attributable to a measurement or reporting issue. They noted strongly that there were multiple such inconsistencies and little follow-up.

Multiple-Component Model

The introduction of more sophisticated WM testing techniques offered evidence to challenge and expand upon the three-component model (Baddeley, 1992, 2003; Duff & Logie, 2001; Logie, 2011; Towse, Hitch, & Hutton, 1998). Like the three-component model, the multiple resource-sharing model conceived of WM as including the executive functions that control allocation of resources. However, it considered that such resources were not shared but rather apportioned and allocated uniquely to a number of associated mechanisms, such as those handling auditory and visual neuro-processing. In effect, it considers WM as a structured workspace with a number of more-or-less discrete components, such as language, visual, and episodic memory, each with their own resources. Logie (2011) commented that the attention-control functions of WM were not seen in this paradigm as standing alone, allocating a pool of resources as needed. Rather, they resided within a group of subsystems, each with its own part to play in storing and processing different types of stimuli and inputs.

Controlled-Attention Model

Essentially, this model emphasized the role of the central executive in Baddeley's (1981) model, such that it became the key component in a system for controlling and focusing attention (Cowan, 1988, 1999; Engle, 2002; Oberauer & Hein, 2012). Baddeley specifically noted that this was essentially "a different emphasis, but not in any fundamental sense incompatible with a multi-component model" (Baddeley, 2003, p. 837, referring to Cowan, 1999).

In a review of the state of knowledge and research on working memory, Logie (2011) asserted the two main strands of thought to be the multiple-component and the controlled-attention models, standing as theoretical equals. In research practice, the primary difference between the competing theories of resource-sharing and multiple resource-sharing would be the differing questions raised on working memory, and conversely, the effect on choice of research designs and data collection methods. The research questions will tend to guide the preference for one theory or the other as a theoretical basis for the research at hand (Logie, 2011; Roberts, Beh, & Stankov, 2002). For example, the multiple-component theory is little affected by considerations of WMC, because it is concerned with processing speed and strategies, whereas the controlled-attention theory lends itself to a focus on individual differences in working-memory capacity and capabilities (Logie, 2011).

Working Memory Capacity

Under cognitive load theory, working memory capacity was believed to be strictly limited (Buschman, Siegel, Roy, & Miller, 2011; Cowan, 2001; Cowan et al., 2005, 2008; Paas, Tuovinen, Tabbers, & Van Gerven, 2003; Zhang & Luck, 2011). The limitation is not simply a theoretical, technical issue; researchers have tested the limits of WMC and sought to measure and predict the various demands and factors that will cause that limit to be reached (Buschman et al., 2011). Some researchers suggested that the limits of WMC may be taken as synonymous with limits on attention (Engle, 2002; Kyllonen & Christal, 1990).

One assumption of working memory capacity has been that people are limited by a limited WM in how many cognitive tasks they can perform. Past research into WM suggested that there was a rule of seven information elements, plus or minus two elements, that a human could hold (Miller, 1956). Cowan (2001) disagreed, noting that many researchers have suggested a significantly smaller limit of about four information elements. And yet WM is not limited simply by raw "capacity," as though it were computer RAM (Cowan, 2001). Jaeggi et al. (2007) noted performance on WM-based tasks well in excess of predicted capabilities, to the extent that the experimental goal of loading participants past their WM limits was not achieved in some cases.

Sweller (2006) suggested that because the processing of new information contains such a significant random element—the "trying-out" of randomly generated alternative implications of the new data—WMC was necessarily limited as an evolutionary protective factor. By implication, a restricted WM prevented the possibility of large-scale corruption in the personal cognitive structure by limiting the amount of information that may be affected by the necessary “randomness” involved in the acquisition of the new information (Sweller, 2006). By contrast, Watson and Strayer (2010) indicated that changing environmental demands—less physical and more cognitive, and including the effects of technology—may be favoring the supertasker’s abilities. These evolutionary advantages have yet to spread to the general populace, however, as evolutionary processes are restricted to generational time constraints. Other factors, however, may serve to enhance WM, apparently overcoming some of the restrictions.

Effectiveness of Filtering Heuristics

Vogel, McCullough, and Machizawa (2005) demonstrated that the key to effective memory use is rejection and filtering heuristics. Subjects with “high capacity” memory were more efficient at sorting out what needed to enter WM and what might be excluded as irrelevant. Vogel et al. (2005) noted that subjects with apparent lower WMC may actually be storing more data than “necessary,” which might have been rejected by a more efficient mechanism. Gazzaley and Nobre (2012) indicated that fMRI data showed a filtering of information to prevent overloading, which tends to support Vogel et al. (2005). Cowan (1988) even suggested that such “filtering” might take preawareness—before certain data even reached the area of activated memory known as the *focus of attention* such that monitoring of inputs not deemed immediately relevant would be outside awareness, yet could be brought into awareness under certain “trigger” conditions.

Working Memory Training

Researchers have demonstrated that executive control may be strengthened through training of WM (Houben, Wiers, & Jansen, 2011; Klingberg, 2010). The specific implication was that improving WM would improve attentional control and reduce distraction, or at least improve the handling of low perceptual load (Lavie, 1995). Jaeggi et al. (2007) noted that following WM training, as with training on other high-end cognitive tasks, there was decreased activation in certain regions of the brain where high activation was associated with lower task performance.

Support for this conclusion was drawn from research (Coubard et al., 2011; Darowski et al., 2008; Milham et al., 2002) suggesting that much of the apparent cognitive decline in older people was actually a weakening of executive function—the “filter mechanism” that sorts and excludes the relevant, the irrelevant and the merely distracting from attention, and thus from processing through WM. (Perhaps too this is associated with decreasing ability to prioritize processing on certain data streams—as noted in Cowan’s Habituation Hypothesis of Selective Attention [1988]—leaving them below awareness unless or until activated.) Engle, Tuholski, Laughlin, and Conway (1999) concurred, equating both WM capacity and fluid intelligence with “the ability to keep a representation active, particularly in the face of interference and distraction” (p. 309). Lavie, Hirst, de Fockert, and Viding (2004), also concurring with such a weakening in executive function, noted older people demonstrated a reduced capacity for processing perceptual stimuli, such that they were able more readily to resist distractive perceptual stimuli (lower threshold for perceptual overload). This tended to at least partially compensate for reduced cognitive capacity that would tend to decrease ability to resist such distractors (Lavie et al., 2004).

Modality Effect

A significant amount of cognitive load theory and research is derived from, and related primarily to, the effect of cognitive load on learning. Indeed, the term *cognitive load* is typically attributed to Sweller (1988), in his study on problem-solving and learning. Much of the research in this area is concerned with the process of information acquisition, processing, and storage (Kirschner et al., 2011). As such, little of that work is directly applicable to a work such as this, which is dealing with processing of real-time tasks--with one very large and notable exception.

Baddeley (1981) reported on unpublished research that required an additional task to be performed simultaneously with a main task. Where the tasks were of a different nature—verbal and reasoning—the additional cognitive load did not impact performance of the main task until it reached quite a high level of cognitive load. This added weight to the assertion of separate WM elements, each with their own resources (Baddeley, 1981). Accordingly, dividing the presentation of information between such channels serves effectively to increase working memory beyond the innate capacity of the individual (Kalyuga, Chandler, & Sweller, 1999). This *modality effect* has been the subject of a considerable amount of research, and has indeed been shown to improve effective WM capacity (Kalyuga et al., 1999). The apparent paradox bears pointing out: Adding additional cognitive load improves overall cognitive capacity. The reverse is also supported; presenting information redundantly, in a manner calculated to force reconciliation of the different data "channels," degrades effective working memory capacity (Kalyuga et al., 1999; Spanjers, van Gog, & van Merriënboer, 2012; Van Merrienboer & Sweller, 2010).

In an echo of the modality effect, Kim, Kim**,** and Chun (2005) noted that cognitive load reduced distraction. Contrary to prevailing theory, they asserted, the addition of load may improve processing efficiency, but it is dependent upon the type of load. However, the importance of WM in this process has been challenged. Oberauer, Lange, and Engle (2004) conducted research that did not support the earlier contention that WMC may be equated with an ability to resist distraction. They further concluded that WM was also not related to any special facility or skill in executive function, such as partitioning attention between task-demands.

Individual Differences

Using the metaphor of a digital camera, Cowan (2001) suggested that while each individual may store only three or four "images," or features, in WM, that there was a "resolution" fixed for each individual, and differences in the "resolution" and number of features stored. Zhang and Luck (2011) then suggested the possibility of actual innate differences in WM between individuals. Such individuals with the ability to store more features had a significant advantage in problem-solving—perhaps through holding more ideas to add to the mix—in object permanence and image rotation.

This accords with other views on the importance of looking at individual differences between research participants, particularly the differences in executive function and attention capture (Engle & Kane, 2003). Vogel et al. (2005) noted that individual differences in filtering of irrelevant information account for much of the observed variation in WMC. Jaeggi et al. (2007) also noted two defining characteristics even of their arbitrarily-selected group of “high-performing participants” (p. 75—selected at the median of scores on a challenging n-back test.) One was individual capacity: These participants, able to function better than predictions under very high cognitive load, used fewer cognitive strategies for their tasks, and were more likely to rely on “intuition” or automatic processes than were lower performers, who were likely to switch between multiple strategies and did not rely upon “intuition” at all (Jaeggi et al., 2007). The second important characteristic was simply intent to succeed at the task, suggesting a degree of self-efficacy—the belief or experience that one will be able to succeed, or at least have sufficient chance of doing so. Such an association between the experience of self-efficacy and the ability to function under increased cognitive load was also noted by Gazzalay and Nobre (2012). Elsewhere, the scope of such individual differences has been found to include individuals with cognitive abilities previously declared impossible. Watson and Strayer (2010) found a very small percentage of people able to perform dual task operations without experiencing a decrease in performance—“supertaskers” (p. 481). Other studies have also shown that such performance beyond predictions is possible on an individual basis even where study participants in aggregate showed a decrease in performance (Hoffmann et al., 2013; Jaeggi et al., 2007; Kim et al., 2005) . The lack of information pertaining to these high performers has demonstrated a gap in the literature.

Theoretical Aspects of Effect of Cognitive Load on Cognitive Processing

According to the modality effect on learning (Kalyuga et al., 1999), as cognitive load increases, the three elements of WM loading—intrinsic, extrinsic and germane—are involved in task- or problem-specific functions, allocating memory elements to the next input or task. When the WM limit is reached—generally when four or more sustained representations would be required (Cowan, 2001)—then processes not already allocated WM will be deprived of it, while active processes will have the existing allocation reduced (Buschman et al., 2011). Thus, the evident effect of cognitive load is to reduce the amount of WM available for the performance of cognitive processes. Cowan (2001) noted the debate over whether such limits were real or apparent; that is, whether they relate mainly to image decay in STM (Engle et al., 1999), to a decreased ability to handle distraction (Lavie, 2010; Lavie et al., 2004), or to the re-allocation of restricted attentional resources (Barrett et al., 2004; Fitousi & Wenger, 2011). Regardless of the debate on the underlying mechanism, the noted effect was accepted—the introduction of additional cognitive tasks eventually results in deterioration in performance, in either a new or existing task (Fitousi & Wenger, 2011). The uncertainty over the mechanism, however, is consistent with complaints and concerns that this area of cognitive science remains inadequately supported (Fitousi & Wenger, 2011; Kirschner et al., 2011). These studies have shown a need for further research.

It should also be noted that other researchers (Sweller, 1988, 2006) speculated it may be likely more complex problems increase cognitive load, so taking up WMC and reducing problem-solving ability. Sweller (1988) described such interference between problem-solving and learning under conditions of high cognitive load as “inevitable” (p. 275). Given the noted relationship between WMC and general intelligence (Süß et al., 2002), it is not then unreasonable to equate increases and decreases in effective WM capacity with apparent corresponding changes in general intelligence or problem-solving ability.

Automaticity in Processes

It was noted over a century ago that it was possible by overtraining to gain the ability to carry out a cognitively demanding task simultaneously with other similarly demanding tasks without degradation in the primary task. The classic example was that of telegraph operators (Bryan & Harter, 1897). Effectively, with training and experience the operator gains the facility to force performance of the primary task below conscious awareness, suggesting that it was awareness, or attention paid to the task, that required most cognitive processing. With such operations performed with a high degree of automaticity, cognitive capacity is freed for the more cognitively demanding and consciously processed tasks (Gilbert & Osborne, 1989). Gilbert and Osborne (1989) concluded that those demands or processes closest to automaticity were the least demanding on resources.

Clearly, too, the switch into unconscious operation is itself automatic, prompted by nothing more than the introduction of a more cognitively demanding task, such as a conversation or other similar interaction, or simply a "trigger" to which the individual has become sensitized or *habituated* (Bryan & Harter, 1897; Cowan, 1988; Jaeggi et al., 2007). By implication, then, the overtrained individual gained not just the facility to perform an otherwise cognitively demanding task with little conscious processing, but also to switch the task automatically into that mode of processing in response to a situational demand, without the need to learn a cognitive technique for making that switch.

Distribution of available resources. When WM is subjected to multiple, simultaneous cognitive demands, those processes demanding most resources are shut down. Gilbert and Osborne (1989) used the term "failure" to describe this process. However, their characterization of this process could readily be re-framed to see it as advantageous to the performance of the other processes at hand: as a re-distribution of available resources, in fact, to run as many simultaneous tasks as possible.

Perceptual Load Theory

Alongside the cognitively driven system that draws directly from WM is another set of demands — that of awareness of external stimuli, and filtering into or away from perception. Lavie (1995) proposed that this mechanism functions alongside the element of WM that controls and focuses attention, while at the same time pulling from the same pool of WM and cognitive capacity. This *perceptual load theory* (Lavie, 1995) defined perceptual load as the demand imposed by stimuli, such as sensory data, while cognitive load then became the load imposed by the processing of object-based data. Under this theory, high levels of perceptual load reduce (or eliminate) the ability to process distracting stimuli, leaving attentional resources free to deal with goal-directed stimuli (Lavie, 1995). Conversely, high levels of cognitive load reduce the executive (attentional) control capacity required for continued suppression of processing of distracting stimuli. Perceptual processing efficiency thus decreased in the presence of both distraction and high cognitive load.

Under situations of high perceptual load, study participants have experienced *selective attention*—the reduction or restriction of the ability to recognize or process extraneous distractions—which has also been termed *inattentional blindness* (Lavie, 2010; Simons, 2007; Simons & Chabris, 1999). At a certain point, stimuli that would distract the individual from the task at hand are simply removed from awareness—that is, no longer granted cognitive resources—leaving newly-available capacity to process essential perceptual inputs (Gazzaley & Nobre, 2012; Simons, 2007; Simons & Chabris, 1999). The phenomenon is well-known, having been recorded as early as 1907 but more extensively studied since about 1975 onwards (Simons & Chabris, 1999). Perhaps the best-known demonstration is the “Invisible Gorilla,” where participants are invited to count passes being made between two basketball teams, and are subsequently shown to be so focused upon the primary task they fail to observe a person in a gorilla suit walking on the court (Simons & Chabris, 1999). More practically, experts who are offered distractor images during a search for specific image types and sizes may filter them out of perception. In one case, radiologists looking for nodules on CT scans missed the image of a gorilla inserted into the scans, at a scale almost 50x the size of the average nodule (Drew, Võ, & Wolfe, 2013). The researchers wrote this up in a regretful tone, as “even experts suffer from inattentional blindness." To me, it would show that the experts had developed appropriate and effective heuristic filters, keeping them focused on the task at hand. The observation that the phenomenon may not be consciously perceived but may still pass into a "perception schema" at some level (Simons & Chabris, 1999) accords well with Gilbert and Osborne's (1989) observations on delayed processing.

Perceptual load theory is antithetical to the basic hypothesis of the present proposal, in its assertion that WM load on its own has not been shown to lead to inattentional blindness. However, it has suggested an alternative possibility—that under conditions of high distraction from non-goal-related stimuli, at a certain threshold, processing and conscious attention paid to such stimuli is relegated below awareness, and attentional resources shifted towards goal-relevant stimuli. While perceptual load may interfere with or block the processing of non-goal-directed stimuli (distractors), it is a function of higher cognitive control mechanisms to maintain the low priority being given to processing such distractors (Lavie et al., 2004). In conditions of high cognitive load, Lavie et al.(2004) argued that resources required for the effective maintenance of such control are not available. In consequence, the reduction in the influence of distractors, an effect of high perceptual load, would be undermined by the absence of effective reinforcement and support from cognitive (attentional) control processes (Lavie et al., 2004). So, if it is believed that the "busiest man" is "loaded" not so much by cognitive tasks (reasoning and thinking, etc.) as by perceptual inputs, then cognitive load theory certainly supports the divestment of excess input—and thus the freeing of "processing" capacity and implicitly increased focus—after a certain point.

The phenomenon of inattentional blindness may be such that it positively affects performance. However, according to Dutt (2007), cognitive performance decreased during real-world tasks imposing high cognitive load, regardless of the level of perceptual load. The contrast between the conclusions reached in Lavie et al. (2004) and Dutt (2007)—the latter essentially a review of Lavie et al. (2004)—was notable. Dutt used different tests, real-world versus computer-based, and different levels of extraneous distractors (Dutt, 2007). Dutt's conclusion, discounting any effect of high perceptual load on the impact of high cognitive load on performance, contrasts strongly not only with Lavie et al. but also with DeLeeuw (2009), who suggested that an "optimal level" of cognitive load "insulates against distractors" (p. 67) and could be mistaken for inattentional blindness. Much like wave frequencies coming together and cancelling the effects of each other, high extraneous (cognitive) load and distractors functioned to maintain focus, as opposed to high perceptual load having that effect (DeLeeuw, 2009)—which is also a partial statement of my own research hypothesis.

Vehicle drivers exemplify this phenomenon very well, as noted by Lavie (2010), because of the high degree of focus required to drive a vehicle and block out extraneous information, whether it be from inside the vehicle or outside. Lavie observed that during periods of high perceptual load, drivers were often unable to differentiate between the irrelevant distractors and those that were relevant, such as traffic lights, pedestrians, and motorcycles. This accords with other research where combined high perceptual load and high cognitive load predicted lower levels of performance for participants in real-world studies (Watson & Strayer, 2010).

Busyness

Although the state of being busy has often been described, finding a generally accepted definition of busyness has remained a challenge. The concept has had a long history, carrying the implication that it is a state of being rather than a phase or a transitory period of high task load (Ray, 1768). Originally described by Gilbert and Osborne (1989), the concept of cognitive busyness was expanded by Lieberman (2000) who described it as the "effects on task A when WM is being used to complete task B" (p. 484). Such effects were found to include reduced function in areas such as reasoning ability (Gilhooly, Logie & Wynn as cited in Mackintosh & Bennett, 2003), decision-making (Ferrari & Dovidio, 2001; Roberts, Beh & Stankov as cited in Mackintosh & Bennett, 2003), and the ability to commit information to long term memory (Whitbourne, 2005; Whitbourne et al., 2008). Kirschner, Ayres and Chandler (2011) noted studies showing degradation of decision-making and the negative effect of extraneous load on learning outcomes. Große and Renkl (2006) and Sweller (1988) observed that offering too many solutions to a problem may so tax WM as to leave insufficient capacity to assess and weigh alternative solutions. In general, research suggested cognitively busy people demonstrate reduced performance on non-core, non-routine cognitive activities such as:

- keeping up appearances at odds with reality (Pontari & Schlenker, 2000), where incongruent self-presentations under cognitive load were notably affected in ways that suggested WM processes were being hindered by the imposed cognitive load;

- inhibition of stereotypical judgments (Kulik, Perry, & Bourhis, 2000; Perry, Kulik, & Bourhis, 1996);
- analyzing situational data and cues and making nuanced decisions and judgments (Ferrari & Dovidio, 2001);
- reconciling or correcting inconsistent information (Hutter & Crisp, 2006);
- inhibiting or interfering with self-control; e.g., cognitive load may inhibit the ability of trait overeaters to restrain their eating (Ward & Mann, 2000), while conversely, strengthening WM through training improves ability to refrain from alcohol abuse (Houben et al., 2011);
- writing to LTM—i.e., schema creation—and then retrieving data, using the efficiency of retrieval from LTM rather than trying to process in WM alone (Kalyuga, Ayres, Chandler, & Sweller, 2003; Kirschner et al., 2011; Sweller, 1988).

Gilbert, Pelham, and Krull (1988) offered the explanation that people exhibiting the effects of cognitive load may simply be "too busy" to use data they are gathering from and about their environment and context. Gilbert and Osborne (1989) noted particularly that those tasks involving interpersonal contact made a notably heavy demand upon cognitive resources. However, assessing the size or nature of the effect of cognitive busyness (i.e., cognitive load) is not an easy matter. In recent years, with changing definitions and understanding of cognitive load, it has been noted that existing measures of cognitive load have been found to be increasingly unreliable (Kirschner et al., 2011; van Gog & Paas, 2008). Paas and Sweller (2012) also noted that performance test results failed to have a direct correlation with subjective measures of cognitive load. Difficulties in assessing or measuring cognitive load may be imputed from the noted practice of assuming that an individual's self-report of task difficulty is sufficient for the purposes of a study of performance involving such load (Kirschner et al., 2011; Paas & Sweller, 2012; Paas et al., 2003). Given the fragmentation of theory in this area, the likely validity of this approach may be limited in application, but alternatives required more specific and sensitive instruments.

Nevertheless, the most familiar dictionary definition of busyness, "occupied with activities," still does not convey the essence of the quality or trait, which seems easier to observe than define. Some researchers (Martin & Park, 2003) have recommended busyness be defined as the extent of being encumbered with tasks. Others expanded the field of view to suggest busyness was the state of being subject to multiple demands that may include social interaction (Milgram, 1970; Segal & McCauley, 1986), and still others asserted busyness was a state of mind, arising from the condition of dealing with multiple simultaneous cognitive demands (Gilbert & Osborne, 1989). Among the many descriptions and forms of busyness are

- busy people have "significantly less free time, less frequency of contacts with friends, less time for physical training…" (Šlachtová, Tomášková, & Šplíchalová, 2003, p. 88);
- busyness is implicitly the condition of being busy with "productive" work, as with Parkinson's "busy man" (Parkinson, 1957, p. 2) compared with his

stereotypical "lady of leisure" (Parkinson, 1957, p. 2) whose time is taken up with "non-productive" tasks;

- busyness is "the density or pace of daily events to which an individual attends" (Martin & Park, 2003, p. 77), with specific regard to the "density of obligations" (Martin & Park, 2003, p. 78);
- busyness is a "mental state" that outside the laboratory is the product of "the many resource-consuming tasks of ordinary life" (Gilbert & Osborne, 1989, p. 940), that may include social interaction.

For the purposes of the current investigation, busyness is described as an observable state associated with multiple calls upon cognitive resources, such as occasioned by undertaking multiple tasks or interactions requiring cognitive resources. Hoffman et al. (2013) indicated that when higher demands were placed upon cognitive load, the cognitive load shifted to a less taxing strategy, which increased performance. Participants were able to ignore distractions while completing the task, which coincided with other research in the field. It follows that people have developed strategies to filter the daily distractions in life while completing tasks.

Measuring Busyness

Concerned with the daily lives of the elderly, and the possibility in particular those demands might interfere with the ability to adhere to a medication regime, Martin and Park (2003) created an instrument to measure busyness. The Martin and Park Environmental Demands Questionnaire (MPEDQ) was developed to assess:

- Self-reported busyness in daily life,

- The degree to which a respondent follows a structured daily routine,
- The degree to which a person's life and time are preoccupied with attempting to complete tasks, and
- The degree to which the tasks remain unfinished.

The instrument poses a total 13 questions on busyness, task-completion, and daily routines, to be answered on a five-point Likert scale. It generates scale data on two independent factors, described by Martin and Park (2003) as Busyness and Routine. Routine is defined as "the predictability or routinization of events independent of density" (Martin & Park, 2003, p. 77). As noted by Martin and Park, they designed the instrument to differentiate between behavior driven by varying or nonconstant task-demands and that driven by established routines. It was also noted that the different demands and routines could reflect very different lifestyles and daily existences.

In the process leading to the development of the MPEDQ, Martin and Park (2003) noted and examined other measures of busyness, predominantly based upon self-reported task-difficulty, and in some cases upon physiological indicators (Paas et al., 2003). Cognitive load theory required busyness measurements as part of the refinement of the process and the materials, typically using self-reporting and physiological indicators of task difficulty. In the case being considered by Martin and Park (2003), the load to be measured was not the load occasioned by tasks, but the prior load—which could be considered a state, or ground of being—in advance of the subject's engagement with a specific task. However, instruments assessing task difficulty were designed to measure specific task-based performance and effort, usually as part of the teaching/learning process. In creating their own instrument, Martin and Park (2003) were following the conceptual lead of Gilbert and Osborne (1989), who asserted that the term busyness was descriptive of “a mental state rather than the activity that gives rise to that state” (p. 940). Gilbert and Osborne added that the multiple demands on cognitive capacity, of which busyness was the product, could take many forms, and the product of busyness, being the state of responding to an environment high in demands, was simply cognitive load. Gilbert and collaborators coined the term *cognitive busyness* (Gilbert & Osborne, 1989, p. 940; Gilbert, Pelham, & Krull, 1988, p. 733) and used it from that point forward to describe cognitive load, reflecting the implicit connection between the mental state and its effects. Blumenthal (2002) also used the terms cognitive load and cognitive busyness interchangeably.

Effects of busyness on cognitive processes. The existence of busyness as a state of being is an old suggestion (Gutierrez & Kouvelis, 1991; Parkinson, 1957; Payn, 1884; Smiles, 1866). By the tenets of evolutionary psychology, the state of being extremely busy would not continue in the absence of some advantage (A. S. Miller & Kanazawa, 2007). However, researchers have expressed concern over the possible deleterious effects of being “too busy.” Martin and Park (2002, for example reported that optimal cognitive efficiency was not generally associated with busyness. Numerous other researchers have demonstrated negative consequences associated with cognitive overload, such as WM degradation and reduced processing efficiency (Kirschner et al., 2011; Paas et al., 2003). Mackintosh and Bennett (2003) suggested that cognitive load deteriorates performance on cognitive tasks; however, they noted that the observed effects will often depend upon the model of WM the researcher is evaluating. Still other researchers demonstrated that it is not possible to perform more than one cognitive task at once with any degree of efficiency, and that performance of any such task performed concurrently with another must be degraded (Dux et al., 2009; Dux, Ivanoff, Asplund, & Marois, 2006; Gilbert & Osborne, 1989; Pashler, 1994).

By contrast, other researchers demonstrated that under high cognitive load, some people are able to display strategies improving focus upon a task at hand (Kulik et al., 2000; Pontari & Schlenker, 2000; Silvera, 1995; Sternberg & Mio, 2008; Watson & Strayer, 2010). Still other researchers demonstrated that performance of some tasks under high cognitive load may not degrade to the degree predicted (Baddeley, 1992), may not apparently be affected at all (Bryan & Harter, 1897), and may even be improved (Sweller, 2006). Such improvements in focus or processing efficiency have been purported to occur as a function of intelligence.

Busyness, Intelligence, and Problem-Solving

Chi, Glaser, and Rees (1981) stated unequivocally that the three key components of cognitive performance were speed of processing, memory span, and the use of complex strategies, and that greater intelligence was associated with greater capacity in all three. “More intelligent individuals have faster processing speed, longer memory span, and use more sophisticated strategies than less intelligent persons” (Chi et al., 1981, p. 7). At least one strand of thought suggested that WMC (available capacity) moderated the ability to learn unfamiliar information by slowing down the process of identifying its implications and committing only those considered “valid” into LTM (Sweller, 2006).

Conversely, the availability of information in LTM greatly increased problem-solving speed, when compared to individuals working with completely new information, as WMC does not restrict the processing of data already in LTM (Hambrick & Engle, 2002; Sweller, 2006). If the issue at hand is problem-solving skills, and conveyed in terms of existing knowledge rather than processing speed and practice effects, an increase in memory span or processing speed might be perceived and measured as an increase in intelligence (Baddeley, 2003; Daneman & Merikle, 1996).

It is further proposed by some researchers that the overlap between WM and *g* (measure of fluid intelligence) may be regarded as a single construct (Colom et al., 2004). Others disagreed in various ways. Hambrick and Engle (2002) stated that prior knowledge in the area in question was a major influence, while noting that WMC was an important factor in performance on memory-based tasks. According to Kaufman, DeYoung, Gray, Brown, and Mackintosh (2009), WM is a component of *g* but so too are processing speed and associative learning. Because of those additional components, they suggested intelligence as a single construct of WM could be disregarded (Kaufman et al., 2009).

Volitional Busyness

If cognitive busyness is to be in any aspect a learned or adopted behavior or condition, then a differentiation must be drawn between busyness that arises from matters outside the immediate control of the individual, and that which is a strategy adopted by the individual. In this context, the term *volitional busyness* is adopted, describing that element that arises from decisions or autonomous actions of the individual. There is a strong implication in the definition of the two scales generated by the MPEDQ—being respectively Busyness and Routine—that there is a difference to be drawn (Martin & Park, 2003). Here Busyness is, by implication, the task-loading adopted by the individual, while Routine is the structural element that forms part of the daily routine of the individual. In order to enhance the differentiation, this author further suggested a variable may be derived from the difference between the two ratings for any individual, which may be considered a measure of Volitional Busyness. However, to allow for the possibility that Busyness alone may be the influencing factor, the research analysis considered Busyness and Routine as co-equal independent variables.

Multiple researchers have noted that cognitively busy subjects tend to adapt to their condition. Just as perceptual load theory stated that perceptually busy subjects simply ceased perceiving non-goal-directed stimuli (Lavie, 2010), so cognitively busy subjects may be able, despite their cognitive preoccupation, to develop a perception of their own cognitive busyness and accommodate to it, or even to adapt unconsciously to eliminate non-goal tasks from processing (e.g., inattentional blindness). Silvera, for example, noted that individuals given a choice of experimental test to perform were more likely to choose the easiest (1995). The defining quality of the response to cognitive overload—the excess of stimulation or demands upon an already cognitivelybusy person—may be simplification, including choosing simpler alternatives or strategies (Hoffmann et al., 2013; Jaeggi et al., 2007; Silvera, 1995).

Restricting the Awareness and Processing of External Information

In situations of high cognitive load, both perceptual and cognitive information may be received but not processed (Gilbert et al., as cited in Gilbert & Osborne, 1989). Whitbourne (2005) noted memory failures in younger adults on the day following a busy day, suggesting that perhaps they either did not absorb data from that day, or alternatively reprocess existing data for use the following day. For the latter, Gilbert and Osborne (1989) noted, "busy subjects … made less complex representations of the target than did not-busy subjects" (Footnotes, para. 2).

Unconscious data gathering and delayed processing. Gilbert and Osborne (1989) noted that data may be held below perception, recalled and processed later, after cognitive load diminished to a level below "busyness." A controlled, or at least programmed, cognitive process of resource-sharing has thus evolved to make most efficient use of available memory without actually losing data. Subsequently, other researchers have made allied observations tending to support the idea that less-automatic processes are placed on hold when cognitive busyness is high (e.g., inattentional blindness), enhancing the cognitive efficiency of the immediate transaction (Cartwright-Finch & Lavie, 2007).

Gilbert and Osborne (1989) noted that although "busy perceivers" are unable to use information they have collected, information recall is not affected (Experiment1, para. 1; see also Cowan, 1988). That being the case, it is likely cognitively busy people are less able to devote processing resources to respond to distractions outside the task(s) in which they are engaged, and as such may perform tasks with greater focus because they are less easily distracted by extraneous data, not just stimuli (Gilbert & Osborne, 1989; see also Cowan, 1988). WM capacity may indeed be seen as primarily an issue of attentional control, as suggested by Gilbert, Krull, et al. (1988)—that is, moderating the amount of expertise or previous experience a person had in the particular task (Engle et al., 1999; Hambrick & Engle, 2002), with controlled attention assuming greater importance for novel tasks but decreasing as an influence as practice increased (Ackerman, cited in Engle et al., 1999).

Additionally, people in a state of cognitive overload may be aware of the fact at some level, even an unconscious one—as for example in the presence of activated memory influencing strategy but below conscious awareness (Cowan, 1988)—and be able to deploy certain strategies to compensate. Bryan and Harter (1897) observed the experienced telegraph operator being able to start and continue a conversation, and even respond to requests for information and direction, without breaking off the central task of operating the telegraph key, yet without engaging in any evident cognitive "switching" process. This accords with Sweller's (2006) suggestion that under high cognitive load, the processing of new information would be impaired, including the conscious synthesis of strategies based upon the new data (see also Cowan, 1988). However, extraction of information from LTM would not be subject to any such restrictions, thus giving additional "processing capacity" to responses drawn from experience (Baddeley, 2001).

Practice effects and expertise. The maintenance of a certain level of cognitive activity, or the regular practice of certain such activities, may facilitate the neural pathways through which they occur (myelination). This could include a facility in reasoning/logical process, in learning, even in learned filtering, the reduction of processing of distractive stimuli. The process of thinking and problem solving is a function of acquired knowledge (Sweller, 2006). Baddeley (2001) suggested much of what we do, and are able to do, was habituated, and by implication required a reduced amount of processing for non-novel tasks. Therefore, while WM may be in use, the way it is being used depends on what has been learned (by the individual) about how to use it.

Could problem-solving techniques, or even distraction-avoidance strategies, be learned and incorporated into personal schemata sufficiently to boost performance? Moreover, why in that case would there be the need for constant rehearsal and refreshment of the facility? It was noted that expertise—long-term practice in a particular domain—may bring long-term benefits in efficiency, as speed of reaction and performance (Paas & Sweller, 2012). It is generally proposed that such expertise is domain-specific—that is, it does not translate outside its own sphere (Healy, Wohldmann, Sutton, & Bourne Jr., 2006). However, research suggested that where such training placed high demands upon WM, the "domain" could be considered the control of attention itself, and could be transferrable to performance in other tasks with high WM demands that would be facilitated by such enhanced control (Barrett et al., 2004; Engle et al., 1999; Jaeggi, Buschkuehl, Jonides, & Perrig, 2008). Colom et al.(2006) went even further and asserted that the entire WM system was simply a mechanism for keeping representation alive (see also Engle et al., 1999), and any additional capacity would be generalized and non-domain-specific.

The process of information-acquisition, and thus of schema modification, as described by Sweller, (2006), is in almost all cases one of "creation." It involves a trial-and-error process during which an adapted schema is generated from the combination of existing information, new information "borrowed" from the actions or statements of others, and a "random generation and effectiveness testing procedure" (Sweller, 2006, p. 166). In the case of new information, this process randomly generates alternative concepts and suggested actions, with the most "effective" being those retained after trials. The remainder, which by not corresponding with previous information would offer no evident "key" to the existing schema, are discarded. Sweller proposed that all new information derived from others (by observation of their actions or assimilation of their statements) is acquired through this process, and that no such information may be acquired otherwise. However, Sweller also proposed that while the capacity of WM to process new information may be limited, retrieval from LTM was not as restricted. (Participants in this research study did not have the opportunity for trial-and-error, nor information acquisition, which would indicate expertise gained from the real world and applied to the test-taking.)

Accordingly, the more experience the individual has in being "busy," in everything from the handling of the physical and emotional experience, through management of the effects upon the individual's personal and daily life, to the potential range of cognitive strategies that may be deployed, the better equipped the individual may be to handle restricted available WMC—i.e., high cognitive load. In effect, the individual has "learned" to be busy (cognitively loaded) and is able to process that data flow without the intervention of consciousness (Jaeggi et al., 2008). The necessary information—the building blocks of strategy, including as Sweller (2006) noted, not just "the conditions under which particular problem-solving moves are appropriate, but also…the consequences of those moves" (Sweller, 2006, p. 167)—is available in LTM and need not be processed as new information.

Sweller (2006) asserted that the process of random generation of new approaches and strategies was at its height in the process of problem-solving. Working memory is inadequate for the performance of this process in demanding and time-sensitive situations (Sweller, 2006). Indeed, Große and Renkl (2006) found that contrary to the suggestions from other research, the more complex the problem, the less the available WM "processing" capacity, and the less the ability to assess and manipulate the multiple possible strategies required to address complex problems. However, the process of random generation of new approaches, which for others involved a high degree of trial-and-error in formulation, may arguably be replaced in the "busy" individual with the much more efficient retrieval of preformed approaches (Hoffmann et al., 2013; Jaeggi et al., 2007).

Experienced "busy" people may thus have developed more effective strategies for finding additional information, which strategies—by efficiently connecting new information to existing information—reduce the demand made on WM by the "inferential" process— the trial-and-error generation of new strategies (Sweller, 2006). Experienced busy people are also skilled at strategy-switching, which reduces the number of strategies employed (Jaeggi et al., 2007). Notably, others not versed in such strategies might find that such additional information actually interfered with their inferential process and in consequence slowed them down (Sweller, 2006).

Multitasking

Until recently, there has been little evidence to indicate that true cognitive multitasking was possible, with some researchers at pains to repudiate the possibility (Tombu & Jolicœur, 2004). Recent research has opened the door to the possibility, even establishing some parameters for the existence of such a facility in the population, and for the size of any effect. Some useful work has come from the area of computer studies—multitasking being basic to modern computer systems—and particularly from the area of human-computer interface (Salvucci & Taatgen, 2008; Salvucci, Taatgen, & Borst, 2009). However, a caution should be added: These studies do not, in the main, demonstrate a common or accepted definition of "multitasking," which in my own assessment truly refers only to the simultaneous performance of multiple operations (or in the term used by Salvucci & Taatgen, "threaded cognition" (2008, p. 101). Adler and Benbunan-Fich (2012) raise the point in their early discussion—the *parallel processing* that would constitute full multitasking is rare, and limited to certain specific circumstances where the data streams being processed are of different types (e.g. words and music.) Most of the "multitasking" operations to which these studies refer would seem in fact to consist of rapid task-switching (Adler & Benbunan-Fich, 2012); most, but not all, as will be discussed.

Adler and Benbunan-Fich (2012) developed an application in their laboratory study that found performance levels improved to a degree for participants engaged with multitasking, as opposed to a control group that completed tasks in a linear progression. These results showed an initial increase in productivity for the multi-tasking group; however, too much multitasking proved to have a negative effect. Moreover, when the researchers used accuracy rather than productivity as a performance measure, “the results [were] not encouraging” (Adler & Benbunan-Fich, 2012, p. 167).

In a related study, Ie, Haller, Langer, and Courvoisier (2012) predicted that *mindful flexibility* while performing a dual-task operation on a computer would lend itself to increased multitasking performance. Mindful flexibility was defined as having components of trait mindfulness, intolerance of ambiguity, thinking style, complexity, and affective state (Ie et al., 2012). Their results indicated no significant affect pertaining to mindfulness and multitasking. However, through regression analysis of the results, younger and more mindful participants displayed elevated multitasking success compared to the rest of the group. This study accords with the observations of Watson and Strayer (2010) and Colom et al. (2010) that in tests of multitasking ability, some individual participants performed significantly better than the group as a whole.

Judd (2013) monitored self-directed computer-based activities for prevalence of multitasking versus task-switching and focused activity. This study involved tasks that were not well-defined or part of a laboratory environment. Results of these monitored sessions indicated that most student activity involved multitasking. The researcher indicated that multitasking was most pronounced during independent studies; however, this increased activity tended to include a significant amount of nonlearning activity, leading to reduced attention to learning and decreased grades (Judd, 2013). Judd’s conclusions, based upon group outcomes, disregarded current research pertaining to individual performance.

Junco and Cotten (2012) studied a group of college students that participated in a survey and reported an overwhelming use of information communication technologies while performing school work. The researchers noted their use of the term “multitasking” as a loose and more colloquial one, actually better-defined in the context as “task-switching.” Moreover, there was no suggestion in the study that the additional information being sourced was congruent with, or even intended to support, the primary goal-directed cognitive tasks with which other activities were being task-switched. After a hierarchical linear regression, results indicated a marked decrease in grade point averages within this test group during high frequency use of Facebook and texting (Junco & Cotten, 2012). Moreover, the increased productivity became detrimental to the accuracy of schoolwork and learning. Taken at face value, this study concurred with Adler and Benbunan-Fich (2012) and other previous studies regarding decreases in accuracy while participants are multitasking and task-switching. However, because (as noted above) no account was taken as to the nature of the other activities, and their congruence with the primary activities, the study remains one only of time use on goal-congruent vs. (presumably) incongruent time use.

In their study investigating the relationship between intelligence, working memory capacity (WMC), and multitasking, Colom et al. (2010) studied multitasking skills at an air traffic control training facility. This study focused on which of the two factors, intelligence or WMC, would be more advantageous predictors of an individual’s ability to multitask. As predicted, both intelligence and WMC contributed to multitasking, which concurred with previous studies cited therein (Colom et al., 2010). However, once WMC was introduced as a correlate with intelligence, the regression analysis resulted in intelligence no longer being able to predict an individual's multitasking performance. The researchers therefore concluded that intelligence was a weaker predictor of an individual's ability to multitask. WMC therefore exhibited as the more efficacious predictor, even though the correlation between WM and intelligence was significant (Colom et al., 2004). Law, Trawley, Brown, Stephens, and Logie (2013) noted that WM and long-term memory contributed to dual-task performance for participants in a study exploring ability to achieve predetermined goals. (It should however be noted that Law et al., 2013, considered multitasking only as time-switching or interleaving rather than true simultaneous task-performance.) Within a laboratory setting, individuals made on-the-fly adjustments to the plans set forth toward completion of their goals, and WM allocated cognitive resources based on contextual circumstances (Law et al., 2013). These results supported Ie et al. (2012) and mindful flexibility, because Law et al. (2013) also noted executive functions managing WM and cognitive load in order to achieve fluctuating goals, regardless of preparation and memorization of plans toward completion.

Where full (dual-task or better) multitasking is given consideration, received wisdom has been that increasing distraction degrades task performance by reducing the attention available for performance of the task (Watson & Strayer, 2010). Watson and Strayer (2010) based their study on the common concern over distracting cellphone conversations while driving, coupled with the noted conviction of many drivers that they personally are able to undertake the activity without loss of attention (see also Salvucci and Taatgen, 2008, who cited the same activity as a common example). Watson and Strayer's special concern was the possibility that for some, this assertion might be true: Some people, countertheoretically, might possess this capability, suggesting then the possibility of true cognitive multitasking. The aim was to explore whether individual differences might encompass such a possibility, hitherto hidden in aggregated data. Use of a cellphone while engaging in the task of driving could be considered equivalent to a standard dual-task methodology for the exploration of task performance under cognitive load. The second task in classic methodology was typically memorization and rehearsal of objects while processing the primary task. In this case the researchers used an auditory version of operation span (OSPAN), a standard test used to measure performance under induced cognitive load (Engle, 2002).

With so many participants (N=200) this was a large study, clearly intended to reveal what was expected to be a very small effect that might otherwise be subsumed within the aggregate of a small population. The study was successful in dis-aggregating the results to uncover an underlying minority of *supertaskers*, approximately 2.5% of the population, who apparently possessed the ability to perform under imposed cognitive load significantly better than the majority, with no degradation of performance under dual-task stress (Watson & Strayer, 2010). Moreover, supertaskers demonstrated surprising proficiency in both single- and dual-task phases. Indeed, while their performance on individual tasks was good, multitasking performance was very good. The researchers were careful to undertake additional testing and simulations (the post-hoc use of a Monte Carlo simulation) to eliminate the possibility of such a result arising by chance or statistical fluke. They were unable to find any such flaw in experiment or analysis. The conclusion was that these subjects, a small but real subset, genuinely possessed abilities that differed both from the general population and from theoretical prediction. Further support was given to the notion of true multi-tasking by Dux et al. (2009), who while not suggesting that true multitasking may generally be found, noted the possibility of being able to develop the facility and demonstrated some initial steps in that direction.

It may also be appropriate to differentiate between the preference for multitasking and the behavior itself. In 1959 the anthropologist Edward Hall coined the term *polychronicity* (cited in König & Waller, 2010) to refer to the tendency to do multiple tasks at once. Subsequently, multiple definitions for polychronicity have complicated the general understanding of the term (König & Waller, 2010). König & Waller reviewed literature concerning the earliest theories of polychronicity, noting multiple assumptions were made regarding the social activity and orientation of individuals, alongside the disregarding of time constraints (2010). König and Waller proposed a more complete definition: “The term polychronicity should only be used to describe the preference for doing several things at the same time, whereas the behavioral aspect of polychronicity should be referred to as multitasking” (König & Waller, 2010, p. 175). Characteristics of participants in research studies in polychronicity were seen to differ little from the suggested definition of volitionally busy participants.

Grawitch and Barber (2013) extended research into polychronicity beyond the laboratory "with practical tasks people perform every day" (p. 222); notably, this description is almost identical to those used by Gilbert & Osborne (1989) and Martin and Park (2002) to describe everyday busyness. Grawitch and Barber's results were in concordance with previous research regarding performance and multitasking: however, they also suggested polychronicity could predict multitasking only in participants with low self-control. The participants that exerted more self-control were able to perform multiple tasks at high levels.

Learned Cognitive Strategies

WM has been conceived as concurrently storing and processing information (Baddeley, 2001, citing Daneman and Carpenter). The strength of the ability to do both simultaneously, known as working memory span, was also noted as a predictor of skill and speed in other cognitive tasks requiring this facility (Engle, 1996). It was suggested some time ago that working memory span would form a good predictor of general intelligence (Carpenter & Just, 1990; Kyllonen & Christal, 1990), which suggestion has found later experimental support (Halford, Cowan, & Andrews, 2007). However, this must be seen against the finding that learned or acquired strategies may account for some of the differences between high-span and low-span research participants (Jaeggi et al., 2007). A parallel could be drawn with Wiseman's work (2003) on the nature of "lucky" and "unlucky" people, demonstrating that differing perceptual and social strategies, which can be re-learned and changed, make a great difference in the way people both perceive themselves and the world, and in the effect they have upon the world.

Jaeggi et al. (2007) suggested it would be possible to differentiate between people who will perform better or worse under cognitive overload, with the two defining characteristics being individual capacity and intent to succeed. This would also suggest a degree of self-efficacy, which is the belief or experience that one will be able either to succeed, or to have a sufficient chance of success to make the effort worth attempting. As described in the section on multitasking above, goal orientation, for certain individuals, increased attentional biases and their ability to perform multiple tasks at the same time, but only with reduced proficiency and poor outcomes. It is, however, established by Jaeggi et al. (2007) and others that test subjects varied as individuals, yet were seen to perform only in a like manner as a group (see also Fitousi & Wenger, 2011). Thus, only with particular attention to such individual differences could a few individuals be observed to overcome the demands of very high cognitive load (Watson & Strayer, 2010). One such reason for a lack of agreement on methodology that would identify such individual differences was a lack of proper definitions and properly-defined constructs, which would determine the proper variables within cognitive load theory (Fitousi & Wenger, 2011). As suggested by Kim et al. (2005), a good start might come from turning the focus of research towards the tasks encountered by WM and not on the differentiation of how WM and attention interact.

Summary

As seen in this review of literature, WM models contributed to other cognitive theories, such as Cognitive Load Theory, Perceptual Load Theory, and Busyness. Continued development into the existing body of research suggests an opportunity for future studies to explore the individual strategies regarding volitional busyness. Research has shown encouraging results with regard to an individual's ability to perform multiple tasks; however, the body of research lacks the findings on an individual's predisposition toward, and background level of, busyness and how this affects cognitive task performance. Of particular importance and interest is establishing the differentiation between group and individual ability to perform under conditions of very high load. It may be safe to suggest that the concept of supertaskers, as indicated by Watson and Strayer (2010), defines a relatively small group with the propensity to perform multiple tasks, yet the necessary data to contribute to and further explore this finding does not yet exist.

This quantitative cross-sectional correlational study investigated the performance of participants on a standard cognitive task, scored using standard measures of performance and working memory. Chapter 3 discusses the methodology and instruments, including the Martin & Park Environmental Demands Questionnaire. This both collects basic demographic data and derives scale data from self-reports on questions related to busyness in daily life, and the degree to which respondent follows a structured daily routine.

Chapter 3: Research Design and Methodology

The purpose of this study was to identify and describe the cognitive performance of a group of people whose levels of volitional busyness differ. This chapter covers the research design, including three independent variables and the two instruments from which they were derived, the single dependent variable, and the research instrument itself. The population and sample are described, the research question and hypotheses are provided, the data analysis plan is presented and explained, and threats to validity are discussed. Finally, IRB documents and considerations are discussed and explained.

Research Design and Rationale

The research design was of a quantitative nature, intended to explore the possible effect of two hypothesized and one recognized influence on cognitive performance. Therefore, a multiple linear regression was used to assess the independent variables of Busyness, Routine, and Working Memory and their predictive effects on the criterion variable of cognitive task performance. Because there was to be no manipulation of the independent or dependent variables, this study followed a nonexperimental quantitative design to investigate a correlational association (Gliner, Morgan, & Leech, 2011). The study was conducted by using online surveys and activities in the form of structured games that gathered data quantifying the constructs of busyness, routine, working memory, and cognitive task performance. The Martin & Park Environmental Demands Questionnaire (MPEDQ) was administered to participants through online surveys, followed by an assessment of working memory and cognitive performance using the Corsi Block Tapping and Tower of London games, respectively.

Consideration was given to use of an analysis of variance (ANOVA), but that would have been limited to a yes/no answer on the existence of an effect, thereby missing any predictive effects available in the three continuous scale variables. As this was new research, with so little prior research from which to draw, the preservation of such data and their use for maximum predictive value were seen to be paramount. A multiple linear regression is the appropriate statistic when the purpose of a study is to look at the relationship that two or more independent variables might have on a continuous dependent variable (Johnson & Christensen, 2014).

Methodology

Population

The target population for the study was adults aged 34 to 84. This coincides with the population for which the core instrument, the Martin and Park Environmental Demands Questionnaire, was validated (see description below). The estimated U.S. population for the closest available demographic (35-84) is 162,199,938, according to the 2013 Census (U.S. Census Bureau, n.d.).

Sampling and Sampling Procedures

The sample was intended to be drawn both online—from or through the Walden University research participant pool, and through any other participants as might be interested—and "live," by direct request to individuals likely to fit the demographic (e.g., through attendance at conventions and similar events). The use of paid participants, through the online Amazon Mechanical Turk service, was also included as a backup option. A simple demographic instrument, included as part of the online process, was to act as a screening tool. Participants were to be recruited according to the age norming for the MPEDQ (34-84) with a backup exclusion in the first demographic instrument for any potential participants actually outside the age range.

Prior research suggested a range of effect strengths for the effect of cognitive load on cognitive processing. Hutter and Crisp (2006) found ηp2 = .120, a medium effect; the creators of the Busyness construct, Martin and Park (2003), reported $r = 0.38$, also a medium effect. However, Crisp et al. (2004) reported $d = 0.34$, a small effect. Based on these studies, a hypothesized effect size of $r = .30$ was adopted. Howell (2012) recommended that power be near .80, an alpha of .05, and at least a small effect size. Using G*Power 3.1.7 with the proposed effect size, an α of .05, a power of .80, it was calculated that a sample of at least 84 participants would be required (Faul, Erdfelder, Lang, & Buchner, 2007).

Procedures for Recruitment, Participation, and Data Collection

Originally, I proposed to post the project in the information area for Walden's participant pool and offer it through other channels such as professional conferences and listservs, as well as through direct recruitment at professional conferences with the offer of a small incentive ($20 gift card) for fully completing the study. While this may appear to be a higher-than-normal cost per participant, I considered it necessary to offer that level of incentive in order to attract the self-described "busy" participant, who might otherwise be inclined to refuse to participate on grounds of being "too busy." Enhancing the range of busyness scores in this way seemed essential to ensure that results were not just based on those participants clustered around the median, but also offered more extreme scores and thus the possibility of relating anomalous scores to measurements outside the norm (Jaeggi et al., 2007; Watson & Strayer, 2010). I had funds available for this from my own resources, originating in student loans and a recent legacy. Amazon Mechanical Turk was included as a backup option in case these sources proved insufficient to reach the required numbers within the time available for research. Due to time constraints, recruitment proceeded using Amazon Mechanical Turk alone. IRB approval was obtained prior to starting the study. Walden University's approval number for this study is 05-04-16-0096896, and it expires on May 3, 2017.

The only directly relevant demographic information to be collected was age. This was partly to ensure participants fell into the normed range for the core instrument, and partly to allow for data correction (see below). However, gender and education were also collected to revalidate MPEDQ and to postanalyze for possible future projects. Participants were offered informed consent information as part of the introduction to the projects, with an opportunity to receive it in hard copy.

Data were to be collected through an online process comprising the following:

1. A survey-type instrument, implemented either through Walden University's online system or through the web-based version of Inquisit 4. This would depend on participant source and combined a demographic data collection instrument and an online version of the MPEDQ.
2. Two games developed by Millisecond Software as online implementations of recognized cognitive tests.
3. An exit form. (See schematic of the process and form data attached.)

Participants could exit the study at any time through a provision built into the process. Noncompensated participants were to be offered an opportunity for questions and/or comments, a means to receive their incentive for participation, and (if requested) their own results on the test. Those who wanted a summary of the final research were to be asked to leave contact details (email for preference), to be held separately from the main data and aggregated for contact purposes only. They would then be sent a link to the final study.

Instrumentation and Operationalization of Constructs

Participants in the study were first offered an online consent form explaining the project, risks and benefits, and exit procedures. At this point, they were assigned a unique identifier. They began the data-collection part of the project by filling out a short survey-type form online, largely using radio buttons and Likert scales. This survey collected basic demographic information alongside the 11 questions that form the Martin and Parks Environmental Demands Questionnaire.

On completion of the opening/welcome module, participants transitioned (online, and in theory, seamlessly) to the two online activities that gathered data on the other variables—working memory (Corsi Block Tapping Test and performance on a cognitive task, the Tower of London).

Martin & Park Environmental Demands Questionnaire (MPEDQ)—Busyness and Routine. Martin and Park (2003) constructed the MPEDQ to assess the level of environmental demands (daily tasks and routines) of a group of adults aged 35-84. Although the initial (norming) sample was a group with rheumatoid arthritis, the authors of the study noted that there was no other significant difference between the sample and other groups in that age band. The MPEDQ is made up of 11 self-report questions that measure two factors, Busyness and Routine. This instrument was integral to the design of the study, relating continuing environmental demands to the ability to perform cognitive tasks through cognitive load.

Busyness, focusing on the perceived engagement in active tasks. This variable is measured by seven items on a 5-point scale, with responses ranging from *not at all* or *never* to *extremely* or *very often.* Scoring for all items (e.g., "How busy are you during an average day?") ranges from 1 to 5. The scores from all items are then averaged, with a higher score indicating greater density of busyness. The total range of scores is 1-35.

Routine, focusing on the perceived engagement in predictable events. This variable is measured by four items on a 5-point scale, with responses ranging from *never* to *very often*. Scoring for all items (e.g., "How often do your days follow a basic routine?") ranges from 1 to 5. The scores from all items are then averaged, with a higher score indicating a higher degree of predictable behaviour. The total range of scores is 1-20.

Permission to use this instrument was received from Dr. Mike Martin, by email received on May 29, 2011, supported by Dr. Denise Park in an email on May 4, 2015, both of which are located in Appendix A. Reliability and internal consistency were acceptable for the two factors of busyness and routine, with alpha values of .88 and .74, respectively (Martin & Park, 2003). Soubelet and Salthouse (2010) used the instrument to investigate the association between openness and intelligence with demanding or routine activities. In their sample of 2,257 adults between the ages of 18 to 96 years (mean age 50.3, *SD* =18.6), busyness and routine had coefficients of reliability of .88 and .81, respectively, with a correlation between the scales of -0.31.

Corsi Block Tapping Test—Working memory. Developed by Corsi in 1972 (as noted by Kessels, Van Zandvoort, Postma, Kappelle, & De Haan [2000] and Pagulayan, Busch, Medina, Bartok, & Krikorian [2006]), the test is widely used among multiple populations for the assessment of working memory. It provides numeric assessment of the "capacity of the visuospatial sketch pad" (Pagulayan et al., 2006, p. 1044). Noting that such capacity is also affected by aging, Monaco, Costa, Caltagirone, and Carlesimo (2013) created corrective tables that may be used to normalize the data from an application of the test.

The Corsi Block-Tapping Test yields two possible scores—Block Span, being the length of the longest sequence remembered, and Total Score, being a product of Block Span and the number of correct trials. The latter is the more sensitive measure, yielding a wider range of possible scores, making it easier to identify performance of individuals and small groups (Kessels et al., 2000). Accordingly, the Total Score was adopted for this project, with higher scores indicating higher working memory. The total range of scores (Total Score) is 2-144.

This particular version is a computer-based implementation running under Inquisit 4 (2014) and was used under paid license. It was chosen because it is an attractive, easy- (and even fun-) to-use implementation requiring few instructions and minimal preparation. Brunetti, Del Gatto, and Delogu (2014) conducted a study of a similar implementation. It also integrates well with the cognitive task that follows it, in terms of administration and flow, running under the same software suite. While there was a cost associated with this instrumentation (approximately $1,000), I was able to meet it from my own resources.

It is to be expected that the results of a test of working memory will be affected by age (Darowski et al., 2008). In the case of the Corsi, a recent study of a large population (Monaco et al., 2013; n=362) yielded correction grids for age, which were available to be applied to the results of this test post hoc.

Tower of London—Cognitive task. This is a version of the Tower of Hanoi, a traditional tower-and-ball game, respecified by Shallice (1982) as a test of executive function and planning abilities. Tower of London has been widely used and studied (Berg & Byrd, 2002; Krikorian, Bartok, & Gay, 1994). I chose this task because, while it imposes attentional and sequential load, calling upon the planning facility believed to form part of frontal-lobe-based executive function (Krikorian et al., 1994), it does not load specifically or substantially on working memory, thus avoiding duplication of testing and increasing separation between the factors. The Tower of London generates a simple numeric score, with increasing score representing increased performance. The total range of scores is 0-36.

Like the Corsi Block Tapping Test (see above), this particular version is a computer-based implementation running under Inquisit 4 (2014) and was used under paid license. It was chosen because it is an attractive, easy- (and even fun-) to-use implementation requiring few instructions and minimal preparation. It also integrates well with the cognitive task that precedes it, running under the same software suite. It generates a simple numeric score (Krikorian et al., 1994).

This test has not been normed on older adults; norming has occurred with young adults only, with a mean age of 21.6 years (Krikorian et al., 1994). Krikorian et al.(1994) noted that in young people, the effect of age on results of this test is only notable in a comparison between fifth graders and young adults, there being otherwise (above age 12) no statistical difference between them and the performance results of the young adults. A similar effect is shown in the Porteus Maze Test, where the effects of age and education in younger populations serve to improve performance, but only up to a certain point (Krikorian & Bartok, 1998). In the absence of correction data for Tower of London, the effect of age was to be investigated in the regression analysis and corrected if necessary.

Data Analysis Plan

All data were inputted and analyzed through SPSS version 22.0 for Windows. Descriptive statistics were assessed and described the sample demographics and the variables of interest used in the analysis. Frequencies and percentages were calculated for categorical data, and means and standard deviations were calculated for continuous data (Howell, 2012).

Data were screened for accuracy, missing data, and outliers. The presence of outliers was tested by the examination of standardized values. Standardized values represent the number of standard deviations the value is from the mean. Standardized values greater than 3.29 are considered to be outliers and were to be potentially removed from the data set (Tabachnick & Fidell, 2013). Cases with missing data were to be examined for nonrandom patterns. Participants were excluded for noncompletion of the research process, either the MPEDQ questionnaire or the cognitive efficiency test itself.

Prior to analysis, the assumptions of multiple linear regression were assessed. The assumptions of the multiple linear regression include normality, homoscedasticity, and absence of multicollinearity. Normality and homoscedasticity were assessed by examination of scatter plots (Tabachnick & Fidell, 2013). Multicollinearity was assessed using variance inflation factors (VIF), with values over 10 suggesting the presence of multicollinearity and a violation of the assumption (Stevens, 2012).

The project gathered data to test the hypothesis that in addition to working memory, the level of volitional or self-induced busyness, as derived from the two MPEDQ measures Busyness and Routine, is also a predictor of performance on a cognitive task.

To explore those potential relationships, the following research questions were proposed.

RQ1: Is busyness related to performance on a cognitive task?

Null Hypothesis 1: Busyness is unrelated to performance on a cognitive task.

Alternative hypothesis: Busyness is associated with performance on a cognitive task.

RQ2: Is routine related to performance on a cognitive task?

Null Hypothesis 2: Routine is unrelated to performance on a cognitive task.

Alternative hypothesis: Routine is associated with performance on a cognitive task.

RQ3: Is working memory related to performance on a cognitive task?

Null Hypothesis 3: Working memory is unrelated to performance on a cognitive task.

Alternative hypothesis: Working memory is associated with performance on a cognitive task.

RQ4: Do Busyness, Routine, and working memory predict performance on a cognitive task?

Null Hypothesis 4: None of the independent variables busyness, routine, and working memory predict performance on a cognitive task.

Alternative Hypothesis: At least one of the variables busyness, routine, and working memory predict performance on a cognitive task.

To assess the research questions, Pearson correlations were posed to inform hypotheses one through three, and were performed first. A multiple linear regression was then used to examine Research Question 4. Multiple regression is an appropriate analysis when the goal of research is to assess the extent of a relationship among a set of dichotomous or interval/ratio predictor variables on an interval/ratio criterion variable.

Variables were to be evaluated based on what each contributed to the prediction of the dependent variable that was different from the predictability provided by the other predictors (Tabachnick & Fidell, 2013). The *F* test was to be used to assess whether the set of independent variables collectively predicts the dependent variable. *R-squared*—the multiple correlation coefficient of determination—was reported and used to determine how much variance in the dependent variable could be accounted for by the set of independent variables. The *t* test was used to determine the significance of each predictor and beta coefficients were to be used to determine the extent of prediction for each independent variable. For significant predictors, every one unit increase in the predictor, the dependent variable would increase or decrease by the number of unstandardized beta coefficients.

Threats to Validity

Threats to the external validity of the study pertain to limitations on the ability to generalize the results to the larger population in different variations (Johnson & Christensen, 2014). However, I structured the sampling strategy in an effort to gather a representative sample of the target population through just one inclusion criterion, which opens the study to a diverse set of potential participants. Additionally, the findings of this study would be applicable to all settings and times, due to the characteristics of interest being a part of the human cognitive architecture (Kalyuga, 2011).

Threats to internal validity pertain to the power of the study to infer relationships between the variables of interest (Gliner et al., 2011). Due to the design of this study, only experimental mortality and instrumentation might be considered possible threats in this area.

Experimental mortality. It has been noted that those with busier lifestyles might not be interested in the study, or prepared to take the time to participate, due to precisely the degree of environmental demands I am attempting to explore. Without question, the tests take some time to perform, and I rejected other tests that were tedious to the point of irritation, judging they would not therefore hold the attention of participants. If participants failed to complete the second part of the study, the section with the Corsi and Tower of London games, then the attrition rate would be high. This might possibly flatten out the Busyness-based demographic. That is, potential participants refusing or failing to take the test/play the game because are “too busy” might eliminate some of the busier, and thus more interesting, participants at the expense of a stronger effect.

While this possibility might not spoil the overall sample, if there was a threshold effect requiring a certain minimum level of Busyness for any effect to be noted (similar to perceptual load—see Lavie, 1995) it might have left me with too few individuals exceeding that level to detect. If, for example, the proportion of the overall population exhibiting the effects of volitional busyness were to be analogous to the proportion of multi-taskers as described by Watson and Strayer (2010), that is only about 2.5% of the population. With the number of participants presently projected, the chance of finding even one such was small. This could possibly be have been dealt with through more targeted recruitment of “busy” people, as I was not looking to generalize the prevalence of high Busyness or of any purported effect to the population as a whole. (While there was little control over the characteristics of the participants that might have been recruited through Walden’s participant pool, more direct recruitment [e.g., professional conventions] might have been targeted more directly at such “busier” individuals.)

Instrumentation. Threats to instrumentation were minimized by the selection of reliable and validated instruments for measuring the proposed constructs. Measurement validity was addressed by the theory review of the variables of interest, as well as the quality of the instruments chosen. Each instrument has psychometric properties gleaned from prior studies that have utilized the instruments.

Chapter 4: Results

Traditional wisdom, backed by research (Baddeley & Hitch, 1972; Tombu & Jolicoeur, 2004), has been that increased cognitive load leads to decreased performance. However, recently there has been research suggesting, or allowing for the possibility of, just the opposite (Baddeley, 2003; Hoffman, von Helversen, & Rieskamp, 2013; Kim, Kim, & Chun, 2005; Pontari & Schenker, 2000). In order to address these apparent contradictions, this study was designed to identify and describe the cognitive performance of a group of people whose levels of volitional busyness differ.

This chapter begins with a description of the data collection and the preanalysis data cleaning, as well as a description of the sample. A summary of the results is given, along with a more detailed analysis. This chapter ends with a brief summary and a transition to the next chapter.

Data Collection

Recruitment of participants for data collection was proposed to take place using the Walden University Participant Pool, through direct recruitment at professional conferences, or through Amazon Mechanical Turk. Though these were the initially proposed methods of data collection, IRB requirements rendered the first two impracticable within the time available. Ultimately, all data collection was conducted through compensated participants using Amazon Mechanical Turk only, in two separate batches on June 16 and 23, 2016 (IRB Approval #05-04-16-0096896).

Mechanical Turk workers were presented with a sequence of data collection instruments, starting with basic demographic questions (age, education, gender) and proceeding directly to an online implementation of the MPEDQ. This was presented as a series of Likert scales using (in this online version) radio buttons, accepting only one selection per question. On completion of the MPEDQ, the worker was taken (in a process designed to be as seamless as possible) straight through to the Corsi Block Tapping Test. On completion of the Corsi, a link took the worker to the final task, the Tower of London.

Before collecting the data, I was concerned that Mechanical Turk respondents, whose remuneration would be based on time spent—the more online tasks they completed, the more they would get paid—might be tempted to take the easy way out and simply make the same selection down the screen through the series of questions presented. I did make a visual examination of the scores, and it was not evident that such spurious scoring was taking place. A comparison of the scores to any other source, such as the small pilot study I conducted or (if available) data from Soubelet and Salthouse (2010) or from the MPEDQ validation study (Martin & Park, 2003), would have been outside the intended scope of this research, and probably impracticable given the nature of this study as dissertation research. There was one instance of outright attempt to enter false data, where one Mechanical Turk worker entered different data under two different "personalities" but still associated with the same Mechanical Turk worker number. This was detected at the data screening stage, and both records were removed.

Preanalysis Data Cleaning

Participants signed in online to a sequence of tasks, beginning with a survey containing basic demographics and a series of questions implementing the MPEDQ, leading in to two brief games. These were online implementations of the standard assessment tools, the Corsi Block Tapping Test and the Tower of Hanoi, developed by Millisecond Software. Because of the data collection method, participant data were received in multiple data sets, though the data collection site also provided a unique identifier for each participant so that data from each set could be matched into a final data set. That also served to preserve the anonymity of the participants, whose personal information (name, address, etc.) was not available to or retrievable by me from any given identifier.

The data were retrieved from these four separate sets, one for demographics, one being the MPEDQ implementation, and two for the remaining tests (Corsi test and Tower test). After these sets were combined by matching participants' unique numbers, a total of 120 participants' scores could be matched to one another to create a full data set with all four subsets; these matched cases were first examined for meeting the age criteria for the study, then for duplicate and missing cases. A total of 28 cases were identified and removed as either (a) not meeting inclusion criteria (i.e., participant was less than 35 years old, *n* =24), (b) not completing one or more of the tests (*n* =2), or (c) being duplicate entries (*n* =2). As such, these cases were removed from the originally gathered 120, and the final dataset contained a total of 92 participants.

Descriptive Statistics

The final sample of 92 participants consisted of 49 (53.30%) men and 43 (46.70%) women, with an average self-reported age of 41.00 years (*SD* = 7.57). The majority of participants were self-reported college graduates (*n* = 41, 44.60%) or had completed some college (*n* = 23, 25.00%). The participants scored an average of 19.98 in

Busyness (*SD* = 3.89), 9.17 in Routine (*SD* = 2.30), and 60.00 in Working Memory (*SD* = 24.30). Participants had an average cognitive task performance score of 31.34 (*SD* = 4.02). All frequencies and percentages are presented in Table 1. All means and standard deviations are presented in Table 2.

Table 1

Frequencies and Percentages for Demographic Information

Variable	*n*	%
Gender		
Male	49	53.30
Female	43	46.70
Education		
High school diploma or equivalent	15	16.30
College graduate	41	44.60
Master's/doctoral/professional degree	9	9.80
Some college—No degree	23	25.00
Some graduate school—No degree	4	4.30

Table 2

Means and Standard Deviations for Variables of Interest

Variable	Min	Max	*M*	*SD*
Age	35.00	74.00	41.00	7.57
Busyness	11.00	29.00	19.98	3.85
Routine	5.00	15.00	9.17	2.30
Working memory	2.00	117.00	60.00	24.30
Cognitive task	15.00	36.00	31.34	4.02

Detailed Analysis

Analyses were conducted in line with the four guiding research questions. A set of one null and one alternative hypothesis aligned with each research question and was used in each inferential test. The four questions were as follows:

RQ1: Is busyness related to performance on a cognitive task?

Null Hypothesis 1: Busyness is unrelated to performance on a cognitive task.

Alternative hypothesis: Busyness is associated with performance on a cognitive task.

RQ2: Is routine related to performance on a cognitive task?

Null Hypothesis 2: Routine is unrelated to performance on a cognitive task.

Alternative hypothesis: Routine is associated with performance on a cognitive task.

RQ3: Is working memory related to performance on a cognitive task?

Null Hypothesis 3: Working memory is unrelated to performance on a cognitive task.

Alternative hypothesis: Working memory is associated with performance on a cognitive task.

RQ4: Do busyness, routine, and working memory predict performance on a cognitive task?

Null Hypothesis 4: None of the independent variables busyness, routine, and working memory predict performance on a cognitive task.

Alternative hypothesis: At least one of the variables busyness, routine, and working memory predict performance on a cognitive task.

The present study included three Pearson correlations and a multiple linear regression, aligned with each of the four research questions.The Pearson correlations were posed to inform hypotheses 1 through 3 and were performed first. These analyses were conducted to assess whether there were bivariate relationships between the three independent variables (i.e., Busyness, Routine, and working memory) and the outcome of performance on a cognitive task. Prior to each analysis, the assumptions of the correlational test were examined. For these Pearson correlations, statistical assumptions include linearity and homoscedasticity. For the linearity assumption to be met, a scatterplot between each pair of variables under examination must show a linear pattern, as opposed to a nonlinear pattern (Tabachnick & Fidell, 2012). For the homoscedasticity assumption, a scatterplot between the correlation residuals and the predicted values must show a rectangular distribution for this assumption to be met (Stevens, 2009).

Research Question 1

$H_0$1: Busyness is unrelated to performance on a cognitive task.

H_a1: Busyness is associated with performance on a cognitive task.

This hypothesis was examined using the first of three Pearson correlations.

Prior to analysis, the assumptions of linearity and homoscedasticity were assessed. The assumption of linearity was met (see Figure 1), as there was no evidence of a nonlinear relationship between the independent and dependent variables. Similarly, the assumption of homoscedasticity was met (see Figure 2), as the distribution of data points on the residual scatterplot was approximately rectangular and random.

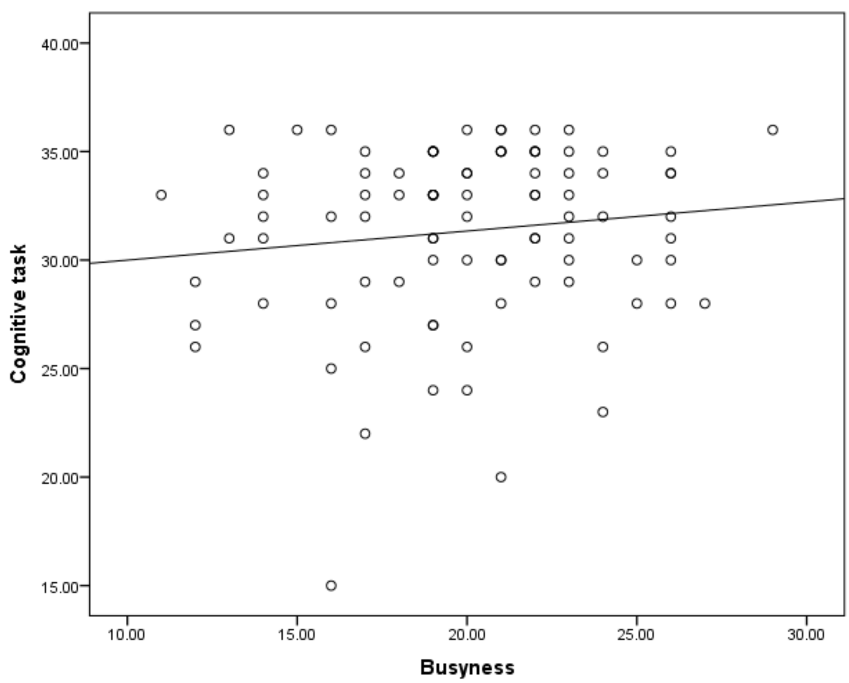

Figure 1. Scatterplot between Busyness and cognitive task performance.

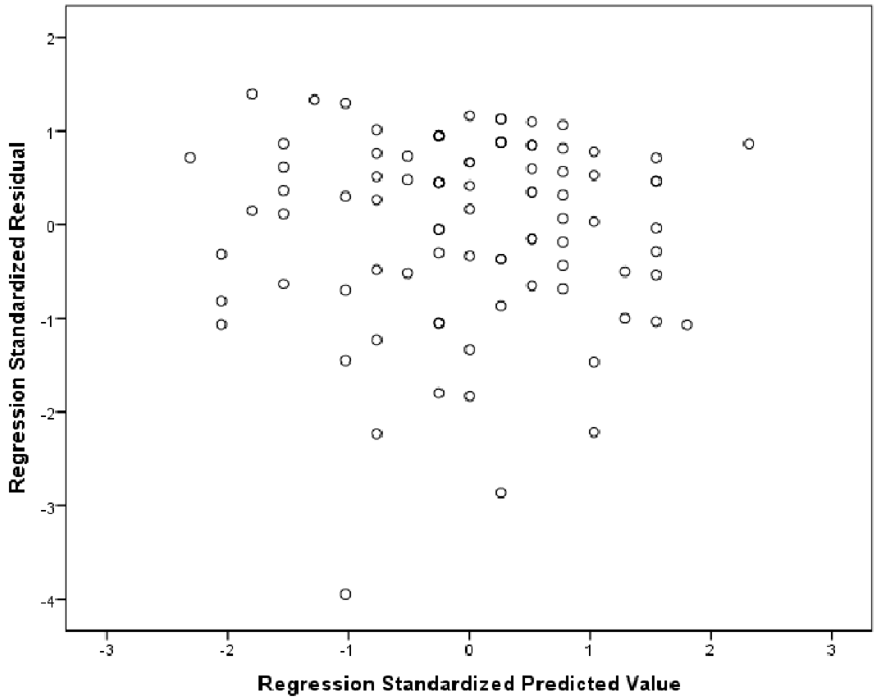

Figure 2. Scatterplot between the standardized and predicted values.

The results of the correlation between busyness and performance on a cognitive task were not significant ($r = .13$, $p = .217$), indicating that there was no evidence for a correlation between the two measurements. As such, the null hypothesis cannot be rejected.

Research Question 2

$H_0$2: Routine is unrelated to performance on a cognitive task.

H_a2: Routine is associated with performance on a cognitive task.

This hypothesis was examined using the second of three Pearson correlations.

Prior to analysis, the assumptions of linearity and homoscedasticity were assessed. The assumption of linearity was met (see Figure 3), as there was no evidence of a nonlinear relationship between the independent and dependent variables. Similarly, the assumption of homoscedasticity was met (see Figure 4), as the distribution of data points on the residual scatterplot was approximately rectangular and random.

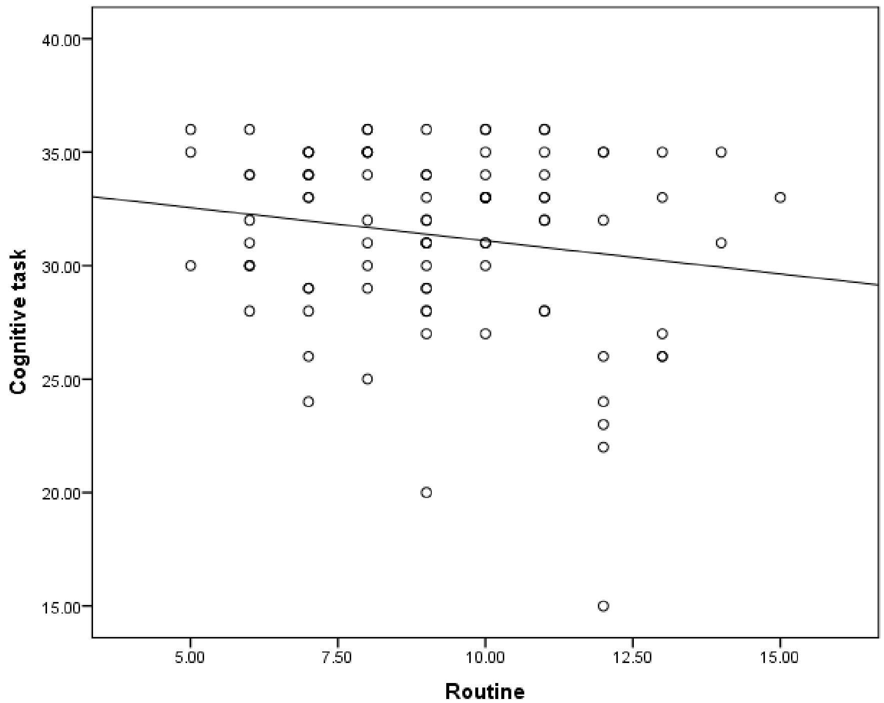

Figure 3. Scatterplot between Routine and cognitive task performance.

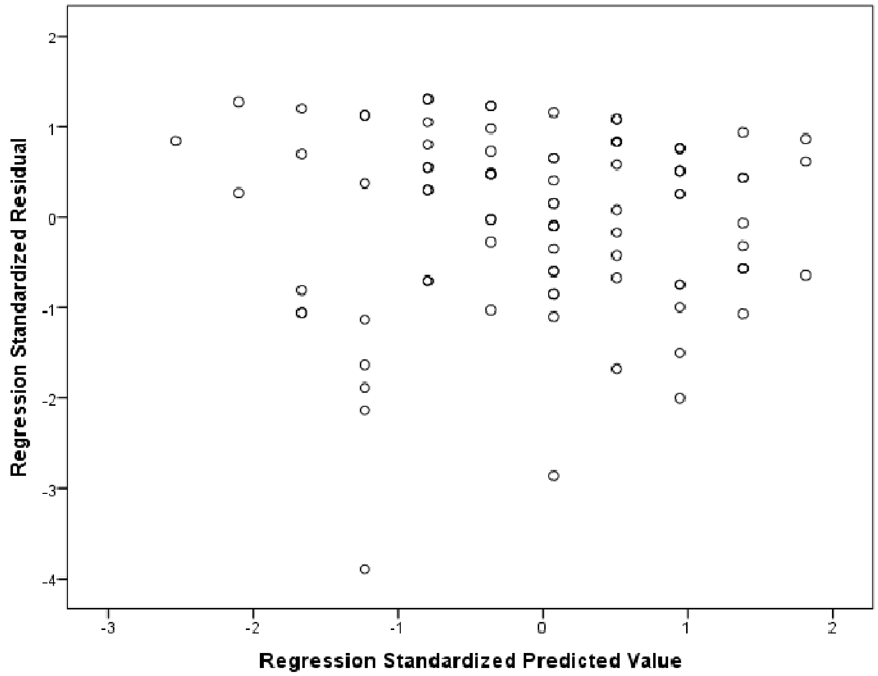

Figure 4. Scatterplot between the standardized and predicted values.

The result of the correlation between routine and performance on a cognitive task was not significant (r = -.18, p = .112), indicating that the null hypothesis cannot be rejected.

Research Question 3

$H_0$3: Working memory is unrelated to performance on a cognitive task.

H_a3: Working memory is associated with performance on a cognitive task.

Hypothesis 3 was examined using the third and final of the Pearson correlations.

Prior to analysis, the assumptions of linearity and homoscedasticity were assessed. The assumption of linearity was met (see Figure 5), as there was no evidence of a nonlinear relationship between the independent and dependent variables. Similarly, the assumption of homoscedasticity was met (see Figure 6), as the distribution of data points on the residual scatterplot was approximately rectangular and random.

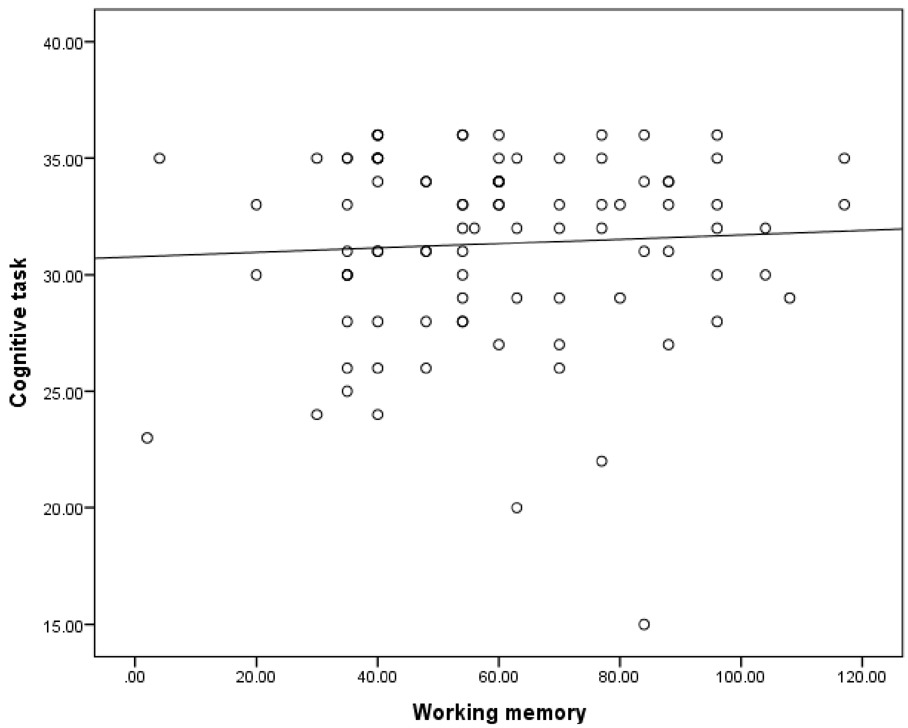

Figure 5. Scatterplot between working memory and cognitive task performance.

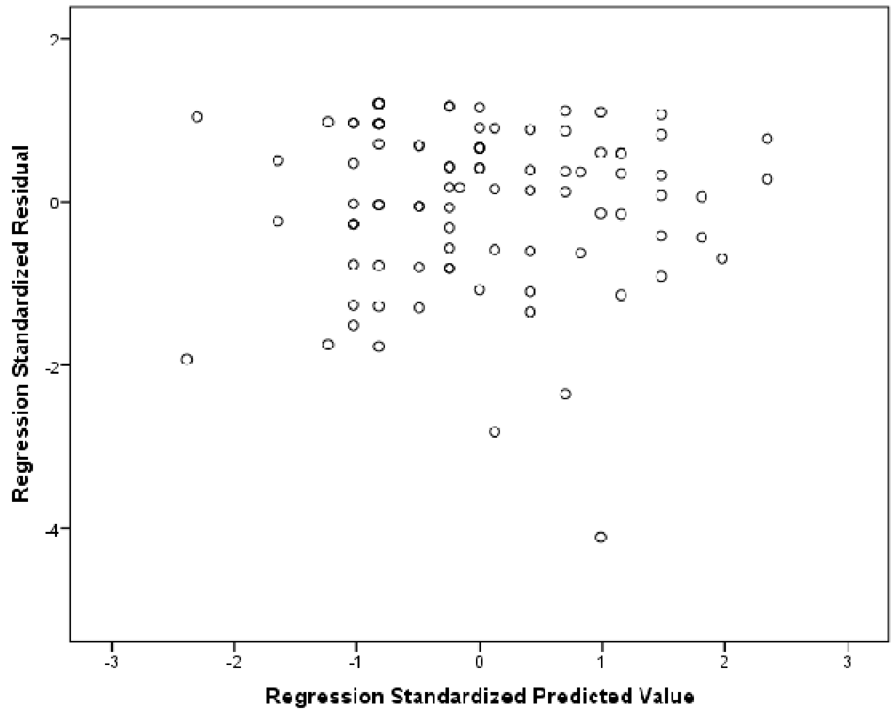

Figure 6. Scatterplot between the standardized and predicted values.

The result of the correlation between working memory and performance on a cognitive task was also not significant (r = .06, p = .587). Thus, the null hypothesis cannot be rejected.

Research Question 4

$H_0$4: None of the independent variables Busyness, Routine, and working memory is useful in predicting performance on a cognitive task.

H_a4: At least one of the variables Busyness, Routine, and working memory is useful in predicting performance on a cognitive task.

In order to assess whether or not these same variables are useful in predicting performance on a cognitive task when analyzed as a linear combination, a multiple linear regression was conducted. The predictor variables for this analysis comprised each of the independent variables from the prior Pearson correlations, including Busyness, Routine, and working memory. Because none of the previous correlational analyses supported the existence of a relationship between any of the independent variables (i.e., Busyness, Routine, or working memory) and the dependent variable (i.e., performance), it was unlikely that a linear combination of the three independent variables would result in a significantly predictive regression equation. Because it is possible that the three combined scores could provide enough information to significantly predict performance, the regression equation was conducted nonetheless. The resulting regression equation under examination for this analysis is as follows:

$$\textit{Performance} = (\text{Busyness})B_1 + (\text{Routine})B_2 + (\text{Working memory})B_3 + \textit{error}$$

For the multiple linear regression, assumptions for analysis include normality, homoscedasticity, and the absence of multicollinearity. Normality was assessed using a P-P plot, and homoscedasticity was assessed using a standardized residual plot. The absence of multicollinearity was determined using variance inflation factor (VIF) scores, where values over 10 indicate the presence of multicollinearity (Stevens, 2009). The assumption of normality was met because the normal line did not deviate greatly from a perfect 45-degree line (see Figure 7). Similarly, the assumption of homoscedasticity was met based on the rectangular, random distribution of data seen in the plot of residuals (see Figure 8). All VIF scores were well below 10 (see Table 3), thus the assumption of absence of multicollinearity was met.

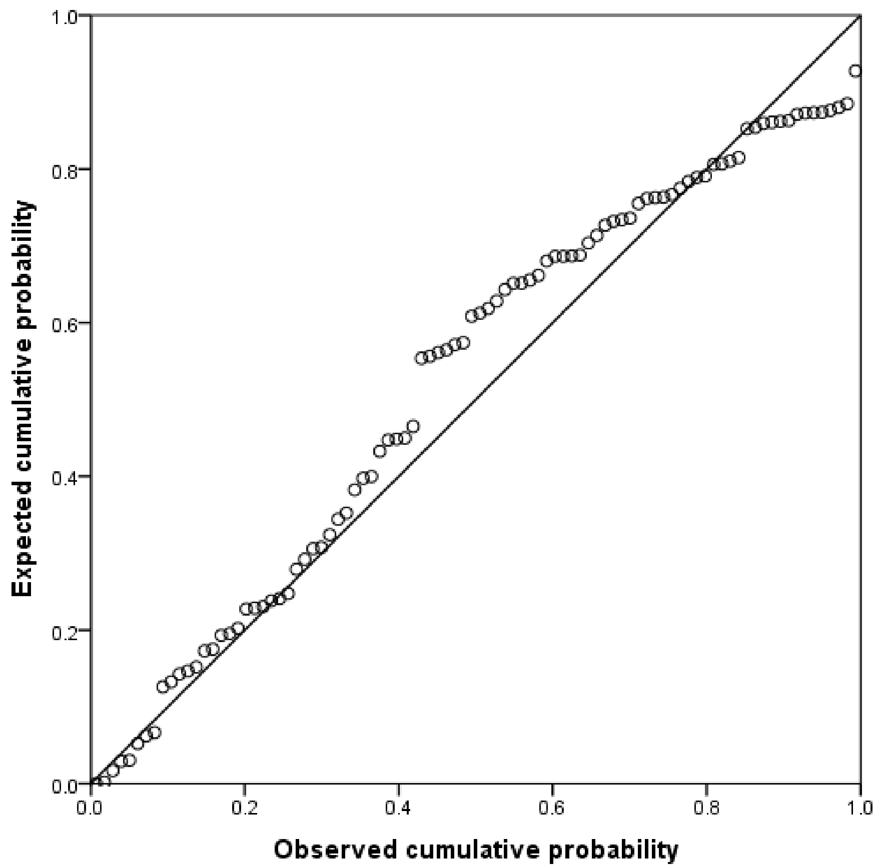

Figure 7. P-P plot to assess for normality of multiple linear regression.

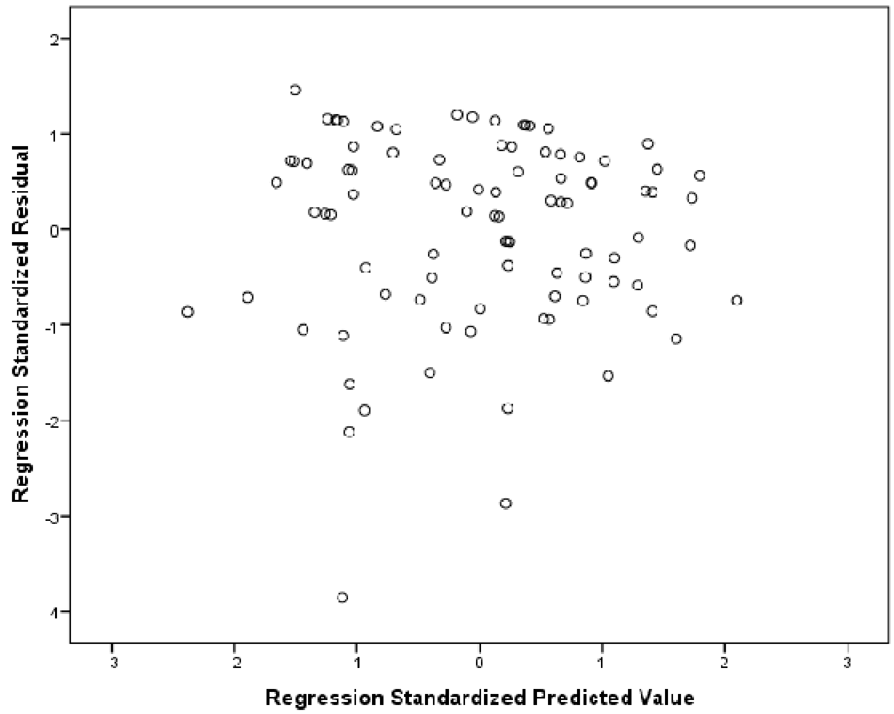

Figure 8. Scatterplot between the standardized and predicted values.

The results of the multiple linear regression were not significant, $F(3, 88) = 1.13$, $p = .329$, $R^2 = .04$, indicating that collectively, busyness, routine, and working memory do not significantly predict performance on a cognitive task. The R^2 coefficient of .04 indicated that only up to 4% of the variance in performance on the cognitive task could be explained by a linear combination of the three predictors, further supporting the lack of significance. As significance was not found in the overall model, the coefficients were not examined further. Table 3 presents the results of the multiple linear regression.

Table 3

Regression Coefficients With Busyness, Routine, and Working Memory Predicting Performance on a Cognitive Task

Variable	*B*	*SE*	*β*	*t*	*p*	VIF
Busyness	0.10	0.11	.10	0.89	.378	1.08
Routine	-0.24	0.19	-.14	-1.25	.216	1.09
Working memory	0.01	0.02	.05	0.46	.648	1.02

Ancillary Analysis

Several researchers have supported, or implicitly allowed for, the possibility that there may be a nonlinear relationship between Busyness, Routine, and working memory and the dependent variable of performance on a cognitive task (Lavie, 1995; Watson & Strayer, 2010; Jaeggi et al., 2007; Ie et al., 2012). These researchers indicated that the influence of cognitive load and working memory on performance on a cognitive task may only be present at certain levels, or that effects only appeared at one end of the spectrum.

To assess this kind of relationship, which would not be monotonic, a modified regression was conducted. In this modified regression, each of the independent variables was squared to allow for the assessment of non-linear effects. Tabachnick and Fidell (2012) cited this as an appropriate method for assessing this form of relationship. In this regression, the same three variables of Busyness, Routine, and working memory were treated as predictors, after being modified to the second power in line with Tabachnick and Fidell's (2012) suggestions. This resulted in a new regression equation being tested, as follows:

$$Performance = (\text{Busyness}^2)B_1 + (\text{Routine}^2)B_2 + (\text{Working memory}^2)B_3 + error$$

Because the modifications to the analysis do not influence the assumption tests, there was no need to reassess the assumptions of normality, homoscedasticity, or multicollinearity. Results of this second regression indicated that there was no significant non-linear relationship between the squared variables of Busyness, Routine, or working memory and performance on a cognitive task, $F(3, 88) = 1.10$, $p = .354$, $R^2 = .04$. Because of this outcome, the findings from hypothesis four can be confirmed, and indicate that no significant relationship was found. Results of this ancillary regression are presented in Table 4.

Table 4

Regression With Squared Values of Busyness, Routine, and Working Memory Predicting Performance on a Cognitive Task

Variable	*B*	*SE*	*β*	*t*	*p*	VIF
Busyness (squared)	.00	.00	.09	0.86	.392	1.07
Routine (squared)	-.01	.01	-.14	-1.27	.207	1.08
Working memory (squared)	.00	.00	.03	0.33	.746	1.02

Chapter Summary

This chapter began with a restatement of the research purpose, a description of the pre-analysis data treatment, as well as a description of the sample. This was followed by both a summary and detailed analysis of the results. These results indicated that Busyness, Routine, and working memory were not significantly correlated with performance on a cognitive task, and thus the null hypothesis for Research Questions 1-3 cannot be rejected. The results also suggested that Busyness, Routine, and working memory were not able to collectively predict performance on a cognitive task, indicating that the null hypothesis for Hypothesis 4 also cannot be rejected. In an ancillary analysis of the three predictor variables, results did not indicate that there was a curvilinear relationship between these variables and performance, and this form of relationship could not be supported by the data either. Chapter 5 will discuss these results in terms of the associated literature. Chapter 5 will also discuss any strengths, limitations, and implications of the study. Additionally, future directions for research will be given.

Chapter 5: Results, Conclusions, and Recommendations

Introduction

During work on my master's thesis, I encountered the idea of the *specialness* of busy people, or of the state of being busy (busyness). It took me only a little research to reveal the widely popular and longstanding belief in the idea. Flying as this did in the face of cognitive theory, I was curious and decided to explore the matter, and I took that opportunity for my doctoral research. At the time (2007), most researchers confirmed the deleterious effect of increased cognitive load on task performance—some notable exceptions being Pontari and Schlenker (2000); Kim, Kim, and Chun (2005); and Jaeggi (2007). Just a few years ago, however, new published research indicated cases of significant performance beyond prediction under high cognitive load (Hoffmann, von Helversen, & Rieskamp, 2013; Watson & Strayer, 2010). Indeed, by the 2011 special summary of cognitive load theory and research in *Computers in Human Behavior,* it was clear that the theory was proving inconsistent at best (Kirschner, Ayres, & Chandler, 2011). This opened a possible pathway to the "busiest man" thesis, as expressed by Parkinson ("It is the busiest man who has time to spare"; 1957, p. 2), being compatible with cognitive theory.

Statement of the Problem

The demands of everyday life impose a cognitive overhead (Gilbert & Osborne, 1989; Milgram, 1970) that may be equated to cognitive load or cognitive busyness (Gilbert & Osborne, 1989; Lieberman, 2000). Increasing cognitive load is associated with a decrease in task performance (Baddeley & Hitch, 1974; Fitousi & Wenger, 2011;

Lieberman, 2000). However, folk wisdom suggests that for some people, such busyness might enhance performance (Payn, 1884; Smiles, 1866), and recent cognitive research has shown performance beyond prediction in situations of high cognitive load (Jaeggi et al., 2007) and even supported the possibility of high cognitive load enhancing processing (Lavie, 1995). Accordingly, I set out to explore whether there were indeed people whose cognitive performance was enhanced by high cognitive load. The effect of any particular level of cognitive load would be affected by working memory capacity (WMC); thus, I included WMC as a covariate. Subsequently, the problem that needs to be explored is whether a high level of busyness has any positive effect on task performance, controlling for working memory.

Review of the Methodology

After an initial trial write-up of a qualitative design, it became evident that a more objective analysis would be needed for assertions such as those contained in the hypotheses, which were outside mainstream cognitive theory. In particular, it would be necessary to obtain a measure of the everyday task load of the participants. The matter of assessing busyness resolved itself with the discovery of the MPEDQ, designed for that purpose, while the link to cognitive theory came through Gilbert and Osborne's (1989) assertion and Milgram's (1970) observation that everyday activities, including tasks and social activities, give rise to cognitive load. Also, given Martin and Park's (2003) assertion that existing instruments for assessment of daily activities offered significant problems in administration, interpretation, and validity, the MPEDQ offered an easy-to-administer instrument that also offered the basis of a construct in which environmentally generated cognitive load might be measured.

Drawing from associated research on reduction of processing load, including ideas on load shedding, delayed processing, and controlled attention contained in perceptual load theory and in earlier cognitive research (Cowan, 1988; Gilbert, Krull, & Pelham, 1988; Gilbert & Osborne, 1989; Lavie, 1995), I adopted Cowan's controlled-attention model of working memory (1988) as the overarching theoretical basis for the project. This reinforced the choice of a measurement-based (quantitative) research project, as the primary issue was comparative performance under conditions of different levels of variables (busyness, routine, working memory). While an experimental or quasi-experimental design was initially considered, the practical matter of establishing a control group made this impractical. Accordingly, a correlational design was adopted.

This quantitative correlational study identified and described the cognitive performance of a group of people whose levels of volitional busyness differed. Specifically, I sought to identify, if they exist, subgroups of people whose cognitive performance improved—rather than deteriorating or remaining unchanged—with greater volitional busyness. As such, this project involved studying performance on a sample cognitive task and exploring how measures of everyday busyness, as implicitly moderated by the element of routine in participants' daily lives, correlated with performance on cognitive tasks. Cowan's model of working memory (1988), and the work of Colom and various collaborators on the relationship between intelligence and working memory (Colom, Abad, Quiroga, Shih, & Flores-Mendoza, 2008; see also

Colom, Rebollo, Palacios, Juan-Espinosa, & Kyllonen, 2004), suggested that working memory might also be a co-correlated factor, and accordingly a measure of working memory was incorporated. In the final design, participants engaged in an online process, starting with completion of a validated self-report instrument to measure busyness. They then participated in two online activities; the first activity was a game that was designed to measure working memory, and the second was a game that measured cognitive performance.

As it was anticipated that any effect to be found would be a combination of the variables rather than any single factor, multiple regressions (linear and curvilinear) were used to identify any groups of participants exhibiting performance beyond predictions. The curvilinear regression was introduced because of research suggesting that some effects of cognitive load beyond predictions or averages would be found only in the upper reaches of values (Ie, Haller, Langer, & Courvoisier, 2012; Jaeggi et al., 2007; Watson & Strayer, 2010).

Summary of the Results

No element of the research hypotheses was substantiated, as neither busyness, routine, nor working memory was seen to have any significant effect on the performance of the cognitive task. As such, there was a failure to reject each hypothesis. Despite suggestions from other research (Watson & Strayer, 2010) that exceptional results might be seen only at one end of the curve, a curvilinear regression gave no results either.

Interpretation of the Findings

The overarching research question was "Do Busyness, Routine, and working memory predict performance on a cognitive task?" This gave rise to four hypotheses, each purporting to describe a different correlation. While there is no research on the topic of busyness as a trait, it is clearly defined as a state of being ("Busyness," n.d.), and there is published research in associated or analogous areas suggesting that at least some of the hypotheses might be upheld.

Research Question 1

Busyness is associated with performance on a cognitive task. There is significant literature on the impact of cognitive load on many types of cognitive activity, ranging from reasoning and decision making to learning (Baddeley & Hitch, 1974; Gilbert & Osborne, 1989; Lieberman, 2000). Accordingly, it was predicted that busyness, being a measure of the type of activity that generates cognitive load (Gilbert & Osborne, 1989), would affect performance on the Tower of London task. However, the effect was not significant in this study. Additionally, Gilbert and Osborne (1989) asserted that laboratory-induced cognitive load was "a mere replication" of environmentally induced cognitive load, or the demands of daily life. Relying upon that assertion, measuring the degree of those demands should prove a good construct for the measurement of ongoing cognitive load. It is possible that the construct is not valid, and there is in fact a difference between environmental and induced cognitive load. As such, the adverse cognitive effect expected of cognitive load does not occur. Alternatively, there may be an issue with the project design, such as the type of task chosen, which did not load directly on working memory—although see Baddeley and Hitch (1974).

Research Question 2

Routine is associated with performance on a cognitive task. The variable Routine is uniquely associated with the MPEDQ instrument. By description, it stands as a measure of structure in daily life activities, which by implication may serve as a moderator of the effect of busyness. No direct reference to such a relationship could be found in research other than Martin and Park (2003), although Tadic, Oerlemans, Bakker, and Veenhoven (2013) did note that for older adults, the structure provided to their lives by having a job does enhance happiness in nonworking times.

Research Question 3

Working memory is associated with performance on a cognitive task. It has long been noted that processing of cognitive tasks is adversely affected when working memory is tasked with more than one job to do (Baddeley & Hitch, 1974; Cowan, 1988). It was also noted by Miller (1956) that working memory itself is subject to capacity limitations (the number of values that may be retained, or the number of alternatives held simultaneously) on an individual basis. That capacity is strongly associated with cognitive task performance (Engle et al., 1999). That being the case, the impact of any degree of cognitive load should be assessed in the light of the working memory restrictions of the individual. However, in this case, working memory was not found to have any significant impact on performance of this particular task.

Research Question 4

At least one of the variables (Busyness, Routine, and working memory) is useful in predicting performance on a cognitive task. It would be expected that any of these variables might have an effect upon the performance of the task at hand. Busyness, in its generation of cognitive load (Gilbert & Osborne, 1989), would restrict the availability of working memory capacity to process the task. Routine could moderate the effect of busyness (Martin & Park, 2003), thus reducing its deleterious impact. Working memory, as the “processing engine” (Baddeley & Hitch, 1974), would provide more or less processing power depending on the capacity of the particular individual. However, none of the Pearson correlations gave a significant result. Moreover, it remained a possibility that some combination of these factors was required; for example, under perceptual load theory, where attentional focus and the rejection of distractors take place only in conditions of simultaneous high perceptual load and no more than moderate cognitive load (Lavie, 2010). The cognitive enhancement effect implied by the “busiest man” hypothesis might only be seen in the outliers. Such was noted by Jaeggi (2007) in the participants who continued to perform a cognitive-challenging task under very high cognitive load, and by Watson and Strayer (2010) in the small percentage of participants who exhibited genuine (and countertheoretical) multitasking abilities. Allowing for this possibility, both linear and curvilinear multiple regression analyses were applied to the data, but without significant result.

Limitations of the Study

In some ways, the absence of support for the alternate hypothesis was not the least anticipated finding. While strongly asserted by folk wisdom (Payn, 1884; Smiles, 1866), and even supported as a possibility by recent cognitive research findings (Hoffmann, von Helversen, & Rieskamp, 2013; Watson & Strayer, 2010), it always stood against mainstream cognitive theory and would have required significant evidence to be demonstrated conclusively. The major surprise, however, was the absence of any finding that any of the variables tested affected performance on the cognitive task to any significant degree. The MPEDQ was devised and designed to address a problem perceived by the developers and others (Martin & Park, 2003; Whitbourne et al., 2008). Yet in this case, there seemed to be no effect on the performance of the designated cognitive task, rendering any rejection of the null hypothesis to be unsupported.

A number of possible explanations for why this may have happened are as follows.

Lack of sensitivity of the MPEDQ. The quality of *busyness* is asserted in the initial folk thesis as being strong, not needing any special equipment, training, or techniques to identify, but capable of being directly observable in a “busy man,” clearly identifiable and to be differentiated from others who are not so (Payn, 1884). As such, if the "busy man" cannot be directly observed, then no effect can be attributed to observed busyness, and the initial thesis fails by definition.

Nature of the working memory instrument: Corsi Block Tapping Test. The Corsi test is a venerable and widely used (Berch, Krikorian, & Huha, 1998) standard measure of working memory span (serial/spatial/visuospatial), forming part of one of the major neuropsychological testing batteries, the WAIS-R Neuropsychological Inventory (Kaplan et al., 1991, as cited in Berch et al., 1998). When the total score is used, it is very sensitive, with a possible score range of 2-144. This sample was slightly older, had slightly more working memory, and was slightly more disparate than those in the original Kessels et al. (2000) norming study. Perhaps the difference in age, or the implicit selection of regular computer users were factors (as Mechanical Turk workers earn at least some of their living through their computer skills). However, the test did pick up variance with demonstrated sensitivity.

Nature of the cognitive task. There are many cognitive tasks available, even under the chosen development software suite. The challenge in the design methodology was to choose one that did not map directly upon working memory; that is, one that offered no more than a score that correlated closely with working memory. The Tower of London was chosen because of its mapping primarily upon executive function and planning (Baddeley & Hitch, 1974; Gilbert & Osborne, 1989; Lieberman, 2000). It is possible that the task does not rely sufficiently upon working memory as to call upon that resource in a manner analogous to the problem being addressed by the MPEDQ developers. The only other recorded use of the MPEDQ (Soubelet & Salthouse, 2010) used intelligence tests, which have been asserted by some to be closely related to working memory (Gutierrez & Kouvelis, 1991; Reimann, 1979), although, it should be noted, not by others (Beier & Ackerman, 2005), or indeed by the same researchers in later years (Colom et al., 2010).

Parkinson's law and Mechanical Turk. In the original source or impetus for this research, Parkinson asserted, “Work expands to fill the time available for its completion,” which is termed *Parkinson’s law* (Parkinson, 1957, p. 2). Later research upheld this thesis to a degree, codifying it as the *excess time effect* (ETE; Aronson & Gerard, 1966; Aronson & Landy, 1967). In an unexpected echo of this source, I found that Mechanical Turk respondents often took far longer on the series of tasks constituting this project than they actually needed—longer, that is, than those who participated in initial pilot testing took. Given that Mechanical Turk workers accumulate income by undertaking as many projects as possible in the shortest time, this was surprising. However, recent research substantiated the observation that time taken on a project is related not to the needs of the project, but to the amount the Mechanical Turk worker is being paid for each task completed (Cohen, Fort, Adda, Zhou, & Farri, 2016). Further replication of some of the ETE studies might further the reliability of Mechanical Turk, with pointers to corrective measures in design and administration.

Recommendations for Further Research

Further Refinement of the MPEDQ

The MPEDQ was designed on the premise that busyness adversely affects performance on the cognitive task of medication adherence. But this study, using an executive function (planning) task, did not find any significant effect. In the interests of further exploration, and of closer definition of the nature of the MPEDQ measure, this present study might usefully be replicated using a task that does load on working memory, or controlling for working memory.

The Nature of "Busy"

Though I have not mentioned it previously, I had suspected that the meaning of the term *busy* had evolved over time; however, I was unsure if this change was significant. The term *busy* did not always mean what it means today: "actively involved in doing something or having a lot of things to do" ("Busy," n.d.). Its original meaning survives in the term *busybody*: "a person who is interested in things that do not involve him or her, esp. other people's private matters" ("Busybody," n.d.). The comment, "It is the busiest person that has time to spare" (Parkinson, 1957, p. 2) then becomes a sarcastic remark, a criticism of the meddling person, rather than an observation on time management or cognitive ability. Perhaps the Victorians, with their zeal for industry and self-improvement, misinterpreted and took on the term, stripping it of the original overtones. It is, then, possible that the survival of the concept is no more than a linguistic stub with a shifted meaning, a misunderstanding absorbed first into popular folklore.

Implications

Implications for Positive Social Change

Going back to Parkinson's original analogy, the "Busy Man/Lady of Leisure" comparison (Parkinson, 1957, p.2), there are still interesting points raised, perhaps unintentionally. The characterizations created by Parkinson – "Busy Man," "Lady of Leisure" -- are not just implicitly sexist; they are also ageist, with the implications of age-related memory issues, and classist, being engaged in different types of activities as befits the evident socioeconomic status of each.

However, within that stereotype, taken as presented or implied, are some useful suggestions. For example, the Busy Man could indeed appear to be unaffected by his [sic] busyness, to the degree that the tasks he is undertaking could be regarded as high-level managerial-type tasks drawing upon planning, or executive function, rather than upon memory. They may even be tasks calling upon expertise (Bedard & Chi, 1992), which is a call on LTM and existing schemas (e.g. the "expert telegraphists"; Bryan & Harter, 1897), rather than those calling upon novel or creative approaches, which are more demanding of working memory (Bedard & Chi, 1992; Kalyuga et al., 2003). The Lady of Leisure, on the other hand, is engaged in significantly memory-based tasks such as "...Finding [a] postcard, ... hunting for spectacles, ...a search for the address" (Parkinson, p.2). Such activities being more memory-based may actually take longer with increased load. It is notable that different values, implicitly, are placed on the task sets–the "Busy Man" embodying those Victorian virtues of industry, and Being A Man, with the Lady being "only" creative, more relaxed, but somehow less "productive."

The primary difference between the two characters could even be seen as an issue of prior organization or planning. The suggestion that Parkinson's law may not apply to "busy people" may be found to be true to the degree that the tasks being undertaken by those busy people are essentially planning tasks.

Implications for Practice

MPEDQ and the nature of medication adherence. Results of this study imply that the MPEDQ may not be useable where the cognitive task was not based on working memory. That is, unless working memory was being called on by the task, its performance did not seem to be affected by the demands of everyday tasks. If further research were to substantiate that hypothesis, perhaps researchers in the area of medication adherence might be encouraged to consider redesigning, or reconceptualising, medication regimes as essentially planning tasks. In that case, the design of the compliance/adherence regime would focus on charting when to take medications and what the reminders would be, rather than handling them as memory-enhancement aids. This might ameliorate the problems noted in the design stage for the MPEDQ.

Conclusion

The idea that busyness as a state of being confers some magical ability to perform tasks more efficiently is a concept accepted by default, and in common belief, since Victorian times or earlier. But common belief is no substitute for scientific examination, which does not appear to have been undertaken prior to my recent research. As is often the case, the belief fails to be supported by evidence. In this case, the belief seems to stem from a Victorian-era distortion in meaning of an old term: *busy*.

It should, however, be noted that the trend lines of the correlations do run in such a fashion as to suggest that a project designed for greater power might produce results at the level of significance--especially on the relationship between Busyness and performance, which might suggest its use as a valid construct for cognitive load. Additionally, the absence of support under cognitive load theory for the “Busy Man” hypothesis should not preclude its exploration under other paradigms, e.g., task or time management.

The results of this work suggest some shortcomings in cognitive theory on induced and environmental cognitive load, and on the differing nature of the effect of such a load on different types of tasks. Along the way, the project gathered useful information on the MPEDQ instrument, suggesting refinements; drew attention to possible shortcomings in the use of Amazon Mechanical Turk as a source of research participants; and suggested future research on both those topics.

While these are useful contributions to the body of cognitive knowledge and theory, perhaps the most useful contribution of the project is emphasizing the need for examination and an evidentiary base for accepted wisdom. For example, as an unfortunate implication on elements of management theory, Parkinson's use of the "Busiest Man" hypothesis as a supporting statement and qualifier to Parkinson's law should suggest a re-examination of works based upon the law. The present research project might be one small step toward correcting an erosion of evidence-based theory, and in the process, it may add to the store of rationality in a society that is increasingly irrational, rejecting of science, and anecdotally based.

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Appendix A: Permissions to Use Instruments

Subject: Re: AW: Martin & Parks Environmental Demands Questionnaire 2002
From: "Graham M Watson, MS" <graham.watson@waldenu.edu>
Date: 5/27/2011 10:13 PM
To: Mike Martin <m.martin@psychologie.uzh.ch>

Thank you!

On 5/29/2011 10:11 PM, Mike Martin wrote:

Dear Dr. Watson:

As in my last reply: Feel free to use the instrument and keep us posted on findings.

Best regards,

Mike

-----UrsprÃ¼ngliche Nachricht-----
Von: Graham M Watson, MS [mailto:graham.watson@waldenu.edu]
Gesendet: Samstag, 28. Mai 2011 06:05
An: m.martin@psychologie.uzh.ch; Pat Carmoney
Betreff: Martin& Parks Environmental Demands Questionnaire 2002

Dear Dr Martin,

I am writing once again, per the protocol of the Walden University IRB, to inquire about the ownership of this instrument originally published in Aging Clinical and Experimental Research, 15(1), 77-81. I am working on my dissertation on self-generated busyness and its effect on task performance, and would like to be able to use the instrument in my research. It offers possibilities that I have not found in any other instrument. Would it be you that from whom I would have to request permission, or some other person or institution? A copy of the dissertation prospectus is attached, and I have copied my committee chair on this email in case you should require any further information.

Your reply would be both appreciated and helpful. Thanking you in advance,

Graham M Watson

Gmail by Google

Graham Watson <graham.watson@waldenu.edu>

MPEDQ, Busyness and "Sustained Engagement"

Graham Watson <graham.watson@waldenu.edu> Sun, May 3, 2015 at 1:41 PM
To: denise@utdallas.edu

Dear Dr. Park,

I was delighted to see your recent piece in Psychological Science on "The Impact Of Sustained Engagement..." I came across your earlier work during my thesis studies about 10 years ago, which centered on Parkinson's Law and his footnote, ".....this does not apply to busy people."

Since then (with the permission of Dr. Martin) I have placed the MPEDQ at front and center of my dissertation research, which treats the Parkinsonian concept of "busy people" as "those having a high Busyness score on MPEDQ" and will be looking at possible cognitive advantage from that state. I had not considered the "sustained engagement" aspect in too much depth, except to consider it under the heading of "optimum arousal," so I'm pleased to see more research in the area.

I'm still finishing the Proposal, so any thoughts on this you might have would be most welcome -- especially as regards the MPEDQ! (Was it ever normed or applied outside its immediate population, by the way?)

Best regards,

Graham M Watson, MS.

Gmail by Google

Graham Watson <graham.watson@waldenu.edu>

MPEDQ, Busyness and "Sustained Engagement"

Park, Denise <denise@utdallas.edu> Mon, May 4, 2015 at 3:11 AM
To: Graham Watson <graham.watson@waldenu.edu>
Cc: "Festini, Sara" <sbf140130@utdallas.edu>

Hi Graham-

I am pleased you are working on this. A postdoc in my lab, Sara Festini, has also taken this issue up since she arrived here, and I am putting you in touch with her. She is finding quite interesting effects on cognition and is working on preparing a manuscript. Please keep us posted on your work.

Best wishes,
Denise

Denise C. Park
Distinguished University Professor of Behavioral and Brain Sciences
University of Texas Regents Research Scholar
Codirector, The Center for Vital Longevity
The University of Texas at Dallas

Adjunct Professor of Psychiatry
University of Texas Southwestern Medical School

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Center for Vital Longevity
1600 Viceroy Drive
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Dallas, TX 75235

Business Phone: (972) 883-3255
Cell: (214) 470-8673

From: Graham Watson [graham.watson@waldenu.edu]
Sent: Sunday, May 03, 2015 6:41 PM
To: Park, Denise
Subject: MPEDQ, Busyness and "Sustained Engagement"
[Quoted text hidden]

MILLISECOND
Precision psychometrics for cognitive, neurophysiological, and online research.

RECEIPT

1508 East Prospect Street, Seattle, WA 98112-3304
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RECEIPT# 11025
DATE: April 18, 2016

BILL TO:
Graham M Watson
134 Halelo St
Lahaina, HI 96761
US
EMAIL: gwlahaina@gmail.com
CC #: XXXXXXXXXXXX0041

Prices are quoted in USD

QTY	PRODUCT	RATE	UNIT PRICE		TOTAL
1	Inquisit Web License: 2 Month	Primary	$[redacted]		$[redacted]
3	Consulting Services	Primary	$[redacted]		$[redacted]
				SUBTOTAL	$[redacted]
				TAX	$0.00
				TOTAL	$[redacted]
				RECEIVED	$[redacted]
				BALANCE	$0.00

THANK YOU FOR YOUR BUSINESS!