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# Validation of the Barkley Deficits of Executive Functioning Scale-Short Form

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# **Validation of the Barkley Deficits of Executive Functioning-Short Form**

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## **Abstract**

The Barkley Deficits of Executive Functioning-Short Form (BDEFS-SF) is a short rating scale measuring executive functioning in adults. The BDEFS-SF was developed using the 5 highest loading questions from the BDEFS-LF. Consequently, the psychometric qualities of the BDEFS-SF were not investigated using formal methods. In this study, the psychometric attributes of the BDEFS-SF were examined using two separate but similar groups. The first group of 264 men and women aged 18-35 years old completed the BDEFS-SF via an internet survey. The second group of 36 men and women aged 18-35 years old completed the BDEFS-SF and individualized assessments of executive functioning and cognition individually with this researcher. Examination of the internal reliability of BDEFS-SF was found to be a more than robust .87. Factor analytic processes uncovered three latent traits in the BDEFS-SF and results also found cognition to be a separate construct from executive functioning. Lastly, measures of executive functioning and ratings from the BDEFS-SF yielded significant relationships. Limitations of this study and recommendations were explained. This study provides some initial evidence for the validity and reliability of the BDEFS-SF.

**Key Words:** Barkley Deficits in Executive Functioning Scale, Principal Component Analysis, Parallel Analysis, Cognition, and Executive Functioning

### **Acknowledgements**

“Wonder is the beginning of philosophy”- Plato

The main lesson learned in completing this doctoral degree is the more you think you know the more you do not know. Learning from life requires a person to know what they know, while understanding what they do not know. It is the not knowing and an attitude of wonder that creates a desire to learn. Second, it is important for people to understand that no one is successful in life without help from others. I would like to thank God for giving me the ability to learn and for placing the right people in my life at the right time to help me be successful. Next, I would like to thank my mother who has been a model of perseverance and taught early on not to listen to people who tell you that you cannot do something. My wife Heather, whom I love has extremely supported me through this entire process and was an encouragement when I would get down. My father also deserves a significant thank you for helping me understand the importance of education and learning as a child.

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## CHAPTER 1

### INTRODUCTION

What are executive functioning skills? Why are executive functioning skills relevant to everyday life? Currently, the subject and construct of executive functioning are garnering significant attention from researchers because of the discovery of how vital executive skills are not just in academic achievement, but in adjusting to living demands (Isquith, Roth, & Gioia, 2013). People use executive functioning skills in just about every part of their lives from solving complex problems, making decisions, evaluating outcomes, and regulating emotions/frustration (Barrett, Fox, Morgan, Fidler, & Daunhauer, 2014; Hunter & Sparrow, 2012). Executive functioning skills are essential in being successful with tasks ranging from solving complex mathematical equations to successfully navigating social interactions at a dinner party. People with executive skill difficulties have problems with planning, judging the intentions of others, using available information to make decisions, and making needed changes when problem-solving is not useful. Based on the previous explanations, it would appear the definition of executive functioning is clearly understood. However, when examining the literature around executive functioning, researchers agree on some aspects of the definition of executive functioning and disagree on others.

Welsh (2002) states

Executive functioning difficulties are the inability to maintain an appropriate problem-solving set for attainment of a future goal. Executive functioning abilities also include the intention to inhibit a response; formulate a strategic plan of action, construct a mental representation of a task, use information encoded in memory, and define a future goal state” (p.105).

Struss and Benson (1986) also add that executive functioning concerns can cause people problems with thinking ahead, selecting meaningful goals, and self-monitoring of the effort needed towards achieving those goals (p. 100). Barkley (2011) also explains that executive functioning problems are related to self-regulation. “Self-regulation involves (1) any action an individual directs at themselves to perform (2) results in a change in their behavior (from what they might otherwise have done) to (3) attain a goal” (Barkley, p. 1, 2012). In short, executive functioning skills are essential when attempting to avoid a simple fight or flight response and creating a well-reasoned thought out response (Hunter & Sparrow, 2012). Overall, being able to use executive functioning skills is essential because as Lazarus, (1999) & Carver, (2006) indicate repetitive use of fight or flight emotion-focused response results in significant psychopathology and adverse outcomes for individuals.

### **Assessment of Executive Functioning**

Historically, the only way for researchers to identify executive functioning concerns was through autopsy and interviews (Fuster, 2006). Currently, researchers have modern tools which allow them to identify executive functioning challenges. Two of the tools psychologists typically use to identify executive functioning concerns include rating scales and individualized administered assessments of executive functioning. These two tools are used together as a part of a psychological evaluation with different purposes (Chan, Shum, Toulopoulou, & Chen, 2008). The rating scale provides a measure of the client’s perception of his or her skills with completing actual real word tasks involving executive functioning, and direct assessments of executive functioning yield data on an individual’s ability to complete tasks that measure specific brain-behavioral relationships



(Barkley, 2011). Both methods are used together as a part of comprehensive psychological evaluations (Fuster, 2015). Overall, these two different types of assessments have different foci, but they are reported to measure the construct of executive functioning.

Magnetic Resonance Imaging (MRI) is a third tool used by researchers who investigate executive functioning disorders. However, psychologists do not use MRI because of the complexity of the neuro-psychological processes under examination. An MRI is a process where pictures of the brain are used to identify executive functioning concerns. However, MRI is a prohibitive cost procedure as they are about ten thousand dollars per MRI. The cost of the MRI procedure is the reason most people see a psychologist who performs assessments to rule out any concerns before considering an MRI. However, it is important to note despite the significant diagnostic powers of MRI even they are not one hundred percent accurate with identifying brain dysfunction (Egger, De Mey, & Janssen, 2007). This inaccuracy of measuring executive functioning occurs because of the inability of the assessments to isolate the parts of the brain which are believed to be executive in nature from those parts which are believed related to other areas of functioning like cognition (Lezak, 2004; Egger et.al, 2007). The difficulties with measurement are related to the specific theories of executive functioning the assessments are based upon (Burgess, Alderman, Evans, Emslie, & Wilson, 1998)). Practically speaking assessments of executive functioning are only as good as the theory the assessment is based. As a result, Barkley (2011) reports too many assessments have been classified as assessments of executive functioning and thus have validity issues because of their inability to measure the construct of executive functioning in a precise manner.

In other words, many executive functioning tasks are complex in nature and overlap with other abilities which makes them difficult to isolate. Lezak (2004) supports the point of view of Barkley (2011) who reports many of the traditional assessments considered to measure executive functioning were not created to measure executive functioning. It is because of these previously stated issues with accuracy and ecological validity that Barkley (2011) developed the Barkley Deficits of Executive Functioning Scale.

Conversely, it is essential to consider that standardized assessments of executive functioning by default will not have ecological validity. These assessments of executive functioning were developed to simulate brain-behavioral relationships and novel problem solving (Casey, Giedd, & Thomas, 2000) Thus, if items on these assessments were composed of real-world tasks like answering the phone or cooking a meal they could not be considered novel tasks because subjects could have prior exposure to the tasks (Burgess et al. 1998). On the other hand, if rating scales of executive functioning and individualized assessments of executive functioning truly measure the same construct which is executive functioning, they should be found to be related to each other.

### **Purpose of Current Study**

The focus of the current study is to examine the validity and reliability of the Barkley Deficits of Executive Functioning-Short Form (BDEFS-SF). Dr. Russell Barkley created the BDEFS because of research indicating significant variability on results yielded on individualized assessments of executive functioning and issues with ecological validity. Dr. Barkley believed that the BDEFS scale might better capture symptom severity and the impairments of people who have executive functioning challenges because of this focus on ecological validity. The BDEFS scale consists of two forms a

long and short form which are correlated (Barkley, 2011). The BDEFS-Long Form consists of 89 questions, and the short form consists of 20 questions. The long form of the BDEFS was created using a formal psychometric process and results of this analysis undertaken by Dr. Barkley are available in the BDEFS manual. However, Dr. Barkley did not create the short form of the BDEFS by using a formal psychometric process as he did with the BDEFS-LF (Anderson, 2014; Schraw, 2014). Instead, to create the short form he used the four highest loading items from the factor analysis of the long form to create the short form (Anderson, 2014; Schraw, 2014; Allee-Smith, Winters, Drake, & Joslin, 2011)

Allee-Smith et al. (2011) describes

By strictly using the four highest loading items on each of the five subscales to construct the short form, Barkley diminished the potential for item discrimination and score validity. An analysis of both the highest and lowest loading items would have revealed that three items on the self-report short form have the highest frequencies within their subscale, increasing the probability of score inflation (p.82).

These concerns raised by Allee-Smith et al. (2011) make a compelling argument for the need to examine the psychometric quality of BDEFS-SF. In summary, it would be a mistake to assume that the BDEFS-SF is a valid or reliable scale without the performance of a psychometric analysis which includes identification of the latent factor structure of the scale (Anderson, 2014 & Allee-Smith et al. 2011). In short, the formal reliability and validity of the BDEFS-SF will be examined using factor analytic and statistical

processes. If this scale is found to have adequate validity and reliability, then it might be a scale which can be used by psychologists.

### **Research Questions**

1. What is the internal reliability of the Barkley Deficits of Executive Functioning Short Form?
2. Is the Barkley Deficits of Executive Functioning Scale-Short Form composed of more than one latent trait?
3. Is the Full-Scale IQ from the WASI-II significantly related to individualized assessments executive functioning?
4. Will individualized assessments of executive functioning be significantly correlated with ratings of executive functioning?

## CHAPTER 2

### LITERATURE REVIEW

#### **Understanding and History of Executive Functioning as a Construct**

Historically, our knowledge of brain functioning has been incomplete because of limitations with technology (Lezak, 1995). Early brain researchers did not have access to MRI machines, CAT scans, or other imaging technology to assist them with research. These researchers examined brain damage by eyewitness testimony and analyzing the brain postmordum through autopsy (Barrash, Tranel, & Anderson, 2000; Linda, Mah, Arnold, & Grafman, 2005). Amazingly, scientists have been able to develop a functional understanding of the brain despite these limitations (Lezak, 1995).

The first major case which brought worldwide attention to brain research was the case of Phineas Gage (Fleischman, 2004). Phineas Gage was the victim of a tragic railroad accident in 1848 where he had an iron bar shot through his head by an explosion from a locomotive. The massive steel bar entered his head through the left cheek and went out the top of his head. This accident caused significant brain damage to Mr. Gage's left frontal lobe and the prefrontal cortex. Mr. Gage suffered significant brain damage because of the accident and somehow miraculously survived. Before the incident, Mr. Gage was described as a thoughtful, even-tempered, outgoing, humorous, and witty person. However, after the accident, Mr. Gage was reported to be anxious, withdrawn, disorganized, impulsive, and easily upset.

These reports are not surprising based upon what we currently know about the functions of the prefrontal cortex and the frontal lobe region of the brain. These areas of the brain are specifically involved with executive functioning, novel problem solving,

behavioral, and emotional control. What is even more interesting about this case, is that researchers believe Gage's overall cognitive skills were not impaired, but his ability to use the knowledge efficiently was impaired. (Otero & Barker, 2013). Observers reported they were puzzled by Mr. Gage's behavior because his behavioral and emotional responses appeared incongruent with verbal reports of intent. Also, they were puzzled because he could recall facts, but could not use the information to solve problems. This discrepancy between cognitive knowledge and behavioral responses is also not surprising based upon what we know about frontal lobe functioning.

In short, being able to understand this discrepancy between cognitive knowledge versus behavioral and emotional understanding is crucial when being able to identify issues as executive in nature and when considering the co-morbidity of attentional and executive functioning challenges (Pessoa, 2013).

### **The Difference between Executive Functioning and Attentional (Cognitive)**

#### **Concerns**

The case of Phineas Gage illustrates what happens to an individual who suffers damage to the frontal lobe part of the brain. Mr. Gage was able to focus his attention on tasks, had access to memory, and could comprehend people, places, things, and ideas. However, he was unable to use executive functions to use that information to make effective decisions, demonstrate the appropriate behavioral action, and evaluate the outcomes of his decisions. At this point, it is important to note that not all executive functioning challenges result from brain injury (Goldstein & Naglieri, 2013). The Diagnostic and Statistical Manual-Fifth Edition (DSM-V) classify executive functioning and attentional concerns under the umbrella of neurodevelopmental challenges. People

previously thought that people could outgrow neurodevelopmental issues and that these issues were due to lack of maturity (Barkley, 2011). Current information indicates that people with these challenges still have challenges in adulthood. According to the Centers for Disease Control (CDC), about 8 to 10% of adults are believed to have some form of executive functioning skills problem or attentional difficulties.

Researchers debate the specific relationship between executive functioning challenges and attentional issues. Most researchers fall into one of three camps when it comes to beliefs about attentional and executive functioning issues. One group believes executive functioning and attention are just names for the same construct, another group thinks executive functioning and attention are similar construct and overlap, and a third group believes executive functioning and attention are different constructs. This debate is significant because it relates to the validity of executive functioning as a construct. If executive functioning challenges are just another name for attentional and cognitive challenges, then it is not worth studying.

Conversely, if executive functioning and cognition/attention are different constructs, then it is worth studying. Barkley (2011) is one of the several researchers who believe the constructs of executive functioning and attention describe the same problem (Willcutt, Doyle, Nigg, Faraone, & Pennington 2005). Conversely, some researchers believe executive functioning and attentional concerns are two separate constructs. While, others like Anderson (2010) and Miyake, Friedman, Emerson, Witzki, Howerter, and Wager, (2000) have generally accepted there is overlap between the constructs of cognition/attention and executive functioning. Nevertheless, of the acceptance of most researchers about the overlap between executive functioning and

cognition/attention, the idea of this overlap is being challenged by current research.

(Barrett, Fox, Morgan, Fidler, & Daunhauer, 2014; Goldstein & Naglari, 2013; Gunning-Dixon & Raz, 2003; Hunter & Sparrow, 2012). New data is available which suggests attentional, and executive functioning challenges are separate constructs. These studies indicate that people who have attentional concerns have more problems with focusing and using cognitive resources, response inhibition, impulsivity, distractibility, hyperactivity, and inattention (Gunning-Dixon & Raz, 2013; Tamnes et al. 2010).

Whereas, people who have executive functioning challenges have problems with time management, problem-solving, evaluating events/ actions, and maintaining effort overtime (Hunter & Sparrow, 2012). Del Missier, Mäntylä, and De Bruin (2012) uncovered significant differences in the decision-making competence of individuals with executive functioning versus those with cognitive/attentional concerns. Despite these previous findings indicating differences between cognitive and executive functioning processes, the literature indicates significant overlap between cognitive and executive functioning processes when people are confronted with strong emotions (Lazarus, 1999; Barkley, 1999) The most conventional point of view presented in the literature and the view accepted by most psychologists for many years has been when people are confronted with strong emotions they will automatically stop using the frontal lobe which results in the individual being effected to use rigid, automatic fight or flight like coping processes (Selye, 1950).

Currently, there is a debate among researchers if people can use purposeful cognitive and executive functioning resources when being overwhelmed by strong emotions (Goldstein et al., 2013). What this practically means is that emotional coping



does not have as much to do with reactivity or fight or flight responses but is a matter of an individual's ability or inability to exercise volition and then ability to maintain efforts to engage in problem-solving. Then finally, the new intriguing idea being discussed by researchers is the idea that cognition and executive functioning have different etiologies (Armstrong & Morrow, 2010; Rau, Suchy, Butner, & Williams, 2016.) Executive functioning challenges may have an environmental etiology. Whereas, attentional/cognitive issues may have a biological etiology.

### **Neuropsychological Correlates of Executive Functioning Challenges**

As a result of recent advances in brain imaging techniques (MRI) researchers have discovered the parts of the brain responsible for executive functioning challenges (Lezak, 2005; Suchy, 2016). Executive functioning challenges stem from specific abnormalities in the prefrontal cortex in the frontal lobe. The prefrontal cortex consists of three different parts: the dorsolateral, orbital, and medial areas which are believed to impact executive functioning (Tekin and Cummings, 2002; Ranta, 2014). Specifically, the dorsolateral part of the prefrontal cortex has been found to impact verbal fluency, problem-solving, and working memory (Daffner, 2004, Miller, 2000, Rolls, 2004 Casey, Giedd, & Thomas, 2000; Tranel, Anderson, & Benton, 1994). Alternatively, the orbital frontal lobe is in charge of helping people sustain the mental effort, be motivated, and get started on tasks (Barkley, 2012; Brocki & Bohlin, 2004; Malloy, Bihrl, Duffy, & Cimino, 1993). Then the medial part of the pre-frontal cortex is charged with planning, evaluating, and choosing between alternative behavioral choices.

### **Brain Integration, Alexander Luria, and Other Foundational Theorists**

Historically, localization and integration are the two ways which researchers understand brain functioning (Sokol, Muller, Carpendale, Young, & Iarocci, 2010). The previous section focused on and emphasized localization. However, the frontal lobe has been found to have extensive connections with other brain regions which include the medulla and brain stem, occipital, temporal, and parietal regions (Fuster, 2015). Because of these connections, damage to the frontal lobe part of the brain can cause changes to other parts of the brain, and this damage is multiplicative/cumulative (Rinehart, Bradshaw, & Enticott, 2016). This idea would appear to support the view that when one part of the brain is damaged the other parts attempt to compensate for the damaged area (Spear, 1996; Wilson, Dhamapurkar, & Rose, 2016). Depending on the severity of the damage the brain is able successfully to rewire itself (Fuster, 2015). One of the first theorists to bring significant attention to the importance of frontal lobe part of the brain was Alexander Luria (Christensen, 2009). Luria was a Russian Neuroscientist who was a contemporary of Lev Vygotsky whose ideas were well ahead of his time. He proposed his ideas before scientists had CT scans and MRI's. Luria proposed the brain is composed of three functional units. Functioning continues in complexity from the back of the brain to the front of the brain (Goldstein & Naglieri, 2013; Fuster, 2015). With each part of the brain having an impact on the one above it. Luria's theory is significantly different from many recent theories that emphasize individual differences in hemispheric preferences for creativity versus logical functioning. Luria's theory emphasizing complexity of back to front brain functioning has been found to be supported by research (Kirk, Skov, Hulme, Christensen, & Zeki, 2009). In Luria's

theory of brain functioning his first functional unit is composed of the medulla and brain stem. The medulla and brain stem control human functions like sleeping, waking, and heartbeat. Luria's second unit is concerned with memory, and processing of verbal and auditory information. While, Luria's third functional unit is concerned with the executive functioning of individuals. Luria's theory is also compelling because the emphasis that is placed on how brain functioning gets more complex going from back to the front of the brain, and how each functional unit depends on the functional unit above it for optimal performance. Most modern theories of neuropsychological functioning are extensions of Luria's theory (Fuster, 2015). Current studies examining brain functioning have confirmed most of Luria's thoughts and theories regarding neuropsychological functioning.

Another contemporary of Luria, Feuchtwanger (1923) theorized that frontal lobe dysfunction results in personality changes in motivation, affective functioning, and the capacity to regulate and integrate other behaviors. However, what makes his theory valuable is that he believed these issues happen separately from speech, memory, or visual-motor integration deficits. Another way to look at this is a team of people each contributing individual parts to the whole collective success of the team. However, frontal lobe damage may prevent the quarterback from running the play called by the coach.

Another pioneer in neuropsychological research who made significant contributions was Donald Broadbent. He became known as the father of selective attention and theories were the starting point for the theory of information processing (Broadbent, 1953). Broadbent (1953) proposed that humans only have a limited capacity

to process information and the sensory buffer is designed to prevent the information-processing system from becoming overloaded. The sensory information decays rapidly if it stays in the sensory buffer and not meaningfully processed by the individual.

Moreover, Broadbent assumed non-observed stimuli would be rejected at a beginning stage of processing. The fact that people may not consider all of the information available to them at one time because of the limitations of the sensory buffer. As a result, the person focuses on the information they deem relevant, and the other information is ignored. The inability of most people to consider all the information available to them could explain the fickleness of human nature. Overall, Luria, Feuchtwanger, and Broadbent all appreciated the concept that the frontal part of the brain was the conductor of the behavioral and emotional functioning of individuals.

### **Modern Perspectives on Executive Functioning**

Most modern theories of executive functioning theorists conceptualize executive functioning as one single or multiple interdependent constructs (Shallice, 1990; Alexander & Stuss, 2000). Some researchers have as few as three cognitive constructs in theory. Whereas, others have as thirty-three cognitive functions (Anderson & Jacobs, 2002; Fuster, 2008). As a result, significant variance exists with the skills which are believed to be related to executive functioning and those believed to be related to cognition. Furthermore, some theorists contend a developmental perspective should be applied to understand executive functioning skills as executive functioning skills develop throughout the lifespan. Conversely, another group of theorists proposes executive functioning skills challenges should be viewed as problems with learning (Anderson, 2002; Vriezen & Pigott, 2002; Welsh, 2002). Regardless of the disagreements,

researchers agree executive functioning is a cogent-testable theory (Farrar, & Ashwell, 2012). In short, researchers agree that self-regulation, planning, goal-directed action, anticipation, making changes to one's behavior, and using feedback are all related to executive functioning (De Haan & Gunnar, 2009; McAlister & Peterson, 2006).

### **Summaries of the Major Theories of Executive Functioning**

**Theory of the Supervisory Activating System.** The first theory reviewed was the theory of the supervisory activating system proposed by (Shallice & Burgess, 1996). Shallice & Burgess, 1996 suggests different executive functioning skills are used by the brain when the behaviors are automatic as compared to those actions that require purposeful problem-solving. According to this theory, automatic actions are those actions that we perform without conscious thought. Specifically, when responses are automatic, an individual uses contention scheduling where pre-existing schemata are used to complete the action (Shallice & Burgess, 1996). As a result, automatic behaviors happen without the use of the supervisory activating system.

In contrast, when actions are purposeful, they require selective attention, problem-solving, planning, novel decision making, and evaluation. In novel situations, traditional attentional control/resources are needed because schemata may not be clear. These more complex behaviors require the use of the supervisory activating system (aka the frontal lobes/executive functioning skills). Shallice proposed this initial model and the model was refined by Anderson (2008). Shallice's original theory conceptualized the supervisory activating system as a holistic/global system performing a variety of processes carried out by specific parts of the prefrontal cortex (Anderson, 2008).

Anderson (2008), a student of Shallice, added to SAS theory by proposing the end goal of the SAS is to help the individual find the best solution to the problem. According to Anderson (2008) the individual attempts to solve the problem by attempting to come up with a primary plan to solve the problem. However, to put the plan into action, the SAS has to choose the resources needed to solve the problem and inhibit mental resources/schemata which are believed to be contrary to successful completion of the plan. Next, the plan is initiated by the individual, and the consequences evaluated. Based on the outcome and consequences the plan is either stopped, continued, or changed.

**The Sequential Theory of Executive Functioning Processes.** This theory proposed by Zelazo, Carter, Reznick, & Frye (1997) proposes a framework that explains a sequential process for executive functioning. According to the theory, the individual first attempts to understand the problem. Then, after understanding the nature of the problem the individual begins to choose options to solve the problem based upon a ranking of possible options from preferred to non-preferred options. After this ranking, the person will then try the preferred methods for solving the problem and if the preferred methods do not work will try the non-preferred methods until the problem is satisfactorily solved. This theory has two ideas that separate it from the other theories reviewed in this dissertation. The importance placed on the idea of volition and the ranking of preferred and non-preferred responses. Volition in this theory refers to the conscious decision to perform an action or carry out goal-directed behavior.

**Lezak's Volitional Theory.** This next theory considers the idea of volition essential but considers the idea of volition as the central and most important concept in

theory. Lezak (1995) conceptualized executive functioning skills as separate functions. According to his theory deficits with executive functioning happen because of problems with task initiation. What makes this theory interesting is problems with task initiation can occur; despite an individual's ability to solve novel problems and complete tasks (Anderson, 2008). An individual's impulse control, working memory, the ability to sustain attention, self-monitor, and shifting attention are all considered volitional skills which are needed to help a person with task initiation (Barkley, 2011). So, from this perspective, all a person has to do is get started in solving the task and the rest will happen automatically. To fully understand this theory, one must understand that meaningful action includes the initiation and continuation of the steps involved in a plan, as well as the ability to change actions as needed. So, throughout the process task initiation is needed to continue the process at each step. According to this theory, each aspect of executive functioning consists of a distinct set of behaviors, and dysfunction in any of these domains may result in executive dysfunction and cause problems with task initiation.

**Baddeley's Theory.** In contrast, the other theories reviewed the model proposed by Baddeley (2000) places vital importance on the working memory of the individual. According to Baddeley's theory executive functioning is conceptualized as an individual's capacity to temporarily store and manipulate information to produce as a result when engaging in complex mental processes (Baddeley, 2000). As a result, the working memory of an individual is composed of a central executive that controls the shifting of attention, and the coordination of multiple activities as the information enters through sensory processes. Then the information is processed by the first secondary

system which is an auditory-based phonological loop which processes phonemic and verbal information. Alternatively, the second secondary system processes the information by use of a visual-spatial sketchpad which allows individuals to hold information in visual short-term memory. In sum, the process of solving problems is about the ability to hold and use information in conscious awareness to produce a result or execute a plan.

**PASS Theory.** The Planning, Attention-Arousal, Simultaneous and Successive (PASS) theory proposed by Jack Naglieri indicates that people that have challenges with executive functioning because they have challenges with Planning, Attention, Sequential, or Simultaneous Processing skills. According to the PASS theory, Planning is the ability to be able to think ahead and decide on a course of action that will most efficiently solve the problem. Attention is the ability to divide, sustain, shift attention, and not be distracted by stimuli. Sequential skills have to do with the ability to hold information in working memory and complete tasks in step by step manner. Then finally, within this theory, simultaneous skills have to do with an individual's ability to understand whole part relationships, organize visually presented material, and solve novel problems.

**Barkley's Theory of Executive Functioning.** Russell Barkley espouses one of the most widely accepted and current theories of executive functioning. Barkley's (1997) self-regulatory model of executive functioning suggests that response inhibition is central to executive functioning and without it solving problems is almost impossible. This theory posits that behavioral inhibition (i.e., inhibition of responses, interference control) fundamentally contributes to the functioning of other executive capacities because it provides a delay period necessary for executive processes to occur (Anderson, 2008). Executive skills include working memory (i.e., capacity to refer the present situation to



previous events, retention of information to generate and retain future-oriented goals), self-regulation of affect, motivation, and arousal, internalization of speech, and reconstitution (i.e., analysis and synthesis of components of situations). Unlike other models of executive functioning, Barkley's model considers behavioral inhibition as hierarchically superior to the other systems controlling executive processes which are the crucial part of his theory (Barkley, 2011).

### **Assessment of Executive Functioning Skills- Basic Concepts**

Now that specific theory of executive functioning has been considered it is essential to consider how executive functioning skills are measured? As reported earlier in this dissertation several different definitions have been proposed for executive functioning (Baddeley, 1986; Shallice & Burgess, 1996). Several different methods are available to measure adults' executive functioning skills. The three primary methods used by researchers are Magnetic Resonance Imaging (MRI), Individualized Assessment of Executive Functioning Skills, and Rating Scales (Anderson, 2008). Much of what we know about executive functioning skills are the result of MRI imaging. The MRI is used to demonstrate which parts of the brain are activated during which behavioral task. The parts of the brain that light up during the MRI are the parts of the brain that are being used to engage in that task (Baddeley, 1986; Shallice & Burgess, 1996).

### **Constructs and Measurements of Executive Functioning**

This study will measure the subjects' executive functioning by using standardized assessments. During this type of assessment, an individual completes tasks related to executive functioning. Each person who takes the assessment is to read the same instructions and takes the assessment in a well-lit room free from distractions. The

assessments administered are either complete assessment batteries or standalone assessments. The assessments chosen depend on the research questions. The Delis Kaplan Executive Functioning Scale would be an example of a comprehensive measure composed of many individual assessments of executive functioning. Whereas, the Stroop Color Word Test is an example of a standalone assessment. Rating scales will be another method which is used to examine the executive functioning of people. When completing a rating scale a person is evaluating their own ability to complete tasks successfully.

**Inhibition.** One of the critical executive functioning skills reported in the literature is the construct of inhibition. The construct of inhibition can be perceived as the ability to delay responding to opposing and seemingly contradictory stimuli. Some of the assessments which measure this construct are the Wisconsin Card Sorting Test and the Stroop Color Word Test. The WSCT measures this construct by requiring the examinee to inhibit responses because the necessary response during the assessment changes from color, to shape, to number, etc. The Stroop Color Word Test also measures this construct because it requires the examinee to read the actual word and not the color the word is printed.

**Perseverance/Vigilance/Attention.** There are many tests of vigilance or attention, but some of the most notable are the: Test of Variables of Attention and Conners's Continuous Performance Test. A single character is shown on the screen at a rate of approximately one per second. The participant is to click a button when a specific character is displayed. The total time of the test varies from a few minutes to approximately 12 minutes. The assessments yield scores for total errors, commission

errors, and omission errors. These tasks require the participant to sustain attention for extended lengths of time.

**Problem Solving and Response Flexibility.** Problem solving and response flexibility are additional constructs often assessed. Common tests which are used to assess this construct are the Wisconsin Card Sorting Test; Tower of London (Shallice and Burgess, 1996) or Tower Tests, and Trail Making Tests (Reitan & Wolfson, 1985). The Trail Making Test is the most noteworthy of the assessments which measure this construct. This test measures visual search skills, scanning, processing speed, and mental flexibility.

**Working Memory.** Working memory is arguably the best-studied construct of EF. Several common working memory tests are The Simon Game, testing non-verbal working memory (Lezak, Howieson, & Loring, 2004); Digit Span and Arithmetic, subtests of the Wechsler Adult Intelligence Scale (Wechsler, 2009); and the Six Element Task (Burgess & Shallice, 1996). Generally, these EF tests measure working memory by incorporating components of straight memorization and a manipulation (or interference) task. For example, in the Digit Span subtest of the WAIS-IV, a participant repeats a string of numbers and then repeats them backward. Finally, the numbers are recited in sequential order.

**Comprehensive Batteries.** Also, the individual assessments presented earlier comprehensive assessment batteries have been created to measure most if not all of the constructs previous reported. The most well-known of these batteries is the Halstead-Reitan Neuropsychological Test Battery (Reitan & Wolfson, 1985). Moreover, another well-known battery used for examining executive functioning in adults is the Delis-

Kaplan Executive Functioning System (Delis, Kaplan, & Kramer, 2001). These batteries are preferred to individual assessments because they were normed using the same sample rather than separate samples. Using assessments normed on the same sample minimizes measurement error and can lead to a more reliable assessment. However, depending on the research questions and availability of assessments different combinations of assessments may need to be used.

### **Review of Studies Examining Executive Functioning with Different Measures**

Many studies were found involving children and executive functioning measurement, but not as many were found on adults (Bennett, Ong, & Ponsford, 2005; Burgess, Alderman, Evans, Emslie, & Wilson, 1998; Norris & Tate, 2000; Wilson, Evans, Emslie, Alderman, & Burgess, 1998, Barkley & Murphy, 2011). This dearth of studies involving adults would appear to indicate a gap in the literature. Moreover, only three of the studies found examined non-clinical samples. Several of the studies found in the literature reported significant associations between constructs on rating scales/individualized measures, while others did not (Barkley & Murphy, 2011; Shuster & Toplak, 2009; Anderson, 2002).

**Significant Findings.** Studies reviewed have yielded significant relationships between constructs on rating scales and individualized assessments of executive functioning. These studies are reported in Table Three below this section. In the studies which found significant results, two of the studies used the long form of the BDEFS, two used the BRIEF, and the other used the Behavioral Rating of Dysexecutive Syndrome. On two of the studies involving the BDEFS, the construct of Time Management and the Interference score on the Stroop Color-Word Test were found to be significantly related.

What's more, subjects who performed better on the Interference scale also rated themselves as having better time management skills on the BDEFS (Barkley & Murphy, 2011; Kamradt, Ullsperger, & Nikolas, 2014)

On the two studies which examined the BRIEF and the Stroop test higher scores were found on the inference scale, and this score was found to be significantly related to ratings on the Inhibit scale of the BRIEF (Shuster & Toplak, 2009). So, being able to sustain attention, ignore distractions, and persevere on tasks appear to be related.

Meanwhile, scores on the Metacognition index on the BRIEF were found to be related to results on the Tower of London (Anderson, 2002). This finding suggests that a person's ability to use meta-cognitive skills could relate to effective problem solving. Bennett et al. (2005) also reported a significant association between results on the Portus Maze (a planning task) and the planning subscale of the BADS assessment. This association might indicate problem-solving ability is related to the ability to anticipate challenges. Two other studies (Barkley et al. (2011) and Kamradt et al. 2014) support the results from the Bennett et al. (2005) study and add that problem solving is significantly related to restraint and inhibition. Holistically, this could mean that the ability to inhibit one's thinking before the acting helps with adapting successfully to changing stimuli and being able to complete multi-step tasks. Then finally, associations between ratings of motivation have been reported between ratings on the BRIEF/BDEFS and performance on the Stroop and WCST. This could mean that being able to initially activate attention and continually activate attention by staying motivated is an important factor in problem solving (Barkley & Murphy, 2011; Kamradt et al., 2014; Anderson, 2002).

**Possible Reasons for Variable Results.** As reported, several of the studies did not report significant findings, and the possible reasons for the lack of significant findings will be considered (Toplak, Connors, Shuster, Knezevic, & Parks, 2008). The first reason offered for the lack of significant findings is the universal idea of the file drawer problem (Iyengar & Greenhouse, 1988; Salkind, 2010; Wolf, 1986). When a body of research is investigated, some studies were completed that were kept by the individuals and never published. This file drawer problem happens for many reasons. For example, if significant results are not found in a study, then the study might not get published. Also, if peer reviewers do not like a study or find it relevant then the study will not be published (Fagley, 1984). Then finally, of course, there are studies which have not been published which contribute to this problem (Shiles & Sinclair, 2015). In sum, because of this file drawer problem researchers never really know the complete body of research involving a topic. In addition to the file drawer dilemma, there are specific factors related to the studies reviewed which can explain the variable results yielded (Toplak et al. 2013).

Another reason for the variability in results when examining rating scales and individualized measures of executive functioning are in some studies both clinical and non-clinical was used which makes it impossible to compare the results in any meaningful way (Shuster & Toplak, 2009). Moreover, a lack of results could indicate variability in the existence of executive functioning challenges demonstrating the disorder could exist on a continuum from mild to severe which indicates a possible issue with instrumentation sensitivity (Sandberg, 2002; Walker & Gresham, 2015). However, the most compelling reason offered by researchers for the lacking relationship between

rating scales of executive functioning and individualized measures of executive functioning is that they measure different constructs (Nadel & MacDonald, 1980; Shuster & Toplak, 2009). In other words, the construct of executive functioning does not exist and is a false construct. The researchers that report this idea contend the skills which are executive in nature cannot be meaningfully separated from the skills which are described as cognitive in nature (McCloskey & Perkins, 2012).

Another idea presented by Barkley (2012) attempts to compensate for the previously presented concern by indicating that executive functioning skills are different from executive functioning abilities. In this conceptualization, executive functioning skills are overarching constructs from which executive functioning skills emanate (Barkley, 2012). This idea can be compared to the idea that human behavior is related to genotypes and phenotypes (Barkley, 1997). With the genotype indicating the ability is present but does not result in a phenotype until the actual behavior is displayed by the individual (Barkley & Fischer, 2011). Overall, this theory purports executive functioning skills can individual's executive functioning skills resulting in the demonstration of a specific behavior. This idea makes sense because it provides a possible explanation why some people have the cognitive knowledge of how to engage in a particular behavior, but can't perform the behavior (Barkley & Fischer, 2011).

Then finally, another possible explanation by some researchers for the lack of association between rating scales and individualized assessments of executive functioning are they have different purposes (McCloskey & Perkins, 2008). Individualized assessments of executive functioning measure an individual's performance under standardized/near perfect conditions in a quiet office environment with no

distraction. Whereas, rating scales of executive functioning are a measure of ecological functioning because they assess an individual's functioning under what would be considered normal environmental conditions.

The overall goal of this study is to examine the psychometric qualities of the Barkley Deficits of Executive Functioning Scale-Short Form. This literature review considered the studies and information related to theories of executive functioning, neuropsychological correlates of executive functioning, methods of measuring executive functioning skills, and studies examining executive functioning in adults. The need for psychologists to be aware of executive functioning as an issue and being able to differentiate executive functioning issues from attentional, learning disabilities, and other mental disorders were considered. The case of Phineas Gage was discussed and was used to demonstrate how cognitive and attentional skills can remain, but an individual's ability to use that information is a problem. People with executive functioning concerns can explain events and can even express remorse if something bad happens to someone.

Yet, they do not have the motor planning ability to carry out the behavior and do not understand feelings on an emotional level. It was also explained that not all executive functioning disorders are due to brain injuries. Moreover, different theories of executive functioning were reviewed with differences in processes were considered. Some theorists articulated a sequential-linear approach to executive functioning and other communicated a much more non-linear approach. The results of research and relationships between measures of executive functioning were reported. For example, Barkley (2011) found relationships between time-management, restraint, and problem-solving ratings on the BDEFS-LF and results from the WSCT and Stroop test.



Significant relationships were found between results on the Trail-Making Tests and Wisconsin Card Sorting Test in the areas of organization and attention. Overall, this literature needed to be reviewed in order to assist with answering research questions in this study and to put assessment results in the context of current research.

## **Chapter 3**

### **Method**

#### **Participants**

Participants in this study included two separate and independent groups of male and female individuals aged 18-35 years of age. The first group of 264 individuals with a mean age of 25.9 years old with a standard deviation of 4.92 participated in taking the BDEFS-SF and answering demographic questions using an internet survey. The educational attainment of the group indicated that 6.5% of the sample completed high school, 7.6% associate's degree, 16 % bachelor's degree, 33% master's degree, and 4.6% doctorate. When considering the ethnicity of the group 63% of the sample was White, 31% Black, 4.6% Hispanic, and 1.5% Asian. Meanwhile, the second group of 35 individuals aged 18-35 years old took part in this study by taking individually administered assessments of executive functioning/cognition, completing the BDEFS-SF, and answering demographic questions. The ethnic breakdown of the group was 70% White, 25% Black, 3% was Hispanic, and 2% Asian. As far as educational attainment 10% of the group earned a high school diploma, 10% completed two years of college, 28% bachelor's degree, 43% master's degree, 1% specialist degree, and 8% doctoral degree. This second group had a mean age of 25.5 years old and a standard deviation of 5.44 years old.

#### **Procedure**

The individuals in group one were invited to participate in this study via an internet hyper-link using Facebook and other social media. When individuals decided they wanted to participate, they clicked the hyperlink on the screen with their mouse, and

after doing so, they were directed to the first page of the internet survey which was the informed consent page. A copy of the informed consent page used can found in the Appendix. This informed consent page contained information about the purpose of the study, procedures, benefits, risks of participating, and an explanation how to acquire the results of the research, voluntary participation, and contact information of the researchers to ask questions if they wished. After reading the consent page, individuals decided if they wanted to participate by selecting the hyperlink on the computer screen. When selecting the hyperlink, subjects were indicating informed consent to participate in a research study. The subjects then answered demographic questions and the questions on the BDEFS-SF. Upon completion, the individual was thanked for their participation on the computer screen and given the phone number of the primary researcher who stated he would be willing to answer any questions people may have about participation in the study.

Meanwhile, the individuals in the second group were invited to participate by either responding to this researcher from a solicitation on Facebook, a flyer posted on campus with pull tabs, or an email invitation from this researcher. After deciding, they wanted to participate individuals made an appointment to meet with the primary researcher at the University of Missouri-St. Louis to complete the needed study tasks. As participants arrived on campus for their appointment, they were asked to have a seat and given their Starbucks gift card for their participation in the study. Then subjects signed the informed consent forms and were explained their rights as a subject in a research study. They were given the opportunity to ask any questions they had about participation. When signing the informed consent document subjects indicated informed consent to

participate in a research study. Subjects were administered the individualized assessment of cognition and executive functioning. During the assessment individuals were read the standardized instructions as required by each individual assessment and assessments were scored by the primary researcher using the procedures as required by each assessment in each assessment manual. The type of response required when answering questions during the assessments varied based upon the type of assessment, but responses either required verbal, non-verbal, motor responses, or a combination thereof. Next, after completing the individualized assessments participants completed the BDEFS-SF and demographic questions. Then finally, after completing all the tasks participants were asked if they had any questions and were thanked for participating in the study. The IRB board at the University of Missouri-St. Louis gave approval for this study.

### **Measures**

The purpose of this study was to examine the validity and reliability of the BDEFS-Short Form by identifying the underlying factor structure by use of a principal components analysis. The measures for this study were selected based upon their use in previous studies examining executive functioning skills. The information below summarizes the measures used in this study and the psychometric properties of each measure to be used in this study.

**Wechsler Abbreviated Scale of Intelligence-Second Edition (WASI-II).** The WASI-II is a brief assessment of cognitive ability designed to assess cognitive functioning in individuals between the ages of 6 and 89 years. The WASI-II is composed of four subtests: Block Design, Matrix Reasoning, Vocabulary, and Similarities. The WASI-II measures the verbal and nonverbal skills of examinees. The

WASI-II provides an estimate of a Full-Scale Intelligence Quotient highly correlated to other Wechsler measures like the WAIS-IV and WISC-V. The subtest scores on the WASI-II are reported as t-scores with a mean of 50 and a standard deviation of 10. Meanwhile, the Verbal Comprehension Index, Perceptual Reasoning Index, and Full-Scale IQ are reported as standard scores with a mean of 100 and a standard deviation of 15. The test boasts excellent reliability coefficients as reported in the manual ranging from .84 to .98 for adults (Psychological Corporation, 2011). Furthermore, the battery has been shown to have excellent convergent reliability (.86) with other brief measures of cognitive assessment, especially when employing the Full-Scale IQ score (Canivez, Konold, Collins, & Wilson, 2009).

**Barkley Deficits in Executive Functioning Scale-Short Form (BDEFS-SF).**

The BDEFS-SF is a 20 question/item self-rating executive functioning scale which uses a Likert scale answer format (1=rarely or not at all, 2=sometimes, 3=often, and 4=very often.) Currently, there are only norms for an overall rating of executive functioning on the BDEFS-SF, which is computed by adding up the overall raw score from all the questions and finding the proper standard score in the manual. When developing the BDEFS-SF, Barkley (2011) selected the four highest loading questions from each of the five factors uncovered as a part of the factor analyses of the BDEFS-LF. In sum, because the BDEFS-SF was developed without formal psychometric procedures, the information from the Long Form of the Barkley Deficits of Executive Functioning Scale-Long Form (BDEFS-LF) will also be reported although this scale will not be used in this study. The BDEFS-LF is an 89-item behavior rating scale, also utilizing a Likert scale (0=rarely or not at all, 1=sometimes, 2=often, and 3=very often). The items on this scale are based

mainly on Barkley's theory of EF understanding, some concepts from other researchers (Denckla, 1996; Fuster, 1997; Welsh & Pennington, 1988), and an examination of patients with frontal lobe damage. Five constructs of executive functioning were identified as a part of the analytic process when developing the BDEFS-LF: time-management, self-organization/problem solving, self-restraint, self-motivation, and self-regulation of emotions. The BDEFS-LF has a self-report and other informant form, and scores are given for each index, ADHD-EF score, and a total overall score. The ADHD-EF index score is a separate score evaluating the likelihood that the individual may have adult ADHD using 11 questions from the questionnaire (Barkley, 2011). The long form of the Barkley Deficits of Executive Functioning Scale has internal reliability of .91 and test-retest reliability of .85. The validity of the Barkley Deficits of Executive Functioning Scale was assessed by comparing it to the Wechsler Adult Intelligence Scale-III, Connors Continuous Performance Test, Stroop Color Word Test, and Five Points Test. All measures indicated significant relationships with the scale. The most robust associations were found between the Barkley Scale Long Form and the Connors Continuous Performance Test (Barkley, 2011).

**Delis Kaplan Executive Functioning System (D-KEFS).** The Delis Kaplan Executive Functioning System is an assessment of executive functioning used to measure several verbal and nonverbal executive functioning skills in both children and adults ages 8–89 years old. The entire inventory is composed of ten different subtests designed to different measured areas of executive functioning skills. This assessment was normed on a representative sample of individuals from all over the United States. Four of the subtests from this battery will be used in this study. The Trail Making Test measures the

flexibility of thinking on a visual-motor sequencing task. The Design Fluency Test measures one's initiation of problem-solving behavior, fluency in generating visual patterns, creativity in drawing new designs, simultaneous processing in drawing the designs while observing the rules and restrictions of the task and inhibiting previously drawn responses. The Color-Word Interference Test measures the ability to inhibit dominant and automatic verbal responses. The Tower Test measures spatial planning, rule learning, inhibition of impulsive and perseverative responding, and the ability to establish and maintain instructional set. These subtests are explained in further detail below along with their historical roots in the assessment of executive functioning skills. The Delis Kaplan Executive Functioning Scale has established validity with other with cognitive tests including California Verbal Learning Test-Second Edition (Delis, Kaplan, & Kramer, 2000) Wisconsin Card Sorting Test (Heaton, Chelune, Talley, Kay & Curtiss, 1993), and Stroop Color Word Test (Delis, Kaplan, Kramer, & 2001). All correlations range from .85 to .95 which are excellent (Delis et al., 2001). Additionally, the Delis Kaplan Executive Functioning Scale has outstanding reliability which ranges from .85 to .93 depending on the subtest.

***Tower Test (DKEFS).*** The Tower Test is a standard assessment of executive functioning. This test has its roots in several earlier tests such as the Towers of Hanoi, London, and Toronto, but extensions in score ranges were made by including both easier and more difficult items so as to improve the overall psychometrics of the test on the DKEFS (Delis, Kaplan, & Kramer, 2001). Examinees on this assessment are presented with a number of discs of varying sizes in a specific array and are asked to arrange the discs on the board so that they match the stimulus picture presented, and to do so in as

few moves as possible. There are a number of rules the examinee must follow, such as moving only one ring at a time and never placing a bigger ring on top of a smaller ring. In each subsequent part, the number of rings and the complexity of the moves become more complicated. This test taps into spatial planning, rule learning, inhibition of impulsive responding, inhibition of perseverative responding, and establishing and maintaining an instructional set (Delis et al. 2001). According to Delis et al., (2001) this subtest has a split-half reliability of .80 and a test-retest reliability of .76. The validity of the Tower Test was compared with the Tower of London task and found to be significantly correlated .77 (Delis et al., 2001).

***Stroop Color Word Test (STROOP).*** This classic test of executive functioning was initially developed by Stroop (1938). However, it has been re-normed several times over the years to maintain an up to date set of norms. On this assessment, the subject first reads a set of words in black and white print for 45 seconds. Then on the second part of the assessment, the subject identifies the color which is listed going down the page in a 45 second-time limit. Then finally, the subject reads the color in which the word is printed in rather than the word itself in a 45 second-time limit. For example, the word listed may be blue, but the color of the font is red. The subject must identify the color of the font which is red. Scoring on this test is based upon the number of stimuli named correctly on the first, second, and third part of the test in 45 seconds. T-scores with a mean of 50 and a standard deviation of 10 are yielded for the four scores on this test in the area of the word, color, color-word reading, and interference. Research on this assessment has indicated different profiles of strengths and weaknesses indicated are related to learning disabilities, ADHD, and other brain dysfunction. The reliability of the



Stroop Test as reported in the assessment manual is reported to be in good to acceptable ranges with a test-retest reliability of .8 (Golden & Hines, 2002). The validity of the Stroop Test is well documented in many studies examining different manifestations of organicity and brain dysfunction (Golden & Hines, 2002). The Stroop Test has been used in studies examining Traumatic Brain Injury, Localized Brain Damage, Dementia, Parkinson's Disease, Turner Syndrome, HIV Dementia, and Schizophrenia (Golden & Hines, 2002). The validity of this assessment has also been established by demonstrating significant correlations with other well-known assessments like the Mental Status Exam, Block Design subtest of the WAIS-III, Minnesota Multiphasic Personality Inventory, and Wisconsin Card Sorting Test (Golden & Hines, 2002).

***Wisconsin Card Sorting Test (WCST).*** The Wisconsin Card Sorting Test (WCST) was developed by Esta Berg at the University of Wisconsin and is a commonly-used psychological assessment instrument designed to assess executive functioning. The WCST requires individuals to sort 64 cards which depict symbols based on shape, color, or number. After getting ten consecutive items correct the sorting criteria change based on shape, color, or number. The assessment continues until all 64 cards are used. The assessment is reported to measure set-shifting, flexibility, attention, and working memory. Scores on this assessment are yielded based on performance and errors demonstrated. Reliability of this assessment according to the manual ranges from .65 to .83 depending on age (Heaton, 1993). Furthermore, the validity of this measure has been demonstrated by its correlation with other assessments of executive functioning like the Stroop Color Word Test and Delis Kaplan Executive Functioning Scale (Heaton, 1993).

## Data Screening

Before statistically examining the data gathered from this study, the data needed to be examined for outliers. The data also needed to be examined to see if the data meets criteria for the running of a factor analytic procedure: linearity, normality, and equal variance. No significant outliers were identified during the screening process. Moreover, no challenges were discovered with multicollinearity, normality, linearity, and equal variance using descriptive statistics. The previously stated issues were examined by looking at visual representations of the data such as histograms, scatterplots, collinearity statistics, skewness, and tolerance. Histograms and scatterplots were examined for large deviations from linearity and normality. Additionally, collinearity, skewness, and kurtosis data were examined as a part of the process to identify possible concerns with data.

The next thing that was considered as a part of the screening process was the consideration of the number of subjects needed in this study to avoid a Type II error. Bryant and Yarnold (1995) recommend that a sample should be at least five times the number of variables to be extracted in the analysis. Based on the literature review and examining the survey it is believed that a factor analytic process will yield three latent variables. Using the guidance provided by Bryant and Yarnold (1995) a minimum of 150 subjects will be required to have enough statistical power to avoid a Type II error. Tabachnick and Fidell (2007) also report at least 150 subjects are needed for a factor analysis to have enough statistical power to avoid a Type II error and indicate if the factor loadings on each of the latent variables extracted are higher than .5, then fewer subjects may be sampled.

## Data Analysis

**Examination of demographic data.** To answer the research questions in this study, it was necessary to gather data from two independent groups who were not randomly selected. Consequently, because the data from these two groups were not randomly selected the data from these two groups had to be examined for group equivalency as scores are being compared across groups. Four different demographic variables from the two groups are being examined to determine possible group similarity in this study: age, gender, ethnicity, and education. Two different statistical methods will be used in this study to determine group similarity: t-test and Chi Square Test of Independence. The T-Test will be used on the continuous variable of age, while the Chi Square Test of Independence will be used on the demographic variables of gender, ethnicity, and education because they are nominal in nature. When examining the results from the different tests if there is not significant variability between the two groups, then it is believed the scores from the groups originate from a similar population. Group similarity or difference will be reported in the next chapter.

**Factor analyses.** Next, to answer research questions 1 and 2 in this study scores yielded were examined using principal components and parallel analysis to identify the latent factor structure of the BDEFS-SF. It is important to note, when performing factor analytic processes scores can be obscured and hidden as a part of the process. As a result, to uncover hidden relationships in the scores, data rotation processes are completed to ensure if there are hidden relationships they are found. According to Gorsuch, (1983) data rotation methods are either orthogonal or oblique depending on the research questions posed by the researcher. Orthogonal rotation methods are used when the

researcher assumes the factors in the analysis are unrelated. In contrast, oblique rotation methods used when the researcher assumes that there are relationships between factors. In this study, a Promax rotation which is an oblique rotation was used because it was assumed there was relationships in the data and the scores will indicate more than one significant trait. After the running of the first factor analysis, each of the latent factors scores that are yielded will be reexamined a second time by factor analysis. This second analysis is done to separately determine if each of the latent traits are unitary and identify the reliability of each latent variable. Then finally, a parallel analysis generates a specific set of predicted factor eigenvalues which are calculated based upon the running of a Monte Carlo Simulation. In this process, the 95% confidence interval was used for establishment of the cut off for the level of statistical significance. Any observed factor eigenvalues which are significantly different from the predicted values are removed from the model to avoid a Type II error. (O'Connor, 2000).

**Correlational Analyses.** When answering questions, 3 and 4 correlational matrices were created to identify possible relationships in the data. Specifically, when answering research question 3, the Full-Scale IQ from the WASI-II was compared with the scores representing the three latent traits of Activation, Regulation, and Learning. These scores were examined for possible statistical relationships. To answer research question number 4 the scores representing the latent traits of Activation, Regulation, and Learning were compared with scores yielded from the individualized assessment of executive functioning abilities in this study from the Stroop Test, Wisconsin Card Sorting Test, Design Fluency Test, Trail Making Test, and Tower Test.

## Chapter 4

### Results

#### Overview

As can be observed in Table 1 when examining the scores in this study no significant concerns were identified with kurtosis or skewness of the data. None of the items displayed kurtosis values beyond the 1<sup>st</sup> standard deviation, and skewedness values were near a value of 0. Moreover, there were no issues related to significant problems with normality, equal variance, or linearity that would inhibit the running or interpretation of scores that resulted from a factor analytic or correlational analysis of data. However, as reported in the previous chapter, before commenting on data related to specific research questions in this study demographic scores were examined for lack of group similarity

#### Demographic Data

**Examination of group similarities and differences.** As reported in Chapter Three the demographic data in this study were examined to see if the scores indicated significant group differences. Chi square and t-test analyses were conducted on the scores of each of the four demographic variables in this study to examine group possible group similarity or difference. The relationship between the variables of gender  $\chi^2 = 1.61$   $\rho = .21$ , ethnicity  $\chi^2 = .56$   $\rho = .45$ , and age  $R^2 = -.922$   $\rho = .36$ . were all non-significant indicating the scores can be considered from the same population. However, the data from the variable of education were significantly different between the two groups indicating these scores are from different populations  $\chi^2 = 524.13$ ,  $\rho = .000$ .

Table 1

*Means, Standard Deviations, Kurtosis, and Skewedness for all Items*

Question	Mean	SD	Kurtosis	Skewedness
Memory	2.19	.632	.821	.998
Motivate	2.23	.757	.698	.448
Self-Talk	2.78	.976	-.049	-.892
Novel	2.04	.660	.595	.641
Sequential	2.02	.787	.485	-.095
Adaptability	1.80	.868	.421	-.179
Processing	1.75	.875	.457	-.194
Inhibit	1.67	.720	.312	.447
Impulsive	1.94	.709	.662	.855
Consequence	1.88	.637	.290	.139
Consider	1.84	.643	.413	.452
Effort	2.44	1.10	.257	.657
Unmotivated	2.24	1.22	.425	.781
Inconsistent	2.12	.807	-.086	-.879
Supervision	1.70	.674	.742	.661
Calm Down	1.97	.658	.759	.987
Regain	1.77	.601	.460	.738
Distraction	2.20	.829	.005	-.853
Remain	1.89	.695	.762	.943

### **Analyses of Data from Research Questions**

**Research question 1.** The first research question in this study was concerned with the internal validity of the BDEFS-SF. This first question posited if the BDEFS-SF would demonstrate adequate internal reliability of at least a .80. The initial analysis of the BDEFS-SF using the scores from this sample in this study indicated the BDEFS-SF has a more than adequate internal validity of .87. Additionally, to check this outcome,

results from the Keiser Meyer Olin Test of Sampling Adequacy (KMO) and Bartlett's Test of Sphericity (Bartlett's Test) were also computed and consulted. The KMO statistic of .85 based upon the scores from this study indicated the sample size in this study was large enough to obtain reliable results.

Moreover, Bartlett's Test of Sphericity statistic yielded was statistically significant which indicated there was not significant repetition in the data which would influence the factor analysis. So, based upon the scores yielded in this study the BDEFS-SF would appear to be a reliable instrument.

**Research question two.** The second research question examined if the scores indicated the BDEFS-SF was composed of three latent traits after all factor analytic processes were completed. Interestingly, the scores yielded from the initial principal components analysis process yielded an initial four latent trait model. However, to check the veracity of the four latent trait model, the scores from each individual factor were each subjected to individual principal components analyses in and of themselves. After the individual examination of the latent traits, the scores yielded upheld the acceptability of the four-latent trait model. Conversely, as a final check of the four-factor model, a parallel analysis was conducted, and the scores from this factor analysis indicated the fourth latent trait's actual eigenvalue was significantly different from the predicted eigenvalue. This previously stated result combined with the fact that the fourth latent trait was only composed of two questions means that it can be dropped from the model. In sum, the factor analysis process resulted in the acceptance of a three-factor model. Table 2 lists the factor analysis scores along with the reliability coefficients for each individual factor. Then, figure 1 illustrates the scree plot showing the results of the

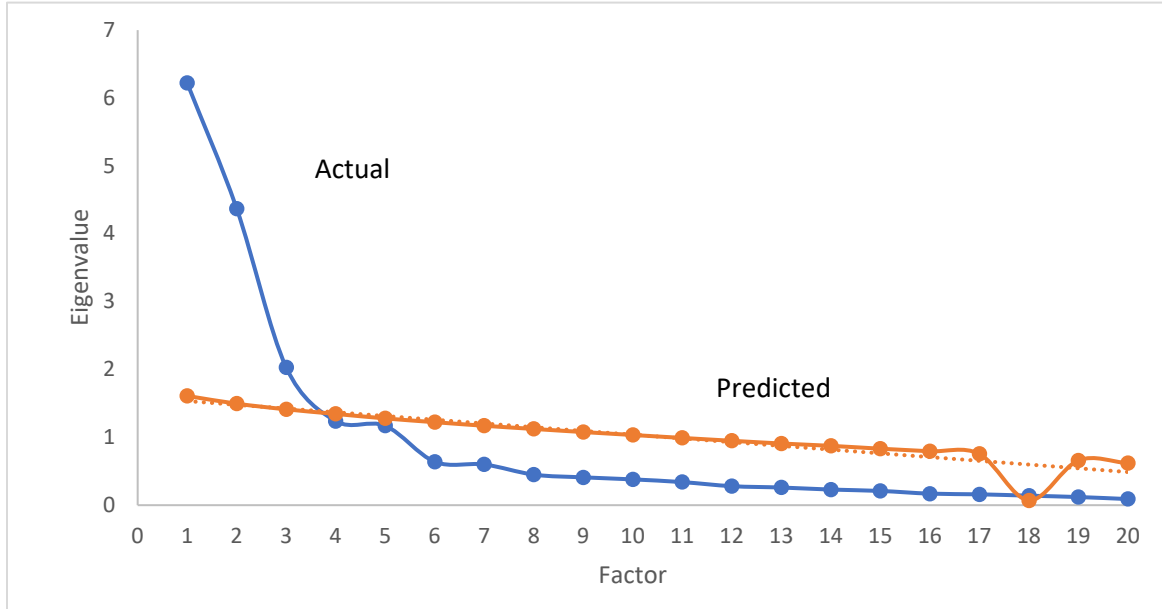
parallel analysis process with the lines representing the actual scores versus the predicted scores from the parallel analysis.

Table 2

*Factor Analysis Results*

<b>Item</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
<b>Factor 1: (<math>\alpha = .750</math>)* Activation</b>				
1. Procrastinate or put off doing things	<b>.780</b>	-.442	.147	.112
4. Can't Tell Yourself What to do	<b>.882</b>	-.181	.286	.045
13. Effort to Put Forth on Tasks	<b>.875</b>	.226	.105	.029
14. Others Tell Them They Are Lazy	<b>.916</b>	.155	.086	.023
15. Quantity and Quality of Work	<b>.810</b>	.229	.120	.097
<b>Factor 2: (<math>\alpha = .893</math>)* Regulation</b>				
9. Response Inhibition	-.606	<b>.587</b>	.038	.088
11. Consider Consequences	.088	<b>.708</b>	.044	.094
12. Consider Past Experience	-.092	<b>.605</b>	.157	.061
17. Calm Down Anger	.143	<b>.859</b>	.073	.121
18. Thinking While Angry	.234	<b>.872</b>	.169	.267
19. Distraction Upset	-.586	<b>.624</b>	.064	.145
20. Remain Emotional	-.137	<b>.796</b>	.084	.108
<b>Factor 3: (<math>\alpha = .767</math>)* Learning</b>				
5. Complex Activities	.024	.163	<b>.973</b>	.072
6. Sequential Explanation	.098	.175	<b>.887</b>	.130
7. Flexibility	-.109	.021	<b>.658</b>	.002
8. Information Processing	.178	.210	<b>.564</b>	.113
<b>Factor 4: Eliminated After Parallel Analysis (<math>\alpha = .804</math>)*</b>				
2. Can't Hold Thinking in Mind	.123	.201	.089	<b>.848</b>
3. Not Motivated to Prepare in Advance	.112	.021	.130	<b>.547</b>





*Figure 1* Scree Plot Actual versus Predicted Values from Parallel Analysis

**Research question three.** The third research question in this study stated the Full-Scale IQ on the WASI-II would not be found to be significantly related to scores on the BDEFS-SF. A correlation matrix was computed using the scores from the WASI-II and the BDEFS-SF from this sample. As can be observed below the scores in Table 3 from the correlation matrix below the scores from the BDEFS-SF were not found to be significantly related to the Full-Scale IQ on the WASI-II.

Table 3

*Correlation Matrix for Three Latent Traits on BDEFS-SF and WASI-II*

	WASI-II	Activation	Regulation	Learning
WASI-II	1			
Activation	-.096	1		
Regulation	-.005	.037	1	
Learning	.146	<b>.360**</b>	<b>.438**</b>	1

\*Significant at  $p < .05$ \*\*Significant at  $p < .01$ 

**Research question four.** Research question number four stated there would be significant statistical relationships between ratings of executive functioning from the BDEFS-SF and individualized assessments of executive functioning. This specific question concerns the validity of the BDEFS-SF. Overall, these measures should be related because they are believed to measure the same construct. The relationships between the BDEFS-SF and individualized assessments of executive functioning were measured using a correlation matrix procedure. When examining the correlation matrix below in table 4 the scores representing the latent trait of Activation were found to be significantly related to scores representing results from the Stroop Test. Furthermore, the results from the Wisconsin Card Sorting Test were found to be related to scores from the latent trait of learning. Then, the results from the Trail Making Test were found to be related to Regulation.

Table 4

*Correlation Matrix for Three Latent Traits on BDEFS-SF and WASI-II*

	Stroop	WCST	Design	Tower	Trails	Activation	Regulation	Learning
Stroop	1							
WCST	.624**	1						
Design	.438**	.628**	1					
Tower	.704**	.644**	.667**	1				
Trails	.557**	.506**	.523**	.738**	1			
Activation	.360*	.107	-.042	.120	.066	1		
Regulation	.178	.055	.107	.039	.275*	.037	1	
Learning	.027	.497**	.091	.036	.157	.360**	.438**	1

\*Significant at  $p < .05$ \*\*Significant at  $p < .01$

## **Chapter 5**

### **Discussion**

The main finding of this study provides initial evidence for the validity and reliability of the BDEFS-SF. First, the reliability of the BDEFS-SF was found to be a robust measure with a more than adequate internal reliability coefficient of .87. This means people can have confidence that the BDEFS-SF is an extremely reliable measure. Factor analytic results originally yielded a four-trait model. However, when the 4-factor model was examined using parallel analysis, it was uncovered that one of the variables no longer fit the model and was eliminated. This resulted in the final acceptance of a 3-factor model. Moreover, the scores from the WASI-II and scores representing the latent traits of Regulation, Activation, and Learning were found not to be significantly related. This is an important result because researchers are currently debating if cognition and executive functioning are separate constructs. The result adds to the data which indicates the two constructs are separate and therefore worthy of examination. In other words, if executive functioning and cognition they would not be worthy of examination because they measuring the same construct. Furthermore, the results from correlation matrices demonstrated significant relationships between individualized assessments and ratings of executive functioning. This outcome is important because the measures report to measure the same construct and it was found they do measure the same construct. In this section, the findings of this study will be interpreted within the context of the extant literature, limitations of the study will be considered, and future research will be suggested.

Analyses of the scores resulted in a three-factor model, which is different from the current one factor model with the BDEFS-SF. This finding is significant for professionals because it provides much needed information regarding the diagnostic utility and specificity of the BDEFS-SF as an instrument. The current one factor model is not diagnostically useful for professionals because it does not provide specificity of an individual's executive functioning challenges. Additionally, the one factor model of executive functioning is not supported by current research because of the multivariate nature of executive functioning skills. One overall score could not be used to summarize the executive functioning abilities of individuals. Moreover, these findings yielded appear to provide professionals with a short-form scale that is reliable and valid while significantly reducing response burden for individuals.

### **Link of Results to Theories of Executive Functioning**

The results and scores yielded in this study are supported by theories of executive functioning which add to their validity. Overall, the results appear to be related to Luria's Theory of Executive Functioning. However, there are other similarities with other theories which will be discussed as well.

**Activation.** The first functional unit in Luria's theory is based in the brain-stem and controls involuntary processes like sleeping and waking, instinctual responses, initiation of sensory processes, and the ability to activate and sustain attention (Luria, 1973 & Nagilari et al, 2007). This is an important point as this part of the brain is not only responsible for initial activation of attention, but also influences the ability of an individual to maintain an ongoing state of arousal. Specifically, Luria (1973) believed that arousal is necessary before a person can utilize the second and third functional units

to learn effectively. Broadbent (1954) & Nagilari & Otero (2007) also describe the significant importance of activation in their theories as a prerequisite to being able to utilize attentional control to engage higher level executive processes to solve complex problems. Lezak (2000) also communicated the importance of activation of mental processes in his theory as it is difficult for an individual to use volition to make decisions if sensory and other processes are not engaged. Lastly, Barkley indicated the importance of activation in his theory with activation being a prerequisite behavioral and emotional regulation. The questions on the BDEFS-SF comprising the first latent trait in this study all have to do with activation or sustaining attention overtime. The questions on this factor ask individuals if they engage in procrastination, put off doing things, are able to tell themselves do engage in actions, and rate the quantity and quality of work they produce overtime. Furthermore, to support this idea, construct validity scores from the Stroop Color Word Test were found to be correlated with the scores from the first latent trait (Activation). Previous research has also found that results on the Stroop Test were found to be related to an individuals ability to sustain, activate, and control attention (Zhang, L, Ding, C, Li, H, 2013 & MacLeod, C., 1991)

**Learning.** Meanwhile, the Second Functional Unit of Luria's theory is related to the verbal and non-verbal processes used by an individual in learning of new material. This second unit is composed of the parietal, occipital, and temporal lobes of the brain. Several researchers believe the temporo-parietal junction to be the location where a significant amount of information from the environment is processed (Decety & Lamm, 2007). Feifer (2000) indicates the Full-Scale IQ score yielded on a cognitive assessment is representative of an individual's brain functioning in this part of the brain. Hale &

Fiorello (2017) also contend most intelligence tests assess an individual's abilities in retaining and comprehending information and do not place a focus on novel problem-solving abilities. Naglieri & Otero, (2011) further communicate Luria's second unit is concerned with organizing and sorting verbal and non-verbal information to be used by the frontal lobe to make decisions. The way information is ordered and organized is believed to influence how the data are retained in the long-term memory of people (Lezak, 2000). Zelazo, Carter, Reznick, and Frye (1997) also place emphasis in their theory on how information is ordered to attempt to understand the nature of problems because of how this information is used to rank preferred from non-preferred options when attempting to solve problems. This idea is important to consider because a person's problem-solving attempts are most likely only as good as the information that an individual has about the nature of the existing problem. In short, the questions on the BDEFS-SF, which composes the third latent trait in this study asks a person to rate how they learn, retain, and process information. To support these previous stated ideas, scores representing the third latent trait of learning in this study were found to be significantly related to scores on the Wisconsin Card Sorting Test. Previous studies have found that results on the WSCT are significantly related to working memory and information processing (Perrine, 2013).

**Regulation.** According to Luria's theory, the third functional unit is the frontal lobe part of the brain. The frontal lobe influences person's ability to use the information to solve problems, make decisions, anticipate consequences, and make cognitive and behavioral changes in the middle of a problem-solving attempt (Antshel et al., 2013; De Haan & Gunnar, 2009). Almost all theories of executive functioning place emphasis on

the frontal lobe role in helping a person engage in effective problem-solving processes (. The differences between the theories involve the degree to which the frontal lobe is used and the linear or non-linear nature of executive processes. The items comprising Regulation involve the consideration of past experience, anticipation of consequences, controlling frustration, and how quickly a person can calm down after being frustrated. In addition, to support the validity of the BDEFS-SF the latent trait of Regulation was found to be related to scores from the Trail Making Test. The Trail Making Test is an assessment which has been found to be related to measures of regulation in past studies (Misdraji, E., 2010).

### **Limitations of Current Study**

This study has limitations that need to be considered when interpreting the results. First, the participants in this study were not randomly selected. The lack of random selection could impact the results because it introduces the possibility of selection bias and impacts the ability to generalize results outside this study. However, to attempt to compensate for the lack of random selection of individuals demographic data were examined for potential group similarity. Three of the four demographic variables were found to be from similar populations when examining the scores between groups. However, it is important to note that this concept of statistical similarity is not exactly the same concept as the concept of random selection. When a researcher uses random selection of subjects, they have a very high level of confidence results will not be impacted by bias because random selection ensures subjects are from a specific population. Whereas, when researchers rely on the concept of statistical similarity the researcher can not have the same level of confidence as can be had when the researcher



uses random selection because the link between population and subject is based upon probability. In this study, three out of the four demographic variables indicated the two groups were from similar populations. However, the variable of education was found to be significantly different between the two groups with group 2 being found to be more educated than group 1. This difference in the education between the two groups could impact results. However, research considering the impact of education on the executive functioning has yielded variable results with some studies finding the level of education of the sample influences executive functioning and other studies found education has no significant impact on executive functioning (Alvarez & Emory, 2006; Follmer, 2018).

Another possible source of bias was all assessments were administered and scored by the primary researcher. However, to minimize this potential bias, all assessments were administered using the standardized procedures recommended for each assessment. When using self-report assessments in research, it is possible for subjects to distort responses to portray themselves in a certain way. This potential issue with bias was addressed by following the standardized procedures in the administration and scoring of the assessments. Another potential way to work with distortion in self-reporting is to use collateral raters. But this was not feasible given the limited budget of this researcher. Another limitation in this study is the difficulty with measuring and isolating those skills which are considered executive in nature. Even advanced assessment approaches like MRI are also not able to identify every executive functioning concern. It is also important to remember that brain-behavioral relationships measured using individualized assessments of executive functioning like the ones used in this study are based upon correlation and not causation. The previously stated point is exactly the reason why

Barkley developed the BDEFS, so that a more ecologically valid measure of executive functioning could be used to identify executive functioning challenges. However, when using a rating scale, the measure does not actually examine an individual's ability to perform tasks it measures a person's perception of their ability to perform tasks. In sum, when using these measures, it is important to understand the limitations of each approach as each of them have advantages and disadvantages. Furthermore, when considering executive functioning the issue of how emotions impact outcomes need to be considered. There is a debate among researchers about the impact that emotions have on executive functioning. Some theories place an emphasis on volition and choice when people attempt solve problems when dealing with strong emotions. These ideas are in contrast to more traditional theories of stress like General Adaption Syndrome which indicates when an individual gets overwhelmed, choice and volition to use executive functioning skills get bypassed in favor of more automatic/rigid responses involving fight or flight.

**Three trait models of executive functioning.** Finally, there is current research that was published at the same time as this study was being conducted which appears to challenge the concept of a three-trait model of executive functioning. Karr, Areshenkoff, Rast Hofer, Iverson, and Garcia-Barrera (2018). performed a confirmatory factor analysis on a sample of 46 studies which examined executive functioning across the life span (10 studies were adult). In these studies, researchers found that there was a relationship between the number of factors accepted in models and the developmental level of the subjects. For example, in studies involving preschool and elementary students, one or two factor models were found. With young adults, three factor model resulted, and with older adults, two to three factor models were uncovered. In most of these studies, the

factors included the variables of inhibition, working memory, and shifting. Statistical analyses of these studies show some evidence for greater uni-dimensionality of executive function among child/adolescent samples and both convergence and divergence among adult samples. In fact, this was observed in this study with some correlations between latent traits and between outcomes of the various individualized assessments of executive functioning. Karr et al. 2018 also indicated a possible bias toward publishing well-fitting models and states concern with sample size and being able to replicate these studies. Karr et al. 2018 makes relevant points regarding the bias toward publishing well-fitting models and convergence-divergence of results. In this study, the latent trait of regulation consisted of both behavioral and emotional components. Additionally, this point could be made about the process of exploratory factor analysis in general which was performed in this study. The overall goal of exploratory factor analysis is to use statistical processes to uncover latent and hidden traits and to fit them into a model. In sum, some bias is inherent as a result of the statistical methods being used to uncover the latent traits.

However, taken as whole, the previously stated findings from Karr et al. (2018) make sense with what is currently known about the nature of executive functioning across the lifespan. For example, the executive functioning skills of children are not fully developed until they begin to reach the age of 18. By contrast, the executive functioning skills of adults are developed and fully differentiated. Therefore, it makes sense that studies examining children would find unidimensional models as their abilities are not fully developed. In addition, it makes sense that three factors identified in most of these studies would be related to working memory, inhibition, and response flexibility as effective problem solving and adaption to the environment involves these basic attributes.

In this study, this researcher addressed possible concerns with sample size by consulting statistics and information related to ensuring adequate sample size. Regarding replication, this researcher gave detailed demographic information about the sample and attempted to determine the similarity of the two samples by using the appropriate statistical procedures. Documenting this information allows other researchers to attempt to replicate studies. One last limitation of this study was the UMMSL IRB board would not allow this researcher to ask subjects if they had medical diagnoses despite giving the board a rationalization why this information was needed. For example, if people in the sample had ADHD, Learning Disabilities, or other disorders it could influence assessment results.

### **Recommendations for Future Research**

This study used a classical test theory approach to the examination of data which placed an emphasis on examination of means and other summary data. One recommendation for future research could be an examination of the BDEFS-SF scale from the perspective of Item Response Theory. IRT theory places more emphasis at the level of the item and provides a different perspective because IRT examines the item difficulty and item discrimination. In addition, to the previous idea, it is always important to recommend the replication of studies. This is important replication will either confirm or refute the results yielded in this study. Moreover, this study only examined one age range of people (i.e. 18-35-year-olds), and as a result, it is recommended that the scale is examined with different age groups. If the factor structure yielded in this study holds up, it will add to the validity of the results yielded. Another area of future examination of these results could be to examine the pattern of specific

relationships between variables using Structural Equation Modeling. Structural Equation Modeling would provide more information about the specific inter-relationships between the variables in this study. This idea would be important to consider because research in this area has not clearly identified a path or direction of how executive functioning skills are utilized. As discussed in the literature review, some researchers have suggested a step by step path and others a more complex interrelated path of how these skills are used. For example, the theory suggested by Zelazo et al. (1997) proposes a step by step process for executive functioning where people make conscious goal directed decisions to attempt to understand the problem and then rank possible solutions to the problem from preferred to non-preferred, with the individual implementing the ranked hypothetical solutions until the goal is achieved.

Conversely, the model suggested by Shallice (1986) and Anderson (2008) is much more fluid and flexible based upon the schemata that people have developed and based upon automatic versus purposeful executive functioning and the ability of the person to inhibit emotions. As can be recalled from the literature review, one of the major differences between Zelazo et al., (1997) and Shallice and Burgess, (1996) and Anderson (2008) was the concept of purposeful/conscious problem solving. Shallice and Burgess (1986) reports executive functioning skills can be automatic and purposeful. When executive functioning happens on an unconscious level, it occurs using pre-existing (instinctual) schemata (Shallice & Burgess, 1986). This is in stark contrast to the theory proposed by Zelazo et al. (1997) which reports that executive functioning must be volitional in nature for it to be considered executive functioning, a specific choice made by the individual, and conscious in nature.

The fluid nature of the theory suggested by Shallice (1986) and Anderson (2008) not only is influenced by the inhibition of the individual at the beginning of the problem-solving attempt, but throughout the process of the attempt to solve the problem. Frustration must be held off during the attempt to engage executive functioning or the unconscious rigid problem-solving methods will be engaged. These ideas are important to consider because they introduce the idea of alternative paths for problem solving/executive functioning that can occur if the attempt becomes unconscious midstream. So, the idea of emotion influencing executive functioning should be considered in any study that attempts to study the path of executive functioning attempts.

Another consideration when studying executive functioning is the level of the novelty of the problem for the individual. According to Anderson (2008), the individual attempts to solve the problem by attempting to come up with a primary plan to solve the problem. This attempt to come with a primary plan can and most likely will be influenced by if the individual has confronted the problem before or a similar problem. In short, if the person has seen the problem before the person will most likely use the method they used previously. Whereas, if the individual has not seen the problem before the person will have to develop a plan that may or may not work. Thus, the novelty of the problem could introduce the likelihood that frustration and emotion may become an issue because of the inability of the individual to solve the problem quickly. As a result, the emotion, frustration, and novelty involved with the problem are a concept that should be considered in future research.

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APPENDIX A- Internet Consent Form

## APPENDIX A- INTERNET CONSENT FORM



Department of Education Sciences  
and Professional Programs

Informed Consent for Participation in Research Activities- Internet Administration Validity  
of the Short Form of the Barkley Deficits of Executive Functioning Scale

HSC ApprovalNumber1095670-2

Principal Investigator Brian Sheble

PI's Phone Number 314-302-3594

- 
1. You are invited to participate in a research study conducted under the supervision of Dr. Cody Ding by Brian Sheble. The purpose of this research is to investigate the validity of the Short Form of the Barkley Deficits of Executive Functioning Scale. Executive Functioning is defined as mental processes which occur in the in the frontal lobe part of the brain that help people engage in goal-directed behavior. They assist people with making appropriate choices, cope with negative feelings and impulses, control behavior, assist people with activating attention, developing and evaluating problem-solving attempts, changing plans if necessary in the middle of a problem-solving attempt, motivate people to achieve our goals, and prepare for future events.
  2. Your participation will involve completing a rating scale measuring how you perceive your ability to remember things, cope with stress, motivate yourself to engage in tasks, and time management skills (i.e.,) executive functioning skills). You will also be giving simple demographic information: age, occupation, gender, race, ethnicity, income level, and the highest level of education completed.
  3. The assessment will only take approximately ten minutes to complete
  4. There are no risks or direct benefits for your participation in this study.
  5. Your participation will contribute to the knowledge and research about executive functioning and cognition. Participation is voluntary, and you may choose not to participate in this research study or to withdraw your consent at any time. You may choose not to answer any questions that you do not want to answer. You will NOT be penalized in any way should you choose not to participate or to withdraw.

6. By selecting the button below you are indicating that are agreeing to participate, you understand and agree that your data may be shared with other researchers and educators in the form of presentations and publications. In all cases, your identity will not be revealed. In rare instances, a researcher's study must undergo an audit or program evaluation by an oversight agency (such as the Office for Human Research Protection). That agency would be required to maintain the confidentiality of your data. Also, all data will be stored on a password-protected computer and in a locked office.

If you have any questions or concerns regarding this study, or if any problems arise, you may call the Investigator, Brian Sheble at 314-302-3594 or the Faculty Advisor, Dr. Cody Ding at 314-516-5994). You may also ask questions or state concerns regarding your rights as a research participant to the Office of Research Administration, at 516-5897.

Yes I wish to Participate

By clicking this button, you are giving your informed consent to participate in this study and understand your rights as a participant in a research study.

APPENDIX B- Direct Assessment Consent Form



## APPENDIX B- DIRECT ASSESSMENT CONSENT FORM


**Department of Education Sciences and Professional Programs**

One University Bl  
 St. Louis, Misso  
 63121-44  
 Telephone: 314-516-59  
 Fax: 314-516-50  
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Informed Consent for Participation in Research Activities- Direct Assessment Validity of the Short Form of the  
 Barkley Deficits of Executive Functioning Scale

Participant \_\_\_\_\_

HSC Approval Number 1095670-2

Principal Investigator Brian Sheble

PI's Phone Number 314-302-3594

- 
1. You are invited to participate in a research study conducted by Brian Sheble under the supervision of Dr. Cody Ding. The purpose of this research is to investigate the Validity of the Short Form of the Barkley Deficits of Executive Functioning Scale. Executive Functioning is defined as mental processes which occur in the in the frontal lobe part of the brain that help people engage in goal-directed behavior. They assist people with making appropriate choices, cope with negative feelings and impulses, control behavior, assist people with activating attention, developing and evaluating problem-solving attempts, changing plans if necessary in the middle of a problem-solving attempt, motivate people to achieve our goals, and prepare for future events.
  2. a) Your participation will involve participating in completing tasks which measure your executive functioning skills such as the ability to learn new tasks, ability to problems, inhibit, responses, deal with frustration, get motivated to engage in tasks, and use time management skills.  
 b) The assessments will take approximately two hours to complete
  3. There may be specific risks or discomforts associated with this research. They include: learning about your cognitive ability, identification of unknown learning concerns, and possible identification of emotional concerns. If this occurs this researcher is a licensed mental health professional who will assist you immediately.
  4. Your participation may contribute to the knowledge and research about executive functioning.
  5. Participants will be provided with a twenty dollar gift card to Starbucks as a thank you for participating in this study.

- 6. Your participation is voluntary, and you may choose not to participate in this research study or to withdraw your consent at any time. You may choose not to answer any question that you do not want to answer. You will NOT be penalized in any way should you choose not to participate or to withdraw.
  
- 7. By agreeing to participate, you understand and agree that your data may be shared with other researchers and educators in the form of presentations and/or publications. In all cases, your identity will not be revealed. In rare instances, a researcher's study must undergo an audit or program evaluation by an oversight agency (such as the Office for Human Research Protection). That agency would be required to maintain the confidentiality of your data. In addition, all data will be stored on a password-protected computer and/or in a locked office.
  
- 8. If you have any questions or concerns regarding this study, or if any problems arise, you may call the Investigator, Brian Sheble at 314-302-3594 or the Faculty Advisor, Dr. Cody Ding at 314-516-5994. You may also ask questions or state concerns regarding your rights as a research participant to the Office of Research Administration, at 516- 5897.

\_\_\_\_\_  
Participant Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Principal Investigator or Designee

\_\_\_\_\_  
Date

APPENDIX C- Demographic Questions

APPENDIX C- DEMOGRAPHIC QUESTIONS

- 1. AGE \_\_\_\_\_
- 2. GENDER     \_\_\_ Male   \_\_\_ Female
- 3. ETHNICITY     \_\_\_ Caucasian/White   \_\_\_ African American   \_\_\_ Hispanic   \_\_\_ Asian   \_\_\_  
Other
- 4. HIGHEST LEVEL Of     \_\_\_ High School   \_\_\_ 2-Yr. College   \_\_\_ Bachelors   \_\_\_ Masters  
\_\_\_ Doctorate  
EDUCATION ATTAINED \_\_\_ Other- List \_\_\_\_\_
- 5. OCCUPATION \_\_\_\_\_ -

APPENDIX D- Barkley Deficits of Executive Functioning-Short Form

**BDEFS-SF: Self-Report**

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Sex: (Circle one) Male Female Age: \_\_\_\_\_

**Instructions**

How often do you experience each of these problems? Please circle the number next to each item that best describes your behavior **DURING THE PAST 6 MONTHS**. Please ignore the sections marked "Office Use Only."

<b>Short Form Items</b>	Never or rarely	Sometimes	Often	Very often
1. Procrastinate or put off doing things until the last minute	1	2	3	4
2. Can't seem to hold in mind things I need to remember to do	1	2	3	4
3. Not motivated to prepare in advance for things I know I am supposed to do	1	2	3	4
4. Have trouble doing what I tell myself to do	1	2	3	4
5. Have trouble learning new or complex activities as well as others	1	2	3	4
6. Have difficulty explaining things in their proper order or sequence	1	2	3	4
7. Unable to "think on my feet" or respond as effectively as others to unexpected events	1	2	3	4
8. I don't seem to process information as quickly or as accurately as others	1	2	3	4
9. Unable to inhibit my reactions or responses to events or others	1	2	3	4
10. Make impulsive comments to others	1	2	3	4
11. Likely to do things without considering the consequences for doing them	1	2	3	4
12. Fail to consider past relevant events or past personal experiences before responding to situations (I act without thinking)	1	2	3	4
13. Do not put as much effort into my work as I should or than others are able to do	1	2	3	4

(cont.)

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**BDEFS-SF: Self-Report** (page 2 of 2)

14. Others tell me I am lazy or unmotivated	1	2	3	4
15. Inconsistent in the quality or quantity of my work performance	1	2	3	4
16. Unable to work as well as others without supervision or frequent instruction	1	2	3	4
17. Have trouble calming myself down once I am emotionally upset	1	2	3	4
18. Cannot seem to regain emotional control and become more reasonable once I am emotional	1	2	3	4
19. Cannot seem to distract myself away from whatever is upsetting me emotionally to help calm me down. I can't refocus my mind to a more positive framework.	1	2	3	4
20. I remain emotional or upset longer than others	1	2	3	4
<b>Office Use Only—Short Form Scores</b>				
Items 1–4 Score _____	Items 5–8 Score _____			
Items 9–12 Score _____	Items 13–16 Score _____			
Items 17–20 Score _____	Total EF Summary Score _____			
EF Symptom Count _____				