THE IMPACT OF PARENTING STRESS ON THE ECOLOGICAL VALIDITY OF EXECUTIVE FUNCTION TESTING IN CHILDREN WITH ADHD

BY

Krystle Paige Ball

APPROVED BY SUPERVISORY COMMITTEE

Cheryl Silver Ph.D. ________________________

Peter Stavinoha Ph.D. ________________________

Kris Weber Ph. D. ________________________

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KRYSTLE PAIGE BALL

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KRYSTLE PAIGE BALL

The University of Texas Southwestern Medical Center at Dallas, 2008

Supervising Professor: Cheryl Silver, Ph.D.

Measurement of executive functioning is difficult and findings from standardized tests may not have ecological validity. Parent report is one way to achieve ecological validity, but correlations between standardized tests and parent report frequently are low. Greater parental stress may lead to parents reporting more problem behaviors, so higher scores on a measure of parenting stress were expected to impact the relationship between parent report of child executive functioning and child performance on a standardized test of executive functioning.

No significant correlations were found between Color-Word Interference scores and the BRIEF and CEFS, controlling for IQ. Many BRIEF and CEFS subscales were

correlated with parenting stress. Relationships between the BRIEF or CEFS and the Color-Word Interference Test were not significantly smaller for parents expressing greater stress.

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LIST OF ABBREVATIONS

ABS ……………………………………………………………Aberrant Behavior Checklist

ABS ………….………………………………………….……Adaptive Behavior Scale

ACPT-P ………………………..Auditory Continuous Performance Test for Preschoolers

ADHD……………………………………….…Attention-Deficit/Hyperactivity Disorder

ADHD NOS ……..…Attention-Deficit/Hyperactivity Disorder, Not Otherwise Specified

BASC ……………………………………..…..Behavior Assessment System for Children

BRIEF …………………………….....Behavioral Rating Inventory of Executive Function

BSI ……………………………………….……………..…Brief Symptom Inventory

CBCL…………………………………………………………..Child Behavior Check List

CBQ ………………………………..………………Children's Behavior Questionnaire

CEFS ………………………………………….….Children's Executive Function Scale

CLEI …………………………...……………………Children's Life-Events Inventory

CNS ………………………….…..………………………………Central Nervous System

CNT………………………………………………………….……Contingency Naming Test

DBD ………………………………………………………Disruptive Behavior Disorders

D-KEFS ………………………………………..Delis-Kaplan Executive Function System

DOF ……………………………………………………….…Direct Observation Form

DSM-III-R ………..….Diagnostic and Statistical Manual of Mental Disorders-3rd Edition-Revised

DSM-IV …………..…Diagnostic and Statistical Manual of Mental Disorders- 4th Edition

DSM-IV-TR ………..Diagnostic and Statistical Manual of Mental Disorders -4th Edition-Text Revision

ECBI ……………………………………………………..Eyeberg Child Behavior Inventory

EF ……………………………………………………………….Executive Functions

EV ………..……………………………………………………….Ecological Validity

FSIQ ……………………………………...…………Full Scale Intelligence Quotient

IRB …………………………………………………………….Institutional Review Board

IVA-CPT ………………....Integrated Visual and Auditory Continuous Performance Test

Lab-TAB ……………..…………………..Laboratory Temperament Assessment Battery

LD …………...…………………………………………………….Learning Disorder

MR …………………………………………………………………Mental Retardation

NEO-FFI ………………………………………………...……NEO Five Factor Inventory

PRECAA ……………….…Parent Rating of Everyday Cognitive and Academic Abilities

RD …………………………………………………………………...…Reading Disability

SES ………………………………………………………..……..Socioeconomic Status

SESBI ……………………………………..….Sutter-Eyeberg School Behavior Inventory

TBAQ ……………………………………Toddler Behavior Assessment Questionnaire

TOL ………………………………………………………...………Tower of London

TRF ……………………………………………………………...…..Teacher Report Form

VMI ………………………………………………………….Visual-Motor Integration

WCST …………………………………………………Wisconsin Card Sorting Test

WISC-III ……………..………………..Wechsler Intelligence Scale for Children-3rd Edition

YSR ………………..………………………………………….…..Youth Self-Report

CHAPTER ONE

Introduction

Executive functioning is a highly complex construct that is more of an umbrella term or collection of abilities. While no one definition of executive functioning exists, the aspects of executive functioning agreed upon by most researchers and clinicians are abstract reasoning, problem solving, concept formation, planning, mental flexibility, self-monitoring, and mental control processes. Children with deficits in executive functioning experience problems in several aspects of their lives, including at home, at school, and in their social lives. These deficits may cause them to experience difficulty completing tasks, planning future actions, handling change, or dealing with unexpected events. They also tend to make social mistakes. Deficits in executive functioning are also strongly associated with deficits experienced by children with Attention-Deficit/Hyperactivity Disorder.

When assessing executive functioning in children, clinicians use standardized measures, such as the Wisconsin Card Sorting Test (Heaton, 1981), Tower test (Krikorian, Bartok, & Gay, 1994), or tests of inhibition, like the Stroop (Stroop, 1935). The results of these measures can then be compared with answers from parent report measures that assess for problem behaviors associated with executive dysfunction. This comparison is called ecological validity, which means looking at how well the standardized measures predict real world functioning, as measured on the parent report forms. Frequently, the correspondence between these measures is low. Several explanations exist to explain this discrepancy, including the influence of parent factors. Studies on ecological validity have examined the impact of factors such as parental psychiatric symptoms, socioeconomic status, and parental stress. However, no one has looked directly at the impact of parenting stress on the ecological validity of executive function testing.

The aim of the current study is to look at several factors that influence ecological validity in executive function testing. This study looks at several relationships between executive functioning measures, analyzing their correspondence. IQ also is addressed to determine its effects on parenting stress and performance on a measure of executive functioning. The relationship between parenting stress and the discrepancies found between parent report of child behaviors associated with executive dysfunction and child performance on a standardized measure of executive functioning are examined. The results of this study may provide helpful suggestions for clinicians and researchers for assessing executive functioning in children with ADHD, as well as rule out possible factors that do not impact the ecological validity of executive function testing. This study anticipates raising several questions to be answered by future research and hopes to lay a foundation to be expanded upon for analyzing the impact of parenting stress on ecological validity.

Chapter II

Review of the Literature

Executive Functioning

Definitions

The following sections will serve to define executive functioning, as well as explain its neurological basis and explore functional deficits of executive functioning. Executive functioning is difficult to define, as it is more of an umbrella term than one specific function. It is thought of as " heterogeneous and includes some very broad, as well as some specific, behaviors" (Baron, 2004, p. 133). A number of professionals have created their own definitions of executive functioning, and most of the definitions are different, but also have some overlap. Anderson, Anderson, Northam, Jacobs, & Mikiewicz note that executive functioning is a "collection of interrelated cognitive and behavioral skills" (2002, p. 231) that some define as "capacities that enable a person to engage successfully in independent, purposeful, self-serving behaviors" (Anderson, 1998, p. 321). Anderson et al. also add that executive functioning includes "those skills necessary for purposeful, goal-directed activity" (2002, p. 231). Other definitions incorporate notions of abstract reasoning, problem solving, concept formation (Baron, 2004), planning, mental flexibility, and self-monitoring (Anderson, 1998). Most people who have defined executive functioning agree that it includes mental control processes (Baron, 2004; Denckla, 1994; Denckla, 1996; Eslinger, 1996; Vriezen & Pigott, 2002; Welsch, Pennington, & Groisser, 1991). Baron defines executive functioning as "higher functions that integrate others that are more basic, such as perception, attention, and memory" (2004, p. 135). Vriezen and Pigott (2002) make a similar statement. Eslinger notes that executive functioning is one of the "crowning achievement(s) of human development" (1996, p. 368). The concept includes many higher-order human abilities, like thinking about the future, delayed gratification, personal goals, and inhibition (Denckla, 1994). One of the primary functions of executive functioning is applying stored information to novel situations. Thus, executive functions are not primarily used for routine behaviors. Barkley (1996) further explains that the gap between an event occurring and a person responding is where executive functions are likely at work. Baron expands upon this point by stating that:

> [her definition of executive functioning] emphasizes the metacognitive capacities that allow an individual to perceive stimuli from his or her environment, respond adaptively, flexibly change direction, anticipate future goals, consider consequences, and respond in an integrated or common-sense way, utilizing all these capacities to serve a common purposive goal (2004, p. 135).

Executive functions also allow humans to "structure behavior and environment across lengthy time periods" and relate behavior to events and later consequences (Barkley, 1996, p. 312). As previously stated, Baron links executive functioning to attention, and Barkley further adds that executive functioning relates to attention in that it is a "special case of attention in which the initial response of the individual to an environmental event alters the probability of a subsequent response of that individual" (1996, p. 312). As previously mentioned, the various definitions of executive functioning are all different, but the common elements that seem to be mentioned by most are problem solving, planning, self monitoring, and inhibition.

Deficits

Having executive dysfunction can be problematic for children at home, in school, and in their social life. According to Anderson et al., lack of skills associated with executive functioning impacts the child's "intellectual development, academic achievement, personality, social skills, relationships, and communication" (2002, p. 232). When dysfunction exists, children experience difficulty completing tasks, planning future actions, handling change, and dealing with unexpected events. They also tend to make social mistakes. Social skills deficits can include "poor social judgment and failure to learn from experience" (Schonfeld, Paley, Frankel, & O'Conner, 2006, p. 440). Executive functioning allows a child to read information, take notes in class, and then integrate the material into a report or other assignment (Altemeier, Jones, Abbott, & Berninger, 2006). School performance may suffer for children with deficits, as they experience difficulty with organization and managing their time. Self-regulation difficulties also make school difficult, as children with executive dysfunction may not be able to stay engaged in tasks or monitor their behavior and make changes when needed. Children may also find it difficult to perform complex acts or express themselves, verbally or in written form. These deficits obviously significantly impact the lives of the children. Since there are so many ways executive dysfunction can manifest itself, the specific type of dysfunction varies from child to child (Gioia & Isquith, 2004).

Brain Basis of Executive Functioning

Historically, very little was understood about the brain areas associated with executive functioning and how they develop (Eslinger, 1996). The frontal and prefrontal cortices are the primary brain regions associated with executive functioning; however, researchers cannot isolate a specific brain area for executive functioning as executive functions cannot easily be separated in standardized testing from other cognitive capacities like language (Welsh, 1991). Barkley notes that simply linking executive functioning to the frontal lobes evades the problem of pinpointing a specific neuroanatomical location (1996). Anderson also notes that localizing executive functioning is not possible when she postulates that the "integrity of the entire brain is necessary for intact executive function" (1998, p. 322). However, she does suggest that the anterior cerebral regions and the prefrontal cortex may be the most likely brain regions associated with executive functioning. She reasons that since performance on executive tasks correlates with development of the frontal lobes, mediation of executive functioning occurs through the anterior cerebral regions and the prefrontal cortex. While this reasoning may explain mediation of executive functioning, the areas involved rely upon other cerebral areas for input. Thus, separating executive functioning in the frontal lobes from other cerebral areas is difficult (1998).

Development

Executive functions can first be seen in childhood (Vriezen & Pigott, 2002; Anderson, 1998). Researchers have lowered the age at which they believe executive functioning first develops. Skills associated with executive functioning mature through childhood, but can be elicited in pre-school aged children, which is earlier than previously thought (Anderson, 1998, Welsh, 1991, Denkla, 1996). Denkla (1996) notes that in the pre-school years, inhibition of emotional responding develops, which allows children to have rational behaviors. Anderson (1998) and Vriezen and Pigott (2002) agree that around twelve months is the first stage that executive functions can be seen. Vriezen and Pigott (2002) propose that basic executive functions develop during the first year of life and continue to develop through adolescence. Anderson (1998) states that human infants and infant monkeys both show planning and self-control, which are executive functions. When frontal lobes are lesioned in infant monkeys, they can no longer exhibit some features of executive functioning, such as object permanence. Thus, according to the reasoning in this study, not only can executive functioning be determined as originating in the frontal lobes, but it can also be elicited in children as young as 6 years, with some features, such as planning, evident as young as 12 months.

Although some researchers believe the frontal lobes follow a continuous development, others argue that the frontal lobes develop in a hierarchical manner, and at different rates (Anderson, 1998; Welsh, Pennington, & Groisser, 1991). Anderson (1998) explained that as children develop, their executive functioning also develops in surges, which correlate with frontal lobe development. The theory of a hierarchical development fits with other theories of stratified development, such as Piaget's theory of cognitive development, giving credence to the theory of hierarchical development of the frontal lobes. Between birth and 2 years, the central nervous system (CNS) has a substantial growth period. Again between ages 7-9 years, the CNS has another growth spurt. During these periods, the number of synaptic connections increases, as does the amount of myelination of neurons in the brain. The final maturation of the frontal lobes is thought to occur in early puberty or even later, which is much later than most other brain regions (1998). Vriezen and Pigott (2002) also note spurts in development, with the greatest gains in development occurring between the ages of 6 and 8 years. So although executive functions can be elicited in children as young as 12 months (Anderson, 1998), they continue to mature through childhood.

Welsh, Pennington, and Groisser (1991) suggest that executive functioning develops in a stage-like manner. They lay out three stages of development, beginning with the ability to resist distraction. They believe this skill develops around age 6 years. Next are the skills of organized search, hypothesis testing, and impulse control. These first develop around age 10. Last are the skills of verbal fluency, motor sequencing, and planning, which are developed by age 12. When comparing research, such as that of Welsh, Pennington, & Groisser, as well as Anderson (1998), a pattern emerges in regard to development of executive functioning. Executive functions mature at varying rates. Certain skills develop earlier, like resisting distraction, while others develop later, like motor sequencing. Another example is that children can pay attention before they can solve a math problem. Why executive functions develop in this manner is debatable. Anderson believes that the lags in development are directly related to differing developmental rates of adjoining neural structures. So, the brain areas associated with executive functioning, namely the frontal lobes, cannot develop until other areas, such as the subcortical regions, develop. Once the posterior and subcortical regions develop, the functioning of the anterior cerebral areas is enhanced.

Executive Functioning and Attention-Deficit/Hyperactivity Disorder (ADHD)

The problems experienced by children with ADHD seem strongly linked to symptoms of executive dysfunction. As previously argued, the frontal lobes are the primary brain region associated with executive functioning. The frontal lobes integrate emotions and behaviors, so dysfunction can lead to poor social judgment, poor impulse control, and poor self-regulation, which are features implicated in ADHD. Denckla (1994) links executive functioning to self-regulation and impulse control. Executive functions also relate to attentional processes, the hallmark of ADHD. Attention is described by Barkley as the "conditional or functional relations between environmental events and the behavior of an organism" (1996, p. 307). He further explains that attention "refers to the relation of the behavior to its environment" (1996, p. 307). Barkley explains that neuroanatomically, attention utilizes the brainstem, limbic system, motivation and emotional centers, premotor cortex, and cortical areas which are all regulated by the prefrontal cortex, which houses the executive system. This explanation again ties attention to executive functioning (1996). Barkley proposes that

> the executive system is, in one sense, a special case of a more general system of attention (responsiveness to the world) and, in another, a governor over it. As a result, the attention system permits the individual to be responsive to or under the control of three-dimensional space, whereas the executive system within and above it makes the individual attentive and responsive to the more subtle yet equally important fourth dimension of the physical world he or she must inhabit: time (1996, p. 323).

The syndrome of ADHD is a disorder of attention and/or impulse control, and is one of the more common disorders that involve executive functioning deficits. Before discussing executive functioning deficits in children with ADHD in depth, the next section will provide background information on the disorder.

Attention-Deficit/Hyperactivity Disorder currently affects 3%-7% of school-age children (DSM-IV-TR, 2000). Barkley (1996) outlines a history of the disorder, explaining that at the turn of the century, symptoms were thought to be due to poor volitional inhibition and issues with moral regulation of behaviors. In the 1960s, clinicians determined that hyperactivity was central to the disorder. The 1970s found clinicians incorporating poor sustained attention as features of ADHD, as well as impulse control. Clinicians in the 1980s expanded the definition of ADHD to include impairment in self-regulation. Later, clinicians proposed that those with ADHD actually have a low level of arousal so hyperactivity serves as self-stimulation to bring arousal to an optimal level. Also in the 1990s, clinicians thought that definitions of the disorder needed to stress poor behavioral inhibition (Barkley, 1997).

ADHD is defined by the Diagnostic and Statistical Manual IV-TR (DSM-IV-TR) as a "persistent pattern of inattention and/or hyperactivity-impulsivity that is frequently displayed and more severe than typically observed in individuals at a comparable level of development" (2000, p. 85). The DSM-IV-TR further requires that symptoms of ADHD must be present before age 7 to warrant a diagnosis of ADHD. Also, symptoms must persist to the extent that they are "maladaptive and inconsistent with developmental level" (2000, p. 92). According to the DSM-IV-TR (2000), symptoms must also be present in at least two settings, such as school and home, and symptoms cannot be due to Pervasive Developmental Disorder, Schizophrenia, a Psychotic Disorder, or any other type of mental disorder, such as a Mood Disorder or Personality Disorder.

The DSM-IV-TR (2000) outlines that Attention-Deficit/Hyperactivity Disorder encompasses three subtypes: predominantly inattentive type, predominantly hyperactive-impulsive type, and combined type. A fourth option for diagnosis is ADHD, Not Otherwise Specified. To meet criteria for ADHD, predominantly inattentive type, one must have six or more symptoms of inattention but fewer than six symptoms of impulsivity, which have persisted for at least 6 months. Some of the symptoms associated with ADHD, predominantly inattentive type, are difficulty organizing tasks, being easily distracted, and forgetfulness in daily activities. The diagnosis of ADHD, predominantly hyperactive-impulsive type, is appropriate if six or more symptoms of hyperactivity-impulsivity are displayed, but fewer than six symptoms of inattention, and the symptoms must again have persisted for 6 months or more. Hyperactivity-impulsivity symptoms include fidgeting, acting as often "on the go," and having difficulty waiting for his or her turn (DSM-IV-TR, 2000, p. 92). Also according to the DSM-IV-TR, the category of combined type is used when six or more symptoms of inattention, as well as six or more symptoms of hyperactivity-impulsivity persist for at least 6 months. If symptoms are present that meet criteria for hyperactivity-impulsivity or inattention, but onset is after age 7 or the child does not have enough symptoms to meet criteria, then ADHD NOS is the most appropriate diagnosis. Other associated features of the disorder are "low frustration tolerance, temper outbursts, bossiness, stubbornness, excessive and frequent insistence that requests be met, mood lability, …and poor self esteem" (2000, p. 87-88).

ADHD, Inhibition, and IQ

One important aspect of ADHD, as previously mentioned, is the presence of deficits in inhibition. Several studies have addressed the relationship between child IQ and scores on measures of inhibition. Herba, Tranah, Rubia, and Yule (2006) looked at the relationship between performance on the Stroop (Stoop, 1935) and child IQ, and did not find a significant relationship between these two measures. In a study by Sonuga-Barke, Dalen, Daley, and Remington (2002), the researchers primarily addressed associations between planning, working memory, and inhibition and symptoms of ADHD in preschool children. They also collected demographic data and assessed for IQ by using the British Abilities Scale (Elliott, 1983). They used the “Puppet Says…” task (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996) as a measure of inhibition. The task is a version of a Go/No-Go task, or the “Simon says” game. The researchers found a significant negative association (r= -.25) between these two tests. Brunnekreef, De Sonneville, Althaus, Minderaa, Oldehinkel, Verhulst, Ormel (2007) also found that IQ influenced performance on an inhibition task. They administered the Shifting Set task from the Amsterdam Neuropsychological Tasks program (De Sonneville, 1999) as a measure of inhibition and the WISC-R (1974) as a measure of IQ. Parents of the children also competed the CBCL to assess for problem behaviors. From the CBCL, the researchers divided the children into four groups: no problems, only internalizing problems, only externalizing problems, and internalizing and externalizing problems. When comparing the performance between the groups on the Shifting Set task, ability to inhibit was significantly different between the groups who had only internalizing problems and only externalizing problems. When the effect of IQ was controlled for, performance differences disappeared. In summary, reports on the effect of IQ on measures of inhibition are mixed, with some finding significant relationships and others failing to find significance.

Testing of Executive Functioning

The following section will serve to explain the rationale for methods of testing executive functioning, as well as address problems that arise in testing. Executive functioning is problematic to assess, because in the clinical setting, many of the functional deficits are difficult to detect (Anderson, 1998; Baron, 2004; Gioia & Isquith, 2004; Vriezen & Pigott, 2002). Early methods of testing had several misconceptions or problems. Historically, the first problem was that neuropsychologists often observed test performance that was within normal limits, but families reported obvious problems with functioning in the real world. The frontal lobes were considered a "silent area" and testing did not point towards impairments (Cripe, 1996). But, as Baron states, "the absence of executive function impairment on neuropsychological testing is not proof of intact executive functioning" (2004, p. 134). The second issue was that clinicians at the time also thought that executive functioning could not be assessed in children. This notion has since been dispelled (Welsh, Pennington, & Groisser, 1991). The third issue encountered was that neuropsychologists tried to localize neuropathology based on cognitive strengths and weaknesses found through testing (Spooner & Pachana, 2006). Neuroimaging can now perform this duty with much greater precision, and neuropsychological evaluations are relied upon to provide functional conclusions.

Today, testing of executive functioning is used to "draw conclusions … regarding patients' abilities to competently perform such tasks as living independently or returning to a previous occupation" (Spooner & Pachana, 2006, p. 328). Unlike earlier times, current approaches take into account several other factors. Clinicians prefer using multiple tests, known as a test battery, as opposed to a single test to assess for executive functioning (Anderson, 1998; Gioia & Isquith, 2004). The use of a range of tests allows for investigation of relationships between measures. Another aspect is that tests must be novel, meaning tests must not resemble something previously known to the child. The tests that are used must be novel, as well as maintain a level of complexity to avoid boredom. Novelty is important because routine tasks do not elicit executive functions, so by introducing a novel task, the executive functions are activated (Cripe, 1996; Gioia & Isquith, 2004). The child being tested must create new strategies and new schema, which require use of executive functioning.

The environment of testing is an important aspect of testing. Real life is quite different from the testing environment. Differences between the testing environment and everyday life include that in the testing environment, the child is motivated by the examiner, competition is nonexistent, the examiner helps focus the child, and failure is not emphasized (Gioia & Isquith, 2004). The motivation and focus provided by the examiner add to the structure of the testing environment, which makes it so unlike real life. Thus, an important aspect of testing is that a less-structured testing environment is preferred for executive functioning assessment (Cripe, 1996; Sbordone & Guilmette, 1999). In a highly structured environment, like that of testing, children may not encounter a problem that elicits their executive functioning (Vriezen & Pigott, 20als an02) because they are told what to do and how to do it. The tests usually have rules that are explained to the child and the environment usually places the examiner in control while the child follows his or her lead. A less structured method, like that used with the Wisconsin Card Sorting Test (WCST; Heaton, 1981), is more like real life and preferred for testing executive functioning. This test is less structured because it does not have overt rules or procedures that are dictated to the child and there is little examiner-determined control. The child is not told exactly what to do during the WCST, and this fact is reiterated in the instructions of the test (Chaytor, Schmitter-Edgecombe, and Burr, 2006). The child must figure out what to do and how to do it, which uses executive functioning much more than a highly structured environment with built in planning and direction.

A contrasting point made by Chaytor, Schmitter-Edgecombe, and Burr (2006) and Sbordone and Guilmette (2000) is that the level of cognitive demand placed on the individual in daily life may either cause significant executive dysfunction not to be noticeable or cause minor executive dysfunction to be magnified. Sbordone and Guilmette (2000) note that depending on the demands that are placed on the person, the person may or may not be seen as having a cognitive deficit. The environment the client is in will allow him or her to either compensate for the cognitive deficit, or it may exacerbate the deficit. Chaytor et al. (2006) expand this viewpoint and propose that for someone with executive dysfunction but little demand for executive functioning in daily life, deficits may only be seen in the testing environment. The child may have deficits, like in planning, but if they are not required to utilize this function, then the deficit will not be seen. Conversely, Chaytor et al. state that if someone has minor executive dysfunction, but very high cognitive demands in his or her environment, then the impairment will be more noticeable. A child may have a minor deficit in executive functioning, but if he or she is asked to perform at a level well above his or her developmental level, a deficit may be magnified. The child is being asked to go above and beyond what a child at his or her developmental level is capable of, so the mild deficit is seen as much larger than it is. This viewpoint postulates that the demands placed on the child highly influence how severe his or her deficit is perceived to be by the parent.

Measures of Executive Functioning

Testing executive functioning is very challenging. Original tests were designed to assess neuropathology, but many are now used to predict real-world functioning (Spooner & Pachana, 2006). Specific issues arise when the tests are used to assess executive functioning in children. Performance-based measures of executive functioning were originally developed for use on adults, so norming was only done with adults. Sensitivity and specificity, or a test's ability to correctly identify deficits or absence of deficits, with children has not been thoroughly explored, and some measures do not have standardized administration and scoring. Thus, several measures of executive functioning that could also be used for children exist, but issues like appropriate normative samples and specificity make selecting which tests to use for children somewhat difficult (Briezen & Pigott, 2002; Anderson, 1998).

Deficits in executive functions are manifested in neuropsychological testing as "impulsivity, disinhibition, difficulties monitoring and regulating performance, poor planning and problem solving, perseveration and cognitive inflexibility" (Anderson et al., 2002, p. 232). Because executive dysfunction can manifest in multiple ways, the test results also vary, with children doing better on some tests but not as well on others (Gioia & Isquith, 2004). This occurs because there are a number of ways to measure executive functioning and not every test covers all parts of executive functioning. Some tests only measure working memory, while others measure problem solving, inhibition, or mental flexibility. According to Anderson (1998), many tests of executive functioning localize to one specific aspect of functioning. For each measure like this, many aspects of executive functioning are not considered. The traditional Stroop procedure (Stroop, 1935) is an example of a localizationalist model as it primarily measures inhibition. One test is not ideal when measuring executive functioning. Anderson states "contemporary neuropsychological theory would argue that such an approach is too simplistic" (1998, 328). The use of many overlapping tests helps the clinician see what is deficient (Anderson, 1998; Cripe, 1996). Anderson (1998) continues that often multiple specific tests are used to look at the multiple aspects of executive functioning. The idea is that the use of many tests creates a whole picture of executive functioning and rules out specific areas as deficient. Cripe (1996) concurs and continues that if part of the picture is left out, then it becomes difficult to be able to accurately predict future behavior and functioning. Anderson (1998) states that the testing battery should also include tests that measure lower-order processes, and not solely the frontal lobes. This inclusion is needed as "the efficiency of executive skills, and also of frontal lobe functioning, is necessarily mediated by lower-order processes" (Anderson, 1998, p. 328).

Executive functioning in children has been measured a number of ways in research, including standardized tests and rating scales. Standardized tests should be distinguished from rating scales for the purposes of understanding the measures described in this thesis. Rating scales are observer-report measures with numerical scores for each behavior or observation. Standardized tests are given in the context of a neuropsychological evaluation in a controlled setting under standardized conditions and involve manipulating things. For the purposes of this thesis, the term tabletop tests will be used to refer to standardized tests. These tabletop tests include tower tests, cart sorting tasks, tests of inhibition and flexible thinking, and other measures.

As previously mentioned, the Wisconsin Card Sorting Test (WCST) is one popular measure of executive functioning (Anderson, 1998). The WCST requires children to sort 128 cards based on similarities to stimulus cards, such as color, form, and number. The unique aspect of this test is that children are not told how to match the cards but are told after each match whether they are right or wrong. After the child matches 10 correct cards to stimulus cards, the criterion for making a correct match changes without the child knowing. The three criteria for matching are each repeated twice, which requires the child to shift his or her strategy for matching, but also maintain set as they must match 10 correct cards in a row before the rules change. Some clinicians rely solely on the WCST, but using this measure alone is not enough (Cripe, 1996). Although historically the WCST was thought to only be sensitive to frontal lobe deficits, it is possible that it may not be specific to these deficits. Sometimes people with frontal lobe damage still perform well on this test because the measure does not assess all aspects of executive functioning, like planning. Cummings (1993) notes that the frontal lobes contain three circuits, which produce circuit-specific behaviors. He states that only one of these circuits seems to be sensitive to tasks like the WCST. This finding supports the fact that although the WCST is sensitive to frontal lobe deficits, it may not be enough to use only the WCST, as it is not sensitive to other aspects of frontal lobe deficits. As previously mentioned, additional measures are necessary for accurate evaluation.

Tower tests are a type of test that measure planning and impulse control. These tests require rings or balls placed on pegs to be rearranged by the participant into specific patterns in a set number of moves. Rules are also applied to direct how the participant may complete this task, such as only one ball or ring may be moved at a time (Anderson, 1998). The Tower of London (TOL) is one version of a tower test and measures "problem-solving aspects of executive functioning" (Anderson, 1998). In the Krikorian, Bartok, and Gay (1994) version of the TOL, the child is presented with three colored balls placed on a series of wooden pegs. The child is then asked to rearrange the colored balls to match a picture on a stimulus card. He or she must also complete the task in a certain number of moves. Scores derived from this measure take into account correct items, failed attempts, planning time, and the time required for each item. Specific executive functions associated with this task are "perceptual and motor abilities, short-term memory, and sustained attention" (Anderson, 1998, p. 335-336). This test is both novel and challenging, which are two important aspects of executive functioning testing. Also, previous research has directly linked performance on the TOL to damage to the frontal lobes in children, which means that the TOL is one of the few measures whose results shows a direct correlation to frontal lobe damage (Anderson, 1998).

The first comprehensive testing battery developed to assess executive functioning is the Delis-Kaplan Executive Function System (D-KEFS; Delis, Kaplan, & Kramer, 2001). Currently, the D-KEFS is one of the most inclusive batteries used to test executive functioning in children. Within this test battery, the Color-Word Interference Test is a form of the Stroop test (Stroop, 1935) and requires the participant to utilize the inhibition and switching aspects of executive functioning (Delis, Kaplan, & Kramer, 2001). The measure requires the child to employ two basic skills of naming a color and reading a color word, e.g., "green." The child is exposed to four conditions, with the first two requiring the child to name the colors and then to read the color words. For condition three, the child must inhibit the urge to read the color word and instead name the color the word is printed in, which is never the same as the color word. Condition four becomes more complicated as the child must continue to inhibit, while also utilizing cognitive flexibility as he or she must switch between naming the color ink the word is printed in and reading the word if it is printed in a little box (Delis, Kaplan, & Kramer 2001).

In addition to standardized tabletop tests, observer ratings have been used to measure executive functioning, including parent-report and teacher-report measures like the BRIEF (Behavior Rating Inventory of Executive Functioning) (Gioia, Isquith, Guy, & Kenworthy, 2000) and the CEFS (Children's Executive Functions Scale; Silver, Kolitz-Russell, Bordini, & Fairbanks, 1993). The BRIEF and the CEFS both measure executive functioning specifically in children. The parent version of the BRIEF consists of 86 items and includes eight subdomains of executive functioning, which are inhibit, shift (flexibility), emotional control, initiate, working memory, plan-organize, organization of materials, and monitor (Gioia & Isquith, 2004). These subdomains contribute to two subscales, Metacognitive and Behavioral Regulation, as well as a total composite score called a Global Executive Composite. Higher scores on the BRIEF indicate higher levels of executive dysfunction. The CEFS (Silver, Kolitz-Russell, Bordini, & Fairbanks, 1993) is a 99-item behavior rating scale developed by members of the National Academy of Neuropsychology Research Consortium. Items are divided into five subscales of Social Appropriateness, Inhibition, Problem Solving, Initiative, and Motor Planning. Again, higher scores indicate more dysfunction.

The previously mentioned measures are commonly used in assessments of executive functioning and are considered reliable and valid. Although these measures and many others are available for testing executive functioning in children, Anderson et al.

(2002) suggest that more measures are needed that are specific to the child population. While creating new measures is one way to address issues of validity of the tests, another way is to use existing measures and look at the ecological validity of the measures to determine how useful they are in assessing executive functioning.

Ecological Validity and Executive Functioning

Definition of Ecological Validity

The following sections will address the many aspects of ecological validity of testing of executive functions. At first glance, clinicians assume that poor performance on a neuropsychological test will also lead to poor performance in daily living. However, a test without strong ecological validity may not predict real-world functioning (Chaytor, Schmitter-Edgecombe, & Burr, 2006). Nadolne and Stringer (2000, p. 680-681) note that to predict functioning in everyday situations, tests need to be "aimed specifically at predicting real-world ability." Another term for this is ecological validity. Ecological validity means that the test is "predictive of everyday behavior" (Odhuba, van den Broek, & Johns, 2005). Hart and Hayden (1986) explain that the original definition of ecological validity was "the conditions under which generalizations may be made from the results of controlled systematic experiments to events occurring in the natural world" (p. 22). Nadolne and Stringer (2000, p. 675) define ecological validity as "the extent to which a test includes materials drawn from the everyday environment, the extent to which performance in a clinic setting resembles performance in a naturalistic setting, or the ability of a test to predict performance on some criterion of everyday functioning." Another way to phrase a definition of ecological validity is "a way to coordinate one's cognitive and behavioral capacities with real-world demand situations" (Gioia & Isquith, 2004, p. 135). To have an ecologically valid measure, the test and testing environment must exert demands similar to everyday life. The performance on the test must also predict future behavior (Gioia & Isquith, 2004). As noted by the various definitions, ecological validity is a complex construct, but most definitions carry the idea that an ecologically valid measure can predict real life functioning (Gioia & Isquith, 2004; Hart & Hayden, 1986; Nadolne & Stringer, 2000; & Odhuba, van den Broek, & Johns, 2005). Gioia and Isquith explain that ecological validity is important because clinicians are not only asked to assess a child's cognitive strengths and weaknesses, but to also "translate such findings into implications and predictions for the individual in his or her everyday milieu" (2004, p. 141). Interestingly, Chaytor, Schmitter-Edgecombe, and Burr (2006) note that little research has been done to investigate the assumption that neuropsychological tests predict behavior out of the context of the testing environment.

Ecological Validity of Executive Functioning Testing

Executive functioning is more difficult than any other cognitive domain to test in an ecologically valid manner. Some clinicians believe that traditional tests of executive functioning are ecologically valid (Spooner & Pachana, 2006). They assume that performance on traditional tests is predictive of everyday functioning. However, limited research has been done to examine the ecological validity of traditional tests. Although some studies have found significant relationships between performance on executive functioning measures and the real world, many others have not (Chaytor et al., 2006).

Cripe's (1996) opinion is that the ecological validity of assessment of executive functioning in children is often very poor. The first basic problem with testing that causes ecological validity to be poor is that the testing environment is highly structured with controlled conditions, which is drastically different from the natural environment (Hart & Hayden, 1986). According to Cripe (1996), another basic problem is that testing uses a reductionist model. Executive functioning is a highly complex concept, as is life in general. To construct a test and try to create a representation of reality is somewhat unrealistic. Executive functions cannot be concisely described, like a concrete object. Since the construct is quite complex, the testing must also be complex to encompass the construct. When measuring executive functioning, "multiple objects moving and interacting as a dynamic system are extremely difficult to measure and describe" (Cripe, 1996, p. 190).

Finding the link between executive functioning deficits found in testing and deficits observed in the real world has proven difficult (Cripe, 1996). One problem, as previously mentioned, is that the testing environment is usually quite different from the natural environment since testing is usually much more structured, with little distraction (Odhuba et al., 2005; Sbordone & Guilmette, 2000). Sbordone and Guilmette (2000) note that this environment has helped standardize testing, but the environment does create an artificial situation. When testing executive functions, a test with good ecological validity can help the clinician determine the person's abilities in daily life, for example, if he or she can return to school and what his or her level of independence is (Odhuba et. al, 2005). Testing should "allow the clinician to make inferences about a patient's everyday functioning" (Obhuba et al., 2005, p. 271) in such things as planning and decision-making. Many tests can address cognitive limitations or deficits, but cannot take the next step of predicting behavior and ability in the real world. Ecological validity is important in a rehabilitation setting where return to school (or work) issues are especially pertinent

(Obhuba et al., 2005). In this setting, determining site and type of cerebral abnormalities is not the main priority. The focus, then, is on treatment planning. Clinicians must create appropriate interventions that incorporate the "type of rehabilitation required and the degree of recovery that can reasonably be expected" (Spooner & Pachana, 2006, p. 329). If tests are ecologically valid, then clinicians can accurately measure deficits and see the full picture of the child's functioning.

Ecological validity is somewhat questionable when tabletop tests of executive functioning are used. Although tabletop measures may be valid in a clinical setting, using the measures to predict future functioning may be unreasonable, as the course of any executive dysfunction may be unpredictable. As has previously been stated, ecological validity in neuropsychological assessments of executive functioning is often poor. One problem is that on some measures, like the WCST, although they are designed to detect executive dysfunction, often people with frontal lobe deficits perform well on them. The measures appear at times not to be sensitive to executive dysfunction (Cripe, 1996). Ecological validity is then compromised as insufficient measures are used as predictors of everyday functioning.

No one answer resolves the issues of ecological validity in assessments of executive functioning in children. While researchers have made progress, Vriezen and Pigott (2002) and Silver (2000) suggest that more research is needed to explore and explain the issues with ecological validity in executive functioning assessment of children. The BRIEF and the CEFS are examples of measures created out of clinicians' need for more ecologically valid measures. According to Gioia and Isquith (2004) as well as Silver (2000), to ameliorate the issue of ecological validity of neuropsychological assessment measures, two options are available: create new testing measures or use the existing measures and examine how well they predict real world functioning, as well as what limits their ecological validity.

Parent Report

Basic Issues

The following sections will explore the use of parent report and he reliability issues associated with it. While some research concludes that parent report is a valuable source of information, other researchers disagree. Proponents of parent report state that multiple measures, including using outside informants like parents, help clinicians determine if their findings from testing the child are generalizeable to his or her whole environment (Anderson, 1998; Gioia & Isquith, 2004; Kolko & Kazdin, 1993; Treutler & Epkins, 2003). In other words, this method promotes ecological validity. Some researchers suggest that parent report is highly useful since parents are in the best position to observe their children (Bodnarchuk & Eaton, 2004). Because of their high level of exposure to the child, their information could be highly accurate. Parents also monitor the child's development and are invested in the child in a way unavailable to researchers. Gioia and Isquith (2004) note that parents have access to a wealth of knowledge about their children's behaviors and some measures, like the BRIEF, take that information and standardize it. Sbordone and Guilmette (2000) note that when testing for executive functioning, the client, family of the client, as well as others that interact with the client should all be used as sources of information about the functioning of the client. Multiple measures also allow researchers to look at the relationships among measures (Anderson, 1998).

Many researchers agree that a multimodel method of assessment is the best method, as using any one method may lead to invalid conclusions (Hayden, Klein, & Durbin, 2005). The use of parent report as well as self-report from the child is important as researchers can glean different information from these sources, but the findings must correlate to be valid (Mahone, Zabel, Levey, Verda, & Kinsman, 2002).

Validity Issues

Although parent report is seen as useful information to gather, whether or not parent report is a valid source of information is questionable. Validity issues typically have been addressed in the literature in one of four ways: comparing parent ratings to independent observer ratings, comparing interparental reports, comparing parent ratings to child self-reports, and comparing parent ratings to standardized tests given to the child. The positive findings from these four methods will be discussed, followed by the negative findings that do not support good validity.

Studies have compared parent ratings of children's behaviors to the ratings given by independent observers, who may be teachers or other caregivers (Bodnarchuk & Eaton, 2004; Goldsmith & Campos, 1990; Hayden, Klein, & Durbin, 2005; Kolko & Kazdin, 1993; Kroes, Veerman, & DeBruyn, 2005; Tripp, Schaughency, & Clarke, 2006). Tripp, Schaughency, and Clarke (2006) compared parent and teacher ratings of symptoms of ADHD through several measures, including the Disruptive Behavior Disorders (DBD) rating scale (Pelham, Gnagy, Greenslade, Milich, 1992), Conners Rating Scales (Conners, 1990) and Child Behavior Checklist (CBCL; Achenbach, 1991b). The researchers stated that the ratings from parents and teachers agreed, but contributed different information to the diagnosis of ADHD. Parents also rated internalizing symptoms as more prevalent than teachers did, while teachers rated behavioral difficulties as occuring more frequently than parents did.

Bodnarchuk and Eaton (2004) also utilized this method of assessing ecological validity, which is comparing parent and outside observer ratings. The researchers found that parent report and laboratory observer ratings agreed when the same measures are used by both groups. These researchers asked parents to record infants' gross motor milestones for seven days, and then on the 8^{th} day, had an independent observer observe the same child for a half hour. Despite several circumstances that lowered concordance between parent and independent observer ratings, such as a child performing a behavior for the first time during the 8^{th} day visit, the ratings had a relatively high correspondence. This finding points towards parent report being accurate. Kroes, Veerman, and DeBruyn (2005) required parents, childcare workers, and independent observers to watch videotapes of children between the ages of 6 and 13 years old. This study eliminated one of the confounding variables listed in the Bodnarchuk and Eaton study, as each observer rated the same segment of behavior. The researchers found that mothers reported fewer behavior problems than the childcare workers, and that the parents and the childcare workers both reported more problem behaviors than the independent observers. The statistical results of this study indicate modest correlations between parent and independent observer responses (r= .18 to .45). In summary, this study found a correlation between parent and independent observer reports of child behavior, but significant differences between the reports.

Cripe explained that often patients with executive dysfunction may not appear impaired while in an office or clinic setting (1996). Also, behavior tends to vary from situation to situation, so parents may observe behaviors different from that exhibited in a laboratory setting. Since their range of data is much wider than that of clinicians, parent report may be better than results found in the lab.

Concerning negative comparisons of parent report and external observations, Goldsmith and Campos (1990) found only modest correlations between parent reports of temperament and behavior observations (r= -.06 to .37 for maternal responses and r=-.17 to .29 for paternal responses). The researchers administered the Infant Behavior Questionnaire (IBQ; Rothbart, 1981) to parents and then used independent observers to observe infants in a laboratory setting. Goldsmith and Campos assumed children's behavior does not vary from situation to situation, so they believe the absence of a strong correlation is a product of how the measures are structured and questions asked, and not that the child exhibits different behaviors for parent versus laboratory observers. In another study comparing parent report and laboratory assessment of child temperament, Hayden, Klein, & Durbin (2005) found a very low correlation between parent report and laboratory assessments on some aspects of temperament. The researchers administered the Laboratory Temperament Assessment Battery (Lab-TAB; Goldsmith, Reilly, Lemery, Longley, & Prescott, 1995) to children, which included 12 episodes designed to elicit different facets of temperament. The assessments were videotaped and later coded by independent student coders. The results of this measure were correlated with reports on the Children's Behavior Questionnaire (CBQ; Rothbart, Ahadi, Hershey, & Fisher, 2001), Toddler Behavior Assessment Questionnaire (TBAQ; Goldsmith, 1996), and the Teacher Report Form (TRF; Achenbach, 1991c). Parents completed the first two measures and teachers completed the third. Researchers found a correlation between two types of measures, laboratory assessments of children and parent-report, when assessing anger. The researchers concluded that higher correlations were found when the behaviors were more obvious and overt, like anger, so both parents and observers easily noticed the behaviors. Hence, more extreme behaviors elicited higher agreement between raters. Other behaviors may be more difficult for both parties to notice, thus causing lower correlations between their ratings. Two possible explanations listed by the researchers for this discrepancy are parent characteristics, like maternal depression, and child characteristics. For example, they proposed that if a child has extreme scores on one dimension of the temperament construct, then it is more likely that the child assessment and parent report will agree. Though specifics were not listed, researchers believed the problem stems from the parent report and not the laboratory observations.

Researchers have also used interparental reporting to look at child behaviors. This method involves having both parents complete parent report measures and looking at their agreement. Differences in responding have been found when the child behaviors are divided into internalizing and externalizing behaviors (Duhig, Renk, Epstein, & Phares, 2000; Kolko & Kazdin, 1993; Treutler & Epkins, 2003). In a meta-analysis of studies comparing mother and father reports of child behavior, Duhig et al. (2000) found that mothers and fathers tended to have higher correspondence rates when reporting on externalizing behaviors, such as aggression and hyperactivity. Mothers tended to report more internalizing behaviors than fathers, such as anxiety and depression. In a study conducted by Treutler & Epkins (2003), the researchers found similar results. The researchers had parents complete behavior-rating forms, including the Child Behavior Checklist (Achenbach, 1991b). They found that mothers reported more internalizing behaviors than fathers. Tripp, Schaughency, and Clarke (2006) did not find significant discrepancies between mothers' and fathers' reports of child behaviors in a study that looked at parent and teacher ratings in assessing ADHD. The researchers state that this result is likely due to the fact that the study was advertised as an ADHD evaluation and that the parents already had good agreement coming into the evaluation.

Another way to measure ecological validity is to compare parent ratings with their children's self-report (Kolko & Kazdin, 1993; Mahone et al., 2002). Mahone et al. (2002) had children and parents use the same measure, the Behavior Rating Inventory of Executive Functioning (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000) and the Behavior Assessment System for Children (BASC; Reynolds & Kamphaus, 1998), to rate executive functioning. This approach used two forms of these measures, the parent and the self-report forms. The researchers found moderate correlations between parent and child versions of the BRIEF, and low to moderate correlations between the parent and child versions of the BASC. The moderate correlations between the versions of the BRIEF occurred when comparing the overall mean from all of the subscales combined, but the researchers also noted that parents rated children higher, meaning more problems, on the Plan/Organize scale while children rated themselves higher on the Inhibit and Shift scales. This implies that the two forms provide some unique information, while overlapping enough to support the validity of the measure. Although the parents and children did not report the same things, the researchers point out that if they had reported exactly the same behaviors, there would be no need for both measures. They would overlap and not provide any additional information. If the correlation is too high, then using both sources provides no additional information. If the correlation is too low, then it is not clear if the information is valid. Thus, a moderate correlation is best.

Kolko and Kazdin (1993) also correlated ratings between parents and their children, as well as between parents and teachers. These researchers used several measures of emotional and behavioral problems, including the CBCL and Youth Self-Report, which were administered to parents, children, and teachers. They found significant correlations between parent and child report on the Child Behavior Checklist and the Youth Self-Report, which parallels symptoms on the CBCL. Under-endorsement by a young child was noted as a possible explanation for parent and child report discrepancies. The researchers found that parent and child report agreement tends to increase with the age of the child. Kolko and Kazdin also found significant correlations between parent and teacher responses on the CBCL and the Teacher Report Form, which also parallels the CBCL, indicating that parent report is a valid source of information. When comparing the reports, correlations were higher between parent and teacher reports than between parent and child reports, but the differences in correlations were not significant.

A fourth method is to compare parent ratings to the results of standardized tests administered to the child in a clinical setting, i.e., tabletop tests (Nauta, Scholing, Rapee, Abbott, Spence, & Waters, 2004). In general, poor correlations between parent report and comparison data can be found in the literature comparing parent report to performance on tabletop tests. Dewey, Crawford, and Kaplan (2003) used parent reports of everyday cognitive functioning, specifically the Parent Ratings of Everyday Cognitive and Academic Abilities (PRECAA; Williams, Ochs, Williams, & Mulhern, 1991), and also assessed children through various measures, like the Woodcock-Johnson Psychoeducational Battery-Revised (Woodcock & Johnson, 1989), WISC-III (Wechsler, 1991), and the Developmental Test of Visual-Motor Integration (VMI; Beery, 1989). The researchers found that parents rated their children as having more impairments than results of the tabletop tests given to the children. These researchers were also looking at accurate prediction of ADHD in the children. When parent report was included in their analysis, they found that accuracy of classifying children with ADHD and reading disabilities (RD) significantly increased. The results of the study found that 66.7% of all the children were correctly classified as having ADHD or RD.

Several studies have compared scores on the BRIEF with results from tabletop tests. In a study of executive functioning in children with a traumatic brain injury, Vriezen and Pigott (2002) had parents complete the BRIEF and children complete several tabletop tests, including the Wisconsin Card Sorting Test. The researchers found that parent reports on the BRIEF indicated more impairment than the results of the tabletop tests administered to the children (WCST Perseverative responses in the clinically significant range =9.5%, BRIEF GEC scores in the clinically significant range =33.3%). The researchers note that there are two explanations of this finding: either parents over-reported problem behaviors or the measures administered to the children lack ecological validity. Anderson et al. (2002) also used the parent report version of the BRIEF and compared results on it to results of tabletop tests, including the Tower of London (TOL) and Contingency Naming Test (CNT; Anderson, Anderson, Northam, & Taylor, 2000), administered to children between the ages of 5 and 18 years. These researchers found the results from the BRIEF were effective in identifying symptoms of frontal lobe pathology;

however, scores from the BRIEF and the TOL did not show a relationship (specific coefficients not reported, but reported correlation coefficients between the BRIEF and the CNT-SC and TOL varied from .01 to .48). The researchers identified several possible explanations for this finding, including the difference between the real world and the testing environment. McCandless and O'Laughlin's (2007) study compared parent ratings on the BRIEF with child scores on the Integrated Visual and Auditory Continuous Performance Test (IVA-CPT; Standford & Turner, 1995) to determine the efficacy of the BRIEF in diagnosing ADHD in children. Lower scores on the IVA-CPT indicated greater impulsivity, and were associated with scores from the Plan/Organize scale on the BRIEF (coefficients not reported). The researchers noted that these results provide support for the ecological validity of the BRIEF. Mahone and Hoffman (2007) also used a sample of children with ADHD to compare tabletop test results with parent ratings on the BRIEF. They administered several measures of executive functioning to children, including the Auditory Continuous Performance Test for Preschoolers (ACPT-P; Mahone, Pillion, & Hiemenz, 2001). Although McCandless and O'Laughlin as well as Mahone and Hoffman compared scores on the BRIEF with scores from continuous performance tests, Mahone and Hoffman did not find any significant correlations between the measures (r ranged from -.05 to -.37 between the BRIEF GEC and scores of the ACPT-P). The researchers note that the BRIEF may measure different constructs than tabletop tests of executive functioning.

Molho (1996) also compared parent report to results from tabletop tests administered to children. The researcher administered the CEFS to parents and several tabletop tests to children, including the Wisconsin Card Sorting Test. The Total Score from the CEFS was significantly negatively correlated with number of categories completed on the WCST (r = -.408), as well as significantly correlated with loss of set on the WCST (r==.385). These results provide evidence for ecological validity.

Parent Factors That Influence Reporting

Although researchers and clinicians have found parent report a useful tool, parents' ratings may be influenced by certain factors, such as parent traits and SES (De Los Reye & Kazdin, 2005; Kolko & Kazdin, 1993; Treutler & Epkins, 2003). Kolko and Kazdin (1993) state that parents usually report more behavioral and emotional dysfunction on parent report measures than their children do on self-report measures. In the previously described study of Kroes et al. (2005), the researchers also looked at the influence of personality traits upon parent report of child behavior problems; those more familiar with the child (the mother and child care workers) reported significantly more behavior problems than independent observers. Thus, the researchers concluded that greater familiarity with the child allowed informants to pick up on cues and detect behaviors more accurately than those not familiar with the child. Kroes et al. suggest that their findings indicate that, contrary to previous research, mothers are not positively or negatively biased towards their children, but rather more attuned to the child's behavior. Additionally, mothers reported fewer problem behaviors in the video than child care professionals. Findings by Kroes et al. suggests that the child may exhibit fewer problem behaviors in a group setting, which was used for the videotape and the environment observed by childcare workers. The parent may see more problem behaviors at home and thus rate the behaviors on the video as less severe since they are better than those normally observed by the parent. The childcare worker may rate them higher since they are the same types of behaviors normally observed. Thus, mothers reported fewer problem behaviors than childcare workers on the video since the child behaved ‘better’ for the group setting.

When discrepancies exist, treatment planning and participation in treatment are often compromised as parents and clinicians are unsure about what kind of deficits the child has (De Los Reyes & Kazdin, 2005). In order to help explain these discrepancies, parent factors can be investigated to determine their effects on rating scales and to determine how much weight to place on the parent reports.

Parents’ emotional functioning has been investigated as an influence upon ratings of their children’s behaviors. Most studies have focused on maternal depression and stress. Research is contradictory on the issue of the influence of parental symptoms of depression upon parent reports of child behavior. Treutler and Epkins (2003) state that parents’ psychological symptoms are related to discrepancies between reports from two parents or between a parent and a teacher. Parents completed forms, including the Child Behavior Checklist (CBCL) to assess child behaviors and the Brief Symptom Inventory (BSI; Derogatis, 1993) to measure parental psychological symptoms. The researchers found that general psychological symptoms of the mothers and fathers, which included depression and anxiety, significantly impacted their ratings of the child’s behaviors. They also found that discrepancies between mother and father reports could be attributed to mothers spending more time with their children than the fathers did. The researchers explained that mothers who spent more time with their children were more attuned to the internalizing behaviors, like anxiety and depression, than the fathers were. This study determined that parental symptoms as well as time spent with their child affected parent reports of child behavior. The authors suggested that maternal depression led to endorsing more internalizing behaviors, but did not examine this trend in their study.

Kroes, Veerman, and DeBruyn (2005) note that several studies have found a link between parents with depressive symptoms and higher reports of child behavior problems, although directionality is not clear. These researchers propose two theories as to why this happens: either depressed parents have a skewed perception of child behaviors or the parental depression leads to children acting out. Either way, the parental trait significantly raises the amount of reported behavior problems. To examine the impact of personality traits on reports of child behaviors, these researchers administered the NEO Five Factor Inventory (NEO-FFI; Costa & McCre, 1992) to parents and teachers to assess personality traits of the parents and teachers, as well the Direct Observation Form (DOF; Achenbach, 1986) to assess parent and teacher ratings of behavior problems in the children. Parents and teachers observed videotapes of the children during a playgroup that had standardized instructions given to the children, such as "ask a friend to play a game." Ratings were compared to those of independent observers who had no previous contact with the children. The researchers found that the personality trait of neuroticism led to teachers and group-care workers endorsing more problem behaviors than parents or independent observers but traits of the parents did not influence reporting. Another factor could explain the findings of these researchers. Mothers, teachers, and group care workers who all had a high level of familiarity with the child reported more behavioral problems than independent observers, so perhaps level of familiarity causes them to "see" more than the independent observer.

De Los Reyes and Kazdin (2005) state that numerous studies have found a link between maternal depression and discrepancy between parent reports of child behaviors and teacher reports or children's ratings of themselves. Unlike Kroes et al. (2005), they note that depression leads to a negative bias, in that mothers endorse more behaviors on parent report measures. The researchers also noted a positive relationship between anxiety in the mother and discrepancies in reports of child behavior. In their own study, they found that discrepancies between parent's rating and ratings of other informants increased as parental psychopathology increased.

In contrast, Conrad and Hammen (1989) found that mothers with symptoms of depression did not show distortions in their parent reports when compared to other observers of the children. Conrad and Hammen further found that personality traits of neuroticism, extraversion, and openness did not influence parental report. The researchers hypothesized that the design of the experiment, which allowed mothers, childcare workers, and independent observers to watch a video of the child, affected how the respondents assessed the child. For the mothers, this situation created distance for the parent from the child and thus lowered parental stress. Therefore, their personality traits were not triggered and did not affect their reports. However, these personality traits did influence childcare workers' responses when observing child behaviors. Childcare workers observed behaviors very similar to those they observed with the child on a daily basis, so their personality traits were triggered and thus affected their reporting. The childcare workers also may not have felt as distanced from the child as the parents did, so their traits were more easily triggered. These findings suggest that in a laboratory setting, parent report may not be affected by personality traits since researchers did not find any trait-related distortion in the parent reports.

Parenting Stress

All parents experience stress (Ross & Blanc, 1998), which may be a factor affecting parents' views of the child's behavior. Treutler and Epkins (2003) stated that family stress level could be a factor that increased discrepancies between mothers' and fathers' reports of child behaviors. Powers, Byars, Mitchell, Patton, Standiford, and Dolan (2006) found that parents who reported high levels of parenting stress also reported more problematic mealtime behaviors than parents who did not report high levels of parenting stress. Phares, Compas, and Howell (1989) noted that family stress led to higher ratings of child deviance on parent-report measures. Their research found that the more severe the parental dysfunction, the lower the correspondence between parent-reports and child self-reports. Thus, family stress and parental dysfunction lead to endorsing more problem behaviors for children.

Kolko and Kazdin (1993) also found that family stress led to parent and child report discrepancies. One of the measures used in this study to measure family stress was the Children's Life Events Inventory (CLEI; Chandler, Million, & Shermis, 1985). They found that elevated scores on the CLEI correlated with discrepancies between parent reports of child behaviors on the CBCL and child reports of behavior on the Youth Self-Report (YSR). In their findings, parent dysfunction contributed to differences between parent and child reports. De Los Reyes and Kazdin (2005) propose, "parental stress may decrease the threshold by which parents gauge whether a child's behavior is problematic" (p. 500). Thus, parents with significant parental stress may endorse more negative information than other informants. Kolko and Kazdin (1993) also note that other parental factors could be a factor in the informant discrepancies, so further research is needed.

According to Ross and Blanc (1998) as well as Moss, Rousseau, Parent, St. Laurent, and Saintonge (1998), the measure most accepted and most used to assess parenting stress is the Parenting Stress Index (PSI; Abdin, 1995). The PSI is a parent-report measure designed to identify characteristics of parent and child that can contribute to parenting stress (Ross & Blanc, 1998). This form consists of 101 items rated on a Likert scale ranging from "strongly agree" to "strongly disagree." The responses are divided into thirteen subscales and three total scores of child domain, parent domain, and a total stress scale. These three domains include the subscales of distractibility, adaptability, reinforces parent, demandingness, mood, acceptability, competence, isolation, attachment, health, role restriction, depression, and spouse. Kolko and Kazdin (1993) noted that the use of a measure for parenting stress could be helpful to determine the relationship between parenting stress and reporting style on parent-report measures.

Kolko and Kazdin (1993) found that disagreement between parents and children, which can create parenting stress, was a strong predictor of discrepancies between parent-report and child self-report measures, as reported on the CLEI. Parent-child disagreement led to low parental acceptance of the child, and over-reporting of problem behaviors. These findings point towards contextual problems and not parental dysfunction, and the authors suggest that it is the stress and not an attribute of the parent the causes discrepancies in parent-reports and child self-reports. Benzies et al. (2004) also found that parenting stress correlated with parent report of child behavior problems. The researchers compared reports on the Parenting Stress Index, Dyadic Adjustment Scale (Spainer, 1989), and Eyeberg Child Behavior Inventory (ECBI; Eyeberg, 1992a) to find that parenting stress significantly predicted frequency of childhood behavior problems, as reported on the ECBI. The researchers also found that socioeconomic status did not significantly predict child behaviors on the ECBI.

Research has found a correlation between parental stress and having a child with intellectual difficulties; however, the way in which the relationship develops is not clear. According to Benzies, Harrison, and Magill-Evans (2004), marital relationships can be impacted by the cognitive abilities of a child, like distractibility. The researchers found the child's distractibility in infancy caused stress in parents. A follow-up at age seven showed that the level of parental stress when the child was an infant could predict the amount of child behavior problems reported. Thus, parental stress levels are impacted by having a child with distractibility, which later correlated with behavior problems in children.

Parental stress also can influence the parents' cognitive appraisal of a child with an intellectual disability (Hassall et al, 2005). In contrast to Benzies et al., who concluded that child characteristics affected parental stress, Hassall et al. (2005) found that the parental cognitive appraisal, not the child characteristics, affects the parental stress. The researchers targeted parental cognitions and examined how these cognitions impact parenting stress. The researchers administered the Vineland Adaptive Behavior Scales (Sparrow, Balla, & Cicchetti, 1984), including the Maladaptive Behavior Domain, through an interview with mothers of children with an intellectual disability. The mothers in the study also completed the Family Support Scale (Dunst, Trivette, & Hamby, 1994), Parenting Sense of Competence Scale (Gibaud-Wallston & Wandersman, 1978), Parental

Locus of Control Scale (Campis, Lyman, & Prentice-Dunn, 1986), and the Parenting Stress Index. Analysis of the data indicated that "variance in parenting stress was explained by parental locus of control, parenting satisfaction, and child behaviour difficulties" (p. 405).

Regardless of which way the relationship develops, parents of children with intellectual difficulties have significantly higher parental stress. This finding may generalize to parents of children with executive functioning problems (Hassall et al, 2005). Mahone et al. (2002) note that previous research has found that high levels of parenting stress may be a factor in low parent-child agreement on observations of behaviors, like hyperactivity and oppositional behaviors. Since some of the symptoms involved with hyperactivity and impulse control are intimately related to executive functioning, that indicates that it will be important to examine the impact of parenting stress on the way parents rate their children's executive functioning.

Age appears to be a moderating factor in the influence of stress. According to Tomanik, Harris, & Hawkins (2004), parenting stress was lower with older children. They postulate that parental stress lowers as children age because the children display more self-help skills than younger children. Ross and Blanc (1998) also found that parents of older hyperactive children reported less parenting stress than parents of younger hyperactive children. As previously mentioned, Kolko and Kazdin (2005) found that as the child's age increases, so does parent and child report agreement.

As mentioned earlier, children with ADHD have behavioral symptoms that cause parenting stress. Symptoms of hyperactivity may cause higher levels of parenting stress (Tomanik, Harris, & Hawkins, 2005; Ross & Blanc, 1998). Ross and Blanc (1998) found that mothers of hyperactive children reported significant levels of parenting stress. The researchers used 92 mothers of children between the ages of 2 and 8 with disruptive behavior problems. Mothers completed a DSM-III-R structured interview, a demographic questionnaire, the CBCL to evaluate behavioral problems, the Parenting Stress Index to assess parent stress levels, and the Eyeberg Child Behavior Inventory to assess conduct problem behaviors; teachers completed the Sutter-Eyeberg School Behavior Inventory (SESBI: Eyeberg, 1992b) to assess problem behaviors in the classroom. The study found that symptoms of hyperactivity, as found in the DSM-III-R structured interview, were positively correlated with scores on the PSI.

In a study conducted by Tomanik, Harris, and Hawkins (2005) looking at the relationship between child behavior and maternal stress levels, hyperactivity in the child caused the greatest levels of parenting stress. The participants in this study were 60 mothers of children with a pervasive developmental disorder. The mothers completed several measures, including the Parenting Stress Index, a demographic questionnaire, the Aberrant Behavior Checklist (ABC: Aman & Singh, 1986) to rate inappropriate behaviors in children, and the AAMR Adaptive Behavior Scale (ABS-S:2, Nihira, Leland, & Lambert, 1993) to measure adaptive behaviors in children. They also found that hyperactivity, as measured on the ABS, was negatively correlated with scores on the ABC. Scores on the ABC also were positively correlated with scores on the PSI. One way to interpret this data is that child behavior has a direct effect on parental stress.

Child IQ

Parenting stress may also be influenced by the IQ of the child. Researchers in Malaysia utilized a sample of 75 children with mental retardation with a mean FSIQ of

54.8, as well as a control group of 75 children with a mean FSIQ of 99.9, and had parents of the children complete the PSI as a measure of parental stress (Ong, Chandran, & Peng, 1999). Parents of children with mental retardation reported significantly higher parental stress. This group reported a mean Total Stress Score of 274 while the control group reported a mean Total Stress Score of 232. In the Child Domain of the PSI, the MR group reported a mean score of 133, while the control group reported a mean score of 106.8. Ong, Chandran, and Boo (2001) also found a relationship between child IQ and parental stress. These researchers found that child IQ was predictive of parental scores on the Child Domain aspect of the PSI, but they also noted that maladaptive child behavior was more closely related to parental stress than child IQ.

Socioeconomic Status

Socioeconomic status (SES) is another factor that has been explored to explain discrepancies between parent reports and reports from teachers or child self-reports. Results in the literature are conflicting (De Los Reyes & Kazdin, 2005). In Tomanik, Harris, and Hawkins' study (2004), no demographic differences were correlated with levels of parenting stress, including socioeconomic status. Kolko and Kazdin (1993) found that characteristics of the child's background did not account for discrepancies between child self-reports and parent-reports. Included in these characteristics were age, sex, and SES. However, Treutler and Epkins (2003) found that lower SES was associated with larger discrepancies in parents' reports of child behaviors, implying that SES is a factor in parent reporting.

In conclusion, parent reports of their children's behaviors may be influenced by a number of factors. These factors may include parenting stress, socioeconomic status, and the IQ of the child.

Summary and Hypotheses

Executive functioning includes many types of cognitive abilities, including planning, abstract thinking, mental flexibility, problem solving, and self-monitoring (Anderson, 1998). Deficits in executive functioning are a problem for many children with developmental disabilities and impact children at home, in school, and in their social lives. Deficits in executive functioning are especially detrimental in children with ADHD. Measurement of executive dysfunction is difficult, however, because different measures of executive functioning address specific deficits (Anderson, 1998). Results on measures used in a standardized testing situation may not be representative of the child's abilities in the real world. To be like the real world, the measures need to have ecological validity (Nadolne & Stringer, 2000). According to Cripe (1996), one way to attain ecological validity is to use a multi-informant method. Therefore, parent report is a good way to gather reports of real world behaviors; however, correlations between parent reports and tabletop tests of executive functioning frequently are low. Several factors may influence this, including the testing environment (Odhuba et al., 2005) and problems with test design (Cripe, 1996). Parent factors also may influence this correlation. Most studies suggest that greater parental stress leads to higher ratings of behavior problems on parent report measures (Powers et al, 2006). While parenting stress has been identified as a factor in parent reports of child behavior, researchers note that the specific role it plays in discrepancies between the informant and tabletop tests, in other words ecological validity, has not been explored (De Los Reyes & Kazdin, 2005). Furthermore, there is evidence that children with ADHD have behaviors that cause parenting stress (Ross & Blanc, 1998). Therefore, greater stress reported by parents of children with ADHD is expected to impact the relationship between the problem behaviors reported by parents and the results of tabletop tests of executive functioning administered to children.

Hypotheses:

Hypothesis 1: For children with ADHD, parents' ratings of impairment in their children's executive functioning will be positively correlated with parents' ratings of their own stress.

Hypothesis 2: For children with ADHD, full scale IQ will be related to children's scores on tabletop tests, as well as parents' ratings of their own stress. Children's scores on tabletop tests and parent's ratings of child problem behaviors will be related when controlling for the effects of the children's IQs.

Hypothesis 3: Higher parenting stress will be associated with lower correlations between scores from the CEFS and BRIEF and scores obtained from the Color-Word Interference Test from the D-KEFS. The Color-Word Interference Test was selected to represent one aspect of executive functioning in order to serve as a model for the relationship of tabletop and rating scales.

Chapter III

Method

Participants

Participants for this study were recruited as part of an ongoing study of executive functioning at the University of Texas Southwestern Medical Center. A total of 49 students from two private schools for children with learning differences in Dallas, Texas, were recruited for a comprehensive study of measurement of executive functioning. The students were between the ages of 6 years, 0 months and 12 years, 11 months. Parenting Stress Indexes, which are the focus of this study, were completed by 32 parents of the students, thus the sample for this study is 32 students. The students whose data are used in this study are between the ages of 8 years, 0 months and 12 years, 11 months. Children were recruited if they had a previous diagnosis of ADHD. Children who had been diagnosed with any major neurological condition, either congenital or acquired, were excluded from the study.

Procedures

This study was approved by the Institutional Review Board (IRB) at the University of Texas Southwestern Medical Center. Potential participants were identified by school staff at two private schools for children with learning differences in Dallas, Texas. The children's parents were contacted by the school and invited to enroll in the study. Information sessions were offered at the two schools to provide more detailed information to interested parents. Informed consent was obtained either at these information sessions or by school staff at another time. In most cases, packets including the parent rating scales were distributed by school staff and returned to school staff after completion. If packets were lost or forms were returned incomplete, the principal investigator for the larger study contacted the parents to have the forms completed. Testing appointments for the children were scheduled with the assistance of school staff, and took place at the school. Testing was performed by this study's author, a faculty associate, and a graduate student in Clinical Psychology, who were trained in the administration and scoring of the tests. All test data and parent data are maintained in locked files in the principal investigator's office.

Measures

Parents of the children involved in this study completed the BRIEF, CEFS, and PSI. Participants in this study were administered a short form of the Wechsler Intelligence Scale for Children IV, the Wisconsin Card Sorting Test, the Tower of London, and the Color-Word Interference subtest from the D-KEFS. For the purposes of this research project, only the Color-Word Interference subtest from the D-KEFS will be used.

Behavioral Rating Inventory of Executive Function

The BRIEF is a parent report measure of child behaviors associated with executive functioning. The BRIEF includes eight subdomains of executive functioning, which are Inhibit, Shift (flexibility), Emotional Control, Initiate, Working Memory, Plan-Organize, Organization of Materials, and Monitor (Gioia & Isquith, 2004). Inhibit refers to the "ability to resist or delay an impulse, to appropriately stop one's own activity at the proper time, or both" (Gioia & Isquith, 2004, p. 146). Shift refers to altering strategies of problem solving and flexibility in thinking and attention. Emotional control looks at the ability to regulate emotional responses. Initiate is "the ability to begin a task or activity, or the process of generating ideas or problem-solving strategies" (Gioia & Isquith, 2004, p. 146). Working memory refers to holding information in mind. Plan-organize "involves anticipating future events, setting goals, and developing appropriate steps ahead of time to carry out an associated task or action" (Gioia & Isquith, 2004, p. 147). Organizing involves "establishing and maintaining order" (Gioia & Isquith, 2004, p. 147). Finally, self-monitor means paying attention to one's own actions and whether or not he/she attained a goal (Gioia & Isquith, 2004). The eight subscales contribute to three composites scores, which are the Behavioral Regulation Index, Metacognition Index, and an overall Global Executive Composite. The scale measures executive functioning in children by using questions on a 3-point Likert scale that ranges from "never," "sometimes," and "often." Higher scores indicate more problem behaviors. According to the test manual, the BRIEF has a test-retest reliability coefficient of .81 for the parent clinical scales.

Children's Executive Functions Scale

The Children's Executive Functions Scale (CEFS; Silver, Kolitz-Russell, Bordini, & Fairbanks, 1993) is another parent report measure of child behaviors associated with executive functioning. The 99-item CEFS includes five subscales of Social Appropriateness, Inhibition, Problem Solving, Initiative, and Motor Planning. Social appropriateness refers to social reciprocity and emotional control. Inhibition refers to distractibility and impulsive behaviors. Problem solving refers to reasoning, organization, and cognitive flexibility. Initiative refers to getting started or getting involved. Motor planning refers to fine motor skills, like handwriting. The scale measures executive functioning in children by using responses on a 3-point Likert scale that range from “never” to “sometime” to “very much” to yield a Total Score as well as the five subscores. Higher scores indicate more problem behaviors. Test-retest reliability coefficients were found using a sample of 44 children (Silver, Benton, Goulden, Molho, & Clark, 1999). Coefficients were Total Score = .92, Social Appropriateness = .85, Problem Solving = .85, Initiative = .81, and Motor Planning = .81.

Parenting Stress Index

As previously mentioned, the Parenting Stress Index (PSI: Abdin, 1995) is the most commonly used measure of parental stress. The measure divides the questions into thirteen subscales of distractibility, adaptability, reinforces parent, demandingness, mood, acceptability, competence, isolation, attachment, health, role restriction, depression, and spouse, which contribute to three domains of child, parent, and total stress scale. The scale uses responses on a 3-point Likert scale that range from “strongly disagree,” “agree,” “not sure,” “disagree,” and “strongly agree.” The PSI total raw score ranges from 36-180, with a higher score indicating a larger amount of parental stress (Tomanik, Harris, & Hawkins, 2004). A raw score over 90 is considered clinically significant, which indicates a likely risk for “developing dysfunctional parenting behaviors… potentially requiring professional evaluation and intervention” (Tomanik, Harris, & Hawkins, 2004). No standard scores or scaled scores are available for this test. Raw scores are converted to percentiles, with a percentile score over 85 being clinically significant. Test-retest reliability coefficients for the PSI Long Form ranged from .55 to .82 for the Child Domain, .69 to .91 for the Parent Domain, and .65 to .96 for the Total Stress score (Abdin, 1995).

Wechsler Intelligence Scale for Children IV

The WISC-IV (Wechsler, 2003) is a highly respected test of child intellectual ability that is divided into ten Core Subtests and five Supplemental Subtests. The Core Subtests are Similarities, Vocabulary, Comprehension, Block Design, Matrix Reasoning, Digit Span, Letter-Number Sequencing, Coding, and Symbol Search. The Five Supplemental Subtests are Information, Word Reasoning, Picture Concepts, Arithmetic, and Cancellation. The subtests contribute to a Full Scale IQ and four composite scores, which are the Verbal Comprehension Index (VCI), Perceptual Reasoning Index (PRI), Working Memory Index (WMI), and Processing Speed Index (PSI). Test-retest reliability coefficients were found using a sample of 243 children. For 94% of the subtests of the WISC-IV, the test-retest reliability coefficients were above .79. For this study, an estimated IQ is derived according to Sattler (1992; 2004), using the Vocabulary and Block Design subtests. The Vocabulary subtest is not timed and requires children to explain the meaning of words. The Block Design subtest is a timed subtest that requires children to rearrange blocks to match patterns

Delis-Kaplan Executive Function System

The Delis-Kaplan Executive Function System (D-KEFS) (Delis, Kaplan, & Kramer, 2001) is a comprehensive battery of tests developed to assess many executive functioning abilities, such as problem solving, planning, and attention. The creators of the measure stated that previous measures of executive functioning were developed in the 1940s. They believed that discoveries since this point in time and modern knowledge of how executive functioning works warranted a new measure that drew upon the years of research and clinical practice in the field. Norms for the measures were developed using

1,700 children and adults. The measure consists of nine tests: Trail Making Test, Verbal Fluency Test, Design Fluency Test, Color-Word Interference Test, Sorting Test, Twenty Questions Test, Word Context Test, Tower Test, and Proverb Test. These tests were created to be game-like in format and in how they are administered, as opposed to previous tests that were highly structured and lacking in novelty. By using several tests, the D-KEFS yields many scores, as opposed to previous tests that yielded a single score. The nine tests also "embrace a cognitive-process approach so that the component functions of higher-level cognitive tasks can be assessed" (Delis, Kaplan, & Kramer, 2001 p. 3). For this study, the Color-Word Interference Test will be used. This form of the Stroop procedure (Stroop, 1935) uses four tasks, which are naming color patches, reading color words (e.g., "green") printed in black ink, reading color words printed in colored inks that do not match the word, and finally switching between reading the word and naming the color of the ink, with the words printed in colored inks that do not match the word. Performance is measured by the speed of completion of each task as well as number of mistakes made. For the D-KEFS Color-Word Interference Test, the test-retest reliability coefficients range from .77 to .90. (Delis, Kaplan, & Kramer, 2001).

Hypotheses and Statistical Analyses

Hypothesis 1: For children with ADHD, parents' ratings of impairment in their children's executive functioning will be positively correlated with parents' ratings of their own stress.

Statistical analysis: The scores from the CEFS and BRIEF were correlated with the scores from the PSI using Pearson's r method. Because this relationship is relatively unexplored, correlations were examined for all CEFS, BRIEF, and PSI scales.

Hypothesis 2: For children with ADHD, estimated IQ will be related to children's scores on tabletop tests, as well as parents' ratings of their own stress. Children's scores on tabletop tests and parent's ratings of child problem behaviors will be related when controlling for the effects of the children's IQs.

Statistical analysis: The scores from the Color-Word Interference Test of the D-KEFS, as well as the Total Stress, Child Domain, and Parent Domain of the PSI were correlated with the IQ scores of the children, using Pearson's *r* method. Following these statistical analyses, a partial correlation was run using the Inhibition and Inhibition/Switching subtests from the Color-Word Interference Test from the D-KEFS and all of the scores from the CEFS and BRIEF, controlling for the effects of the IQ scores. The Color-Word Interference Test was selected to represent one aspect of executive functioning in order to serve as a model for the relationship of tabletop and rating scales.

Hypothesis 3: Higher parenting stress will be associated with lower correlations between scores from the CEFS and BRIEF and scores obtained from the Color-Word Interference Test from the D-KEFS.

Statistical analysis: Two parenting stress groups were created. Parents whose total stress was at a percentile of 70 or higher were considered high stress. The other group was defined as those with a total stress at a percentile of less than 70. The scores from the Inhibition and Inhibition/Switching subtests of the Color-Word Interference Test were correlated with all CEFS and BRIEF scales. Fisher's Z transformations, followed by a series of *t*-tests, were used to determine if the correlation coefficients for the two groups are statistically different from each other.

Chapter IV

Results

Descriptive Statistics

Data were collected and entered into and managed by SPSS version 12.0. All data were checked twice for accuracy by two individuals. Descriptive statistics were calculated for demographic variables, including age, gender, ethnicity, psychiatric diagnoses, comorbidity of diagnoses, and medications used by the children. Descriptive statistics for the demographic variables are presented in Table 1. The average age of the sample was 10.4 years (SD=1.27 years). The participants were 62.5% male and 37.5% female. The majority of the sample was Caucasian (87.5%). Comorbid diagnoses in the sample are also presented in Table 1. Diagnoses for the sample were attained through parent report. For the parent report measures, 94% were completed by the mother of the child and 6% were completed by the father. Almost all of the children had comorbid diagnoses (81%). In this sample, 65.6% of the children had 3 or more diagnoses, which included the diagnosis of ADHD. Overall, the most common comorbid diagnosis in this sample was dyslexia (37.5%), followed by anxiety (34.4%) and depression (31.3%). Medications reported for the children are reported in Table 2. The most common type of medication reported was stimulant ADHD medication (20), followed by antidepressant medication (11). A total of 66 % of the sample reported ADHD medication use. Four participants (12.5%) did not report any medication use, either prescription or over-the-counter. For those reporting medication use, 43.6% (14) reported using one medication, 25% (8) reported using two medications, and 18.8% (6) reported using three or more medications.

Table 3 lists the performance levels of the sample on IQ and all measures of executive functioning. Estimated IQ is presented as a standard score, with a mean of 100 and a standard deviation of 15. The average IQ for the sample was a standard score of 109.53, which is in the average range. Individual scores ranged from 81 to 152.

The D-KEFS scores are scaled scores, with a mean of 10 and standard deviation of 3. The average performance of the sample on the Inhibition scale was a scaled score of 9.63, which is solidly within the average range. The average performance of the sample on the Inhibition/Switching scale was a scaled score of 10.13, also within the average range. However, individual scores on these scales ranged from 2 to 14.

The CEFS scores are raw scores, with a larger number reflecting greater problems. Possible scores for the subscales range as follows: Social Appropriateness- 0 to 30 points; Inhibition- 0 to 50 points; Problem Solving- 0 to 68 points; Initiative- 0 to 30 points; Motor Planning- 0 to 20 points; and Total CEFS- 0 to 198 points. A large normative sample is not available, but based upon preliminary data, the CEFS Total score has a mean of 25 for normally-achieving children between the ages of 7 and 13; typically, normally-achieving children do not earn scores above 31. The average CEFS Total score for this sample was 77.66. The means of the subscales are as follows: Social Appropriateness 8.75; Inhibition 25.97; Problem Solving 26.56; Initiative 9.38; and Motor Planning 7.00. Thus, many children were seen by their parents as having executive dysfunction.

The BRIEF scores are T scores, with a larger number reflecting greater problems. T scores have a mean of 50 and standard deviation of 10. The means for the sample follows: Inhibit 62.55; Shift 59.39; Emotional Control 60.48; Initiate 60.77; Working

Memory 67.61; Plan/Organize 61.32; Organization of Materials 61.39; Monitor 60.77; Behavioral Regulation Index 62.52; Metacognition Index 64.58; and Global Executive Composite 64.16. The average parent rating for the sample on each of the subscales was slightly greater than one standard deviation above the normative mean, with the exception of the Working Memory scale, which approached two standard deviations above the mean. The Behavioral Regulation Index, Metacognition Index, and GEC were all between one and 1.5 standard deviations above the mean. Thus, many children were seen by their parents as having executive dysfunction on this measure, as well.

Table 4 provides scores for the scales and domains of the PSI. The PSI scores are percentiles with a mean score of 50%. The normal range of scores is between the 15th and 80th percentiles, with higher scores indicating more parental stress. The means of the subscales and domains for this sample are as follows: Distractibility/Hyperactivity 72.28; Adaptability 73.00; Reinforces Parent 68.41; Demandingness 69.34; Mood 75.66; Acceptability 81.63; Competence 36.66; Isolation 36.22; Attachment 43.28; Health 37.44; Role Restriction 38.31; Depression 33.37; Spouse 51.16; Child Domain 78.06; Parent Domain 33.28; Life Stress 48.03; and Total Stress 57.81.

Hypothesis-Testing

Hypothesis 1

To test Hypothesis 1, Pearson's *r* correlations were calculated between all CEFS, BRIEF, and PSI scales. Hypothesis 1 was supported by the data. The results of these correlations are presented in Table 5. When examining the correlations between these two measures and the Parenting Stress Index, a number of significant correlations were found. Several significant correlations were also found between the scores from the CEFS and BRIEF. Since many correlations were calculated, to be cautious, only those that are significant at a 0.01 level will be reported.

For the CEFS, the following correlations were significant at the 0.01 level: Social Appropriateness and PSI Reinforces Parent (*r*=.472), Social Appropriateness and PSI Attachment (*r*=.462), Inhibition and PSI Total Stress (*r*=.511), Inhibition and PSI Child Domain (*r*=.512), Inhibition and PSI Distractibility/Hyperactivity (*r*=.724), Inhibition and PSI Adaptability (*r*=.451), Problem Solving and PSI Total Stress (*r*=.771), Problem Solving and PSI Child Domain (*r*=.715), Problem Solving and Parent Domain (*r*=.581), Problem Solving and PSI Distractibility/Hyperactivity (*r*=.701), Problem Solving and PSI Adaptability (*r*=.681), Problem Solving and PSI Reinforces Parent (*r*=.622), Problem Solving and PSI Demandingness (*r*=.485), Problem Solving and PSI Competence (*r*=.573), Problem Solving and PSI Attachment (*r*=.510), Problem Solving and PSI Depression (*r*=.462), Problem Solving and PSI Spouse (*r*=.484), Initiative and PSI Adaptability (*r*=.534), Motor Planning and PSI Adaptability (*r*=.528), Motor Planning and PSI Role Restriction (*r*=.491), Total Score and PSI Total Score (*r*=.721), Total Score and PSI Child Domain (*r*=.695), Total Score and PSI Parent Domain (*r*=.513), Total

Score and PSI Distractibility/Hyperactivity (*r*=.720), Total Score and PSI Adaptability (*r*=.685), Total Score and PSI Reinforces Parent (*r*=.564), Total Score and PSI Demandingness (*r*=.478), Total Score and PSI Attachment (*r*=.507), and Total Score and PSI Role Restriction (*r*=.451).

For the BRIEF, the following correlations were significant at the 0.01 level: Inhibit and PSI Total Stress (*r*=.547), Inhibit and PSI Child Domain (*r*=.573), Inhibit and PSI Distractibility/Hyperactivity (*r*=.609), Inhibit and PSI Reinforces Parent (*r*=.475), Inhibit and PSI Competence (*r*=.476), Inhibit and PSI Attachment (*r*=.490), Shift and PSI Total Stress (*r*=.497), Shift and PSI Child Domain (*r*=.536), Shift and PSI Adaptability (*r*=.594), Shift and PSI Role Restriction (*r*=.527), Emotional Control and PSI Child Domain (*r*=.494), Emotional Control and PSI Attachment (*r*=.491), Initiate and PSI Total Stress (*r*=.532), Initiate and PSI Child Domain (*r*=.619), Initiate and PSI Reinforces Parent (*r*=.614), Working Memory and PSI Total Stress (*r*=.472), Working Memory and PSI Child Domain (*r*=.543), Working Memory and PSI Distractibility/Hyperactivity (*r*=.553), Working Memory and PSI Adaptability (*r*=.508), Plan/Organize and PSI Total Stress (*r*=.555), Plan/Organize and PSI Child Domain (*r*=.697), Plan/Organize and PSI Distractibility/Hyperactivity (*r*=.556), Plan/Organize and PSI Adaptability (*r*=.591), Plan/Organize and PSI Reinforces Parent (*r*=.603), Plan/Organize and PSI Demandingness (*r*=.520), Plan/Organize and PSI Attachment (*r*=.487), Organization of Materials and PSI Total Stress (*r*=.518), Organization of Materials and PSI Child Domain (*r*=.488), Organization of Materials and PSI Adaptability (*r*=.486), Organization of Materials and PSI Reinforces Parent (*r*=.580), Monitor and PSI Total Stress (*r*=.589), Monitor and PSI Child Domain (*r*=.718), Monitor and PSI Distractibility/Hyperactivity (*r*=.632), Monitor and PSI Adaptability (*r*=.681), Monitor and PSI Demandingness (*r*=.599), Monitor and PSI Mood (*r*=.476), BRI and PSI Total Stress (*r*=.556), BRI and PSI Child Domain (*r*=.628), BRI and PSI Adaptability (*r*=.536), BRI and PSI Competence (*r*=.463), BRI and PSI Attachment (*r*=.535), BRI and PSI Role Restriction (*r*=.483), MI and PSI Total Stress (*r*=.655), MI and PSI Child Domain (*r*=.757), MI and PSI Distractibility/Hyperactivity (*r*=.624), MI and PSI Adaptability (*r*=.662), MI and PSI Reinforces Parent (*r*=.639), MI and PSI Demandingness (*r*=.558), MI and PSI Competence (*r*=.488), MI and PSI Attachment (*r*=.471), GEC and PSI Total Stress (*r*=.579), GEC and PSI Child Domain (*r*=.709), GEC and PSI Distractibility/Hyperactivity (*r*=.547), GEC and PSI Adaptability (*r*=.599), GEC and PSI Reinforces Parent (*r*=.561), GEC and PSI Demandingness (*r*=.460), and GEC and PSI Attachment (*r*=.553).

Hypothesis 2

Hypothesis 2 has two parts. To test the first part of Hypothesis 2, Pearson's *r* correlations were calculated between the Inhibition and Inhibition/Switching subtest scores from the Color-Word Interference Test and the child's IQ score, followed by correlations between the Total Stress, Child Domain, and Parent Domain from the PSI and the child's IQ score. This part of Hypothesis 2 was not supported. The correlation coefficients are presented in Table 7. No significant correlations were found between Color-Word Interference Test scores and IQ scores or between PSI scores and IQ scores. A partial correlation was then used to control for the effects of IQ upon the relationship between BRIEF, CEFS, and Color-Word Interference Test scores. This part of Hypothesis 2 was also not supported. For comparison purposes, correlations were also conducted between the BRIEF, CEFS, and Color-Word Interference Test scores without controlling for IQ. When IQ scores were controlled for, only one significant correlation was found between Color-Word Interference test scores and scores from the BRIEF and CEFS, which was between the Inhibition subscale of the Color-Word Interference Test and the CEFS Initiative subscale (r=-.480). When IQ scores were not controlled for, again only one correlation was found between Color-Word Interference test scores and scores from the BRIEF and CEFS, which was between the Inhibition subscale of the Color-Word Interference test and the CEFS Initiative subscale (r=-.486). No other significant correlations were found.

Hypothesis 3

The analysis for Hypothesis 3 has multiple steps. For this Hypothesis, two groups were created based on level of parenting stress. Parents whose total stress was at a percentile of 70 or higher were considered high stress. The other group was defined as those with a total stress at a percentile of less than 70. This sample had 13 parents who qualified as high stress and 19 parents who qualified as low stress. This first step in the statistical analysis for this hypothesis was to correlate the two scores on the D-KEFS Color-Word Interference Test (Inhibition and Inhibition/Switching) with the subscales of CEFS and BRIEF tests for the two stress groups. Correlations for parents scoring above and below 70 on the Total Stress scale of the PSI are presented in Table 8. For the low stress group, significant correlations were found between CEFS Inhibition and Inhibition/Switching (r=.51), as well as between CEFS Initiative and Inhibition (r=-.50). No significant correlations were found for the high stress group. This finding can be compared to the previously mentioned correlations between the CEFS, BRIEF, and

Color-Word Interference Test listed in Table 7, which only found one significant correlation between CEFS Initiative and Inhibition (r=-.486). By dividing the sample into two stress groups, the correlation between CEFS Inhibition and Inhibition/Switching appears, and the correlation between CEFS Initiative and Inhibition increased in strength for the low stress group. The significant correlation between CEFS Initiative and Inhibition disappears for the high stress group.

In order to test for whether the correlations differed between the low and high stress groups, the correlations were converted to Fisher's Z scores and the differences in *z*-scores were computed. The *z*-score differences were then evaluated for significance by dividing them by the standard error of their differences (i.e., $\sqrt{\frac{1}{n_1-3}+\frac{1}{n_2-3}}$), and referring the result to the *t* distribution with $\left[(n_1-3)+(n_2-3)\right]/2$ degrees of freedom. A 1-tailed test was used for these statistical analyses as the low stress group was hypothesized to have higher correlation coefficients on the measures than the high stress group. The results from these calculations are presented in Table 9. From these calculations, only one significant difference between the stress groups was found, which was for the relationship between CEFS Social Appropriateness and Inhibition/Switching (t=2.14, p=.0259).

An additional step was added to the statistical analysis to further explore the relationships between parenting stress and the BRIEF, CEFS, and Color-Word Interference Test. Further analyses were conducted to explore if mean scores for the low stress group on the CEFS and BRIEF scales would be significantly lower than those of the high stress group. Again, low and high stress were operationalized by scores of below

70 and 70 or above on the PSI Total Stress scale, respectively. The results of independent groups *t*-tests of the means of the two groups on the two sets of scales are presented in Table 10. A one-tailed *t*-test also was used for these analyses. In every case, the mean of the low stress group was lower than the mean of the high stress group. This difference was significant for ten out of eleven BRIEF scales and for 5 out of the 6 CEFS scales (BRIEF Initiate and CEFS Initiative were not significant). The results are as follows for the CEFS: Social Appropriateness (*t*=-2.383), Inhibition (*t*=-3.19), Problem Solving (*t*=-5.87), Initiative (*t*=-1.479), Motor Planning (t=-2.028), and Total Score (*t*=-4.659). For the BRIEF, the results were as follows: Inhibit (*t*=-3.869), Shift (*t*=-1.944), Emotional Control (*t*=-1.986), Initiate (*t*=-1.336), Working Memory (*t*=-2.147), Plan/Organize (*t*=-3.048), Organization of Materials (*t*=-3.674), Monitor (*t*=-2.933), BRI (*t*=-3.382), MI (*t*=-3.421), and GEC (*t*= -2.93).

Chapter V

Discussion

Hypothesis 1

Many significant relationships were found between parent report measures of child executive functioning and parent report of parenting stress, indicating that CEFS and BRIEF ratings are related to parents' perceptions of child symptoms that may cause stress. Specifically, significant correlations were found between the PSI Distractibility/Hyperactivity subdomain and the CEFS subdomains of Inhibition and Problem Solving. These behaviors, as previously discussed, are strongly linked to executive dysfunction and symptoms of ADHD. The PSI Adaptability scale was significantly correlated with the CEFS subdomains of Inhibition, Problem, Solving, Initiative, Motor Planning, as well as the Total Score. The PSI Demandingness scale was significantly correlated with the CEFS subdomains of Problem Solving and Motor Planning, as well as the Total Score. The PSI Reinforces Parent scale was significantly correlated with the CEFS subdomains of Social Appropriateness and Problem Solving, as well as the Total Score. These findings suggest that parent perceptions of deficits in the child characteristics of adaptability, or being able to adapt to situations, as well as hyperactivity and demandingness may be strongly linked to parent experiences of child's symptoms of executive dysfunction, as measured on the CEFS. The CEFS Total Score was significantly correlated with PSI Total Stress, PSI Parent Domain, PSI Child Domain, PSI Distractibility/Hyperactivity, PSI Adaptability, PSI Reinforces Parent, PSI Demandingness, PSI Attachment, and PSI Role Restriction.

The results of correlations between the BRIEF and PSI are similar to those found between the CEFS and PSI, indicating several overlaps between the BRIEF and CEFS. PSI Total Stress was significantly correlated with the Inhibit, Shift, Initiate, Working Memory, Plan/Organize, Organization of Materials, Monitor, BRI, MI, and GEC from the BRIEF. Correlations using the PSI Child Domain were similar to those using the PSI Total Stress. For the PSI Child Domain, the BRIEF Inhibit, Emotional Control, Initiate, Working Memory, Plan/Organize, Organization of Materials, Monitor, BRI, MI, and GEC were significantly correlated. PSI Adaptability was found to significantly correlate with the BRIEF subdomains of Shift, Plan/Organize, Organization of Materials, Monitor, BRI, MI, and GEC. Several BRIEF subdomains significantly correlated with PSI Distractibility/Hyperactivity, including the BRIEF subdomains of Inhibit, Working Memory, Plan/Organize, Monitor, MI, and GEC. Few significant correlations were found between the BRIEF and the PSI subscales of Parent Domain, Life Stress, Mood, Acceptability, Isolation, Health, Role Restriction, Depression, and Spouse. The significant correlations that were found between the PSI and the BRIEF suggest the aspects of the child, like hyperactivity, influence parental stress more than parent factors, like depression.

These results suggest that there is a strong relationship between certain elements of parental stress and parent ratings of the child's executive functioning and may be interpreted to mean that higher stress can bias parent report. In particular, higher stress related to the parent-child relationship may lead to over-reporting of child problem behaviors. This finding makes sense in that the items on the BRIEF and CEFS are ratings of child problem behaviors, and problem behaviors have been found to influence parental stress (Ross & Blanc, 1998; Tomanik, Harris, & Hawkins, 2005). Tomanik Harris, and Hawkins (2005) compared parental stress with parent report of child behavior on the Aberrant Behavior Checklist (Aman & Singh, 1986) and the Adaptive Behavior Scale (Nihira, Leland, & Lambert, 1993) and found that hyperactivity caused higher levels of parental stress. The current study found several other aspects of child behavior that are associated with parental stress. Specifically, the child domains of the PSI, like Distractibility/Hyperactivity and Adaptability, were strongly related to several subscales of the CEFS and BRIEF. Not all subscales of the PSI were strongly related to the CEFS and BRIEF. The parent domains, such as Isolation and Health, had less influence. These relationships suggest that parent-child interaction has more of an impact on parenting report of problems with executive functioning than do parent characteristics. Ross and Blanc (1998) compared scores on the PSI with ratings of ADHD on the CBCL. This study is similar to the present one in that it compared the PSI with parent report of child behaviors, but this study was specific to behaviors associated with ADHD. By using the BRIEF and CEFS, this study looks at a broader range of behaviors and deficits associated with executive functioning.

This study adds to the body of literature on parent report of executive functioning by comparing parent report on the BRIEF and CEFS with the PSI, which was not found in the existing literature. As previously discussed, several studies have looked at parent report of child behavior and parental stress.

Several significant correlations were also found between the scores from the CEFS and BRIEF. This finding is not surprising as the two measures are both parent report designed to assess child behaviors associated with executive dysfunction.

Hypothesis 2

The statistical analysis for Hypothesis 2 did not reveal significant relationships between IQ scores and scores from the Color-Word Interference Test of the D-KEFS, nor between IQ scores and scores from a measure of parenting stress. Additionally, no significant relationships were found between scores from the Color-Word Interference Test and the BRIEF and CEFS when controlling for effects of child IQ. This finding suggests that when IQs for a group of children are not in the impaired range, then IQ may not exert a strong influence on the children's performance on tabletop tests of executive functioning, specifically the Color-Word Interference Test of the D-KEFS. The weak relationship between the scores from the Color-Word Interference Test and IQ scores is consistent with previous findings by Herba, Tranah, Rubia, and Yule (2006) and Brunnekreef, De Sonneville, Althaus, Minderaa, Oldehinkel, Verhulst, and Ormel, (2007), although these researchers used the Stroop rather than the Color-Word Interference Test from the D-KEFS as a measure of inhibition. This correlation may be low because IQ does not involve as much unstructured problem-solving, while executive functioning is an ability that is not as crystallized as IQ. However, inhibition and mental flexibility, as measured by the Color-Word Interference Test, are only two aspects of executive functioning, which, as previously mentioned, is a highly complex construct that encompasses several abilities.

Child IQ and parental stress also were not significantly correlated. This suggests that IQ of the child did not influence parenting stress in this sample, which is surprising because several studies have noted links between parental stress and IQ scores for their children. As previously discussed, Ong, Chandran, and Peng's (1999) study did find a relationship between child IQ and parental stress on the PSI, but these researchers used a sample of children with mental retardation whose mean FSIQ was 54.8. The mean estimated IQ of the sample used for this study was 109.53 with the lowest score being 81, which is much higher than those in Ong, Chandran, and Peng's study. These elevated IQs may not have shown the same effect as found in Ong, Chandran, and Peng's study because the IQs of this sample were not low enough to cause the problem behaviors associated with significantly low IQ scores.

When the effects of IQ were controlled for, only one significant relationship was found between scores from the Color-Word Interference Test and parents' ratings of child problem behaviors. The significant relationship was between the Inhibition subscale of the Color-Word Interference Test and the CEFS Initiative subscale (r=-.480). However, these findings were only slightly different from those found when conducting correlations between CEFS, BRIEF, and Color-Word Interference test scores without controlling for IQ (r=-.486). Since this relationship existed before and after IQ was partialled out, the findings suggest that the relationship remains the same, with or without the influence of IQ. The correlations for this hypothesis, before and after controlling for the effects of IQ, were not significant between the CEFS and BRIEF, and Color-Word Interference test scores, indicating that these measures do not have a very strong relationship and that IQ does not have much of an influence on the relationship between child performance on standardized test of executive functioning and parent report of child problem behaviors.

Hypothesis 3

There was little support for Hypothesis 3. For the entire sample, only one significant relationship was found between the CEFS, BRIEF, and Color-Word Interference Test, which was between the CEFS Initiative and Color-Word Inhibition (r=-.486). After dividing the sample into groups based on stress level, this relationship increased in strength (r=-.50) for the low stress group and an additional significant relationship was found in the low stress group, which was between CEFS Inhibition and Inhibition/Switching (r=.51). No significant correlations were found for the high stress group. The lack of significant correlation implies that high levels of parental stress lead to fewer significant correlations between parent report and child performance on the tabletop test.

After correlation coefficients were transformed and t-tests performed, only one group difference between groups was found, which was for the correlation between CEFS Social Appropriateness and child performance on the Inhibition/Switching scale of the Color-Word Interference Test. This finding suggests that parental stress may influence the relationship between parent reporting of child social skills and emotional control and actual child performance on a test of inhibition and mental flexibility. As the comparison of the correlation coefficients did not result in further significant relationships, parenting stress does not appear to account for problems with ecological validity. While parenting stress was found to significantly affect parent report of child executive functioning, the findings of Hypothesis 3 do not point towards parenting stress affecting the relationship between rating scales and performance on the Color-Word Interference Test. However, due to several limitations of this study, which will be addressed in the next section, parenting stress should not be quickly ruled out as a factor in ecological validity.

The findings from this part of Hypothesis 3 may also be attributed to low correlations between the BRIEF, CEFS, and Color-Word Interference Test. These results, found in Table 7, indicate that the BRIEF and CEFS do not significantly correlate with the Color-Word Interference Test. Other tabletop measures of executive functioning may have a stronger relationship to the BRIEF and CEFS, and parenting stress has not yet been examined for these variables.

Additional analyses were conducted to further explore the role of parenting stress on the BRIEF, CEFS, and Color-Word Interference Test. These analyses were surprising, given the lack of significance thus far for Hypothesis 3, but they match the findings of Hypothesis 1. When mean scores of the BRIEF, CEFS, and Color-Word Interference Test were compared, the high stress group had higher scores for all BRIEF and CEFS subdomains, and almost all of the BRIEF and CEFS subdomain scores were significantly higher for the high stress group. CEFS Initiative and BRIEF Initiate were the only subdomains to not show a significant difference between groups. This finding suggests that high stress leads to parents reporting more problem behaviors for their children, consistent with the results of Hypothesis 1. This finding is consistent the existing body of literature (Kolko & Kazdin, 1993), which states that higher parental stress leads to reporting more problem behaviors for their children.

This study adds to the existing body of literature in that no other study known to the author has addressed the influence of parenting stress on correlations between parent report of child executive functioning and child performance on a standardized measure of executive functioning. Other studies have looked at the influence of parental stress on agreement between parent reports and child self-reports of behavior (Phares, Compas, & Howell, 1989; Kolko & Kazdin, 1993) and the relationship between parental stress and over-endorsement of child problem behaviors (De Los Reyes & Kazdin, 2005; Rowers, Byars, Mitchell, Patton, Standiford, & Dolan, 2006). When addressing ecological validity specifically, other studies have compared parent report with children's scores on standardized tests (Dewey, Crawford, & Kaplan, 2003; Vriezen & Pigott, 2002; Molho, 1996), but none have looked at parenting stress when making these comparisons.

Overall, as Hypotheses 1 and the secondary analysis of Hypothesis 3 are both at least partially supported, future use of parent report scales of executive functioning may need to be combined with a measure of parenting stress. This would be relevant in both the clinical and research setting. Parenting stress was shown to influence parent report of child behaviors; however, parenting stress was not found to be a significant factor in the discrepancies between parent ratings and the tabletop test. So, while parenting stress affects ratings of the children's executive functioning, there are clearly other factors besides stress that affect the ecological validity of this tabletop test. The lack of significant relationships between the BRIEF, CEFS, and Color-Word Interference Test may explain why parenting stress did not impact these relationships. If the basic relationship is not significant, then it is seems that the parent ratings and tabletop test do not measure the same aspects of executive functioning. Thus, parenting stress may have little influence upon a relationship that is initially so low. Furthermore, while parenting stress affects ratings of their children's executive functioning, it does not appear to influence the fact that the ratings and tabletop test used in this study have a weak relationship. Other unidentified factors are creating the discrepancy between parent ratings of executive functioning and tabletop scores. Researchers still have several areas to explore to fully explain these relationships. The next step will be to look at other factors, such as sensitivity and specificity of tests of executive functioning for children. Replication of this study, using other measures of executive functioning, like the WCST, may be helpful to address other aspects of executive functioning. These other measures may show different relationships to the BRIEF and CEFS, and may find further effects of parenting stress on the relationships between these measures.

Limitations of the Current Study

This study has several limitations. The number of participants (32) for this study is lower than was desired. Having subjects and parents complete of all of the study measures was quite difficult. A significant number of the initial participants (16) did not complete the Parenting Stress Index; thus, they could not be included in the data analysis. Having a small sample size decreases the power of a statistical test. This decreases the likelihood of finding statistical significance.

The subjects for this study are from a very specific population. They all have a diagnosis of ADHD and were recruited from private schools for children who learn differently. While having a sample of children with ADHD provides some insight into executive functioning, parent report, and parenting stress for this population, the results of this study are not generalizeable to groups with other emotional/behavior disorders nor to the general population. Further research on other populations will be helpful in gaining more insight into the ecological validity of executive function testing and should be explored by researchers. Also, the environment most likely played a role in the results of this study. The schools from which the children were recruited specialize in teaching social skills and coping mechanisms that this population needs. This teaching is invaluable to the children, but may have altered responses on the BRIEF and CEFS, as well as performance on the D-KEFS Color-Word Interference Test. Thus the ratings on the parent report measures may have been suppressed as the children may exhibit fewer problem behaviors and the tabletop test results may have been better than expected for this population. Children may have performed better on the Color-Word Interference Test due to strategies they learn to aid them in attention and concentration. For example, some children used their fingers to keep their place on the pages. This strategy seemed to aid their performance. Without tools like this, the children may not have performed as well. Replication of this study in public schools may yield a broader range of diagnoses, socio-economic status, and functioning levels. Having a more diverse sample may lead to further significant findings and would allow the results to more likely be generalizeable to the general population.

Another factor may have influenced parent report. Most participants in this study were using prescription ADHD medication (66%). The use of this type of medication may have influenced parent ratings of executive functioning, as well as child performance on the Color-Word Interference Test. It is hypothesized that these medications may have suppressed ratings, as these medications may be alleviating the symptoms associated with ADHD, which are very similar to the behaviors listed on the BRIEF and CEFS. Fewer symptoms associated with ADHD may also have lowered parenting stress levels. Child performance may have also improved due to the effects of ADHD medication as it aids attention and concentration.

The version of the IQ test used in this study may influence findings. The data for this study were collected at two separate intervals, as the data are part of an ongoing study of executive functioning. The subjects in the first phase were tested using the WISC-III as a measure of intellectual functioning, whereas the subjects in the second phase were testing using the WISC-IV as a measure of intellectual functioning. The difference in tests is significant, as the WISC-IV Technical and Interpretive Manual (Wechsler, 2003) states that when children were administered both versions of the IQ test, WISC-III scores were significantly higher than WISC-IV scores. The mean WISC-III FSIQ was reported as 107.0 while the mean WISC-IV FSIQ was 104.5. For our study, this means that the IQ scores for the children who were administered the WISC-III may have been slightly inflated and may have negatively influenced correlations between IQ and the Color-Word Interference Test, as well as the correlation between the Color-Word Interference Test and parent report measures when IQ was held constant.

When IQ scores were examined for influence upon tabletop test performance and parenting stress, this sample was again skewed in that the lowest IQ score reported for the sample was 81, which falls into the Low Average range of IQ. This may have limited the findings for Hypothesis 2, as the sample did not have significantly low IQ scores. A sample with a full range of IQ scores may have shown a greater impact on test performance, as well as shown significant elevations in parenting stress.

Additionally, only one tabletop measure of executive functioning was used in the data analysis for this project, the Color-Word Interference Test from the D-KEFS. While this test provides scores for two separate aspects of executive functioning (inhibition and mental flexibility), the use of only one test is not ideal when trying to assess executive functioning. Future studies should examine scores from additional tests, such as the Tower of London or the Wisconsin Card Sorting test, and additional information may be gleaned. It is important to continue to explore these relationships and for future researchers to do this type of statistical analysis with other measures of executive functioning.

While parent factors were explored by using a measure of parenting stress, several other parent factors were not explored. Specifically, parent psychiatric symptoms were not explored. This data was not available, but could be useful if explored. Specifically, parental depression has been explored in the literature for effects on parent reporting, but not in the context of how it affects measurement of executive functioning. SES may also be a factor to be explored. Due to the skewed nature of this sample, with nearly all of the subjects coming from above average SES groups, SES was not explored. Future research, with a more diverse SES base, could reveal the impact of SES on ecological validity of executive function testing.

Finally, due to the exploratory nature of this study, correlations were completed for all subscales of the BRIEF and CEFS. Conducting many correlations increases the likelihood for statistical error, as it is more likely to find significance by chance. Also, correlations only indicate a relationship, not causation. For example, correlations between parenting stress and parent report were found. The reason for this relationship may be that higher stress leads to parents over-reporting problem behaviors, or possibly children with ADHD display so many problem behaviors that they cause their parents higher stress. The direction of this relationship is unknown based on the results of this study, although the differential sensitivity of the PSI subscales lends evidence to child factors influencing parenting stress more than parent factors. For example, the PSI Distractibility/Hyperactivity subscale was highly related to several subscales of the BRIEF and CEFS, while the PSI Health subscale had far less influence. This finding indicates that stress created by the child's behaviors and parent-child interactions have more influence on parent ratings of executive functioning than parent factors or characteristics. Replication of the study will allow for further exploration into the causes of these relationships and help future researchers and clinicians understand how to factor in the influence of parental stress when looking at the ecological validity of executive function testing.

Appendix A

Executive Functioning Study Information Sheet

EXECUTIVE FUNCTIONING STUDY
Information Sheet

The following information will be utilized as part of your child participating in this study of children's problem solving skills through The University of Southwestern Medical Center and The Shelton School. This information will remain strictly confidential, and will be coded and entered into a database with all identifying information removed.

Name of Child: ___________________________________

Date of Birth: ______________ Age: _______ Last Grade completed: ________

Name of parent/guardian completing this form: _________________________________

Parent(s) mailing address: ____

Parent(s) Home number: ______________Cell: ______________Work:______________

The following questions are necessary in order to verify your child's diagnoses:

Has you child been diagnosed with a Learning Disability? Y N

If so, what kind (e.g., nonverbal, mathematics, reading, etc.________________________

Has you child been diagnosed with Attention Deficit/Hyperactivity Disorder (ADHD/ADD)? Y N

If so, what kind (e.g., Inattentive, Hyperactive/Impulsive, or Combined subtype)?_________

Has your child been diagnosed with developmental or neurological condition? (for example, Tourette's, autism, seizure disorder) Y N

Has your child ever suffered a hit to the head (from a car accident, fall, or fight) that resulted in a loss of consciousness or blacking out? Y N

If you answered "yes" to the previous question, how long was your child unconscious, and what was the nature of their injury?

____

Is your child being treated for any medical disorder? Y N

If "yes" what is the nature of their illness?____

Has you child been diagnosed/treated for a mental disorder(s)?
(for example, depression, anxiety, etc.) Y N

If "yes: what is the nature of their illness?____

Is your child taking any prescription medications? Y N

If so, please list:

____

Is your child taking any over-the-counter (non-prescription) medications? Y N

If so, please list:

____

The following questions are necessary in order to determine demographic information:

Who is currently living in the home:

____

Years of schooling/degree mother has completed:

____

Mother's occupation:

____

Years of schooling/degree father has completed:

____

Father's occupation:

____

Thank you for your time and cooperation in completing this form!

CHILDREN'S EXECUTIVE FUNCTIONS SCALE

PILOT VERSION 1.1

****

The following items describe children's behaviors. Please rate how well each item describes your child, compared to other children of the same age. Some of the items refer to behaviors that might be expected in a younger child but would not be seen in an older child, so be sure to make your rating based on your child's age. Think about how your child has behaved in the past four weeks. For each item, circle 2 if the description VERY MUCH matches your child's behaviors, circle 1 if the description SOMETIMES matches your child's behaviors, and circle 0 if the description NEVER or ALMOST NEVER matches your child's behaviors.

****

0= *Never or Almost Never* 1= *Sometimes* 2= *Very Much*

Compared to other children of the same age, my child:

0	1	2	1.	Gets into fights with other children
0	1	2	2.	Does not understand jokes
0	1	2	3.	Laughs at the wrong time
0	1	2	4.	Makes fun of others
0	1	2	5.	Hurts others' feelings without meaning to
0	1	2	6.	Shows little emotion
0	1	2	7.	Over-reacts emotionally
0	1	2	8.	Has mood swings
0	1	2	9.	Is a show-off
0	1	2	10.	Is giggly or silly
0	1	2	11.	Displays inappropriate sexual behaviors
0	1	2	12.	Acts like a younger child or acts babyish
0	1	2	13.	Makes inappropriate joking remarks
0	1	2	14.	Is not able to adapt play to older or younger children
0	1	2	15.	Cannot seem to compromise with others
0	1	2	16.	Is easily distracted
0	1	2	17.	Is fidgety
0	1	2	18.	Cannot sit still

0	1	2	19.	Is excitable
0	1	2	20.	Is irritable or fussy
0	1	2	21.	Has a quick temper
0	1	2	22.	Is impulsive
0	1	2	23.	Is overactive
0	1	2	24.	Shifts from activity to activity
0	1	2	25.	Touches everything
0	1	2	26.	Talks out of turn
0	1	2	27.	Interrupts others
0	1	2	28.	Is difficult to interpret
0	1	2	29.	Has a short attention span
0	1	2	30.	Is easily frustrated
0	1	2	31.	Does not respond to discipline
0	1	2	32.	Does not wait for her/his turn in activities
0	1	2	33.	Does not follow directions
0	1	2	34.	Does not complete assigned chores
0	1	2	35.	Does not complete school assignments
0	1	2	36.	Cannot pay attention for long periods during routine work
0	1	2	37.	Cannot concentrate even when necessary
0	1	2	38.	Does not think before acting
0	1	2	39.	Does not apologize for misbehavior
0	1	2	40.	Is not alert to surroundings
0	1	2	41.	Does not recognize categories of objects or ideas (for example: Dogs and bears are animals. Sad and happy are feelings.)
0	1	2	42.	Cannot follow logical reasoning
0	1	2	43.	Cannot use step-by-step reasoning

0	1	2	44.	Does not understand unspoken rules
0	1	2	45.	Does not use what she/he has learned in the past in new situations
0	1	2	46.	Cannot see more than one way to solve a problem
0	1	2	47.	Does not change behaviors in response to feedback from other children
0	1	2	48.	Does not change behaviors when it seems necessary to get what she/he wants
0	1	2	49.	Does not use reasoning instead of arguing or fighting with other children
0	1	2	50.	Does not use reasoning instead of arguing or fighting with adults
0	1	2	51.	Cannot follow rules in games
0	1	2	52.	Cannot switch activities without getting confused
0	1	2	53.	Does not anticipate consequences of her/his actions
0	1	2	54.	Behaves in ways that do not seem to be guided by plans or goals
0	1	2	55.	Cannot use a good sequence of actions to reach a goal
0	1	2	56.	Does not know whether her/his own behaviors are successful or not
0	1	2	57.	Does not know when she/he doesn't know something
0	1	2	58.	Is not aware of social mistakes
0	1	2	59.	Gets caught up in the details and misses the big picture
0	1	2	60.	Doesn't seem to learn from mistakes
0	1	2	61.	Gets stuck on an idea or in a certain behavior
0	1	2	62.	Acts confused
0	1	2	63.	Uses poor judgment
0	1	2	64.	Thinks slowly
0	1	2	65.	Is disorganized
0	1	2	66.	Does not organize materials before starting something

0	1	2	67.	Gets confused in a sequence of steps
0	1	2	68.	Gets distracted by irrelevant ideas
0	1	2	69.	Acts disoriented
0	1	2	70.	Forgets things
0	1	2	71.	Loses things
0	1	2	72.	Gets lost easily
0	1	2	73.	Fails to ask necessary questions in order to solve a problem
0	1	2	74.	Does not know his/her own abilities and limits
0	1	2	75.	Does not start conversations
0	1	2	76.	Is not a good leader
0	1	2	77.	Does not get others motivated
0	1	2	78.	Cannot think up new activities or games
0	1	2	79.	Does not introduce himself/herself to a new group of children
0	1	2	80.	Does not seem to have much to say
0	1	2	81.	Hangs back in activities
0	1	2	82.	Waits for others to direct him/her
0	1	2	83.	Hesitates to attempt something new
0	1	2	84.	Takes a long time to respond
0	1	2	85.	Needs prompts to change activities
0	1	2	86.	Speaks only when spoken to
0	1	2	87.	Shows little interest in most things
0	1	2	88.	Becomes focused on things and cannot refocus
0	1	2	89.	Has trouble resuming work once interrupted
0	1	2	90.	Has handwriting that is messy, poorly spaced or has odd slant
0	1	2	91.	Runs off the page when he/she draws or writes
0	1	2	92.	Has awkward or immature arm or hand gestures

0	1	2	93.	Has trouble writing quickly enough when taking notes
0	1	2	94.	Does not use eating utensils well
0	1	2	95.	Dos not construct puzzles or models well
0	1	2	96.	Had trouble learning games involving hand sequences (patty-cake)
0	1	2	97.	Cannot draw well
0	1	2	98.	Has trouble typing or is slow on the keyboard of a computer
0	1	2	99.	Has an unusual pencil grip

Additional Questions:

Is your child right-handed left-handed ambidextrous ?

Does your child have a movement disorder such as cerebral palsy?

yes no If yes, what kind? ____

Does your child have paralysis or motor weakness from an injury?

yes no If yes, describe the kind of injury, the date of injury, and the type of motor problem resulting from it. __________________________________

____

Table 1

Demographic Variables

N= 32

Age at testing	*M*= 10.41 years Range= 8-12 years	*SD*= 1.266 years
Gender	Males=20 (62.5%)	Females= 12 (37.5)
Ethnicity	Caucasian = 28 (87.5%) No Response = 1 (3.1%)	African American = 3 (9.4%)

Number of Children per Diagnosis	Number of Diagnoses per Child
ADHD = 32	1 Diagnosis = 6
Anxiety = 11	2 Diagnoses = 5
Aspergers Disorder = 2	3 Diagnoses = 7
Auditory Disorder = 5	4 Diagnoses = 4
Depression = 10	5 Diagnoses = 8
Dysgraphia = 6	6 Diagnoses = 2
Dyslexia = 12	
Expressive Language Disorder = 1	
Mathematic Disorder = 4	
Memory Processing Disorder = 1	
Motor Disorder = 2	
Nonverbal Learning Disorder = 2	
Oral Language/Processing Disorder = 3	
Reading Disorder = 3	
Sensory Integration Disorder = 2	
Visual Perception Disorder = 1	
Writing Disorder = 4	

Informant for Parent Report Measures

Mother = 30 (94%)	Father = 2 (6%)

Table 2

Descriptive Statistics for Medications Reported

Number of Children per Medication Type

Allergy Medication = 8
Anticonvulsant Medication = 4
Antidepressant Medication = 11
Antipsychotic Medication = 1
Asthma Medication = 3
Atypical Antipsychotic Medication = 3
Bladder Medication = 1
Non-Stimulant ADHD Medication = 2
Stimulant ADHD Medication = 20
Vitamins = 3

Number of Children Reporting no Medications = 4

Number of Children per Specific Medication

Abilify = 1	Nasonex = 1
Adderall = 4	Oxybutynin = 1
Advair = 1	Prozac = 2
Albuterol = 1	Remeron = 1
Celexa = 1	Risperdal = 1
Concerta = 12	Seroquel = 1
Depakote = 1	Singular = 1
Flonase = 1	Strattera = 2
Fluoxetine = 1	Trileptal = 1
Focalin = 1	Vitamins = 3
Geodon = 1	Wellbutrin = 1
Klonipin = 1	Xopenex = 1
Lamictal = 1	Zoloft = 4
Lexapro = 1	Zyrtec = 4
Metadate = 3	

Number of Medications per Child

0 Medications = 4 (12.5 %)
1 Medication = 14 (43.6 %)
2 Medications = 8 (25 %)
3 Medications = 4 (12.5 %)
4 Medications = 0 (0 %)
5 Medications = 2 (6.3 %)

ADHD Medication Use

No ADHD Medication = 11 (34 %)
ADHD Medication = 21 (66 %)

N= 32

Table 3

Descriptive Statistics for the Executive Function (EF) Measures

	Mean	Standard Deviation	Range
N= 32			
Estimated IQ Measure			
Estimated IQ standard score	109.53	16.69	81-152
EF Performance Measures (scaled scores)			
D-KEFS Inhibition	9.63	3.13	2-14
D-KEFS Inhibition/Switching	10.13	2.55	4-14
EF Informant Measures			
CEFS Scores (raw scores)			
Social Appropriateness	8.75	3.77	2-18
Inhibition	25.97	10.72	3-41
Problem Solving	26.56	12.00	1-51
Initiative	9.38	5.74	0-22
Motor Planning	7.00	3.72	1-15
Total CEFS	77.66	28.48	9-126
BRIEF Scores (T scores)			
Inhibit	62.55	13.65	40-91
Shift	59.39	11.35	36-77
Emotional Control	60.48	12.43	40-85
Initiate	60.77	12.12	38-86
Working Memory	67.61	10.95	47-84
Plan/Organize	61.32	11.24	37-78

Organization of Materials	61.39	9.37	39-71
Monitor	60.77	10.97	31-81
Behavioral Regulation Index	62.52	12.41	39-88
Metacognition Index	64.58	10.51	41-78
Global Executive Composite	64.16	11.25	40-83

Table 4

Descriptive Statistics for the Parenting Stress Index

	Mean	Standard Deviation	Range
N= 32			
Parenting Stress Index (percentiles)			
Distractibility/Hyperactivity	72.28	29.54	3-99
Adaptability	73.00	28.09	3-99
Reinforces Parent	68.41	28.64	3-99
Demandingness	69.34	33.69	1-99
Mood	75.66	28.57	1-99
Acceptability	81.63	24.33	15-99
Competence	36.66	26.93	1-95
Isolation	36.22	31.45	1-99
Attachment	43.28	32.40	1-96
Health	37.44	25.42	1-97
Role Restriction	38.31	26.18	3-95
Depression	33.37	27.55	1-90
Spouse	51.16	28.89	1-99
Child Domain	78.06	30.08	3-99
Parent Domain	33.28	28.75	1-93
Life Stress	48.03	31.16	0-95
Total Stress	57.81	31.84	1-99

Table 5

CEFS scores compared with BRIEF and PSI scores

	Social Appropriateness	Inhibition	Problem Solving	Initiative	Motor Planning	Total Score
BRIEF						
Inhibit	.724 **	.714 **	.720 **	.300	.237	.749 **
Shift	.288	.322	.434 *	.365 *	.562 **	.482 **
Emotional Control	.341	.320	.397 *	.161	.305	.400 *
Initiate	.500 **	.394 *	.520 **	.389 *	.201	.530 **
Working Memory	.523 **	.582 **	.643 **	.451 *	.255	.674 **
Plan/Organize	.511 **	.601 **	.629 **	.391 *	.223	.657 **
Org. of Materials	.469 **	.594 **	.636 **	.448 *	.276	.670 **
Monitor	.395 *	.492 **	.656 **	.168	.445 *	.598 **
BRI	.555 **	.552 **	.630 **	.307	.413 *	.654 **
MI	.572 **	.652 **	.744 **	.460 **	.357 *	.763 **
GEC	.645 **	.705 **	.708 **	.480 **	.432 *	.791 **
PSI						
Total Stress	.445 *	.511 **	.771 **	.436 *	.437 *	.721 **
Child Domain	.448 *	.512 **	.715 **	.421 *	.435 *	.695 **
Parent Domain	.274	.345	.581 **	.337	.264	.513 **
Life Stress	-.011	-.010	-.014	.040	-.238	-.034
Distractibility/ Hyperactivity	.437 *	.724 **	.701 **	.239	.352 *	.720 **
Adaptability	.390 *	.451 **	.681 **	.534 **	.528 **	.685 **
Reinforces Parent	.472 **	.414 *	.622 **	.278	.215	.564 **
Demandingness	.307	.361 *	.485 **	.238	.374 *	.478 **
Mood	.156	.104	.418 *	.337	.284	.341
Acceptability	.069	.208	.346	.060	.336	.289
Competence	.202	.288	.573 **	.231	.185	.447*
Isolation	.177	.239	.253	.272	.183	.299
Attachment	.462 **	.349	.510 **	.320	.269	.507 **
Health	.262	.126	.161	.211	-.011	.191
Role Restriction	.162	.447 *	.422 *	.094	.491 **	.451 **
Depression	.098	.211	.462 **	.385 *	.245	.396 *
Spouse	.224	.331	.484 **	.265	.275	.447*

N= 32

Table 6

BRIEF Scores Compared with CEFS and PSI

	Inhibit	Shift	Emot. Control	Initiate	Working Memory	Plan/ Org.	Org. of Materials
CEFS							
Social Appropriateness	.724 **	.288	.341	.500 **	.523 **	.511 **	.469 **
Inhibition	.714 **	.322	.320	.394 *	.582 **	.601 **	.594 **
Problem Solving	.720 **	.434 *	.397 *	.520 **	.643 **	.629 **	.636 **
Initiative	.300	.365 *	.161	.389 *	.451 *	.391 *	.448 *
Motor Planning	.237	.562 **	.305	.201	.255	.223	.276
Total Score	.749 **	.482 **	.400 *	.530 **	.674 **	.657 **	.670 **
PSI							
Total Stress	.547 **	.497 **	.360 *	.532 **	.472 **	.555 **	.518 **
Child Domain	.573 **	.536 **	.494 **	.619 **	.543 **	.697 **	.488 **
Parent Domain	.347	.304	.257	.329	.257	.340	.403 *
Life Stress	-.135	-.260	-.252	-.067	-.155	.023	.000
Distractibility/ Hyperactivity	.609 **	.265	.238	.351	.553 **	.556 **	.450 *
Adaptability	.402 *	.594 **	.400 *	.395 *	.508 **	.591 **	.486 **
Reinforces Parent	.475 **	.273	.310	.614 **	.403 *	.603 **	.580 **
Demandingness	.368 *	.334	.302	.397 *	.383 *	.520 **	.339
Mood	.123	.247	.254	.197	.214	.436 *	.199
Acceptability	.175	.232	.275	.053	-.021	.225	.122
Competence	.476 **	.298	.349	.394 *	.311	.419 *	.441 *
Isolation	.012	.105	.106	.157	-.023	.247	.241
Attachment	.490 **	.324	.491 **	.392 *	.249	.487 **	.432 *
Health	.013	.053	.084	.040	-.165	.115	.063
Role Restriction	.408 *	.527 **	.320	.300	.191	.168	.317
Depression	.235	.371 *	.281	.265	.213	.203	.234
Spouse	.141	.145	-.041	.401 *	.316	.291	.276

	Monitor	BRI	MI	GEC
CEFS				
Social Appropriateness	.395 *	.555 **	.572 **	.645 **
Inhibition	.492 **	.552 **	.652 **	.705 **
Problem Solving	.656 **	.630 **	.744 **	.708 **
Initiative	.168	.307	.460 **	.480 **
Motor Planning	.445 *	.413 *	.357 *	.432 *
Total Score	.598 **	.654 **	.763 **	.791 **
PSI				
Total Stress	.589 **	.556 **	.655 **	.579 **
Child Domain	.718 **	.628 **	.757 **	.709 **
Parent Domain	.407 *	.363 *	.420 *	.306
Life Stress	-.031	-.257	-.051	-.169
Distractibility/ Hyperactivity	.632 **	.455 *	.624 **	.547 **
Adaptability	.681 **	.536 **	.662 **	.599 **
Reinforces Parent	.445 *	.434 *	.639 **	.561 **
Demandingness	.599 **	.390 *	.558 **	.460 **
Mood	.476 **	.243	.386 *	.309
Acceptability	.445 *	.266	.207	.217
Competence	.450 *	.463 **	.488 **	.387 *
Isolation	.221	.090	.204	.065
Attachment	.362 *	.535 **	.471 **	.553 **
Health	.233	.069	.044	-.052
Role Restriction	.364 *	.483 **	.327	.389 *
Depression	.363 *	.342	.317	.233
Spouse	.308	.098	.388 *	.209

* Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level
N= 32

Table 7

Correlations Between IQ Scores, PSI, and Color-Word Interference Test

	Inhibition	Inhibition/Switching
Estimated IQ	.110	.064

N= 32

	PSI Total Stress	PSI Child Domain	PSI Parent Domain
Estimated IQ	-.124	-.141	-.120

N= 32

Correlations Between BRIEF, CEFS, and Color-Word Interference Test

	Inhibition	Inhibition/Switching
BRIEF		
Inhibit	.039	-.007
Shift	-.330	-.146
Emotional Control	-.037	.012
Initiate	-.115	.160
Working Memory	-.179	-.017
Plan/Organize	.007	.079
Organization of Materials	-.040	-.065
Monitor	.104	.073
BRI	-.095	-.049
MI	-.080	.059
GEC	-.092	.035
CEFS		
Social Appropriateness	-.044	-.024

Inhibition	.102	.279
Problem Solving	-.079	-.031
Initiative	-.486**	-.297
Motor Planning	-.183	.116
Total Score	-.123	.044

** Correlation is significant at the 0.01 level (2-tailed)
N= 32

Partial Correlation between BRIEF, CEFS, and Color-Word Interference Test, controlling for Estimated IQ

Control Variables			Inhibition	Inhibition/Switching
Estimated IQ	*CEFS Scores (raw scores)*			
	Social Appropriateness	*r* p	-.053 .782	-.044 .819
	Inhibition	*r* p	.119 .531	.284 .129
	Problem Solving	*r* p	-.044 .818	.006 .974
	Initiative	*r* p	-.480** .007	-.274 .143
	Motor Planning	*r* p	-.172 .364	.139 .463
	Total Score	*r* p	-.100 .600	.066 .731
	BRIEF Scores (T-scores)			
	Inhibit	*r* p	.045 .813	-.004 .981
	Shift	*r* p	-.318 .086	-.141 .458
	Emotional Control	*r* p	-.030 .873	.014 .940
	Initiate	*r* p	-.101 .594	.169 .372

	Working Memory	*r* p	-.169 .371	-.012 .949
	Plan/Organize	*r* p	.027 .889	.089 .640
	Organization of Materials	*r* p	-.022 .910	-.058 .762
	Monitor	*r* p	.115 .545	.078 .683
	BRI	*r* p	-.086 .651	-.045 .812
	MI	*r* p	-.063 .740	.068 .720
	GEC	*r* p	-.074 .699	.045 .814

** Correlation is significant at the 0.01 level
N= 32

Table 8

Correlations Between Color-Word Interference Test, CEFS, and BRIEF for Low and High Stress Groups

CEFS AND BRIEF Scales	Inhibition		Inhibition/Switching	
	PSI Total Stress < 70 N= 19	PSI Total Stress >= 70 N=13	PSI Total Stress < 70 N= 19	PSI Total Stress >= 70 N= 13
CEFS				
Social Appropriateness	.04	-.17	.36	-.45
Inhibition	.05	.18	.51 *	.03
Problem Solving	-.13	-.19	.21	-.37
Initiative	-.50 *	-.53	-.17	-.47
Motor Planning	-.31	-.10	-.05	.22
Total Score	-.18	-.24	.31	-.35
BRIEF				
Inhibit	.13	-.12	.15	-.19
Shift	-.35	-.45	-.10	-.28
Emotional Control	-.09	-.02	.03	-.03
Initiate	-.25	.07	.16	.19
Working Memory	-.43	.11	.02	-.08
Plan/Organize	-.15	.30	.07	.16
Organization of Materials	-.20	.25	-.14	.09
Monitor	.09	.10	.21	-.15
BRI	-.12	-.19	.01	-.18
MI	-.27	.21	.08	.05
GEC	-.22	-.01	.06	.00

* Correlation is significant at the 0.05 level

Table 9

Significance of Differences Between Correlations in High and Low Stress Groups

	Difference in High vs. Low Stress Group Correlations			
	Inhibition		Inhibition/Switching	
	t^A	*p*	t^A	*p*
CEFS				
Social Appropriateness	.053	.3025	2.14	.0259 *
Inhibition	-.33	.3733	1.32	.1048
Problem Solving	.16	.4377	1.49	.08
Initiative	.11	.4570	.85	.2054
Motor Planning	-.54	.2992	-.43	.3371
Total Score	.16	.4377	1.69	.0574
BRIEF				
Inhibit	.61	.2764	.84	.2083
Shift	.31	.3808	.47	.3232
Emotional Control	-.17	.4339	.16	.4377
Initiate	-.80	.2193	-.07	.4727
Working Memory	-.140	.0929	.24	.4071
Plan/Organize	-1.11	.1439	-.23	.4109
Organization of Materials	-1.15	.1358	-.57	.2894
Monitor	-.02	.4922	.89	.1951
BRI	.20	.4223	.47	.3232
MI	-1.19	.1281	.08	.4688
GEC	-.52	.3061	.15	.4416

* Correlation is significant at the .05 level

N= 32

Table 10

Differences Between Low and High Stress Groups on the CEFS, BRIEF, and Color-Word Interference Test

	Stress Group	Means	Std. Deviation	t	df	*p* (1-tailed)
CEFS						
Social Appropriateness	Low	7.53	3.255	-2.383[A]	30	.012
	High	10.54	3.865			
Inhibition	Low	21.58	10.378	-3.190[A]	30	.0015
	High	32.38	7.741			
Problem Solving	Low	19.42	8.566	-5.870[A]	30	<.001
	High	37.00	7.937			
Initiative	Low	8.16	5.530	-1.479[A]	30	.075
	High	11.15	5.771			
Motor Planning	Low	5.95	3.291	-2.028[A]	30	.026
	High	8.54	3.908			
Total Score	Low	62.63	24.302	-4.659[A]	30	<.001
	High	99.62	18.164			

	Stress Group	Means	Std. Deviation	t	df	*p* (1-tailed)
BRIEF						
Inhibit	Low	55.89	10.889	-3.869[A]	29	<.001
	High	71.77	11.805			
Shift	Low	56.17	12.411	-1.944[A]	29	.031
	High	63.85	8.153			
Emotional Control	Low	56.89	13.297	-1.986[A]	29	.028
	High	65.46	9.448			
Initiate	Low	58.33	13.698	-1.336[A]	29	.096
	High	64.15	8.961			
Working Memory	Low	64.22	11.487	-2.147[A]	29	.020
	High	72.31	8.469			
Plan/Organize	Low	57.06	12.331	-3.048[B]	25.848	.0025

	High	67.23	5.918			
Org. of Materials	Low	57.33	10.100	-3.674 [B]	23.722	<.001
	High	67.00	4.041			
Monitor	Low	56.39	10.874	-2.933 [A]	29	.003
	High	66.85	8.019			
BRI	Low	57.00	11.540	-3.382 [A]	29	.001
	High	70.15	9.344			
MI	Low	60.22	11.280	-3.421 [B]	25.593	.001
	High	70.62	5.300			
GEC	Low	59.67	10.677	-2.930 [A]	29	.0035
	High	70.38	9.088			

[A] = Equal variances assumed; no df correction applied
[B] = Equal variances not assumed; df correction applied
Low Stress Group N= 19
High Stress Group N= 13

Table 11

Descriptive Statistics Broken Down By Stress Groups

	Stress Group	N	Mean	Std. Deviation	Std. Error Mean
Inhibition	Low Stress	19	9.53	2.894	.664
	High Stress	13	9.77	3.563	.988
Inhibition/Switching	Low Stress	19	10.16	2.455	.563
	High Stress	13	10.08	2.783	.772
BRIEF Inhibition	Low Stress	18	55.89	10.889	2.567
	High Stress	13	71.77	11.805	3.274
BRIEF Shift	Low Stress	18	56.17	12.411	2.925
	High Stress	13	63.85	8.153	2.261
BRIEF Emotional Control	Low Stress	18	56.89	13.297	3.134
	High Stress	13	65.46	9.448	2.620
BRIEF Initiate	Low Stress	18	58.33	13.698	3.229
	High Stress	13	64.15	8.961	2.485
BRIEF Working Memory	Low Stress	18	64.22	11.487	2.707
	High Stress	13	72.31	8.469	2.349
BRIEF Plan/Organize	Low Stress	18	57.06	12.331	2.906
	High Stress	13	67.23	5.918	1.641
BRIEF Org. of Materials	Low Stress	18	57.33	10.100	2.380
	High Stress	13	67.00	4.041	1.121
BRIEF Monitor	Low Stress	18	56.39	10.874	2.563
	High Stress	13	66.85	8.019	2.224
BRIEF BRI	Low Stress	18	57.00	11.540	2.720
	High Stress	13	70.15	9.344	2.592
BRIEF MI	Low Stress	18	60.22	11.280	2.659
	High Stress	13	70.62	5.300	1.470
BRIEF GEC	Low Stress	18	59.67	10.677	2.517
	High Stress	13	70.38	9.088	2.521
CEF-Social Appropriateness	Low Stress	19	7.53	3.255	.747
	High Stress	13	10.54	3.865	1.072
CEF-Inhibition	Low Stress	19	21.58	10.378	2.381
	High Stress	13	32.38	7.741	2.147
CEF-Problem Solving	Low Stress	19	19.42	8.566	1.965
	High Stress	13	37.00	7.937	2.201
CEF-Initiative	Low Stress	19	8.16	5.530	1.269
	High Stress	13	11.15	5.771	1.601
CEF-Motor Planning	Low Stress	19	5.95	3.291	.755
	High Stress	13	8.54	3.908	1.084
CEF-Total Score	Low Stress	19	62.63	24.302	5.575
	High Stress	13	99.62	18.164	5.038

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VITAE

Krystle Paige Ball was born in Fort Worth, Texas, on September 8, 1983, the daughter of Chris Allan Ball and Cathi Rogers Ball. After completing her work at Eastland High School, Eastland, Texas, in 2002, she entered Texas Christian University in Fort Worth, Texas. During her final year at TCU, she held a research position in the Developmental Research Laboratory under Dr. David Cross and Dr. Karyn Purvis. She received the degree of Bachelor of Science from TCU in May 2005, with a major in Psychology and a minor in Social Work. In August of 2005, she entered The Graduate School of Biomedical Sciences at The University of Texas Southwestern Medical Center at Dallas. She was awarded the degree of Master of Science in May 2008. In 2007, she married Justin Steven Joyner of Perryton, Texas.

Permanent Address: P.O. Box 818

Eastland, Texas 76448