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Abstract

Background and purpose. Executive function (EF) deficits is a growing area of focus in pediatric occupational therapy practice. However, there is a lack of performance-based assessments of EF in preschool-aged children. This study sought to establish preliminary criterion-related validity of the Preschool Kitchen Task Assessment (PKTA), a test of EF in preschoolers developed by Christine Berg, Ph.D., OTR/L, in which children complete a multi-step craft project.

Subjects. Fifteen typically developing preschool-aged children participated in this study.

Methods. An exploratory design was used to assess criterion-related validity of the PKTA. Participants completed the PKTA along with several established neuropsychological assessments of EF: the Behavior Rating Inventory of Executive Function - Preschool Version (BRIEF-P), the Dimensional Change Card Sort, and the Forward and Backward Digit Span Tasks. Relationships between scores were examined by calculating a Pearson *r* correlation.

Results. A good significant correlation was found between the PKTA total score and the BRIEF-P Inhibitory Control (r=.52), as well as the Inhibitory Self-Control Index (r=.53). A fair non-significant correlation was found between the PKTA total score and BRIEF-P Global Executive Composite (r=.34), Emotional Control (r=.39) and Working Memory (r=.29) scores. Results showed a moderate non-significant relationship between the PKTA and the Backward Digit Span (r=-.48).

Discussion and conclusion. Results support the preliminary validity of the PKTA, particularly the strong relationships found with the BRIEF-P scores. The PKTA was sensitive to age-related cognitive development and demonstrated ecological validity. The PKTA is a promising tool to enable occupational therapists to assess for EF in this age group.

TABLE OF CONTENTS

LIST OF TABLES & FIGURES

Introduction

Over the past 16 years, the Centers for Disease Control and Prevention has reported a rise in the number of children diagnosed with developmental disabilities, such as autism spectrum disorder (ASD) and attention deficit hyperactive disorder (ADHD). Between 1997 and 2008, there was an increase in the prevalence of these developmental disabilities from 12.86% to 15.04%, or 1 in every 6 children (Boyle, et al., 2011). Conditions such as ASD, ADHD, traumatic brain injuries (TBI), intellectual disability (ID), and fetal alcohol spectrum disorder (FASD) are posited to affect a child's executive function capabilities. Executive function (EF) refers to a collection of distinct, yet interrelated skills, involving higher cognitive processes that allow people to participate in goal-directed behaviors and problem solving, especially during novel activities (Berg, Edwards & King, 2012; Chevignard et al., 2009; Weiner, Toglia, & Berg, 2012). Preschool years present a critical time period for the emergence of EF wherein children between the ages of three and five are developing skills required for participation in meaningful occupations. Executive function skill development directly relates to occupational therapy (OT) practice in that it is essential for OTs to assess a child's development of EF skills and provide early intervention in this skill development so the child may fully participate in their daily activities.

Executive functioning assessments present various implications for OT practice; the need for EF assessments translates to the development of ecologically valid assessments to be used by OTs in various settings. In the past several years, several ecologically valid assessments have been developed in order to gauge EF skills in children so as to augment or replace the traditional paper and pencil format of established neuropsychological assessments (Chevignard et al., 2009; Chevignard, Catroppa, Galvin, & Anderson, 2010; Rocke, Hayes, Edwards, & Berg, 2008).

Sbordone (as quoted in Lamberts, Evans & Spikman, 2010) defined ecological validity as the "functional and predictive relationship between the patient's performance on a set of neuropsychological tests and the patient's behavior in a variety of real-world settings" (p. 56). Several ecologically valid assessments are available for school-aged children, as well as a checklist questionnaire measuring EF in preschoolers; however, currently no published assessments of EF exist for preschool-aged children that involve direct observation of performance in a complex, real-world activity. The development of ecologically valid assessments is important in order to evaluate the impact of executive dysfunctions on preschool-aged children's performance in meaningful occupations.

The Preschool Kitchen Task Assessment (PKTA) was recently developed by Christine Berg, Ph.D., OTR/L, FAOTA, with the intention of providing an ecologically valid measure of EF abilities in preschool-aged children. The purpose of the present study is to validate the PKTA as an ecological assessment used to measure EF in typically developing three to five-year-olds, as compared to established neuropsychological EF assessments, including: the Behavioral Rating Inventory of Executive Function-Preschool Version (BRIEF-P), the Forward and Backward Digit Span (FDS and BDS), and the Dimensional Change Card Sort (DCCS) task (Diamond, Carlson & Beck, 2005; Isquith, Gioia & Epsy, 2004). This type of validation process, known as criterion-related validity, is the most practical and objective method for validating an assessment, thereby determining that the assessment is truly measuring what it purports to be measuring (Portney & Watkins, 2009, p. 102). Establishing the validity of the PKTA will allow OTs to use the assessment with confidence that the PKTA is actually measuring for delays and deficits in preschoolers' overall EF development, thus accurately informing intervention to promote children's participation in meaningful activities.

Background and Significance

Executive function is an umbrella term used to describe the development of cognitive skills required for participation in goal-directed activities, such as planning, problem solving, and following multi-step directions (Center on the Developing Child at Harvard University, 2011). The three skills of working memory, inhibition, and cognitive flexibility, or shifting, are commonly studied subcomponents of EF. Considerable research over the past 30 years has established that EF is a crucial foundational skill necessary for successful engagement in childhood and adult occupations, which include: play, education, social participation, work, and leisure. Research regarding EF, originating from the fields of developmental psychology and cognitive neuroscience, has investigated the development of EF throughout childhood in both typical and atypical populations, thereby elucidating the internal and external factors impacting development of EF abilities and the overall impact on children's participation in occupations (Diamond, 2006).

The majority of studies investigating the development of EF in children have focused on measuring three particular cognitive abilities associated with EF: inhibition, working memory, and shifting attention (Hughes, 2011). While these three skills are often divided and differentiated for the purpose of research, in real life activities, such as playing with peers or following a teacher's directions during circle time, they are most often used in combination. Working memory is used to hold information in mind for short periods of time in order to manipulate it, remember it for later use, or to direct current efforts (Diamond, 2006). Inhibition is the ability to pause before acting, thus allowing time to screen out irrelevant information or automatic responses that are not applicable to the current task or situation (Center on the Developing Child at Harvard University, 2011). Finally, shifting attention is the ability to change focus according to the needs and demands of a particular setting, situation or activity. Shifting is related to overall cognitive flexibility, which allows for multitasking, creativity, and effective social skills (Diamond, 2006).

Typical Development of Executive Function in Preschoolers and Impact on Occupations

Typical development of EF in early childhood is affected by numerous internal factors, including: brain development, genetics, temperament, and self-regulation. External factors also play a role in EF development, including child rearing environments and parenting styles. Most central to the development of EF is the growth and maturation of the brain. In particular, the development of the prefrontal cortex from early infancy to young adulthood has been connected to the development of various EF skills (Diamond, 2006; Miller & Cohen, 2001; Zelazo, Frye, & Marcovitch, 2003). As the brain and EF skills develop, children are able to more fully and successfully participate in childhood occupations, such as: play, social participation, education, feeding, sleep, and exercise. In turn, their participation in these occupations further supports the ongoing development of their EF skills.

Internal factors affecting development of executive function in children. Prolific research in the last 20 years has increased our understanding of the development of cognitive abilities during early childhood. A number of longitudinal studies have investigated the developmental progression of EF using specially designed tasks suitable for children under five years of age, such as testing their abilities to inhibit an impulse by waiting to open a present (Carlson, 2005; Davidson, Amso, Anderson, & Diamond, 2006; Diamond, Carlson, & Beck, 2005; Hughes, Ensor, Wilson, & Graham, 2010). Research has shown that skills in inhibition and working memory begin in early infancy and develop across early childhood at varying rates, with tasks that require combinations of inhibition and working memory presenting the greatest difficulty for young children to accomplish (Carlson, 2005). The addition of shifting tasks, such as changing from one dimension (color) to another dimension (shape) when sorting items, is especially challenging for children under age five (Diamond et al., 2005). Cognitive flexibility required for shifting tasks typically develops later in childhood (Anderson, 2002; Davidson et al., 2006).

Individual differences in EF skills in typically developing children may be attributed to genetics or temperament (Friedman, Miyake, Robinson, & Hewitt, 2011; Leve et al., 2013; Ursache, Blair, Stifter, & Voegtline, 2013). Studies utilizing large samples of twins or children who were adopted have found that genetic factors typically contribute to individual differences in EF abilities, specifically in regards to emotional regulation. Genes may be more influential in the development of EF than environmental or prenatal risk factors, particularly in regards to inhibition or delay of gratification (Friedman et al., 2011; Leve et al., 2013). In addition, temperament in infancy also contributes to the development of EF skills. According to Ursache et al. (2013), children exhibiting high levels of negative emotional reactivity, coupled with low levels of emotional regulation, showed delays in their development of EF. Internal factors must be considered in the development of EF and the subsequent impact on children's occupations, including: play, social participation, education, and feeding. In turn, participation in these occupations contributes to the development of EF in young children.

External factors affecting development of executive function. The environments and contexts of typically developing children significantly impact the development of EF, by either supporting or presenting obstacles to optimal development. External factors affecting the development of EF in typical children include: physical environmental influences, such as child rearing environments, and contextual influences, such as parenting styles and the socioeconomic status of the family (Blair, Raver, & Berry, 2014; NICHD Early Childcare Research Network, 2005; Raver, Blair, & Willoughby, 2013). A longitudinal study conducted by the National Institute of Child Health and Human Development (NICHD) Early Child Care Research Network (2005) tracked 700 children from infancy to first grade. Results of the study found the quality of the child-rearing environments (including home, child-care and school environments) were related to the development of attention and memory in young children. Results also showed the quality of the home environment, which includes stimulating and sensitive care, was most associated with optimal cognitive development.

An increasing number of researchers are examining the impact of parenting in the development of EF skills during early childhood (Bernier, Carlson, & Whipple, 2010; Blair, Raver, & Berry, 2014; Hammond, Muller, Carpendale, Bibok, & Liebermann-Finestone, 2011). Prospective, longitudinal studies have found that high quality parenting results in improvement in EF skills to a higher extent than what is expected based on maturation alone. Parenting behaviors that support the child's developing sense of autonomy were most associated with improvements in overall EF in young children. This parenting technique, termed 'parental scaffolding', is the support a parent offers a child to accomplish activities that are just beyond his or her independent ability level (Hammond et al., 2011; Hughes & Ensor, 2009; Landry, Miller-Loncar, Smith, & Swank, 2002). Several studies have concluded that the pairing of parental scaffolding and higher quality caregiving results in higher gains in EF abilities by ages 5 or 6 years (Landry et al., 2002; Blair, et al. 2014).

Living in poverty is a secondary contextual factor that has been shown to affect the development of EF skills in young children. According to Blair, Raver and Berry (2014), exposure to chronic poverty from infancy to 4 years has a significant impact on the development of EF by age 4. Exposure to poverty may result in significant decreases in subsequent EF performance for each additional year wherein a child lived in poverty. In addition, families with a low income-to-need ratio showed a significant decrease in parenting quality, which further impacted the development of EF skills in their young children (Blair, et al., 2014). High quality parenting styles coupled with low reactivity, which is typically defined as 'easy temperament', were positive mediators regarding the effects of chronic poverty on the development of EF in young children (Blair, et al., 2014). Higher quality child rearing environments occurring in combination with wellness-promoting occupations, such as higher amounts of sleep and exercise, may also improve EF in young children.

Impact of sleep on executive function. Recent research has investigated the relationship between sleep and the development of EF skills in young children. Sleep serves as an essential organizing function for complex processes involved in cognition (Dahl, 1996; Dionne et al., 2011). Sleep also aids in the formation of higher order EF skills, such as the development of language and knowledge in children (Buckhalt, El-Sheikh & Keller, 2007). A study conducted by Bernier, Beauchamp, Bouvette-Turcot, Carlson and Carrier (2013) investigated the links between sleep in one-year-old children and their subsequent cognitive performance at four years. According to their results, children who received higher proportions of sleep at night as infants were found to perform better on tasks utilizing complex EF skills, such as: abstract reasoning, concept formation, and problem-solving at four-years-old. Therefore, increased levels of sleep may improve the development of EF skills between infancy and four years (Bernier et al., 2013).

Impact of exercise on executive function. Another environmental mediator affecting the development of EF is young children's engagement in aerobic exercise. Research has shown improvements in base levels of EF measured immediately following exercise, with increases in baseline EF found with regular exercise (Best, 2010; Davis, et al., 2011). A systematic review by Best (2010) found there are multiple pathways by which exercise has an effect on executive processes. Regular aerobic exercise that is cognitively engaging, such as group aerobic games, appears to result in the strongest improvements in EF skills. While these exercise studies have focused on school-age children, future studies of preschool-aged children and the effects of gross motor play on their EF development may be an important contribution to research regarding EF development in children.

Impact of executive function on social-emotional and social participation skills. The development of social-emotional skills, including self-regulation and social cognition, are tied to the development of EF. Self-regulation involves cognitive and behavioral processes that allow individuals to maintain optimal levels of emotional, motivational, and cognitive arousal for a particular task or situation (Blair & Diamond, 2008; Rafaelli, Crockett, & Shen, 2005). Self-regulation skills require a combination of EF subcomponents, including: working memory, inhibition, and cognitive flexibility (Liew, 2012). Better working memory is connected to less frequent expressions of negative affect, while poor inhibition is related to higher levels of expressed negative affect (Blair & Diamond, 2008). Overall emotional regulation, including the ability to express both negative and positive affect appropriately, is correlated with the development of an intermediate level of inhibition (Carlson & Wang, 2007). Anger modulation is also related to the development of shifting focus, because children who are able to shift then sustain their attention when faced with a conflict are better able to control their emotions appropriately. The EF skills of shifting attention and sustaining attention both show considerable development from toddler to preschool years.

Successful social participation is also dependent on the development of EF skills, which allow a child to inhibit behavioral impulses and utilize problem-solving skills in order to appropriately navigate various social-emotional situations. Executive function has been directly implicated in a number of studies wherein children's social skills were impacted in areas related to the following: distractibility, impulsivity, lack of concentration, action selection, and recognition of consequences of actions (Pennington, 2002; Hughes & Ensor, 2009). These skills, along with delay of gratification - which is the ability to resist immediate rewards for a later, more valued outcome - are dependent on strong EF abilities (Mischel, Shoda, & Rodriguez, 1989). Delay of gratification typically leads to more successful social participation in children, specifically in regards to their ability to withstand temptations and regulate their feelings of frustration and stress (Mischel et al., 1989; Sethi, Mischel, Aber, Shoda, & Rodriguez, 2000).

Impact of executive function on children's participation in meaningful occupations.

Executive functioning skills have an inherent impact on an individual's ability to participate in meaningful occupations. As a child develops EF skills - such as working memory, inhibition, problem-solving, etc. - they experience increased independence in their ability to participate in daily activities. These complex skills allow them to more successfully participate in various occupations, such as: play scenarios, school readiness activities, and interactions that involve feeding.

Impact of executive function on play. Play is an integral aspect of children's socialization and allows for the development of various skills, including EF. According to Hoffman and Russ (2012), pretend play incorporates the use of lucid symbols in order to deconstruct reality and incorporate imagination and fantasy into play activities. Children utilize cognitive, affective and personal processes while engaging in pretend play, which build on EF skills such as: inhibition, working memory, cognitive flexibility and self-regulation (Denham et al., 2003). Vygotsky (1978) theorized that pretend play serves as an opportunity for cognitive development, thereby providing a vehicle for children to develop their capacities for self-regulation and impulse control. Hoffman and Russ (2012) found links between organized play and divergent thinking, wherein children who incorporated more imagination in their play appeared to generate a higher volume of ideas within the context of their play. Recent research has shown a link between high levels of sociodramatic play, conflict resolution, and well-developed self-regulation skills in preschoolers (Fantuzzo, Sekino, & Cohen, 2004; Lemche et al., 2003). The facilitation of pretend play in a preschool environment allows children to practice skills that may be generalized to real life scenarios through the promotion of opportunities for divergent thinking and exploration of social norms and parameters (Hoffman & Russ, 2012).

Impact of executive function on education. Children's readiness for school is dependent on their ability to learn pre-academic and social-emotional skills, which appear to be highly influenced by EF development (Liew, 2012). According to Blair (2002), the classroom environment requires children to use creative thinking skills in order to engage in self-regulated learning, during which children practice goal setting, strategy use, and self-monitoring. According to Blair and Razza (2007), effortful control, which is the ability to approach or withdraw from a situation through the incorporation of inhibition, contributes to the development of math skills and emergent literacy skills. McClelland et al. (2007) found that behavioral measures of self-regulation, including attention and working memory, were also significantly associated with early mathematics and literacy skills. Overall, children who incorporate self-regulation skills in the classroom environment tend to be more successful in activities such as: turn-taking, resisting the urge to act aggressively, and persisting during challenging situations (Berk, Mann, & Ogan, 2006).

Children who do not follow typical trajectories of EF development appear to be at risk for difficulties with school readiness due to poor self-regulation skills that often lead to impulsive or aggressive behavior (Tremblay, Masse, Vitaro, & Dobkin, 1995). Children prone to aggression are more likely to make impulsive and hostile assumptions of others during social interactions due to difficulties interpreting and understanding the emotional responses of others (Dunn & Cutting, 1999; Dunn & Herrera, 1997). Their response generation, evaluation, and decision-making are impacted due to a lack of social knowledge necessary to understand their own emotions and the emotions of others (Denham et al., 2003). Children's interpretations and attribution of their own and others' emotions affects their emotional response and subsequent behaviors (Denham, 1998; Graham, Hudley, & Williams, 1992). Overall EF deficits may inhibit a child's ability to react appropriately to others, thereby impacting their relationships with peers and overall academic and social experiences (Hughes, Dunn, & White, 1998). Many behaviors and attributes associated with successful school adjustment may be influenced by a child's ability to regulate feelings of aggression or impulsivity in social scenarios, which are dependent on development of EF skills (Blair, 2002).

Impact of executive function on feeding. Decreased EF has been linked to unhealthy eating behaviors in children due to their increased likelihood of engaging in emotional-based overeating patterns (Pieper & Laugero, 2013). According to Dallman (2010), increased development of the prefrontal cortex, which corresponds with improved EF skills, may be integral to a person's ability to override emotional and habitual eating behaviors. Thereby, deficits in EF may be related to increased snack food intake in children, whereas impulsivity is directly linked to greater binge-eating behaviors (Guerrieri, Nederkoorn, & Jansen, 2007). Francis and Susman (2009) found that lower self-regulation, which is strongly associated with

EF, was linked to higher weight gain in young children, thereby suggesting that EF skills support behaviors that allow a child to maintain better weight. Furthermore, Pieper and Laugero (2013) found that children who receive lower cognitive scores on standardized placement exams, as indicated by teacher reports, experienced higher incidences of eating in the absence of hunger, thus indicating that deficits in EF skills may correlate with children's weight gain.

Overall impact of executive function on preschool development. Numerous factors affect a child's development of EF skills during the preschool years. Development of EF is closely related to children's participation in meaningful occupations; subsequently, deficits in EF may significantly impact a child's ability to effectively engage in these tasks (i.e., play, school readiness, feeding, sleeping, etc.). Deficits in EF may impact a child's ability to inhibit negative behaviors and utilize self-regulation strategies during school activities. A child's overall health may also be impacted due to poor development of EF, specifically in regards to sleeping and eating in the absence of hunger. Typical development of EF skills is essential to a child's overall quality of life and their participation in meaningful activities.

Conditions and Their Impacts on Executive Function

Various childhood conditions appear to affect the development of EF abilities in young children. Children diagnosed with conditions such as attention deficit hyperactivity disorder (ADHD), fetal alcohol spectrum disorder (FASD), and autism spectrum disorder (ASD) have documented EF dysfunction, which typically disrupts their occupational participation. Executive function deficits may affect a child's meaningful engagement in school, social participation, and their ability to learn and retain new information.

Attention deficit hyperactivity disorder. Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder affecting approximately 3-5% of children throughout the world under the age of 7 and approximately 50% of children, adolescents and adults (Frank-Briggs, 2011). Attention deficit hyperactivity disorder is categorized as a child experiencing six out of nine inattention symptoms and/or six out of nine hyperactivity-impulsivity symptoms for a period of at least six months or more. The symptoms must be severe enough to result in maladaptive behaviors or interfere with typical development (Frank-Briggs, 2013). Children diagnosed with ADHD may experience difficulty with the following: task and activity organization, sustaining attention during tasks or activities, follow-through when given directions, finishing tasks or activities, and impulsivity (American Psychiatric Association, 2000). These characteristics of ADHD are considered to be EF deficits and result in overall impacts on children's participation in meaningful occupations.

Children diagnosed with ADHD experience greater difficulty engaging in academic performance, specifically in areas of mathematics and reading, due to deficits in working memory (van der Donk et al., 2013). Deficits in working memory may likely lead to decreased participation in school activities in structured settings and social situations (Gunter, 2013). Children who are diagnosed with ADHD may experience impairments in their length of attention span and have greater difficulty gathering and organizing important information (van der Donk et al., 2013). Impulsivity may also affect a child's ability to take turns during social participation and play activities, which may lead to onset or development of more aggressive behaviors (Frank-Briggs, 2011). Poor overall establishment of EF, specifically inhibition and working memory, impacts children's abilities to successfully participate in multiple school settings and contexts. Therefore, children diagnosed with ADHD may experience limited engagement in social and academic activities.

A child diagnosed with ADHD may be particularly challenged by participation in reading groups, handwriting tasks, and playing with peers; this may result in poor impulse control and further impact their development of EF skills (i.e., working memory, problem-solving, etc.). Overall lack of organizational skills in children living with ADHD may impact their success in school (van der Donk, et al., 2013). The challenges experienced by school-aged children diagnosed with ADHD are also apparent in preschool children living with ADHD, or who are at risk for a diagnosis of ADHD. Shoemaker, et al. (2012) found that preschool-aged children diagnosed with ADHD experience lower inhibition scores than in typically developing children, further positing that children diagnosed with ADHD experience deficits in their development of EF. Overall, it is clear there is a correlational relationship between EF deficits and a diagnosis of ADHD, which impacts children's participation in meaningful occupations.

Fetal alcohol spectrum disorder. Fetal alcohol spectrum disorder (FASD) consists of neurocognitive and behavioral deficits, in conjunction with various physical deformities caused by prenatal exposure to alcohol (Hoyme, et al., 2005). The Centers for Disease Control and Prevention (CDC) reports 0.3-1.5 live births out of 1000 are estimated to result in an onset of FASD (Cannon, et al., 2014). Research has shown that children living with FASD experience significant deficits in their development of EF skills (Jirikowic, 2008). Executive functioning deficits may affect children living with FASD during their participation in meaningful activities, specifically in regards to communication, academics, and social interactions (Hoyme, et al., 2005).

Children living with FASD may experience executive dysfunctions, such as: behavioral issues, poor working memory, poor attention span, and hyperactivity (Carpenter, 2011; Pinto & Schub, 2012). A specific skill affected is the child's development and implementation of working memory; typically, a child diagnosed with FASD may experience difficulty playing games or following directions due to an inability to remember rules or directions. Children diagnosed with FASD may also experience difficulty processing and storing new information in their long-term memory due to poor working memory and attention (Carpenter, 2011). Children with hyperactivity as a symptom of FASD may experience difficulty sitting still for prolonged periods of time, which is required during academic or learning activities. Deficits in EF associated with FASD are often manifested during school activities, social participation activities, and behavioral aspects of a child's life, and may determine their ability to participate in meaningful occupations.

Autism spectrum disorder. According to the DSM-V, autism spectrum disorder (ASD) is characterized as meeting criteria in four areas: deficits in social communication; repetitive behavior or restricted interests; symptoms present in early development; and symptoms causing significant functional impairment (American Psychiatric Association, 2013). Children diagnosed with ASD experience deficits in EF, specifically in regards to working memory, shifting, and inhibition (Rosenthal, et al., 2013). Children living with ASD experience difficulty transitioning or shifting from one activity to another, thus affecting participation in school and social settings. Children diagnosed with ASD may have exceptional rote memory but often experience difficulty with working memory in different contexts (Rosenthal, et al., 2013). Pooraghal, Kafi and Sotodeh (2013) found significant correlations between ASD and children's difficulty utilizing inhibition during tasks. Further research examining younger children is necessary to determine the need for assessments to be accessible by OTs to support preschool children experiencing deficits in EF as a result of ASD.

Traumatic brain injury. Acquired conditions, such as a traumatic brain injury (TBI), impact the development of EF, depending on the extent of the injury to the brain, the age at which the injury occurred, and the location of the injury (Nadebaum, Anderson, & Catroppa, 2007). The extent of a TBI appears to be the greatest predictor of executive dysfunctions in children prior to age 7. Therefore, a more severe TBI results in significant executive dysfunction 5 years after onset of injury, whereas a moderate or mild injury shows no significant differences when compared to their same-aged, typically developing peers (Nadebaum, et al., 2007). The age at which the injury occurred may also play a role in the onset of executive dysfunction, with younger children being more severely affected than older children. In addition, a TBI resulting in frontal lobe damage appears to be connected to behavioral symptoms, such as difficulty adapting to changing situations and overall lack of initiative (Nadebaum, et al., 2007). It is important to understand the implications of a TBI and its affect on children in order for caregivers, parents and teachers to promote children's successful participation in future tasks.

Overall impact of conditions on executive function development. There are multiple conditions that may impact a child's development of EF skills. The aforementioned conditions may affect a child's quality of life as well as their ability to engage in meaningful activities of daily living. Many known conditions often result in deficits in EF skill development, which may lead to decreased participation in school and social settings. The onset of these conditions and further impact of EF deficits make it difficult for children to sustain meaningful interactions with others, utilize working memory and other EF skills in order to retain information learned in school and engage in activities that further typical development of EF skills.

Assessment of Executive Function in Preschoolers

Current research supports the need for early identification of children living with executive dysfunctions by utilizing valid, appropriate and feasible assessments (Center on the Developing Child at Harvard University, 2011). Pediatric OTs may benefit from the development of such assessment tools. Incorporation of the PKTA will help to identify children experiencing deficits in EF skills, who may also be diagnosed with developmental delays, such as: ADHD, FASD, or ASD. The most frequent tools used to measure EF skills in young children are neuropsychological tests, clinical observations, and informant-answered questionnaires. Results from these assessments are used to predict children's everyday functioning abilities; however, these assessments do not simulate a real life environment and therefore are not ecologically valid (Chaytor, Schmitter-Edgecombe, & Burr, 2006). An ecologically valid assessment takes place in a naturalistic setting, requires activity demands that are representative of that setting, and results in a response that is typical for the setting and activity (Shmuckler, 2001; Spooner & Pachana, 2006). While there are few ecologically valid assessments measuring EF skills in OT practice, the PKTA is a newly developed assessment that may be an appropriate measure of EF in preschool-aged children; however, this assessment requires validation.

Hughes (2011) stated in her review of EF research that there is an increase in the number of studies concerning children; however, there is a lack of ecologically valid assessments of EF that are intrinsically motivating to preschool-aged children. Moreover, less attention and research has focused on the development of EF assessments in children aged zero to five years (Hughes, 2011; Isquith, Gioia, & Espy, 2004). Children in this age range lack the ability to participate in lengthy assessments (Isquith et al., 2004) and typically experience immature motor and verbal skills, which may impact their ability to successfully participate during assessments (Isquith et al., 2005). However, there remains an evident need for assessment tools that specifically measure EF skills in young children during this critical period of development.

Current assessments of executive function in children. Traditional neuropsychological tests of EF in children, which are typically described as paper and pencil tasks, attempt to measure various subcategories of EF (i.e., inhibition, cognitive flexibility, and working memory) separately, and take place in a clinical, structured environment (Chevignard et al., 2009). For example, the Dimensional Change Card Sort Task (DCCS) requires a child to sort cards by shape (truck versus star) and then alternatively switch to sorting by color (Diamond, Carlson, & Beck, 2005). The DCCS task requires working memory to maintain a mental image of the direction, *sort by shape*, cognitive flexibility to follow new directions, *sort by color*, and inhibition to avoid following the previous directions. Another example of a neuropsychological assessment is the Delay of Gratification task, wherein a child is presented with a preferred snack and is told they will be rewarded with a bigger food portion if they refrain from eating the snack while left alone (Mischel, Shoda, & Rodriguez, 1989). This task requires inhibition, *not eating the snack*, and working memory, which entails the prospect of organizing information, such as *remembering the reward ahead*.

Neuropsychological tasks are most often supplemented with clinical observations of target behaviors to be divulged through questionnaires completed by parents, teachers, or caregivers (Isquith, Crawford, Espy, & Gioia, 2005). One such informant questionnaire is the Behavior Rating Inventory of Executive Function-Preschool Version (BRIEF-P), which has become the ‘gold standard’ for an ecologically valid measure of EF in preschool-aged children (Sherman & Brooks, 2010) due to accessibility of information regarding children’s behavior in their typical environment (Isquith, Gioia, & Espy, 2004). The BRIEF-P may also be used as an indicator for children’s behavior, rather than specifically focusing on EF skills. A limitation of the BRIEF-P is a high incidence of rater bias due to the prevalence of answers based on the viewpoint of someone close to the child (such as a parent or guardian) (Isquith et al., 2005). The BRIEF-P may provide insight regarding a preschool-aged child’s EF abilities; however, it does not involve clinical observation of the child in a natural environment during task completion. Currently, there are limited assessments of EF used with preschool-aged children; furthermore, there are no EF assessments targeted for use of OTs working with this population.

Ecologically valid assessments and occupational therapy. Current approaches to assessments of EF in preschool-aged children present two problems in application to OT practice. First, children may not be intrinsically motivated to complete certain tasks required by the assessment tool (Chevignard et al., 2009). Second, OTs need to observe children functioning in a typical daily setting, yet traditional assessments do not allow for this natural occurrence (Rocke, Hays, Edwards, & Berg, 2008; Weiner, Toglia, & Berg, 2012). Ecologically valid assessment tools have previously been developed to assess EF in adults with the use of the Kitchen Task Assessment (KTA) (Baum & Edwards, 1993) and in school-aged children with the Children's Kitchen Task Assessment (CKTA) (Rocke, et al., 2008). Ecological assessments measure EF skills by objectively quantifying the level of assistance required for an individual to perform a developmentally appropriate cooking task (i.e., making pudding for adults and play dough for children). However, there is no similarly established measure to assess EF in preschool-aged children.

The PKTA, a new assessment developed by Christine Berg, Ph.D., OTR/L, FAOTA, at Washington University, St. Louis, extends the previous Kitchen Task Assessments to incorporate children in the preschool years, between the ages of three and five (Berg, 2009). It assesses a child's ability to use multiple components of EF skills when completing a multi-step activity wherein the child follows a series of picture instructions to create a craft project – a picture of a caterpillar. Cognitive assistance required by the child to complete the project is objectively measured as the clinician observes the child in the following four areas: *initiation*, the capability to begin the activity and gather needed materials; *sequencing and planning*, following and completing the steps of the task; *judgment and safety*, handling materials safely; and *completion*, finishing the project (Rocke et al., 2008). The parameters of the assessment posit the following: child completes the craft activity at their preschool site, using known materials, and sitting at familiar tables and chairs. The child uses skills they have practiced and integrated during preschool, which include: cutting, gluing, following directions, and attending to a task.

Only one pilot study has examined the PKTA prior to this research study (Yuson, Engelhardt, & Dizon, 2014). According to Rocke, Hays, Edward and Berg (2008) the CKTA has preliminary reliability and validity. This justification includes high levels of interrater reliability, or consistency of scores across multiple observers, especially when conducted and scored by trained examiners. Moreover, the CKTA has discriminant validity regarding the amount of cues needed to complete the project and distinguish children living with high and low EF abilities. Validity of the CKTA presents implications for establishing the validity of the PKTA as an ecological measure of EF in preschoolers.

The use of an ecologically valid assessment in young children, such as the PKTA, may allow for increased accuracy in assessment results that reflect the child's EF abilities while participating in real world occupations. However, the PKTA is currently in the process of further development and requires validation. The process of validation will help to establish whether the PKTA is an accurate and useful measure of EF in preschool-aged children. If validated, the PKTA will provide an important tool for pediatric OTs to assess and treat preschool-aged children who may be experiencing deficits in EF. The PKTA will also educate parents and teachers regarding the impact of EF on children's participation in various tasks (Rocke et al., 2008; Weiner et al., 2012).

Summary and Conclusions

The development of EF is necessary for children to fully participate in their valued occupations that occur during their youth and adulthood. Deficits in EF may negatively impact a child's performance during school, play, and social interactions. Children living with conditions such as ADHD and ASD, along with others, are known to experience challenges with their development of EF skills. Pediatric OTs are often asked to work with children living with these conditions in order to promote their independence and full participation in meaningful activities of daily living. In order for OTs to complete early interventions for preschool-aged children who exhibit EF deficits, there is an evident need for an ecologically valid measure of EF specifically assessing this population. The PKTA is an ecologically valid measure that may fulfill this evident need, but validation of this assessment must first be established.

Statement of Purpose

There is a lack of ecologically valid assessments measuring EF skills in preschool-aged children for OTs. Further development of the PKTA may result in the production of a useful tool to measure EF within children ages three to five; however, no current research studies have published information regarding its validity. Therefore, the purpose of our research project is to determine the validity of the PKTA as a measurement of EF skills in preschool-aged children. This leads the research team to form the following questions to guide our research:

1. Is the PKTA a valid measurement of EF in preschoolers when compared to traditional neuropsychological assessments?
    a. Do scores on the PKTA correlate with scores on normed parent questionnaires of EF (BRIEF-P)?
    b. Do scores on the PKTA correlate with scores on the DCCS task?
    c. Do scores on the PKTA correlate with scores on the FDS and BDS tasks?
2. What are the mean scores for typically developing three-, four-, and five-year-olds on the PKTA?
3. Is the PKTA sensitive to the age of the child or able to predict a child's chronological age based on performance?

Theoretical Framework

Cognitive Developmental Theories

Cognitive developmental theories span the theory of behaviorism, Piaget's internal stages of cognitive development, Vygotsky's developmental theory of social learning, as well as current scientific research pertaining to the study of EF in children. This research is influential in this study assessing the PKTA as a measurement of EF in preschool-aged children.

Executive function concepts are inherently based on Piaget's theories regarding children's cognitive development as a progression through various stages. Piaget theorized that children move through stages of development in their thinking and reasoning skills, beginning with a foundation of sensorimotor exploration, occurring from birth to approximately 18 months. During this period of exploration, the child acts upon the world and observes the effects of their actions. Children begin to develop schemas regarding the external environment, discover new concepts, and assimilate new actions and insights into their existing schemas. The next stage in cognitive development is the preoperational stage, occurring between ages two to seven wherein children are learning to connect their schemas of the external world with their internal mental representations. The child gradually becomes less self-centered and understands others' differing points of view; this allows a child to perform various skills, such as ordering, organizing, and transforming information (Piaget & Inhelder, 1969, pp. 93-96). The concept of EF was not formally acknowledged in Piaget's theories yet many aspects of EF were implicit in his description of the development of thinking and reasoning skills.

A counterpoint to Piaget's work is Vygotsky's developmental theory of social learning, which posited that the internal developmental process occurred after the learning process, rather than preceding it as Piaget had claimed (Vygotsky, 1978, p. 35). Vygotsky focused on the process of learning within a supportive social environment as key to a child's cognitive development. He coined the phrase 'zone of proximal development' to describe those skills that are slightly more advanced than what the child is able to do on their own, but can be achieved with the support of a more knowledgeable other, such as an adult or peer (Vygotsky, 1978, p. 32). Vygotsky also developed the concept of scaffolding, wherein the teacher or parent provides a framework for the child to learn new skills and reach new levels of development by segmenting the task into increasingly challenging scenarios.

While these early theorists in developmental psychology emphasized a 'stages' or 'pyramid' approach to development, wherein each stage or layer prepares the child for the next, higher level of development, current theory tends to view development as overlapping systems. Current research in cognitive development stems from evidence pertaining to biology, psychology, linguistics, and child development. Many research studies are now incorporating the use of new technologies, such as functional Magnetic Resonance Imaging (fMRI) and genome analysis, with implications for studying EF as a component of cognitive development.

Research on the impact of EF on children's successful participation in occupations has expanded over the past 30 years (Diamond, 2006). Executive functioning research has examined both basic and applied questions, looking at the following: regions of the brain involved in various EF sub-skills; the typical developmental sequence of EF; internal and external factors that promote or hinder EF development; and specific interventions for improving EF development in at-risk populations (Center on the Developing Child at Harvard University, 2011). Our current research study builds on this evidence-based foundation by assessing the validity of the PKTA as a measure of EF in preschoolers to be used by therapists and educators. The PKTA aims to provide information that is directly relevant to formulating goals and creating therapeutic interventions for a child experiencing EF deficits, which is explicitly connected to the ecological validity of the assessment.

Ecological Validity

The theory of ecological validity is a concept often used in child development and education, particularly pertaining to the type of assessments used with young children to best support their educational goals (Brassard, 2007). Ecological validity is achieved by utilizing naturalistic characteristics in three areas, including: the environment, stimuli, and response (Shmuckler, 2001). First, the environment is said to be ecologically valid when it takes place in a naturalistic setting wherein the specific behavior typically occurs. Second, the stimuli, or activity demands required for task completion, are said to be ecologically valid if they are typical and integral to the child's life. Third, if the first two steps are successfully achieved, the child's response will be ecologically valid because it is a 'typical behavior' due to the context and activity. The incorporation of an ecologically valid framework will allow therapists to observe desired behaviors in a naturalistic setting and obtain information that directly translates to the intervention.

Methodology

Design

The purpose of this study is to determine the validity of the PKTA as a measure of EF in preschool-aged children. The validity of an assessment is the extent to which an assessment measures what it is intended to measure (Portney & Watkins, 2009, p. 97). The current study utilized an exploratory methodological design with a qualitative component to assess concurrent and criterion-related validity of the PKTA. Quantitative data was obtained through comparison of scores on the PKTA to scores on the BRIEF-P, FDS, BDS, and DCCS. Additional data was collected through parent's completion of a questionnaire pertaining to the child's developmental history and through clinical observations conducted by the researchers during the assessment process.

Participants

A convenience sample of typically developing preschool-aged children was recruited from two preschools in the California Bay Area. Inclusion criteria included: 1) all children must be typically developing, 2) between the ages of three and five years, 11 months, 3) must speak English and, 4) parents of the participants must be able to speak and read English. Children were excluded if they had any diagnosed condition that might interfere with their full participation during administration of the assessments tools. A total of 15 children participated in the present study, with 10 males and five females.

Participants were recruited at two preschools in West Contra Costa County and Marin County, California. Student researchers utilized the following recruitment procedures: 1) face-to-face interaction at the preschool site, 2) word of mouth, 3) flyers, and 4) emails to contacts affiliated with the study. Student researchers approached the two preschool site directors, described the research parameters, and obtained permission to use the sites for research purposes. Flyers and an information packet were distributed to parents and included: information about the study, descriptions of the activities the children will participate in, and consent forms (See Appendices A, B, and C). Interested individuals were asked to respond directly to the research students, with all communication monitored by the faculty advisor for this study, Julia Wilbarger, Ph.D., OTR/L.

Ethical Considerations

Researchers complied with the American Occupational Therapy Association's Code of Ethics in order to maintain research participants' rights and the Institutional Review Board of Dominican University of California approved the study (See Appendix D). All parents of the participants gave full-informed written consent and all children gave verbal assent prior to participation in this study. Any potential risks to participants were minimized through the use of verbal cueing during implementation of the assessment and other task procedures. In order to ensure confidentiality, researchers used subject identification numbers assigned to each study participant in order to keep their information private. All assessments used were commercially available and all forms were purchased by researchers and the faculty advisor.

Data Collection

All parents, guardians, and participants provided consent or assent prior to beginning their participation in the present study (See Appendix B and C). After consent was received, the researchers asked the parents to complete the BRIEF-P and a background questionnaire for their child and to return the forms to the student researchers. In addition, a quiet room was reserved in the child's preschool for the assessments to take place in order to ensure the testing would be completed in an ecologically valid setting. All participants were assessed in an environment that was private, safe, and conducive for testing; a faculty member from the preschool site was present for the duration of the assessment to ensure the comfort and safety of the child.

Occupational therapy graduate students were trained in the administration of all assessments used in the study. Standard cueing guidelines and scoring criteria, as determined by standardized assessment instructions and outlines, were used for all assessments. On the established date, the researchers administered the DST, DCCS, and PKTA to each participant; this took approximately 30 to 45 minutes per child. One researcher administered the three assessments while two other researchers observed the session to ensure inter-rater reliability. Each researcher assessed approximately three to four participants out of the 15 total. The assessments were administered in the following order: the DST (Forward then Backward), the DCCS (Color then Shape), and the PKTA (Part A, B, C).

Measurement/Instruments

The preschool kitchen task assessment. The PKTA assesses a child's EF abilities during completion of a multi-step activity that follows picture instructions to create a craft project, which is a multimodal picture of a caterpillar (Berg, 2009). The clinician observes the child completing a sequence of projected steps in the following order: *initiation*, which is the ability to begin the task when asked and move to the provided container to gather the materials; *sequencing and planning*, following the steps of the task in the correct order: 1) use a glue stick to first add the green circle, then the pink circle, and lastly the orange circle; 2) add the antenna, 3) add red stamp; 4) let stamp dry for one minute using a timer to keep time; 5) add blue cloud, eyes, and mouth; 6) cut the grass and bend it forward; *judgment and safety*, avoids dangerous situations with art materials by handling materials safely; *completion*, the child knows he or she is finished by stopping at the word 'stop' in the instruction booklet.

The directions for the PKTA state the tester provides two cues per assistance level. Total scores are calculated by multiplying the amount of cues required at each level by the level of cue (range of zero to five). The assistance required by the child to complete each step was scored by the amount and type of cues required at each step and recorded on a score sheet. The type of cue is scored zero to five and will be given in the following order until the child is able to complete the step successfully: (0) child completes step independently, (1) child requires general verbal guidance, (2) child requires gesture guidance, (3) child requires direct verbal guidance, (4) child requires physical assistance, and (5) examiner completes step for child. Self-corrections that are completed within 10 seconds of the specific step are not counted as errors.

The forward and backward digit span. The FDS and BDS, which are both adapted from the Digit Span Task (DST) developed by Davis and Pratt (1996), are measures of working memory as the child is asked to repeat a series of numbers both forward and backwards. The FDS task requires participants to verbally repeat numbers in forward order, starting with two digits and ending at the highest level of seven digits. Children are provided with verbal instructions and a puppet is used to model the expected answer. The highest level completed results in the participant's overall score (e.g., individual correctly repeats four numbers, with a resulting score of four). In the BDS, the experimenter reads a series of numbers to the participant and the participant is asked to repeat the sequence in the reverse order. The puppet is used again to model the expected answer. This sequence is continued until the participant makes an error and is given three trials to complete the level. They are scored based on the highest sequence of numbers correctly repeated in reverse order (See Appendix E).

The dimensional change card sort task. The DCCS task, developed by Diamond, Carlson and Beck (2005), tests three subcomponents of EF – shifting, working memory, and inhibition – as children sort cards by shape or color. Children are asked to sort the cards into two piles by shape (truck/star) and then switch to sorting by color (red/blue). The DCCS is a frequently used measure of EF in preschoolers that has been tested for reliability and validity, and has normed data available. Data pertaining to reliability, validity and norms of the DCCS is currently being sought from the Diamond Laboratory (See Appendix F).

Behavior rating inventory of executive function-preschool version. The BRIEF-P, developed by Gioia, Espy, and Isquith (2002), is a questionnaire in which parents, teachers, and caregivers rate a preschool-aged child's EF abilities in their everyday environment. It consists of 63 questions that assess five categories of EF: inhibition, cognitive flexibility, working memory, emotional control, and planning/organization. The informant answers questions based on how often a behavior has been a concern in the past six months. Responses are scored one to three and are indicated by circling one of three responses: never (1), sometimes (2), and often (3). The scores are added up to equate the raw score, which may then be converted into a standardized score. A Global Executive Control composite score is derived from the five categories. Three index scores are taken from these categories: inhibitory/self control index, flexibility index, and emergent metacognition index.

According to Sherman and Brooks (2010), the BRIEF-P is considered a reliable and valid measure of behavior in children. The BRIEF-P has high internal consistency, moderate test-retest reliability, and moderate inter-rater reliability. Research conducted by Sherman and Brook (2010) shows the BRIEF-P manual maintains good construct validity, thereby indicating the questionnaire measures what it claims to measure, which is evidenced by slight correlations between working memory scores and IQ levels.

Measures to insure reliability. Student researchers participated in three test assessments with preschool-aged children, who served as ‘practice participants.’ Upon completion of the assessment procedures, total scores were calculated to determine variance and the potential need for further training. During data collection, standard cueing guidelines and scoring criteria were used for all assessments to support reliability and to ensure each participant shared the same experience during the administration of all assessments. After each participant completed the three assessments, student researchers would compare score sheets to determine inter-rater reliability. If there were any discrepancies, researchers would discuss what they each observed and decide on an official score to be used in data analysis. Typically the scores were based on the responses of the observers due to potential discrepancies on behalf of the individual administering the assessment.

Data Analysis

All statistical analyses were conducted using Statistical Package for the Social Sciences (SPSS) software version 12. Pearson’s *r* correlations coefficient statistics were used to compare total scores on the PKTA to the BRIEF-P, DCCS, and DST. Coefficients were classified as follows: between .25 to .50 indicates a fair relationship, while .50-.75 indicates a moderate to good relationship (Portney & Watkins, 2009). Descriptive statistics were calculated separately for three-year-olds, four-year-olds, and five-year-olds for each group. Linear regression analysis and visual inspection of the resulting scatter plot was used to determine the relationship between the age of the child and their score on the PKTA.

Results

A total of 15 participants ranging in ages between 42 to 62 months completed the study. Information about the participants and their parents is reported in Table 1.

Table 1

Participant Demographic Data

Participant Characteristic	(n = 15)
Child Variables	
Age, months, *M (SD)*	52.7 (8.8)
Gender, n (%)	
Male	10 (66.7)
Female	5 (33.3)
Race, *n* (%)	
White, not Hispanic	11 (73.3)
Asian or Pacific Islander	2 (13.3)
Hispanic	1 (6.7)
Other, or unknown	1 (6.7)
Parent Variables	
Education level, %	
Graduate	43.3
4 year college or university	43.3
Some college or specialized training	13.3

Note. *M* = mean; *SD* = standard deviation.

Relationships Between the Preschool Kitchen Task Assessment and Established Assessments of Executive Function

Behavior rating inventory of executive function – Preschool version (BRIEF-P).

Scores on the PKTA correlated significantly with several of the scores on the BRIEF-P and are reported in Table 2. A fair but non-significant correlation was found between the PKTA total score and the BRIEF-P Global Executive Composite (GEC) score. A moderate significant relationship was found between the PKTA total score and the BRIEF-P subscore for Inhibitory Control and the composite score of Inhibitory Control and Emotional Control. A fair non-significant relationship was found between the PKTA total score and the BRIEF-P subscore for Emotional Control.

Table 2

Correlation Scores between PKTA Total Score and BRIEF-P Clinical Scales

BRIEF-P clinical scales	M (SD)	PKTA Total Score Pearson Correlation
Working Memory	46.20 (8.14)	**.29**
Inhibitory Control	46.60 (6.34)	**.52***
Shifting	49.73 (8.71)	.10
Emotional Control	49.00 (9.67)	**.39**
Planning/Organizing	44.87 (9.21)	.18
Inhibitory Self-Control Index	47.13 (7.33)	**.53***
Flexibility Index	49.27 (9.07)	**.28**
Emergent Metacognition Index	45.27 (8.69)	.24
Global Executive Composite	47.27 (9.33)	**.34**

Note. Significant correlations ($p < .05$) are marked with an *. Fair or better correlations ($r > .25$) are in bold. BRIEF-P = The Behavior Rating Inventory of Executive Function. PKTA = Preschool Kitchen Task Assessment.

Correlations between the PKTA time and BRIEF-P clinical scales are reported in Table 3. Four non-significant but moderate relationships were found between the PKTA time and BRIEF-P subscores, including Inhibitory Control, Emotional Control, the Inhibitory Self-Control Index, and the Flexibility Index.

Table 3

Correlation Scores between PKTA Time Score and Clinical Scales of the BRIEF-P

BRIEF-P clinical scales	Total Time to complete PKTA (Person Correlation)
Working Memory	.13
Inhibitory Control	**.36**
Shifting	.21
Emotional Control	**.36**
Planning/Organizing	.09
Inhibitory Self-Control Index	**.43**
Flexibility Index	**.33**
Emergent Metacognition Index	.10
Global Executive Composite	.17

Note. Fair or better correlation ($r > .25$) are in bold. BRIEF-P = The Behavior Rating Inventory of Executive Function. PKTA = Preschool Kitchen Task Assessment.

Dimensional change card sort.

Little to no relationship was found between the PKTA total score and the Dimensional Change Card Sort, as reported in Table 4.

Forward and backward digit span.

Little to no relationship was found between the PKTA total score and Forward Digit Span Task. A moderate non-significant relationship was found between the PKTA total score and the Backward Digit Span Task, as reported in Table 4.

Table 4

Correlation Scores between Total Score on PKTA and the Neuropsychological Assessments

Neuropsychological Assessments	PKTA total score (Person Correlation) r = n
DCCS	-.09
FDS	-.03
BDS	**-.48**

Note. Fair or better correlation (r >.25) are in bold, no relationships are significant. PKTA = Preschool Kitchen Task Assessment. DCCS = Dimensional Change Card Sort. FDS = Forward Digit Span Task. BDS = Backward Digit Span Task.

Description of Performance on the PKTA By Age

There were a total of seven three-year-olds, four four-year-olds, and four five-year-olds. The mean total score on the PKTA for all participants was 61.00 (SD = 33.52). The age-related scores are reported in Table 5.

Table 5

Performance on the PKTA by Age

Age	%	M (SD)
3-year-olds	46.7	46.20 (8.14)
4-year-olds	28.6	46.60 (6.34)
5 year-olds	28.6	49.73 (8.71)

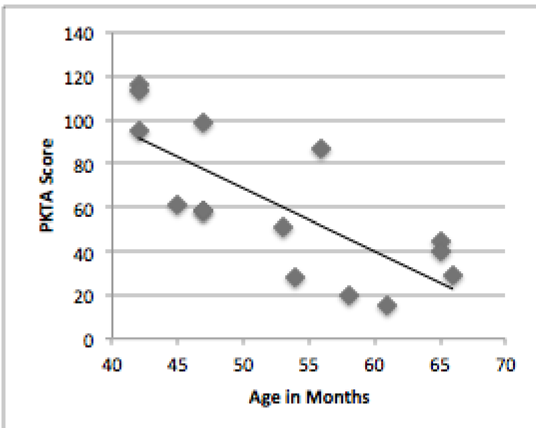
Note. M = mean; *SD* = standard deviation. PKTA = Preschool Kitchen Task Assessment.

Age Sensitivity of the PKTA

A good negative significant relationship was found between the age of the participant in months and their total score on the PKTA, as seen in Figure 1. As the child's age increased, their score on the PKTA tended to decrease, indicating improvement of EF with age.

Figure 1

Relationship of Age to PKTA Score



Qualitative Observations

Researchers made qualitative observations of the participants throughout the study to assess the participants' responses to the battery of assessments. Observations included a high level of engagement when completing the PKTA as compared to the neuropsychological assessments. All children appeared intrinsically motivated and proud of their final craft project. Furthermore, a variety of skills could be observed during the craft project, including: fine motor, visual motor, visual perceptual, sensory processing, and social referencing.

Discussion

The purpose of the present study was to examine the validity of the PKTA as a measure of EF skills in preschool-aged children. The researchers compared typical preschoolers' scores on the PKTA to their scores on the BRIEF-P, DCCS, and FDS and BDS to determine the validity of the PKTA. The research findings support the preliminary validity of the PKTA. The preschoolers' scores on the PKTA had moderate significant correlations, and fair non-significant correlations with scores on specific subsets of the BRIEF-P, with little to no relationship found between the PKTA, DCCS, and FDS, and a moderate correlation with the BDS. Results show scores on the PKTA appear to be sensitive to age. Qualitative observations appear to support the PKTA as an ecologically valid assessment.

Is the PKTA a Valid Measure of Executive Function?

The first research question analyzed the validity of the PKTA as a measure of EF by comparing it to several established neuropsychological assessments: the BRIEF-P, DCCS, FDS, and BDS. The scores compared on the BRIEF-P and PKTA indicated fair to moderate significance in the categories of inhibitory control, emotional control, and a non-significant correlation to shifting attention. Therefore, children with developed inhibition and emotional control may be less impulsive and more likely to follow directions and attend to a meaningful task such as the PKTA. No significant relationship between the PKTA and children's ability to shift attention was noted with the BRIEF-P or DCCS; this may indicate the PKTA does not require children to shift their attention due to environmental demands or the familiarity of the task. Overall, this study supports the PKTA as a measure of inhibitory control and working memory and further research may be used to determine whether the PKTA is a valid measure of shifting attention.

Results of the DCCS and FDS show little to no relationship between scores on the PKTA with these existing assessments; however, a moderate non-significant relationship was found between the PKTA total score and scores on the BDS. The moderate correlation between the BDS and PKTA corroborates with previous theory regarding the increase in utilization and incorporation of EF skills as the child gets older. Therefore, it is evident children who are younger in age will typically obtain higher scores on the PKTA and subsequently receive lower scores on the BDS. Overall, these assessments provided secondary quantitative and qualitative information to supplement the findings posited by total scores and observations pertaining to children's performance on the PKTA.

Is the PKTA Sensitive to Age?

Results demonstrated that the PKTA is sensitive to age. Younger children received higher total scores on the PKTA, whereas older children scored lower on the assessment, thus indicating that younger children may require more cueing and assistance than older children. This finding is consistent with developmental theory of EF in that EF skills, such as inhibitory control, emotional control, and working memory, are known to develop and proliferate during the preschool years. It is evident that assessments measuring EF skill development in preschoolers should show significant changes in total score as children age; results of the PKTA corroborate with this assumption.

Ecological Validity of the PKTA

Qualitative observations of children's performance provide further implications for the ecological validity of the PKTA as a measurement of EF in preschoolers. A secondary relationship to be considered when assessing the ecological validity of the PKTA is the interaction between preschool and the development of EF skills. All participants were attending preschool at the time of the present study; this experience may potentially influence their performance and subsequent total scores on the PKTA. It is likely there is a correlation between attending preschool and EF development due to children's participation in meaningful activities that incorporate and enhance their development of EF skills. Therefore, future studies assessing the PKTA as a measurement of EF should include children who are not currently attending preschool classes.

Qualitative Results of the PKTA

All of the children tested demonstrated full engagement and intrinsic motivation while completing the PKTA, were able to successfully complete the picture, and were proud of their final product. In contrast, while all children eventually cooperated with completing the DCCS and DST, some children were initially resistant to participating in these assessments, and seemed to understand that they were being 'tested' with an artificial type of activity.

Qualitative observations of children's performance on the PKTA showed a high level of motivation and increased use of social referencing, non-verbal communication, and incorporation of self-regulation strategies. Children who relied heavily on verbal cues provided by the instructor also appeared to solicit frequent eye contact and non-verbal cues (i.e., smiling, nodding, shaking head, etc.). Children who continually applied social referencing throughout their completion of the PKTA typically required direct verbal instructions for the majority of PKTA steps and therefore received a higher total score. On the other hand, children who required less verbal instructions (i.e., verbal guidance or gesture guidance) typically did not require frequent eye contact or forms of non-verbal reinforcement from the instructor. Furthermore, children who appeared to self-regulate through the use of intrinsic strategies (e.g., deep breaths, looking at image multiple times, self-talk) required less directive instructions and typically completed the step with either verbal or gesture guidance. Qualitative observations show that children who appear to utilize and maintain established EF skills, such as inhibition, emotional control, and working memory, tend to be more successful in their completion of the PKTA and typically obtain lower total scores as a result.

The PKTA also provided an opportunity to observe children's behaviors related to organization, fine motor skills, sensory processing, and visual perceptual skills. Organization skills could be observed in the way the child arranged their workspace and the attention paid to retrieving materials and putting them away after use. The administrator was also able to observe the effect of organization skills on the ability of the child to complete the project in a reasonable amount of time. The PKTA provided an opportunity to observe a child's fine motor skills, including scissor use, grasp, and eye-hand coordination while using scissors, a crayon, a stamp pad, a glue stick, and a variety of other materials. Sensorimotor processing could be observed through observation of postural control during this tabletop activity, as well as aspects of body awareness and proprioception, such as functional modulation of force to produce the desired outcome when gluing, cutting, stamping and drawing. Finally, visual perceptual skills were apparent in the degree to which the child was able to observe the sample picture and replicate the sample on his own paper with varying degrees of assistance.

Limitations and Future Recommendations

There are several potential limitations present in this research study. A major limitation was the small size of the population being tested, with a sample of 15 preschool-aged children (five girls and ten boys). Results of the study showed few significant correlations and the small sample size may impact generalizability of the results to a larger population of young children. A secondary limitation of the study is that some of the data may be subject to potential bias. Data obtained through parent completion of the BRIEF-P may be subject to biases due to personal interpretation of proposed questions, or there may be experimenter bias wherein participants may be influenced by a desire to please the researchers. A final limitation of the present study is the primary use of English in the assessment measures, thereby limiting the population to children and parents who are proficient in English. These limitations may be addressed by testing a wider population of children in order to incorporate a larger sample size. Future studies utilizing the PKTA and BRIEF-P may be translated into other languages to encompass more diverse populations and thereby result in a more diverse sample of participants.

Conclusion

Many common childhood disorders, such as ASD and ADHD, present with deficits in EF development. Pediatric OTs work with preschool-aged children living with these disorders, as well as other young children without specific diagnoses, who are at-risk for EF deficits due to internal or external factors. Delays in the development of discrete EF skills, such as inhibition and working memory, as well as the complex EF skills of problem-solving and goal-directed activity, impact a child's participation in their daily occupations and overall quality of life. The neuropsychological tests currently available for assessing EF may be useful for screening purposes, but they do not provide the depth of information required to assist an OT in planning interventions for a child with EF deficits. Therefore, it is necessary to develop an ecological measure of EF in preschool-aged children, such as the PKTA.

The PKTA is a performance-based assessment that engages a child in a real world task of completing a craft project, thus providing more detailed and relevant information pertaining to a child's EF development. Overall, results of this pilot study showed that the PKTA demonstrates preliminary validity as a measure of EF in preschoolers. With further research, the PKTA may serve as an effective tool for OTs to gain a holistic understanding of how EF deficits may be impacting a child's performance in meaningful occupations, thereby allowing OTs to contribute their specialized knowledge and skills to the team of individuals supporting the child's participation in meaningful activities.

References

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5*. Washington, D.C.: American Psychiatric Association.

Baum, C., & Edwards, D. F. (1993). Cognitive performance in senile dementia of the Alzheimer's type: the Kitchen Task Assessment. *The American Journal of Occupational Therapy*, *47*(5), 431-436. doi: 10.5014/ajot.47.5.431

Berg, C. (2009). *PKTA technical manual.* Unpublished assessment, Program in Occupational Therapy, Washington University School of Medicine, St. Louis, Missouri.

Berg, C., Edwards, D., & King, A. (2012). Executive function performance on the Children's Kitchen Task Assessment with children with sickle cell disease and matched controls. *Child Neuropsychology: A Journal on Normal and Abnormal Development in Childhood and Adolescence*, *18*(5), 432-448. doi: 10.1080/0927049.2011.613813

Berk, L. E., Mann, T. D., & Ogan, A. T. (2006). Make-believe play: Wellspring for development of self-regulation. *Child Development*, *63*(2), 281-304. doi: 10.1037/a0026299

Bernier, A., Beauchamp, M. H., Bouvette-Turcot, A. A., Carlson, S. M., & Carrier, J. (2013). Sleep and cognition in preschool years: specific links to executive functioning. *Child Development*, *84*(5), 1542-1553. doi: 10.1111/cdev.12063

Bernier, A., Carlson, S. M., & Whipple, N. (2010). From external regulation to self-regulation: Early parenting precursors of young children's executive functioning. *Child Development*, *81*(1), 326-339. doi:10.1111/j.1467-8624.2009.01397.x

Best, J. R. (2010). Effects of physical activity on children's executive function: Contributions of experimental research on aerobic exercise. *Developmental Review*, *30*(4), 331-351. doi:10.1016/j.dr.2010.08.001

Blair, C. (2002). School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *American Psychologist, 57*(1), 111-127. doi: 10.1037/0003-066X.57.2.111

Blair, C. & Diamond, A. (2008). Biological processes in prevention and intervention: The promotion of self-regulation as a means of preventing school failure. *Development and Psychopathology*, *20*(1), 899-911. doi: 10.1017/S0954579408000436

Blair, C., Raver, C. C., & Berry, D. J. (2014). Two approaches to estimating the effect of parenting on the development of executive function in early childhood. *Developmental Psychology*, *50*(2), 554-565. doi: 10.1037/a0033647

Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development*, *78*(2), 647-663. doi: 10.1111/j.1467-8624.2007.01019.x

Boyle, C. A., Boulet, S., Schieve, L. A., Cohen, R. A., Blumberg, S. J., Yeargin-Allsopp, M., & Kogan, M. D. (2011). Trends in the prevalence of developmental disabilities in US children, 1997-2008. *Pediatrics, 127*(6), 1034-1042. doi: 10.1542/peds.2010-2989

Brassard, M. A. (2007). A multifactor ecocultural model of assessment and the assessment process. In M. Brassard & A. Boehm (Eds.), *Preschool assessment: Principles and practices* (pp. 22-40). New York, NY: Guilford Press.

Buckhalt, J. A., El-Sheikh, M., & Keller, P. (2007). Children's sleep and cognitive functioning: race and socioeconomic status as moderators of effects. *Child Development*, *78*(1), 213-231. doi: 10.1111/j.1467-8624.2007.00993.x

Cannon, M. J., Guo, J., Denny, C. H., Green, P. P., Miracle, H., Sniezek, J. E., & Floyd, R. L. (2014). Prevalence and characteristics of women at risk for an alcohol-exposed pregnancy (AEP) in the United States: Estimates from the National Survey of Family Growth. *Maternal and Child Health Journal*. Online publication. doi: 10.1007/s10995-014-1563-3

Carlson, S. M. (2005). Developmentally sensitive measures of executive function in preschool children. *Developmental Neuropsychology*, *28*(2), 595-616. doi:10.1207/s15326942dn2802_3

Carlson, S. M. & Wang, T. S. (2007). Inhibitory control and emotion regulation in preschool children. *Cognitive Development*, *22*, 489–510. doi:10.1016/j.cogdev.2007.08.002

Carpenter, B. (2011). Pedagogically bereft! Improving learning outcomes for children with foetal alcohol spectrum disorders. *British Journal of Special Education*, *38*(1), 37-43. doi:10.1111/j.1467-8578.2011.00495.x

Center on the Developing Child at Harvard University. (2011). Building the brain's "air traffic control" system: How early experiences shape the development of executive function (Working Paper #11). Retrieved from Harvard University, Center on the Developing Child website: http://developingchild.harvard.edu/index.php/resources/reports_and_working_papers/working_papers/wp11/

Chaytor, N., Schmitter-Edgecombe, M., & Burr, R. (2006). Improving ecological validity of executive functioning assessment. *Archives of Neuropsychology*, *21*, 217-227. doi: 10.1016/j.acn.2005.12.002

Chevignard, M. P., Catroppa, C., Galvin, J. & Anderson, V. (2010). Development and evaluation of an ecological task to assess executive functioning post childhood TBI: The children's cooking task. *Brain Impairment, 11*(*2*), 125-143. doi: 10.1375/brim.11.2.125

Chevignard, M. P., Servant, V., Mariller, A., Abada, G., Pradat-Diehl, P., & Laurent-Vannier, A. (2009). Assessment of executive functioning in children after TBI with a naturalistic open-ended task: A pilot study. *Developmental Neurorehabilitation*, *12*(2), 76-91. doi: 10.1080/17518420902777019

Cole, M. W., Etzel, J. A., Zacks, J. M., Schneider W., & Braver, T. S. (2011). Rapid transfer of abstract rules to novel contexts in human lateral prefrontal cortex. *Frontiers in Human Neuroscience*, *5(*142). doi:10.3389/fnhum.2011.00142

Dahl, R. (1996). The regulation of sleep and arousal: Development and psychopathology. *Development and Psychopatholog*y, *8*(1), 3-27. doi: 10.1017/S0954579400006945

Dallman, M.F. (2010). Stress-induced obesity and the emotional nervous system. *Trends in Endocrinology & Metabolism*, *21*(3), 159-65. doi: 10.1016/j.tem.2009.10.004

Davidson, M. C., Amso, D., Anderson, L. C., & Diamond, A. (2006). Development of cognitive control and executive functions from 4 to 13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia*, *44*(11), 2037-2078. doi:10.1016/j.neuropsychologia.2006.02.006

Davis, H. L., & Pratt, C. (1995). The development of children's theory of mind: The working memory explanation. *Australian Journal of Psychology*, *47*(1), 25-31. doi: 10.1080/00049539508258765

Davis, C. L., Tomporowski, P. D., McDowell, J. E., Austin, B. P., Miller, P. H., Yanasak, N. E., & Naglieri, J. A. (2011). Exercise improves executive function and achievement and alters brain activation in overweight children: A randomized, controlled trial. *Health Psychology*, *30*(1), 91-98. doi: 10.1037/a0021766

Denham, S. A. (1998). *Emotional development in young children*. New York, NY: Guilford Press.

Denham, S.A., Blair, K.A., DeMulder, E., Levitas, J., Sawyer, K., Auerbach-Major, S. (2003). Preschool emotional competence: Pathways to social competence? *Child Development*, *74*(1), 238-256. doi: 10.1111/1467-8624.00533

Diamond, A. (2006). The early development of executive functions. In E. Bialystok & F. Craik (Eds.), *Lifespan cognition: Mechanisms of change* (pp. 70-95). New York, NY: Oxford University Press.

Diamond, A., Carlson, S. M., & Beck, D. M. (2005). Preschool children's performance in task switching on the dimensional change card sort task: Separating the dimensions aids the ability to switch. *Developmental Neuropsychology, 28*(2), 689-729. doi: 10.1207/s15326942dn2802_7

Dionne, G., Touchette, E., Forget-Dubois, N., Petit, D., Tremblay, R. E., Montplaisir, J. Y. (2011). Associations between sleep-wake consolidation and language development in early childhood: A longitudinal twin study. *Sleep, 34*(1), 987–995.

Dunn, J., & Cutting, A. L. (1999). Understanding others, and individual differences in friendship interactions in young children. *Social Development, 8*(1), 201-219. doi: 10.1111/1467-9507.00091

Dunn, J., & Herrera, C. (1997). Conflict resolution with friends, siblings, and mothers: A developmental perspective. *Aggressive Behavior*, *23*(5), 343-357. doi: 10.1002/(SICI)1098-2337(1997)23:5<343::AID-AB4>3.0.CO;2-J

Fantuzzo. J., Sekino, Y., & Cohen, H. L. (2004). An examination of the contributions of interactive peer play to salient classroom competencies for urban head start children. *Psychology in the Schools, 41*(1), 323-336. doi: 10.1002/pits.10162

Francis, L. A., & Susman, E. J. (2009). Self-regulation and rapid weight gain in children from age 3 to 12 years. *Archives of Pediatrics & Adolescent Medicine*, *163*(4), 297-302. doi:10.1001/archpediatrics.2008.579

Frank-Briggs, A. (2011). Attention deficit hyperactivity disorder (ADHD). *Journal of Pediatric Neurology*, *9*(3), 291-298. doi:10.3233/JPN-2011-0494

Friedman, N. P., Miyake, A., Young, S. E., DeFries, J. C., Corley, R. P., & Hewitt, J. K. (2008). Individual differences in executive functions are almost entirely genetic in origin. *Journal of Experimental Psychology: General*, *137*(2), 201-225. doi:10.1037/0096-3445.137.2.201

Gioia, G. A., Espy, K. A., & Isquith, P. K. (2002). *Behavior Rating Inventory of Executive Function, Preschool Version (BRIEF-P).* Odessa, FL: Psychological Assessment Resources.

Graham, S., Hudley, C., & Williams, E. (1992). Attributional and emotional determinants of aggression among African-American and Latino young adolescents. *Developmental Psychology*, *28*(4), 731-740. doi:10.1037/0012-1649.28.4.731

Guerrieri, R., Nederkoorn, C., & Jansen, A. (2007). The interaction between impulsivity and a varied food environment: its influence on food intake and overweight. *International Journal of Obesity*, *32*(4), 708-714. doi:10.1038/sj.ijo.0803770

Gunter, J. (2013). An update on attention deficit/hyperactivity disorder. *Formulary, 48*(3), 98-109.

Hammond, S. I., Müller, U., Carpendale, J. I. M., Bibok, M. B., & Liebermann-Finestone, D. (2012). The effects of parental scaffolding on preschoolers' executive function. *Developmental Psychology*, *48*(1), 271-281. doi:10.1037/a0025519

Hoffman, J. & Russ, S. (2012). Pretend play, creativity, and emotion regulation in children. *Psychology of Aesthetics, Creativity, and the Arts*, *6*(2), 175-184. doi:10.1037/a0026299

Hoyme, H. E., May, P. A., Kalberg, W. O., Kodituwakku, P., Gossage, J. P., Trujillo, P. M., D. G., Miller, J. H., Aragon, A. S., Khaole, N., Viljoen, D. L., Jones, K. L., & Robinson, L. K. (2005). A practical clinical approach to diagnosis of fetal alcohol spectrum disorders: Clarification of the 1996 institute of medicine criteria. *Pediatrics, 115*(1), 39 - 47. doi: 10.1542/peds.2004-0259

Hughes, C. (2011). Changes and challenges in 20 years of research into the development of executive functions. *Infant & Child Development*, *20*(3), 251-271. doi:10.1002/icd.736

Hughes, C., Dunn, J., & White, A. (1998). Trick or treat?: Uneven understanding of mind and emotion and executive dysfunction in ‘hard to manage’ preschoolers. *Journal of Child Psychology and Psychiatry*, *39*(1), 981-994. doi: 10.1111/1469-7610.00401

Hughes, C., & Ensor, R. (2009). How do families help or hinder the emergence of early executive function? *New Directions for Child & Adolescent Development*, *123*, 35-50. doi:10.1002/cd.234

Hughes, C., Ensor, R., Wilson, A., & Graham, A. (2010). Tracking executive function across the transition to school: A latent variable approach. *Developmental Neuropsychology*, *35*(1), 20-36. doi:10.1080/87565640903325691

Isquith, P. K., Crawford, J. S., Espy, K. A., & Gioia, G. A. (2005). Assessment of executive function in preschool-aged children. *Mental Retardation and Developmental Disabilities Research Review*, *11*, 209-215. doi: 10.1002/mrdd.20075

Isquith, P. K., Gioia, G. A., & Espy, K. A. (2004). Executive function in preschool children: Examination through everyday behavior. *Developmental Neuropsychology*, *26*(1), 403-422. DOI:10.1207/s15326942dn2601_3

Jirikowic, T. (2008). Fetal alcohol spectrum disorders: implications for pediatric occupational therapy. *Developmental Disabilities Special Interest Section Quarterly*, *31*(2), 1-4.

Lamberts, K. F., Evans, J. J., & Spikman, J. M. (2010). A real-life, ecologically valid test of executive functioning: The executive secretarial task. *Journal of Clinical & Experimental Neuropsychology*, *32*(1), 56-65. doi: 10.1080/13803390902806550

Landry, S. H., Miller-Loncar, C. L., Smith, K. E., & Swank, P. R. (2002). The role of early parenting in children's development of executive processes. *Developmental Neuropsychology*, *21*(1), 15-41. doi:10.1207/S15326942DN2101_2

Lemche, E., Lennertz, I., Rothmann, C., Ari, A., Grote, K., Hafker, J., & Klann-Delius, G. (2003). Emotion-regulatory process in evoked play narratives: Their relation with mental representatives and family interactions. *Journal of Child Psychology*, *52*(1), 156-171.

Leve, L. D., DeGarmo, D. S., Bridgett, D. J., Neiderhiser, J. M., Shaw, D. S., Harold, G. T., Natsuaki, M.N., & Reiss, D. (2013). Using an adoption design to separate genetic, prenatal, and temperament influences on toddler executive function. *Developmental Psychology, 49*(6), 1045-1057. doi:10.1037/a0029390

Liew, J. (2012). Effortful control, executive functions, and education: Bringing self-regulatory and social-emotional competencies to the table. *Child Development Perspectives, 6*(2), 105-111. doi: 10.1111/j.1750-8606.2011.00196.x

McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology, 43*(4), 947–959. doi:10.1037/0012-1649.43.4.947

Miller, E. K., & Cohen, J. D. (2001). An integrative theory of prefrontal cortex function. *Annual Review of Neuroscience*, *24*(1), 167-202. doi: 10.1146/annurev.neuro.24.1.167

Mischel, W., Shoda, Y., & Rodriguez, M. L. (1989). Delay of gratification in children. *Science*, *244*(1), 933–938. *doi:* 10.1126/science.2658056

Nadebaum, C., Anderson, V., & Catroppa, C. (2007). Executive function outcomes following traumatic brain injury in young children: A five year follow-up. *Developmental Neuropsychology, 32*(2), 703-728. doi: 10.1080/87565640701376086

NICHD Early Child Care Research Network (2005). Predicting individual differences in attention, memory, and planning in first graders from experiences at home, child care, and school. *Developmental Psychology, 41*(1), 99-114. doi:10.1037/0012-1649.41.1.99

Pennington, B. F. (2002). *Development of psychopathology: Nature and nurture*. New York, NY: The Guilford Press.

Piaget, J., & Inhelder, B. (1969). *The psychology of the child*. New York: Basic Books.

Pieper, J. R. & Laugero, K. D. (2013). Preschool children with lower executive function may be more vulnerable to emotional-based eating in the absence of hunger. *Appetite, 62*(1), 103-109. doi: 10.1016/j.appet.2012.11.020

Pinto, S., & Schub, T. (2012). In Pravikoff, D. (Ed.), *Fetal alcohol syndrome*. Glendale, California: Cinahl Information Systems.

Pooragha, F., Kafi, S. M., & Sotodeh, S. O. (2013). Comparing response inhibition and flexibility for two components of executive functioning in children with autism spectrum disorder and normal children. *Iran Journal of Pediatrics, 23*(3), 309-314. Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3684476/

Portney, L. G. & Watkins, M. P. (3rd ed.) (2009). *Foundations of clinical research: Application to practice*. Upper Saddle River, New Jersey: Pearson Prentice Hall.

Raffaelli, M., Crockett, L. J., & Shen, Y. (2005). Developmental stability and change in self-regulation from childhood to adolescence. *Journal of Genetic Psychology, 166*(1), 54-75. doi:10.3200/GNTP.166.1.54-76

Raver, C. C., Blair, C., & Willoughby, M. (2013). Poverty as a predictor of 4-year-olds' executive function: New perspectives on models of differential susceptibility. *Developmental Psychology, 49*(2), 292-304. doi:10.1037/a0028343

Rocke, K., Hays, P., Edwards, D., & Berg, C. (2008). Development of a performance assessment of executive function: the Children's Kitchen Task Assessment. *American Journal of Occupational Therapy, 62*(5), 528–537. doi: 10.5014/ajot.62.5.528

Rosenthal, M., Wallace, G. L., Lawson, R., Wills, M. C., Dixon, E., Yerys, B. E., & Kenworthy, L. (2013). Impairments in real-world executive function increase from childhood to adolescence in autism spectrum disorders. *American Psychological Association Neuropsychology, 27*(1), 13-18. doi:10.1037/a0031299

Schmuckler, M. A. (2001). What is ecological validity? A dimensional analysis. *Infancy, 2*(4), 419-436. doi: 10.1207/S15327078IN0204_02

Schoemaker, K., Bunte, T., Wiebe, S. A., Espy, K. A., Dekovic, M., & Matthys, W. (2012). Executive function deficits in preschool children with ADHD and DBD. *Journal of Child Psychology & Psychiatry, 53*(2), 111-119. doi:10.1111/j.1469-7610.2011.02468.x

Sethi, A., Mischel, W., Aber, J. L., Shoda, Y., & Rodriguez, M. L. (2000). The role of strategic attention deployment in development of self-regulation: Predicting preschoolers' delay of gratification from mother–toddler interactions. *Developmental Psychology, 36*(1), 767–777. doi:10.1037/0012-1649.36.6.767

Sherman, E. M. S. & Brooks, B. L. (2010). Behavior rating inventory of executive function-preschool version (BRIEF-P): Test review and clinical guidelines for use. *Child Neuropsychology, 16*, 503-519. doi: 10.1080/092970410003679344

Spooner, D. M., & Pachana, N. A. (2006). Ecological validity in neuropsychological assessment: A case for greater consideration in research with neurologically intact populations. *Archives of Clinical Neuropsychology, 21*(4), 327-337. doi:10.1016/j.acn.2006.04.004

Tremblay, R.E., Masse, L.C., Vitaro, F., & Dobkin, P.L. (1995). The impact of friends' deviant behavior on early onset delinquency: Longitudinal data from 6 to 13 years of age. *Development and Psychopathology, 7*(1), 649-667. doi:10.1017/S0954579400006763

Ursache, A., Blair, C., Stifter, C., & Voegtline, K. (2013). Emotional reactivity and regulation in infancy interact to predict executive functioning in early childhood. *Developmental Psychology*, *49*(1), 127-137. doi:10.1037/a0027728

van der Donk, M. A., Hiemstra-Beernink, A., Tjeenk-Kalff, A. C., van der Leij, A. V., & Lindauer, R. L. (2013). Interventions to improve executive functioning and working memory in school-aged children with AD(H)D: a randomised controlled trial and stepped-care approach. *BMC Psychiatry*, *13*(1), 1-7. doi:10.1186/1471-244X-13-23

Vygotsky, L. (1978). Interaction between learning and development. In M. Gauvain & M. Cole (Eds.), *Readings on the development children* (pp. 29-36). Retrieved from http://www.psy.cmu.edu/~siegler/vygotsky78.pdf

Weiner, N. W., Toglia, J., & Berg, C. (2012). Weekly calendar planning activity (WCPA): A performance-based assessment of executive function piloted with at-risk adolescents. *American Journal of Occupational Therapy*, *66*(6), 699-708. doi: 10.5014/ajot.2012.004754

Yuson, A. M., Engelhardt, M. H., & Dizon, F. C. (2014). *The Preschool Kitchen Task Assessment (PKTA): A pilot study exploring executive functioning in children ages 3 to 6 years* (Master's thesis, Dominican University of California). Retrieved from http://scholar.dominican.edu/cgi/viewcontent.cgi?article=1015&context=masters-theses

Zelazo, P. D., Müller, U., Frye, D., & Marcovitch, S. (2003). The development of executive function in early childhood [Monograph]. *Monographs of the Society for Research in Child Development*, *68*(3, Serial No. 274), i-151. Retrieved from http://libres.uncg.edu/ir/uncg/f/J_Boseovski_Development_2003.pdf

Appendix A
SAMPLE LETTER TO PRESCHOOL

Program Director, Name of Preschool

Dear (Name of Preschool Director):

This letter confirms that you have been provided with a brief description of our graduate thesis research project, which concerns assessment of thinking skills and problem solving in preschool children using the Preschool Kitchen Task Assessment. This project is an important part of my graduation requirements as an Occupational Therapy major, and is being supervised by Dr. Julia Wilbarger, Professor of Occupational Therapy at Dominican University of California.

As we discussed, I will make every effort to ensure that my data collection will be scheduled at a time convenient for your school, and that your students are treated with the utmost discretion and sensitivity. I will be sure to share all forms with you for your comments and final approval before distributing anything to parents. If you have questions about the research you may contact me at xxx-xxxx. If you have further concerns you may contact my research supervisor, Dr. Wilbarger, at xxx-xxxx or the Institutional Review Board for the Protection of Human Subjects at Dominican University of California by calling xxx-xxxx.

After my research project has been completed in November 2014, I will be glad to send you a summary of my research results.

If my request to visit your school and to assess your students meets with your approval, please sign and date this letter below and return it to me in the enclosed self-addressed, stamped envelope as soon as possible. Please feel free to contact me if you have any questions about this project.

Thank you very much for your time and cooperation.

Sincerely,

Team PKTA

I agree with the above request

____

Signature **Date**

Appendix B
CONSENT FORM TO ACT AS A RESEARCH PARTICIPANT
DOMINICAN UNIVERSITY OF CALIFORNIA
Preschool Kitchen Task Assessment Study

Purpose and Background of the Study:

Emily Fry, Hayley Gilligan, Liza Henty-Clark, and Jennifer Weissensee, graduate students and their faculty advisor Dr. Julia Wilbarger from the Department of Occupational Therapy at Dominican University of California, are conducting a research study designed to look at the validity of a new assessment of thinking and problem solving skills in young children: The Preschool Kitchen Task Assessment.

The purpose of this research is to examine how accurately the Preschool Kitchen Task Assessment (PKTA) measures a child's ability to initiate, organize, plan, and sequence a craft activity. Scores on the PKTA record the level of assistance the child needs to complete a simple craft activity. Children's scores on the PKTA will be compared to their scores on the Parent Behavior Rating Inventory for Executive Function (P-BRIEF), the Dimensional Change Card Sort (DCCS) (sorting task) and a Digit Span Task (memory task). All are established tool for assessing thinking and problem solving skills (executive functions) in children. Parent's role in this study is to provide information about their child's past and current developmental, medical, and behavioral history.

I am being asked to participate in this study because I am a parent of a typically developing 3 to 5 year old child

Procedures:

If I agree to be a participant in this study, the following will happen:

1. I will be asked to complete a background information questionnaire about my child's developmental and medical history, my education and current occupation. It will take about 10 minutes to complete this form.

2. I will complete the Behavior Rating Inventory of Executive Function (P-BRIEF), which asks questions about my child's behaviors in areas such as attention and self-control. It will take about 20 minutes to complete this form. I am encouraged to answer all of the questions, but may omit any items that I do not want to answer.

Risks and/or Discomforts:

1. I understand that my participation involves minimal to no physical risk, but may involve some psychological discomfort completing the Parent BRIEF which asks about a child's behavior problems.

2. I may decline to answer any question that seems to be too personal in nature, causes me distress or seems an invasion of my privacy. I may elect to stop participating before or after the study is started without any adverse effects.

3. Study records will be kept as confidential as possible. No individual identities will be used in any reports or publications resulting from the study. All personal references and identifying information will be eliminated when the data are recorded, and all participants will be identified by numerical code only, thereby assuring confidentiality regarding the participant's results. The master list for these codes will be kept by the researchers in a locked file separate from other records. Only the researchers, their faculty adviser, and research assistants will see the data.

One year after the completion of the research, all written and recorded materials will be destroyed.

Benefits:

There will be no direct benefit to me from participating in this study. The anticipated benefit of this study is to begin validating the PKTA, a potentially useful tool for assessing thinking skills in young children.

Costs/Financial Considerations:

There will be no cost to me or my child as a result of taking part in this study.

Payment/Reimbursement:

Neither my child no I will be reimbursed for participation in this study.

Questions:

I have talked to the student researchers about this study and have had my questions answered. If I have further questions about the study, I may contact them at PKTAthesis@gmail.com or their research supervisor, Julia Wilbarger, PhD, OTR/L, Occupational Therapy Department, Dominican University of California, xxx-xxxx.

If I have any questions or comments about participation in this study, I should talk first with the research team and the research supervisor. If for some reason I do not wish to do this, I may contact the Dominican University of California Institutional Review Board for the Protection of Human Subjects (IRBPHS), which is concerned with the protection of volunteers in research projects. I may reach the IRBPHS Office by calling xxx-xxxx and leaving a voicemail message, by FAX at xxx-xxxx or by writing to the IRBPHS, Office of the Associate Vice President for Academic Affairs, Dominican University of California, 50 Acacia Avenue, San Rafael, CA 94901.

Consent

I have been given a copy of this consent form, signed and dated, to keep.

PARTICIPATION IN RESEARCH IS VOLUNTARY. I am free to decline to be in this study or withdraw my participation at any time without fear of adverse consequences. My decision to participate or not will not affect my child's participation in their preschool program.

My signature below indicates that I agree to participate in this study.

Subject's Signature **Date**

Researcher's Signature **Date**

Appendix C
PROXY CONSENT FORM FOR RESEARCH PARTICIPATION
DOMINICAN UNIVERSITY of CALIFORNIA
Preschool Kitchen Task Assessment Study

Child Assent Form

Title of Study: The Preschool Kitchen Task Assessment: A Valid Measure of Executive Functions in Preschoolers?

Student Researchers: Hayley Gilligan, Liza Henty-Clark, Emily Veith, and Jenn Weissensee

Principal Investigator: Julia Wilbarger, Ph.D., OTR/L
Phone: xxx-xxxx Email: julia.wilbarger@dominican.edu

You are being asked to be in a research study to see how you can make something. If you say yes, you will have to do two things. You will work for a while and you can take breaks if you need them. Some of the parts might be hard but try to do the best you can.

Today you get to:
Make a caterpillar: You will look at pictures to make your caterpillar. You should try to follow the directions by yourself. We will give you help if you need it. You will be able to keep the picture of the caterpillar that you make.
Card game: We will show you some cards with pictures on it. You will have to put the cards into two piles.
Number game: We will tell you two numbers and you have to repeat them back to us. Sometimes the numbers will be backwards.

Being in this study will help us learn better ways to look at how children can solve problems.

You can decide not to be in this study and you can choose to stop at any time.

The researcher will sign below to indicate verbal assent of child.

I have described the study and explained the risks and benefits in language that is understandable to the child. I believe the child understood and has assented to participate in the study.

____
Printed Name Date

____
Signature of Investigator or Person Obtaining Consent Date

Appendix D
IRB Approval Letter

February 4, 2014

Hayley Gilligan
50 Acacia Ave.
San Rafael, CA 94901

Dear Hayley:

I have reviewed your proposal entitled *The Preschool Kitchen Task Assessment: A Valid Measure of Executive Functions in Preschoolers?* submitted to the Dominican University Institutional Review Board for the Protection of Human Participants (IRBPHP Application, #10235). I am approving it as having met the requirements for minimizing risk and protecting the rights of the participants in your research.

In your final report or paper please indicate that your project was approved by the IRBPHP and indicate the identification number.

I wish you well in your very interesting research effort.

Sincerely,
Martha Nelson, Ph.D.
Associate Vice President for Academic Affairs
Chair, IRBPHP

cc: Julia Wilbarger

Institutional Review Board for the Protection of Human Subjects
Office of the Associate Vice President for Academic Affairs • 50 Acacia Avenue, San Rafael, California 95901-2298 • 415-257-1310
www.dominican.edu

Appendix E
DST CUEING GUIDELINES

FORWARD DIGIT SPAN (ERNIE)

Let's play a game where you copy me, OK? (get Ernie)

Here's my friend Ernie. (says hi)

Ernie's going to copy me first, so whatever I say, he says it too!

Like this. If I say 1, 2, 3, Ernie says, 1, 2, 3 (diff voice). Like that!

Now you try. (put Ernie out of view)

I'll say some numbers and then you say those numbers, just exactly the same way I did.

Practice
Let's practice: 4, 2 **C's Final Response: __________** **# tries_____**
(correct as needed, up to 6 tries, then do test trials)

Great! Let's do some more like that.

Remember, whatever I say, you say it the same.

Test trials

Digits: (circle correct items; strike out failures; move up a level after a correct answer; discontinue after three consecutive failures)

	2-digits		3-digits	4-digits	5-digits
Fail ↓	1, 4	**Pass**→	6, 4, 2	1, 2, 4, 6	4, 2, 1, 3, 5
	5, 3		3, 5, 1	3, 1, 5, 2	5, 6, 4, 3, 2
	2, 6		2, 3, 6	6, 5, 3, 4	2, 3, 4, 1, 6

6-digits	7-digits
1, 2, 5, 9, 3, 7	9, 7, 2, 1, 5, 4, 6
7, 2, 5, 2, 1, 4	7, 4, 6, 2, 9, 3, 1
5, 4, 2, 8, 3, 6	8, 4, 6, 7, 2, 5, 9

Highest Level on FDS: _____
(Note to coders: If C could not do Level 2, Highest Level on FDS = 1.)

BACKWARD DIGIT SPAN (ERNIE)

Now I have a new game where we say things backward. (get Ernie)

Here's Ernie again. (says hi)

Now Ernie's being silly, so whatever I say, he says it backward. He says it the wrong way.

Like this, if I say the numbers "1, 2" Ernie says "2, 1" (diff. voice) Like that!

Isn't that silly?

Now you try. (put Ernie out of view)

Whatever I say, you say it backward, OK?

Practice
Let's practice: 1, 2 **C's Final Response**: __________ **# tries**_____
(correct as needed, up to 6 tries, then do test trials)

Great! Let's do some more like that.

Test Trials

Remember, whatever I say, you say it backward.

Digits: (circle correct items; strike out failures; move up a level after a correct answer; discontinue after three consecutive failures)

	2-digits		3-digits	4-digits	5-digits
Fail ↓	1, 4	**Pass**→	6, 4, 2	1, 2, 4, 6	4, 2, 1, 3, 5
	5, 3		3, 5, 1	3, 1, 5, 2	5, 6, 4, 3, 2
	2, 6		2, 3, 6	6, 5, 3, 4	2, 3, 4, 1, 6

Highest Level on BDS: _____

(Note to coders: If C could not do Level 2, Highest Level on BDS = 1)

Appendix F
DCCS CUEING INSTRUCTIONS

INITIAL RULES (Shape)		
Let's play a game called the shape game. We will play with two shapes: one of them is a star and the other one is a truck. So, in the shape game….		
Gesture to boxes on "here" and "there" throughout. *Place star card in box.*	…all the stars go here, and all the trucks go there. See, here's a star. So, it goes here. If it's a star, it goes here; if it's a truck, it goes there. Now, here's a truck. Where does this one go?	
If correct:	Very good. You know how to play the **SHAPE** game.	
If points only:	Can you put it inside (the box) (for me)? [or: Can you help me put this truck in the box?]	
If incorrect:	No, this one's a truck, so it has to go over here in the **SHAPE** game. Can you help me put this truck down?	
All right. Now, it's your turn. So, remember…		
Say for cards *1, 2, & 3*	In this game, if it's a star, it goes here; if it's a truck, it goes there. 1. **(blue truck)** Here's a truck.	

	Star _____ **Truck** _____ 2. **(red star)** Here's a star. **Star** _____ Truck _____ 3. **(blue truck)** Here's a truck. Star _____ **Truck** _____	
(If needed…) *Interim Reminder for card 4*	Remember, we're playing the **SHAPE** game. If it's a star, it goes here; if it's a truck, it goes there. 4. **(blue truck)** Here's a truck. Star _____ **Truck** _____	
(If needed…) *Say for cards 5 & 6*	In this game, if it's a star, it goes here; if it's a truck, it goes there. 5. **(red star)** Here's a star. **Star** _____ Truck _____ 6**. (red star)** Here's a star. **Star** _____ Truck _____	
RULE SWITCH (Color)		
Now, we're going to play a new game. We're going to play the **COLOR** game. We will play with two colors: one of them is blue, And the other one is red. So, in the color game… all the blue ones go here, and all the red ones go there. Remember…		
Say for cards 1, 2, & 3	In this game, if it's blue, it goes here; if it's red, it goes there. 1. **(red star)** Here's a red one.	

	Blue ____ **Red** _____ 2. **(blue truck)** Here's a blue one. **Blue** ____ Red _____ 3. **(blue truck)** Here's a blue one. **Blue** ____ Red _____	
(If needed…) *Interim Reminder for card 4*	Remember, we're playing the **COLOR** game. If it's blue it goes here; if it's red, it goes there. 4. **(red star)** Here's a red one. Blue ____ **Red** _____	
(If needed…) *Say for cards 5 & 6*	In this game, if it's blue, it goes here; if it's red, it goes there. 5. **(red star)** Here's a red one. Blue ____ **Red** _____ **6. (blue truck)** Here's a blue one. **Blue** ____ Red _____	
We finished all the cards! You did such a great job playing that game with me! *(END OF TASK!)*		