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## An Examination of a Yoga Intervention and Elementary Students' Selective Attention and Executive Function in the School Setting

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Dr. Kenneth Tyler, Director of Graduate Studies

AN EXAMINATION OF A YOGA INTERVENTION AND  
ELEMENTARY STUDENTS' SELECTIVE ATTENTION AND EXECUTIVE  
FUNCTION IN THE SCHOOL SETTING

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DISSERTATION

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A dissertation submitted in partial fulfillment of the  
requirements for the degree of Doctor of Philosophy in the  
College of Education  
at the University of Kentucky

By  
M. Jill Rogers

Lexington, Kentucky

Director: Dr. Alicia Fedewa, Associate Professor and Program Chair, College of  
Education, Department of Educational, School, and Counseling Psychology  
Lexington, Kentucky

2016

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## ABSTRACT OF DISSERTATION

### AN EXAMINATION OF A YOGA INTERVENTION AND ELEMENTARY STUDENTS' SELECTIVE ATTENTION AND EXECUTIVE FUNCTION IN THE SCHOOL SETTING

The purpose of this study was to examine the effect of yoga on children's executive function and selective attention. There were three primary aims of this study. The first aim was to examine whether yoga would have a positive effect on children's selective attention in a school setting. Another aim was to explore if teachers will report an improved change in children's executive function in the classroom. The final aim was to determine if yoga would be a socially acceptable intervention to teachers and students. Participants included three fifth grade students and two teachers. Mixed methods were used to visually analyze selective attention data using a Multiple Probe Across Participants Multiple Baseline design, as well quantitative analysis of executive functioning data and qualitative analysis of social validity data. Results indicated that no functional relations were found between selective attention and yoga and no significant differences were found on pre-post measures of executive functioning. Improvements were seen when descriptive data was analyzed for dependent variables and the intervention was determined to be socially acceptable to teachers and students. Implications from the findings and recommendations for future research are presented.

KEYWORDS: children, executive function, attention, yoga, school

M. Jill Rogers

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Student's Signature

June 7, 2016

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Date

AN EXAMINATION OF A YOGA INTERVENTION AND  
ELEMENTARY STUDENTS' SELECTIVE ATTENTION AND EXECUTIVE  
FUNCTION IN THE SCHOOL SETTING

By

M. Jill Rogers

Alicia Fedewa  
Director of Dissertation

Kenneth Tyler  
Director of Graduate Studies

June 7, 2016  
Date

## DEDICATION

I would never have attempted to pursue this path in life without the encouragement of my husband, Trip Rogers. He helped me see how capable I was of pursuing my doctorate, increasing my confidence to aim for the top and to take the path less traveled. His unconditional love and support inspires me to be the best version of myself, and here I am, full of gratitude and awe at the successes I have had so far in life. My son, Chance, has also been an unwavering support. I cannot express how fortunate I am to have such a fine young man in my life who has been understanding of the sacrifices I have had to make in pursuing my doctorate. I can gladly say that I completed my education before he graduates with his first college degree! My mother and sister, Pam Denny and Tesha McCarty, have always been my first teachers, caregivers, and exemplars of how to become a strong and intelligent woman myself. My extra parents that I gained through marriage, Carl and Lynne Rogers, have been selfless in supporting my family and me through the ups and downs of bettering myself through my education. In addition, I have to acknowledge all of my dearest friends for sticking with me through this journey. The companionship I have received from my family and friends is vast compared to this dedication that I humbly make to each and every one of them; I love you all. Thank you for riding these waves with me.

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## **Chapter 1: Introduction**

Executive function allows individuals to self-regulate behavior through mental processes that control planning and decision-making (Berger, 2011). Selective attention is one of many aspects of executive functioning and influences how individuals process information in order to make decisions about dividing up mental resources when presented with multiple demands from the environment (Plude, Enns, & Brodeur, 1994). These skills are important in child development and academic learning (Norman & Breznitz, 1992; Plude et al., 1994; Ridderinkhof & van der Stelt, 2000). Children that are diagnosed with Attention Deficit Hyperactivity Disorder (ADHD) as well as children from disadvantaged backgrounds are at-risk for executive function and selective attention deficits (Biederman et al., 2007; Carter, Krener, Chaderjian, & Northcutt, 1995). Both populations may benefit from interventions that develop executive function and selective attention skills (Berger, 2011; Diamond & Lee, 2011). One such intervention that is growing in popularity is yoga (Jensen & Kenny, 2004; Klatt, Harpster, Browne, White, & Case-Smith, 2013; Peck, Kehle, Bray, & Theodore, 2005). Chapter one will explain the relationship between yoga and the development of executive function and attention in children.

The chapter will begin with a definition of constructs and how executive function and selective attention develops in children. An in-depth look at the research on these constructs in at-risk children and how these skills affect kids' learning will be explored. Last, a comprehensive review of evidence-based research that build children's executive functioning and selective attention skills will be provided.

Upon reviewing the literature on children's executive functioning and selective attention, yoga will then be explored as a potential treatment in remediating these two deficits. In particular, the background of yoga as a practice will be introduced before laying out a conceptual model for potential mechanisms of how yoga may affect children's selective attention. Last, the research on the relationship between yoga and children's executive function and attention will be presented.

### **Defining Executive Function and Selective Attention**

Executive function consists of mental processes involved in self-regulation such as adapting behavior and emotions to a situation, integrating information from past and present, using selective and sustained attention on demand, planning future tasks and goals, organizing information, and problem solving (Berger, 2011; Gioia, Isquith, Guy, & Kenworthy, 2012; Holler & Green, 2010). Being able to filter overwhelming amounts of incoming stimuli (i.e., stresses from outside of school, distractions from peers and technology, limited attention span) and select the most important information (i.e., class content, appropriate responses to external stimuli) is a skill that children need to be successful academically and behaviorally.

To better understand selective attention, Plude et al. (1994) created an overview of attention across the lifespan. The researchers define selective attention as comprised of arousal, capacity, and selectivity or "the specificity with which resources are allocated to task demands" that are finite (Plude et al., 1994, p. 230). Plude et al., categorizes selective attention into four types of attention: orienting, filtering, searching, and expecting. Orienting is described as the physical changes of the body and organs when encountering a stimulus, such as turning the head towards a sound (reflexive) or

increased heart rate when aroused (covert). Filtering is being able to ignore certain characteristics of a stimulus while processing others. Searching is a combination of filtering and orienting, while expecting involves using previously or newly acquired information to predict when and where events may occur. It is important to understand how executive function and selective attention are defined so that development of these mental processes can be examined over the lifetime.

### **Development of Executive Function and Selective Attention**

Several researchers agree that executive function develops throughout childhood and into adulthood (Bialecka-Pikul & Kantaruk, 2004; Hagen & Hale, 1973; Hale & Alderman, 1978; Plude et al., 1994; Posner & Rothbart, 1998; Ridderinkhof & van der Stelt, 2000; Williams, Ponesse, Schachar, Logan, & Tannock, 1999). Research indicates that executive function continues to develop throughout the lifespan (Passler, Isaac, & Hynd, 1985; Welsh & Pennington, 1988). Without adequate development of some executive function skills in the early years, the foundation for later executive function development for children may fail to fully mature (Berger, 2011; Biederman et al., 2004; 2007; Levine, 2002).

The concept of early development affecting maturation is exemplified by the research of Holler and Green (2010) in examining executive function during a child's neurocognitive development. Holler and Green state that as a child enters school in the Piagetian preoperational stage (age 2 - 7), a phase of synaptic pruning in the brain has stopped while one of myelination begins, which can be seen in certain executive function skills such as sustained attention and emotion and behavior regulation. The researchers state that during the concrete operations stage (age 6 - 10), a child can sustain attention

for up to thirty minutes and behavior becomes goal directed. Then, myelination is occurring in the corpus callosum, which connects the brain hemispheres, while the areas of the brain that are developing are those that connect to other neurocognitive systems. This can be seen in the pre-adolescent child's ability to better organize and multi-task when overwhelming amounts of information are being integrated across subcortical brain structures (Holler and Green, 2010).

Holler and Green's model of neurocognitive and executive function development aligns with Levine's (2002) neurodevelopment stages. Levine states that children of ages nine and ten (Piaget's concrete operation stage) are more distracted due to an increased social awareness, need more attention skills when expected to engage in low-interest subjects, and are expected to put forth more mental effort, planning, and self-regulation skills. Levine also states that when children adequately develop selective attention as an executive function, they are able to direct, shift, and maintain attention while children with poor development of selective attention have a hard time attending to necessary stimuli for task completion.

Plude et al. (1994) explain the development of the four types of selective attention. The researchers state that orienting is the most stable aspect of selective attention, which is present at birth and lasts across the life span. The researchers also state that searching and expectancy tend to improve throughout childhood, while filtering is the most difficult for children who are less able to ignore interference from involuntary intrusions and less able to activate response mechanisms. The agenda of the current study is supported by the belief that children often have the most difficulty with filtering

selective attention although it is found to improve throughout childhood (Plude et al., 1994).

The existence of filter-interference in childhood aligns with Ridderinkhof and van der Stelts' (2000) literature review on age-related neurological changes in the executive function of selective attention. The researchers explain that selective attention deficiencies impair the ability to select, analyze, and react to relevant information and can be seen in the interference paradigm of filter tasks, which requires participants to discriminate between the target and competing non-target. One type of interference task is a conflict task, such as the Stroop task (Golden, 1978; MacLeod, 1991; Stroop, 1935), and is challenging because the competing stimulus may signal a reaction similar to the response that the target stimulus elicits. This type of task is important because it allows examination of how targets are processed when interrupted or aided by incongruent or congruent targets. Interference conflict tasks such as the Stroop task present a target and non-target stimulus that are very similar, thus prompting correct and incorrect responses that create competition for cognitive resources, causing the correct response to be delayed.

Research has shown that children tend to inefficiently filter and suppress responding to irrelevant stimuli, which creates response competition between the target and non-target stimuli (Ridderinkhof & van der Molan, 1995; Ridderinkhof et al., 1997; Tipper, Bourque, Anderson, & Brehaut, et al., 1989). Under optimal conditions, young children are able to efficiently filter information, but they are more sensitive to distractions created by response competition than older children and adults (Ridderinkhof & van der Stelt, 2000). This is supported by results of two Stroop-based tasks and one



central-incident learning task that shows that younger children (age 7 - 8) are more easily distracted by irrelevant stimuli because the inhibition mechanism is not as fully developed as it is in older children (Tipper et al., 1989). Less than optimal conditions increase the response competition, as was found in a study by Pick and Frankle (1973) when second grade participants performed more poorly than seventh grade participants in a selective attention task when alternative, interfering stimuli (i.e., more shapes, colors, sizes in an incidental-learning task) were introduced. Complex, less-than-optimal conditions are more common in society than optimal conditions and warrants researching children's abilities to selectively attend to relevant information in stressful conditions.

Overall, Ridderinkhof and van der Stelt (2000) and others (e.g. Białecka-Pikul & Kantaruk, 2004) have found support for the lifespan pattern of development of selective attention, with selection of stimulus being the most difficult in young children, making them more sensitive to adverse events that compete for attention in a complex environment. It is possible that children who encounter regular interfering events in the environment may have more difficulty in developing executive functions such as selective attention. Plude et al., (1994) addressed the issue of adverse effects on selective attention, stating that attention development is not linear and must be considered in context of biological (i.e., neurocognitive myelination) and environmental (i.e., parental attachment, home environment) influence. So far, the research reviewed on executive function and selective attention development infers that executive function development begins at an early age as building blocks for later executive function skills. If much neurocognitive and environmental interference occurs in childhood, executive function deficits may persist throughout the life span unless intervention occurs.

## **Selective Attention and Children At-Risk**

A special interest population for the current study is children considered to be at risk for executive function and selective attention deficits, or children with multiple-risk factors. Multiple-risk may include interference factors such as “low socioeconomic status (SES); single-parent family status; ethnic minority status; family history of psychological, substance use, and legal problems; marital discord; and lack of social support” (Lengua, 2002, p. 144). McDermott, Westerlund, Zeanah, Nelson, and Fox, (2012) conducted a study that included participants that meet many of the at-risk descriptors. The researchers examined the executive function of abandoned, institutionalized children with adverse backgrounds and a lack of parental care who were in a care-as-usual group or a foster care program group, as well as a control group of non-institutionalized children. The results showed that institutionalized children made more errors and showed a different neural pattern when responding to a go/no-go task of executive function. The neural pattern of the institutionalized care-as-usual children showed that when processing information, only one frontal lobe site was activated, while children that were never institutionalized or that were in the foster care program had a pattern of three frontal lobes sites being activated. McDermott et al., (2012) indicated that the difference in information processing could lead to missed information in a school setting, lessening the at-risk child’s opportunities to develop and function normally. The findings support the theory presented by Plude et al., (2004) which implies that executive function in children must be considered alongside risk-factors, such as lack of parental care and a stable environment as in the case of the participants in McDermott et al.’s study. Other researchers have focused on how other risk-factors affect executive function

and selective attention in children with the at-risk descriptors of population density and SES.

Some researchers have focused on how children in different settings based on population density selectively attend to competing stimuli. Sinha, Alka, Rishi, Parul, & Vibha (1998) examined how selective attention is affected by high social density and processing demands. Results showed that participants that preferred less dense spaces performed more poorly in a recall task when in the high density situation, no matter the level of processing demand required, while the participants that preferred more dense spaces performed more poorly when in the high density/high processing demands condition alone. The findings from this study imply that a child's ability to selectively attend to target information may be hindered if placed in a social situation that her or she is not comfortable with when expected to process complex information. Wagner (1974) also examined changes in development of memory and concentration based on geographic setting and education. He found that rural and less educated participants used less complex attention and memory strategies at any age when compared to urban, educated participants. The implication of Wagner's study is that more complex attention strategies are related to the environment and that education may determine whether complex attention strategies develop beyond cognitive maturation. Combined, the studies on population density and selective attention inform researchers that rural and less educated children tend to use inadequate selective attention strategies if placed in a more dense population setting, such as an urban school setting or large group testing situation. Some densely populated urban schools have large populations of students from lower SES backgrounds.

Other researchers have focused on how SES plays a role in at-risk children's selective attention. A study by Stevens, Lauinger, and Neville (2009) focused on at-risk children by exploring the neurobiological bases of selective auditory attention in youth of various SES backgrounds. Selective auditory attention was measured by comprehension questions about two competing stories being presented to the participant simultaneously from the left or right audio speaker. Results indicated that participants from lower SES backgrounds were not able to filter irrelevant information during the selective auditory attention task as well as the higher SES background participants. The findings from this study support the need to further examine at-risk children's ability to selectively attend in the school setting where multiple distractions may occur, especially if education plays a critical role in development of selective attention strategies beyond cognitive maturation as Wagner suggests (1974).

Additional studies have also examined executive function, selective attention, and academic-related outcomes of children from different SES backgrounds. One study found that students' from low-income urban schools with poorer executive functioning have been found to be less able to perform well on standardized tests, which is an important finding because this is the criteria used to measure progress for most students, teachers, schools, and districts (Waber, Gerber, Turcios, Wagner, & Forbes, 2006). Another study by Norman and Breznitz (1992) examined differences in high and low SES first grade students' concentration and academic achievement. Academic achievement was measured by reading and math tests while concentration was measured by coding, digit span, and math subtests, teacher evaluations, reading comprehension test with distractors embedded (unrelated pictures), and recognition of distractors. Results

showed that the low SES participants were not able to selectively attend to relevant stimuli as well as high SES participants, effecting reading comprehension scores due to paying more attention to irrelevant distractors. It was concluded that low SES participants have an even greater disadvantage than middle or higher SES children: children from low SES backgrounds were not able to concentrate as well to the reading task due to distractors, which inhibited reading comprehension, and possibly general learning (Norman & Breznitz, 1992). This notion is supported by longitudinal findings of delay-of gratification studies reviewed by Mischel et al., (2011) who describes the strategy as a combination of the ability to control attention and cognitively evaluate situations. One of the studies by Ayduk (2000) found that participants high in rejection sensitivity (which could be considered as a multiple-risk factor) with low levels of gratification delay attained lower education levels than participants with high levels of the strategy 20 years later.

Overall, the research on executive function and selective attention in at-risk children suggests that development should be considered in conjunction with risk-factors such as parental care, home environment, geographical setting, population density, level of education, and SES. The research examined implies that children with these risk-factors have negatively affected executive function and selective attention strategy use as well as filtering ability, which influences learning such as reading comprehension, and can impact future development.

### **Selective Attention and Learning**

At-risk children are not the only population that may have deficits in executive function and selective attention that are related to academic outcomes. Some researchers

have found that struggling readers' attention is compromised when distracted (Elkind, Larson, & Van Doorninck, 1965; Pelham & Ross; 1977; Staats, 1968). Findings such as these have led researchers to examine executive function and selective attention deficits in children with learning disabilities (LD).

Vrana and Pihl (1980) explored the effect of the spatial proximity of central and incidental learning tasks on selective attention as measured by information recall in children with LD and a control group. Two sets of central-incidental learning tasks were used to demonstrate spatial proximity: one with shapes close together on a card and one with shapes at each end of a card. Results showed that children with LD are more distracted when recalling central learning information that is presented alongside incidental learning when compared to children without LD. This indicates that children with LD are less able to filter irrelevant stimuli when it is presented in conjunction with relevant stimuli during recall tasks, such as processing which information to attend to on reading comprehension probes.

Another study by Richards, Samuels, Turnure, and Ysseldyke (1990) examined the selective and sustained attention and information processing rates of children with and without learning disabilities. The researchers found that students with LD had no significant differences in performance on the Continuous Performance Test of sustained attention but that they performed worse on the selective attention flanker tasks and is an indication that the LD group processes information at a lower rate than the non-LD group. The students with LD were also more distracted than students without LD on the flanker test of selective attention when the interfering stimuli was next to the target, supporting the findings from the Vrana and Pihl study (1980). The finding that students

with LD took longer to process and respond to flanker tasks alone indicates that information processing may be the core component of selective attention deficit in children with LD (Richards et al., 1990).

The research on selective attention and children with LD indicates that the participants who struggle with learning have difficulty filtering irrelevant stimuli, have a slower rate of processing information, and a slower response rate. One implication for these children in the classroom is the possibility of missing important content, especially when in a more densely populated, fast-paced classroom environment. Another implication for struggling learners in this scenario is over-identification for disorders that may be alleviated by interventions that improve executive function. One other implication for this scenario is a poor performance on high-stakes testing, which impacts not only students but teachers, schools, and districts. Another population known to have similar attention deficits as indicated by the research on children with LD is children with Attention Deficit Hyperactivity Disorder, which may also be susceptible to the implications drawn from the research on attention and children with LD.

### **Selective Attention and Attention Deficits**

Attention Deficit Hyperactivity Disorder (ADHD) is an increasingly pervasive diagnosis for children in the United States. Visser et al., (2014) reviewed diagnostic trends of ADHD from 2003 to 2011 and report that 6.4 million or 11% of children ages four to 17 had a health-care provider diagnosis of ADHD. This is an increase of 2 million child ADHD diagnoses from 2003 to 2011 (Visser et al., 2014). Individuals with ADHD may have symptoms that interfere with some executive functions such as missing important details, a lack of planning, frequent shifts in attention that hinder processing,

failure to complete tasks or goals, difficulty organizing, and avoidance of tasks that require sustained attention or close concentration (Diagnostic and Statistical Manual, Fourth Edition, Text Revision, 2000). This apparent relationship between ADHD diagnoses and impaired executive function has resulted in a multitude of research.

An early study by Weiner and Berzonsky (1975) explored how impulsivity, one type of ADHD diagnosis, affects attention, and learning. The researchers examined how the selective attention of children who were categorized as reflective or impulsive performed on an incidental learning task. Results showed that impulsive participants in the sixth grade engaged in more incidental learning than reflective participants, indicating that impulsive children did not employ the same complex attention strategies that the reflective children employed. The authors determined that this might be because of a delay in selective attention development or ability to utilize selective attention strategies in impulsive children. Weiner and Berzonsky's (1975) results indicate that impulsive children may have processing difficulties because the child may try to remember all the cues presented and be unable to distinguish relevant from irrelevant cues, which would lead to incidental learning of irrelevant material. The findings from Weiner and Berzonsky's (1975) and Richards et al. (1995) supports the idea that information processing may play a critical role in being able to selectively attend.

Carter, Krener, Chaderjian, and Northcutt (1995) also examined abnormal processing and selective attention in children with ADHD. The researchers tested whether children with ADHD showed more interference from irrelevant stimuli during the Stroop task by having more delayed responses to incongruent trials than unrelated trials and found that participants with ADHD were more distracted by irrelevant stimuli



than controls. Carter et al. (1995) found that participants with ADHD had a longer response time for incongruent trials but a similar amount of errors as compared to controls, indicating that the issue may not be impulsivity but a specific deficit in information processing. Additionally, the researchers' findings support a specific deficit in information processing in ADHD populations due to having similar performance levels as controls and a lack of relationship existing between the Stroop task scores, a Continuous Performance Task, and the Wisconsin Card Sorting Task (Carter et al., 1995). Other researchers have had similar results by examining attention in ADHD populations using multiple measures including the Stroop task, cancellation tasks, and neuropsychological assessments, thus increasing the validity of the findings of ADHD populations' poorer performance than controls on multiple measures (Kiliç, Şener, Koçkar, & Karakaş, 2007).

The research on executive function and selective attention in children with attention deficits has been even further validated with longitudinal studies. Brocki, Eninger, Thorell, and Bohlin (2010) explored the relationships of the executive function skills of selective attention, inhibition, and working memory along with the ADHD symptoms of inattention and hyperactivity/impulsivity across two years. Using the measures of a go/no-go task, an auditory attention subtest of a neuropsychology assessment, a Stroop-like picture task, a sorting-recall task, and a block design task of a cognitive assessment, findings indicate that at age 5, selective attention and simple inhibition performance predicted working memory and complex inhibition performance a year later. The researchers also found that executive functioning predicted inattention symptoms of ADHD instead of hyperactivity/impulsivity symptoms and that complex

inhibition performance at age 6 appeared to mediate the relationships between executive function at age 5 and inattention at age 7. The results of the Brocki et al. (2010) study indicate that if multiple executive functions are not adequately developed during a critical period in early age, attention deficits may develop within the next couple of years.

Another study by Biederman and colleagues (2004) examined the relationship between ADHD diagnoses, executive function deficits, and psychosocial functioning. The researchers results showed that the participants with ADHD had lower academic achievement and school functioning scores, while those with executive functioning deficits scored significantly worse on all academic assessments than those without ADHD. The participants with ADHD and executive function deficits were twice as likely to experience grade retention, were three times more likely to have a learning disorder, and have lower IQ scores than children without executive function deficits.

Biederman et al., (2007) also conducted a longitudinal study to explore the stability of executive function deficits in young males with ADHD diagnoses from a previous study seven years later. Executive function skills that were examined included selective attention, visual scanning, sustained attention, planning and organizing, memory, interference control, shifting and categorization, and verbal and visual learning and were measured by a battery of neuropsychological tests including cognitive assessment tasks and the Stroop color-word task. The researchers' results showed that the majority of executive functioning deficits were stable from youth to adulthood, emphasizing the importance of recognizing and intervening with this type of deficit early before it leads to educational and occupational short-comings.

The research on selective attention and attention deficits aligns with the indications from the research on attention in children with LD because participants from both populations have difficulties filtering irrelevant stimuli and slower response rates, implying information processing deficits. The attention deficit research reviewed also indicates that some early executive function skills predict future executive function skills, are stable over the lifespan, and relate to poor academic performance. Specifically, executive functions in children with attention deficits seem to be related to inattention and information processing instead of the hyperactive symptoms of ADHD. It appears that learned inhibition accounts for the relationship between previously acquired executive functions and later developed inattentiveness. Knowing that executive function skills appear to be stable, it is crucial to intervene with deficits at an early age so that academic achievement and further executive functions are not hindered.

### **Executive Function and Selective Attention Interventions**

While interventions for ADHD often involve prescription medication (Visser et al., 2014), executive function interventions tend to focus on improving self-regulation of attention or other related skills through behavioral treatments (Berger, 2011). Moreover, there are emerging complementary and alternative treatments for intervening with executive function skills as well.

Over two-thirds of the 6.4 million children with ADHD diagnoses in the United States are on medication to treat symptoms (Visser et al., 2014). Although medications are helpful for controlling ADHD symptoms in many cases, issues remain such as not knowing the long-term affects of the medication, the controversy of whether ADHD medication use leads to later substance abuse, and the use of the medication as a surface-

level treatment for symptoms instead of the actual underlying deficit (Carter et al., 1995; Visser et al., 2014). Some of the research reviewed so far has implicated that information processing may be the core deficit in ADHD, not inattention or impulsivity (Carter et al., 1995; Kiliç et al., 2007; Weiner & Berzonsky, 1975). Brodeur and Pond (2001) found support for this idea when testing whether selective attention changes over time in children with ADHD and how distractors and methylphenidate affect this population's selective attention performance. The researchers found that the participants in the ADHD group performed more poorly on a go/no-go task when off medication and implied that the findings were due to a deficit in selective attention because medication reduces impulsivity while increasing target selection and distractor inhibition. The Brodeur and Pond (2001) results indicate that medication improved on-task behavior, not information processing.

Other behavioral-based interventions may be more thorough and less aversive in treating the root of attention deficits for some cases. Complementary and alternative treatments have been recommended as adjunct treatments for ADHD symptoms due to providing mental and physical benefits for children in general without negative side effects that often occur with medication, herbal remedies, or dietary changes (Rojas & Chan, 2005).

Berger (2011) summarizes the benefits and disadvantages with different types of interventions that focus on executive function training, which focuses on self-regulation of attention and inhibition and range from computerized training to mind-body integration practices. She states that computerized training, such as attention training programs and tasks that focus on visual or auditory object tracking are well-designed and

controlled for research purposes but may not be generalizable to everyday events. She also states that non-computerized training programs such as the Attention Processing Training program focus on improving neurocognitive processes, although promising results are hindered by a limited amount of studies. Berger (2011) also states that curriculum-based interventions such as the Promoting Alternate Thinking Strategies are seen as the best-fit practice for education settings due to being standardized programs with an ease of generalization of effects; however, these packages do not delineate what the exact intervention and outcome variables are or how mediators come into play.

In addition to these traditional interventions, Berger (2011) suggests that an alternative approach to improving children's executive function has surfaced in integrated body-mind training (IBMT). Tang et al., (2010) found that IBMT, which is a meditation technique composed of body relaxation, mindfulness training, and mental imagery accompanied by music and instruction, increased the activity in the anterior cingulate cortex, which is associated with capacity to self-regulate. Because populations without ADHD diagnoses that are at-risk for executive function and selective attention deficits are often not treated with medication, it seems that a non-medication, behavioral-based intervention would be a better fit for an intervention for this group of children.

Therefore, intervening with children who may be at-risk for executive function or attention deficits due to not having an environment that nurtures the crucial neurocognitive development that is important at an early age may be vital for future higher level executive function. A non-prescriptive, needs-based intervention would allow the child to build skills that empower him or her to improve executive function

that, once learned, can be implemented independently as needed without relying on adult-lead standardized interventions.

One emerging alternative treatment for executive function deficits that meets the individual need is yoga, which also aligns with some research recommendations for interventions. Diamond and Lee (2011) reviewed executive function training interventions to discover what aspects of the training are universally important for children at-risk for deficits. Some of the researchers findings include the following: a) physical activity with character development (i.e., yoga or martial arts) improves executive function more than exercise alone, b) schools are the best opportunity for applying executive function training to all children, with non-computer training being easily implemented (i.e., martial arts, yoga, mindfulness, exercise), and c) findings on computerized trainings ability to improve inhibition and selective attention are unclear. Other researchers support the exploration of mind body practices such as Holler and Green (2010) who recommend that educators can aid in a student's development of executive function by providing supportive structure for executive function strategies such as deep breathing or progressive muscle relaxation to teach the child to internally regulate their behavior. All of these strategies are integral components in the practice of yoga. Therefore, the practice of yoga and research that examines the effects of it on children's executive function and attention will be reviewed.

### **Introduction to Yoga**

Yoga is a growing sensation in the U.S. as a complementary and alternative medicine (CAM) for physical health, mental health, and overall wellness (Survey, 2009; NCAAM, 2013). In a review by Kaley-Isley, Peterson, Fischer, & Peterson (2010) a

report of a 2008 market study by *Yoga Journal*, the leading popular yoga magazine, states that an estimated 15.8 million Americans practice yoga, 9.4 million indicated a desire to try it in the next year, and 14 million reported that a doctor or therapist recommended yoga as a practice to improve health. Today, the *Yoga Journal* reports that 36.7 million Americans practice yoga (2016). It has been a treatment for medical diseases such as chronic pain (Brands, Purperhart, & Deckens-Kocken, 2011), cancer (Geyer, Lyons, Amazeen, Alisihio, & Cooks, 2011; Thygeson, Hooke, Clapsaddle, & Mosquist, 2010), and asthma (Khanam, Sachdeva, Guleria, & Deepak, 1996; Nagarathna & Nagendra, 1985); as a mental health treatment for reducing anxiety, depression, and stress (Lavey et al., 2005; Telles, Naveen, & Dash, 2007); as a cognitive functioning intervention to increase focus, attention, and concentration (Hopkins & Hopkins, 1979; Sarang & Telles, 2007); as well as aiding with other varied deficits and issues such as improving motor skill functioning (Dash & Telles, 1999), decreasing undesirable behavior (Berger, Silver, & Stein, 2009), increasing self-awareness (Clance, Mitchell, & Engelman, 1980), and creating a general feeling of calm and well-being (Brown & Gerbarg, 2009; Zipkin, 1985). According to the reported uses of yoga, it appears to be an intervention that can positively impact the mind and body.

Yoga may be able to impact so many outcomes due to unifying multiple aspects of well-being in the human body and is reflected in the definition of yoga, which is to yoke together; to unite. Yoga as a process of unification has been verified by the National Institute of Health branch of National Center for Complementary and Alternative Medicine, which categorizes yoga as a mind-body medicine that "...practices focus on the interactions among the brain, mind, body, and behavior, with the intent to

use the mind to affect physical functioning and promote health” (NCCAM, 2012). This concept of unification is also represented in the practice of yoga, which typically includes a combination of breathing techniques, physical postures, and relaxation meditation.

### **Conceptual Model of How Yoga Affects Attention**

Yoga’s combination of breathing, postures, and meditation appear to create a unique opportunity for physical and mental well-being. According to research, yoga may have the potential to improve various forms of quality of life through balancing the autonomic nervous system and other related systems in the body, strengthening the body, and calming the mind (Kaley-Isley, et al., 2010). Doctors Annellen and Alexander Simpkins (2011), psychologists who specialize in meditation and neuroscience, state “the yoga practices of voluntary focus and self-control build the capacity to take charge over behavior and cognition and guide it toward healthier adjustment” in order to break destructive patterns and form healthy ones (p. 25). It is suggested that this occurs through regular practice of breathing techniques, physical postures, relaxation, and meditative techniques that unify the mind and body (Simpkins & Simpkins, 2011).

**Breathing techniques.** Theoretically, the breath is the yoga component that allows for regulation of systems in the brain and body (Jensen, Stevens, & Kenny, 2012; Simpkins & Simpkins, 2011; White, 2009). It has been suggested that practicing yoga can calm the emotional centers of the brains limbic system, allowing for regulation of behaviors through strengthened executive control functions in the frontal lobe. This purportedly occurs when the breath affects the autonomic nervous system, the parasympathetic nervous system, the lungs, and the hypothalamus (of the limbic system) when the vagus nerve communicates reaction information between these systems based



on the rate of the breath. Through this communication instigated by the breath, the nervous system may be sped up or slowed down and affects emotions, cognitions, and behaviors (Cooper, 2010; Simpkins & Simpkins, 2011).

For example, when a person cognitively perceives a negative experience, the limbic system can activate the emotion of anxiety, which may increase the rate of the breath, causing lower oxygen consumption, increased heart rate and blood pressure, and activation of the parasympathetic nervous system to rebalance the autonomic nervous system (Simpkins & Simpkins, 2011). Theoretically, practicing yogic breathing techniques when exposed to stressors can create a conscious intervention to rebalance the autonomic nervous system, thus preventing a fight-or-flight behavior reaction. Some children who often face negative experiences (such as at-risk children) that invoke the flight-or-flight reaction may lose the ability to practice self-regulatory functions. Using yogic breathing techniques may buffer stressors that affect the ability to regulate oneself and practice executive function skills.

**Physical postures.** It is suggested that physical postures are the yoga component that can develop strength and flexibility in the body as well as self-awareness and positive emotions (Simpkins & Simpkins, 2011). By practicing variations of standing, sitting, or lying poses, a person may become more aware of his or her physical abilities, which may affect emotions and traits that are linked to self-concepts like esteem and confidence (Simpkins & Simpkins, 2011). Improving self-concepts like esteem and confidence through yoga may generalize to other self-concepts such as the ability to regulate one's attention, impulsivity, thoughts, and behaviors. Generalizations may occur because of the interactions of physical, mental, and executive function systems of the

motor cortex, basal ganglia, cerebellum, brain stem, spinal cord, and musculoskeletal system in creating thoughts, feelings, and actions (Simpkins & Simpkins, 2011).

Not only can yoga possibly improve self-regulation of executive functions, it is also a physical activity that relieves tension and stress (Zipkin, 1985). As a form of energetic, stress-reducing physical activity, yoga may have an effect on outcomes related to executive functioning, such as learning. In a meta-analysis examining the relationships of physical activity, cognitive, and academic outcomes, Fedewa and Ahn (2011) report “...that physical activity has a significantly positive impact on children’s cognitive outcomes and academic achievement” (p. 530). The results from the meta-analyses demonstrated strong effects of physical activity on cognitive and academic outcomes when children engaged in physical activity three times a week in small groups (Fedewa & Ahn, 2011), and that programs that consisted of high intensity aerobic and strength training/resistance exercises were most effective in improving children’s mental health (Ahn & Fedewa, 2010). The results from Ahn and Fedewa’s research did not show that yoga had this effect, as it was hypothesized the practice did not reach moderate to vigorous levels of physical activity. However, it is apparent that frequent and more intensive physical activity is beneficial to children’s physical and mental well-being.

Yoga postures can be as intense as aerobic and strength training exercises depending on the level of rigorousness and challenge that the chosen poses present. Most forms of yoga begin with a warm-up period of breathing techniques that may be paired with gentle movements, which then flow into a series of more challenging physical postures, and ends with returning the focus to the breath with a meditative component while sitting or lying in a relaxed position on the floor. After practicing these

components, one may feel a sense of calmness in the mind and body in the form of tension reduction in the muscles and clarified mindfulness attention, resulting in improved relaxation, strength, flexibility, and belief in oneself (Simpkins & Simpkins, 2011). The unification of mind and body through the combination of breath, movement, and focus is suggested to be the added benefit of yoga that is missing from typical aerobic and strength training activities, and may also be associated with the positive benefits found in engaging in physical activity as found by the Ahn and Fedewa research team (2010; 2011).

**Relaxation and meditation.** Relaxation and meditation techniques are the yoga components that may calm the mind through focusing attention. Cognitive behavioral therapists have utilized the relaxation response as a helpful intervention in improving coping skills and self-regulation skills in children (Wisner, Jones, & Gwin, 2010). Relaxation techniques include a combination of breathing, guided imagery, and progressive muscle relaxation, which have been found to be effective in increasing attention and calming the mind (Jensen, Stevens, & Kenny, 2012; Peck, Kehle, Bray, & Theodore, 2005). The ability to induce relaxation during situations that prompt the autonomic nervous system response can help children improve executive functioning, as well as develop coping mechanisms, increase self-esteem, enter a cognitive state that aids learning, creates overall feelings of well-being, increase body awareness such as muscle tension, create a positive attitude change, and reduce impulsivity (Wisner, et al., 2010; Zipkin, 1985).

In improving concentration through relaxed meditation, three types of attention may be affected. One can concentrate on selective attention, which purportedly activates

parts of the parietal lobe, prefrontal cortex, and frontal eye fields (Simpkin & Simpkin, 2011). Selective attention, which is the focus of this study, has been found to be necessary for filtering information to avoid distractions, to manage response conflict, and to regulate one's behaviors (Stevens, Lauinger, & Neville, 2009). Yoga may also focus sustained attention, which activates the prefrontal cortex, the parietal lobe areas, and the thalamus, or the gateway to the senses (Simpkins & Simpkins, 2011). Sustained attention is important for children to develop so that large amounts of information can be processed, understood, and integrated over long periods of time to aid in academic achievement (Betts, McKay, Maruff, & Anderson, 2006). Meta-attention, or noticing a drift in attention and the having ability to refocus, is another form of attention utilized in yoga meditation. Meta-attention is suggested to activate the dorsal lateral and dorsal anterior areas of the prefrontal cortex when error detection, decision-making, planning, organization, and thought regulation occur (Simpkins & Simpkins, 2011).

As meditation affects three types of attention, there are different ways to focus the attention through meditation. An introductory level meditator can start with open meditation, an unfocused form of being aware of attention that is suggested to use the right frontal lobe which is related to avoiding distractions, monitoring, and being vigilant (Simpkins & Simpkins, 2011). In this practice, the attention is turned inward to disengage from undesirable thoughts and feelings (Simpkins & Simpkins, 2011). The next level of meditation allows free-roam of thoughts that are focused on one object or concept and is a practice of narrowing attention while filtering distractions (Simpkins & Simpkins, 2011). This second level practice of meditation seems to be related to the desired behavior of a student focusing on content learning in a classroom while avoiding

distracting thoughts or actions. A third type of meditation focuses on the unification of thought, thinker, and object of focus through contemplation (Simpkins & Simpkins, 2011). An example is contemplating a concept learned in the classroom and making connections between the aspects of the concept, what they are, how they relate, and associating one thought to another. The practice of increased associations during yoga meditation is what may lead to a deeper understanding of the concept learned (Simpkins & Simpkins, 2011).

**Yoga and learning.** No studies have been found that examine the effects of yoga on specific academic achievement outcomes. Simpkins & Simpkins (2011) theoretically report that yoga aids in neuroplasticity (changes in synapse connections) and neurogenesis (growth of new neurons) by providing a novel, enriching environment within the yoga practice itself, which allows improved memory and learning through non-declarative learning processes. Yoga and meditation are considered a non-declarative type of learning that is unconscious, performance based, and implicit, involving the actions and conditioned reflexes related to procedural knowing, such as how to complete a posture sequence or achieve a focused, meditative state (Simpkins & Simpkins, 2011). Because the body of research exploring the relationships of yoga and academic achievement is scant, outcomes related to executive function, which affect learning, is examined (Biederman, Monuteaux, Doyle, Seidman, Wilens, Ferrero, et al., 2004; Norman & Breznitz, 1992).

### **Yoga and Children**

Minimal research has examined the effects of yoga on children's executive functions, while slightly more research has explored attention as the specific outcome. A

special population of interest for the proposed research is children from disadvantaged backgrounds who are at-risk for attention deficits. Literature examining the outcomes of executive function and attention deficits after practicing yoga will be reviewed, as well as studies that have implemented a yoga intervention with at-risk populations.

**Yoga and the outcome of executive function.** Manjunath and Telles (2001; 2004) have conducted separate research studies that examined how yoga affects the specific executive functions of planning and memory. The purpose of the first study by Manjunath and Telles (2001) was to assess if yoga training affected twenty 10 to 13 year-old girls' performance on the Tower of London Test. The design of the study was random assignment to treatment or comparison groups with a pretest-posttest measure. The participants were sampled from a residential home in India who participated in 75 minutes of yoga in the experimental group or physical training in the comparison group seven days a week for one month. Experimental group yoga included postures, breathing exercises, internal cleansing activities, meditation, singing, and relaxation exercises. Comparison group physical training included bending, standing and floor exercises, jogging, and weight lifting. The executive function outcome of planning was measured by three assessments of the Tower of London test, where beads are to be arranged in a certain way on a vertical rod using two, three, and five moves. Data was recorded on time to plan moves, time to execute them, and number of moves.

Manjunath and Telles (2001) results showed that the experimental yoga group took significantly less time in planning two and four moves, lower times in executing moves in four and five moves, and less number of moves in the four move assessment when compared to the control/physical activity group. The comparison physical training

group had no change. This indicates that a yoga practice that included postures, breathing exercises, internal cleansing activities, meditation, singing, and relaxation exercises improved the alertness of participants when planning and executing moves as a frontal lobe function. Despite the limitations of a small, homogenous sample, possible confounding variables that are unknown due to a lack of description of intensity of comparison group activities, and the fact that the comparison group showed no difference and had no relaxation or meditation may indicate that these components are important in planning ability as a frontal lobe function. This indication should be included in future yoga interventions with similar populations when improving the performance of the executive function of planning.

The second study conducted by Manjunath and Telles (2004) had the purpose of examining the hypothesis that yoga and fine arts training improve memory as a right hemisphere function. The experiment design was a 10-day test-retest of comparison groups with a control group analyzing a between-subjects factor of groups and within-subjects factor of measures. Participants were 43 13 year-old girls at an Indian summer vacation program in one of three groups: yoga (n = 13), fine arts (n = 16), and control (n = 14). The fine arts camp included four hours of drama, one hour of games, two hours of creative activities, and a one-hour talent show. The yoga camp included one and a half hours of yoga poses, one hour of breathing, a half hour of internal cleansing, an hour and a half of meditation, a half hour of relaxation, two hours of games, and an hour of story telling that focused on responsibility. The dependent variable of interest was delayed recall of spatial and verbal memory.

Manjunath and Telles (2004) study included measures of memory tasks that required the participant to recall and write or draw a spatial or verbal memory task that was viewed briefly by the participants. The verbal memory task used two sets of ten three-letter nonsense syllables and the spatial task used two sets of ten simple line drawings that combined geometric and other shapes. Each item was delayed by showing a mathematical problem after the stimulus and before the response. The results showed that the yoga group had a significantly higher spatial memory as compared to the fine arts and control group. Although this study is limited by the variance introduced by the many "other" activities besides yoga and drama, unexplored right hemisphere functions, the short duration of the interventions, and the homogeneity and small size of the sample, this study supports Manjunath and Telles' (2001) findings that executive functions are positively affected by practicing yoga.

It is helpful to know that the executive functions of planning and spatial memory have found to be improved after practicing yoga in certain populations. However, it cannot be assumed that interventions practiced in residential homes and summer vacation programs in Eastern cultures will generalize to similar aged girls in Western cultures, nor that because one or two executive functions are improved, that the effects of yoga will generalize to other executive functions, namely attention.

**Yoga and the outcome of attention.** Recent literature has shown an interest in yoga's ability to improve children's attention. Studies have been conducted in Eastern and Western cultures, and populations range from children without attention deficits to children diagnosed with Attention Deficit Hyperactivity Disorder (ADHD). While most



studies implemented a full yoga practice of breathing, postures, and meditation, some focus only on meditation.

Rani and Rao (1996) conducted a study with the purpose of testing the hypothesis that school children who practice Transcendental Meditation (TM) procedures would improve the cognitive exercise of controlling attention compared to students who do not meditate. The design used a group comparison post-test measure that included an experimental group of 19 nine to ten year-old boys and girls trained in TM as part of the school curriculum since year one of school. The control group consisted of 20 participants matched for age and SES but who attended a different school and did not meditate. The experimental group practiced TM for 15 minutes twice a day, focusing on an internalization of attention to seek the source of thoughts in order to expand the conscience. There was no mention of the control groups' activity. The outcome of the function of attention regulation was measured by the Star Counting Test which measures the function of attention regulation by having the participant count a pattern of stars while attending to addition or subtractions signs in a designated amount of time. This procedure is repeated twice, once forward and once backward, creating a total score for each participant. The results showed that the meditators scored significantly better on the Star Counting Test than the non-meditators, indicating that the meditators had greater attention regulation. The results of the study imply that practicing inward attention such as the introductory level of open meditation may improve outward attention such as the mid-level free-roaming meditation (Simpkins & Simpkins, 2011). Although this study is limited by a lack of information about control group activity and statistical analyses, it is

helpful to know that one component of yoga seems to be positively related to attention regulation.

Another study by Harrison, Manocha, and Rubia (2004) examined Sahaja Yoga Meditation as a family complementary and alternative medicine for children's ADHD symptoms, self-esteem, school difficulties, and the parent-child relationship. The research design was a non-random assignment wait-list and quasi-control group's pre-post measure. Two groups were formed of participants that included 48 boys and girls age four - 12 who were diagnosed with ADHD. The sample included parents or guardians from diverse education and marital status backgrounds and were 95% Caucasian. Meditation groups met twice a week for six weeks at a voluntary clinic in Australia. For the first three weeks, parents and children were in separate groups for 90 minutes, learning to meditate for two brief 15-minute intervals and reflecting on meditative techniques. During the last three weeks, parents and children joined for one session per week. Families were encouraged to practice and record meditations at home.

The Harrison et al. (2004) outcome measures included ADHD behaviors, parent perceived outcomes of meditation for self and child, psycho-stimulant medication adjustment, self-esteem, school difficulties, acceptability of the intervention, and parent-child relationship. Measurements included the following: Conner's Parent Rating Form for ADHD behaviors; questionnaire on benefits of meditation for child's ADHD symptoms, school difficulties, and relationship with child; medication adjustment; Biobehavioural Indicators of Self-Esteem and Burnett Self Scale; Peabody Picture Vocabulary Test - III (academic performance); child interview for acceptability; questionnaire for parents on acceptability and perceived outcomes of practice on stress,

anger, and interaction with child; and the Child Parent Relationship Scale. Overall, the results showed that meditation reduced ADHD symptoms and that some medication doses were reduced during intervention indicating that children were better able to self-manage ADHD symptoms after meditation. Parent-child relationships also improved as well as child's self-esteem, school functioning, and sleep. These findings were further validated when controlling for cognitive ability, demographics, and medication. Although this study is limited by a small number of participants, not having a control group, attrition, and possible bias in self- and parent-reports, the findings support the yoga component of meditation as an adjunct treatment for children with ADHD symptoms, as well as their families. Harrison et al.'s (2004) results regarding reductions in medications and improved self-management of ADHD symptoms further supports Rani and Rao's (1996) findings that meditation improves attention regulation. However, neither of these studies examined how a complete yoga practice that includes breathing and postures may affect attention.

Two studies examined all components of yoga as an intervention with children that were not diagnosed with ADHD. In a seminal study, Hopkins and Hopkins (1979) evaluated the effects of yoga and general psychomotor activities on attention and concentration levels of elementary students with educational problems. The design was a 2x2x2 ANOVA of order effects, treatments plus control, and treatments versus control. The participants were 34 children with a mean age of 8.9 years, who were placed in an educational center for displaying severe educational problems that required a resource teacher for academic progress. In groups, the participants practiced 15 minutes of yoga or general psychomotor exercise in phases with the control being fine-motor activities

such as paper games (e.g., group ABACA: A = baseline/control phase of fine motor skill activities, B = yoga intervention phase, C = general psychomotor exercises phase). The outcome variable of attention was measured by a daily version of an alphabetic coding task that was gathered after all conditions. The task used a coded message and Key decoder to create mean scores that were based on the correct number of decoded characters in a five-minute trial. Results showed that task performance was significantly better after both yoga and general psychomotor activities than controls. General task performance was also better after yoga compared to the alternative treatment, but not at a significant level. Although the study is limited by a lack of description of yoga instruction or general psychomotor activity and a small sample size, the results support other researchers' implications that physical activity may be important in elementary education (e.g., Ahn & Fedewa, 2010; Fedewa & Ahn, 2011; Zipkin, 1985), lending encouragement to the use of the physical posture component of yoga as a possible intervention for attention.

Peck, Kehle, Bray, and Theodore (2005) also conducted a study with the purpose of testing on the effectiveness of yoga in improving the attention of elementary students. The research design was a multiple baseline (ABA design) across grade levels. Participants included ten elementary students age six to ten across grades one through three that were identified as having attention deficits by the school psychologist [defined as having less than 80% time-on-task (TOT) at baseline] but not diagnosed with ADHD. The intervention consisted of a yoga videotape, "*Yoga Fitness for Kids*" (produced by Gaiam, 2003) with two versions: one for first grade children and another for second and third grade children. The video required students to follow an instructor and three

children in 30 minutes of deep breathing, postures, and relaxation twice a week. The postures are described as game-like and the relaxation used guided imagery. The treatment was implemented in the school psychologists' office. The outcome variable of TOT was defined as the percentage of intervals of eye contact with the teacher or task and performed assignment. Ten-minute observations were conducted to collect the data with ten-second intervals using a momentary time sampling procedure twice a week across phases. The data were compared to a control that was a same gendered peer in the classroom. Results showed that effect sizes were large (1.51 to 2.72) for all grade groups in comparison to control groups and were slightly lower (but still higher than baseline) at follow up (.77 to 1.95). The outcome of TOT did not change for the control group and the treatment groups TOT met the control groups TOT levels after yoga. One session of the treatment was needed for each group before seeing an effect in TOT and social validity findings showed that participants enjoyed the treatment. Although the study was limited by a lack of description of the TOT activity, possible bias introduced by the dual role of investigator as implementer and observer, and lack of controls with attention deficits, the findings support Hopkins and Hopkins' (1979) results that indicate a full yoga practice has a positive effect on elementary students with attention deficits.

Other researchers have focused on the effects yoga has on populations that have been diagnosed with ADHD. Two studies explored whether yoga reduced ADHD symptoms. Jensen and Kenny (2004) evaluated yoga as an adjunct treatment to medicinal therapy in reducing symptoms of ADHD. The research design was a randomized crossover pre-/post-test design, allowing participants in the control group to randomly move into the treatment group after the first program was completed.

Participants included 14 eight to 13 year-old males who were mostly from lower to middle SES Caucasian families. All child participants were diagnosed with ADHD while five had diagnoses of ODD and/or LD and 12 were on ADHD medications. Due to the crossover design, 11 participants completed the treatment and eight were controls. The yoga program was a piloted 20-week one-hour group held in a hospital in Australia. Yoga included respiratory, postural, relaxation, and concentration training. Participants were encouraged to practice at home. Controls engaged in interactive and cooperative games and activities for one hour once a month at the same location. The Conners' Teacher and Parent Rating Scale-Revised-Long Form measured behavioral changes, while the Test of Variables of Attention (TOVA) measured attention and impulsivity, and a Motion Logger Actigraph (a device worn on the body) measured hyperactivity. The parent rating form, the TOVA and some of the actigraph data were collected when participants were not medicated. The rest of the actigraph data and the teacher rating form data were collected while the participants were medicated. Participants and controls attended approximately two-thirds of the sessions.

Results from Jensen and Kenny's (2004) study showed mixed findings. There were no significant differences in the teacher ratings although there was a trend indicating that the yoga group had a better Global Index score than the control group, which could possibly be affected by medication use during this form of data collection. At post-test, parents reported that participants of the yoga group had less temper outbursts; were less restless, impulsive, inattentive, and oppositional; could better control their own behavior and remain engaged in activities; and had overall less ADHD behavioral symptoms. There were no significant differences on the TOVA and the

Motion Logger Actigraph data was inconclusive due to technical errors. Mean attendance was 13.9 of 20 sessions and 54.7 of 116 days of practice at home and dose of treatment indicated that the participants who attended more yoga sessions showed lower post-test scores on teacher ratings of hyperactive-impulsive subscales and parent ratings of inattentive subscales. The study is limited by the following factors: the small number of participants in a heterogeneous sample; variability in attendance to sessions; disparity of duration of activities between groups; inappropriateness of the Conner's Teacher Rating scale due to participants being medicated while these observations were made; inconsistency of medication use across data collection; and too many errors occurring with the TOVA and actigraphs to gather reliable data. Despite these limitations, Jensen and Kenny's (2004) study shows some support that yoga reduces ADHD symptoms when used as an adjunct treatment.

Abadi, Madgaonkar, and Venkatesan (2008) conducted another study that examined the effect of yoga as an alternative treatment program to reduce children's ADHD symptoms. The design included experimental groups with a pre- post-test. The sample included 40 male and female children with a mean age of 10.1 years in public schools in Iran. All were diagnosed with ADHD, with 20 assigned to the experimental group and 20 to the control group. The intervention was a yoga program that consisted of breathing (10 minutes), postures (25 minutes of seated, standing, inverted, balance, tension release), and relaxation (10 minutes of visual imagery) exercises twice a week for 45 minutes over eight weeks at a psychiatric institute. The control group received no treatment. The outcome of ADHD symptoms was measured before and after yoga with the Child Symptoms Inventory (CSI-4) teacher and/or parent forms. Results showed that

the yoga group had a significant reduction in post-test CSI-4 scores compared to the control group. Significant differences were found for the yoga group on the inattention and hyperactivity/impulsivity symptom subscales indicating that yoga helped the experimental group reduce the physically active symptoms of ADHD. Although the study was limited by a lack of procedural fidelity, no comparative control group activity, and inconsistent use of teacher and parent behavior rating forms, the findings support Jensen and Kenny's (2004) results that yoga is useful in reducing attention deficits symptoms in populations of children with ADHD diagnoses.

The research studied so far suggests that yoga is a promising intervention in improving attention and reducing attention-deficit symptoms in populations that are typically developing, have been identified as possibly having attention deficits, or being diagnosed with ADHD. However, attention is a very broad category that needs to be narrowed as are the populations being studied. The remaining research to be reviewed consists of implementation of yoga interventions with populations of at-risk children.

**Yoga and at-risk children.** A special interest population for the current study is children with multiple-risk factors and those who are at-risk for attention deficits. Lengua (2002) defines children with multiple-risk to be those that are susceptible to a combination of adverse background factors that may interfere with development, including "low socioeconomic status (SES); single-parent family status; ethnic minority status; family history of psychological, substance use, and legal problems; marital discord; and lack of social support," all of which are related to an increased likelihood of developing psychological problems (p. 144). Being exposed to adverse background factors, such as poverty, has also been found to negatively affect children's performance



on executive function tasks, which in relation reduces learning opportunities (Raver, Blair, & Willoughby, 2013). Due to the threats of adverse background factors on developmental, mental health, and academic gains, the population of at-risk children may be the best candidates for a yoga intervention that can be implemented by the individual when needed. Researchers have begun exploring the effects of yoga with at-risk children.

Six studies were found that examined yoga and outcomes for at-risk children. One was a comparison study of yoga and physical activity, two were feasibility studies, and three explored the effects of yoga on specific outcomes. The outcomes ranged from cognitive performance to behavioral and self-concept variable to overall adjustment. Research conducted by Chaya, Nagendra, Selvam, Kurpad, and Srinivasan (2012) compared the effects of yoga and physical exercise on disadvantaged socioeconomic status (SES) children's cognitive performance. Participants were 200 male and female children between seven and nine years of age who attended a socioeconomically disadvantaged community school. The design was a longitudinal randomized-controlled group design where each participant was randomly assigned to yoga or physical exercise. Both groups were conducted for 45 minutes, six days a week at two separate locations at the school for three months. The yoga group difficulty gradually increased from stretching poses, to sun salutations, to a complete practice of postures, breathing, and meditation. The exercise group completed games that included stretching and aerobics. The cognitive abilities of attention and concentration, visuo-spatial abilities, and abstract thinking were measured at the end of the three-month interventions and at three-month follow-up after the summer break. Cognitive assessments included verbal tests of

comprehension, arithmetic, vocabulary, analogies, block design, object assessment, and coding from the Malin's Intelligence Scale for Indian Children and Weschler's Intelligence Scale for Children II. Results showed that both groups performed better on most cognitive tasks post-intervention, although there were no significant differences between groups, which aligns with the findings of Ahn and Fedewa (2011). The lack of significant differences between yoga and physical activity comparison groups in both studies may be because yoga is not always practiced at a moderate to intense level, thus not effecting cognitive performance. More intense physical activity, including fast-paced, challenging yoga, can create an elevated heart and respiratory rate and increase release of endorphins, which may be the mediating variable between exercise and cognitive performance and is a relationship that should be explored.

Although Chaya et al., (2012) found no significant differences in cognitive performance between participants practicing yoga and participants engaging in physical activity, at follow up, the yoga group participants performed better on attention and visual-spatial tasks. Even though the study was limited by not having a true control group and possible practice effects of repeated cognitive measures, it is promising to find that children from low SES backgrounds cognitive performance tasks, specifically attention, were improved and maintained at six months.

In addition to cognitive outcomes, other researchers have explored how yoga affects behavioral outcomes in at-risk children. Klatt, Harpster, Browne, White, and Case-Smith, (2013) tested how feasible the Move Into Learning intervention was to implement and what effects it had on students at-risk for stress-related behaviors in third grade classrooms. A mixed method, pre-post cross-sectional design with partial follow

up for maintenance and qualitative data on feasibility was used. Participants were students from two school classrooms in a poverty-stricken neighborhood of a large Midwestern U.S. town. Forty-nine students participated with 41 completing the program and 20 completing a two-month follow up. Of the participants, 25 were female with the mean age of 8.54 years old from ethnically diverse backgrounds. One classroom completed the eight-week Move Into Learning program with the second class following sequentially to complete the same program. Sessions were implemented daily for 15 minutes with a weekly 45 minute group session. Trained graduate students led the 45 minutes sessions and a CD of music and instructions were given to the teachers to lead the 15-minute daily sessions. Each daily session had three components of background music that matched the yoga intensity, yoga postures, and meditation via visual imagery. The weekly 45-minute session spent more time on those three components and added an arts-based activity that reflected on Appreciative Inquiry, which included prompts that focus on creating change by acknowledging existing supports, skills, and coping mechanisms (i.e. drawing a picture of someone the participant is comfortable with). Semi-structured interviews were used to assess the feasibility of the intervention implementation by asking teachers about feasibility and acceptability to students, classroom impact, percentage of students that benefitted from the intervention, helpfulness of art portion, student take-away, and impact on class attendance. The Connors Teaching Rating Scale - Revised Short Form measured students' oppositional behavior, cognitive problems and inattention, hyperactivity, and provided an overall ADHD index. The Connors was given before and after the intervention, then eight weeks after for the first classroom as a maintenance measure.

The findings from Klatt et al. (2013) were positive. Qualitative findings reported that teachers thought Move Into Learning was feasible and acceptable for reducing stress in the classroom and that it benefitted students' relaxation before test-taking. Teachers reported that the majority of students benefitted from participating because students learned the coping skill of relaxing, and that the Move Into Learning program improved attendance, especially on the days where the program ran 45 minute sessions. Quantitative findings showed that students improved on three of the four behavior outcomes. Effect sizes for the three improved outcomes were moderate. At follow up the ADHD index improvement was maintained and the cognitive inattentiveness was not only maintained but had improved. The study was limited by a small sample, no comparison or control group, potential teacher bias due to rating the students outcomes based on an intervention they were aware of and may have participated in, and not having certified yoga instructors involved to either create, implement, or conduct training for the intervention. However, this study supports Chaya et al.'s (2012) findings that yoga is related to improved and maintained attention performance in at-risk children. Klatt et al.'s (2013) findings also adds to the body of work by showing that at-risk children can improve ADHD symptomology after yoga and that yoga is a feasible and acceptable intervention with at-risk children in the school setting.

Another study by Sale, Weil, and Kryah (2012) examined the effects of yoga on at-risk children's social skills behaviors. The purpose of the study was to explore the effectiveness of a St. Louis violence and substance use prevention program (Promoting Responsibility through Education and Preparation Program; PREP) on fourth and fifth grade students' social skills. The research design used was an exploratory pre-post

measure and observation checklist of comparison groups. Participants included 88 fourth and fifth grades students from St. Louis public schools in predominantly African American neighborhoods who were considered at-risk after a home visit by a PREP Social Worker for two or more of the domains of individual, family, peer, school, neighborhood, or community risks. The participants were 50% male, on free or reduced lunch, and were identified by a teacher or principal referral for being behaviorally or academically challenged. Four cohorts were included to assess dosage effects: Group 1) 21 students in spring 2006 who were exposed to 54 hours, 3 days a week of PREP after school program; Group 2) 25 students in fall of 2006 with 54 hours, 3 days a week; Group 3) 24 students in fall of 2007 with 60 hours, 4 days a week; and Group 4) 18 students in spring 2008 with 85 hours, 4 days a week plus weekly 30 minute therapeutic sessions in school. The PREP after-school program included the activities of cooking, yoga, art instruction, and social skills training to prevent violence and substance use. The authors indicate that yoga was utilized as a stress reduction and anger management technique, although these variables were not directly measured, and that PREP is designed to prevent at-risk children from engaging in violence and substance use, although these variables were not directly measured, either. However, general social skills used in the school setting were measured by a revised version of the School Social Behavioral Scales, shortened from 32 items to 17 for teacher feasibility of use in the classroom.

Sale et al.'s (2012) findings were generally positive. Overall, the extended PREP program of 85 hours, 4 days a week, with weekly 30 minute therapeutic sessions was found to improve the participants' social skills. However, when all groups were

combined, no significant differences were found for social skills scores from pre- to post-intervention. There was a time-by-cohort interaction effect where Groups 3 and 4 had significantly higher social skills scores post-intervention as compared to Groups 1 and 2, indicating that the dosage of PREP may have more of an effect on at-risk children's social skills. Unfortunately, the study was limited by numerous factors, including: not having a control group, thus no random assignment of participants; significantly different social skills score of Group 2 at baseline; components of PREP were not analyzed separately, therefore possibly confounding the yoga results; uni-modal data collected by teachers via observation checklist and received a monetary incentive to do so, although the amount was not stated and therefore it is unknown if it could have been coercive; a lack of follow-up to determine maintenance; and although treatment fidelity appears to have been measured, there is not enough detail for replication. Despite the limitations that interfere with the study's findings, Sale et al.'s (2012) results show some support that at-risk children's social skills may be positively affected by higher dosages of yoga as part of an intervention package.

Powell, Gilchrist, and Stapley (2008) also researched the effects of yoga on at-risk children's behavior along with self-concepts by assessing the Self-Discovery Programs (SDP) effects on participants' self-esteem, behavior, and self-competencies. The research design used was a random assignment comparison of groups with control and a pre-post measure. Participants were 107 children with special educational needs, including emotional, behavioral, or learning difficulties that were at risk of being excluded from school. The students were invited by head-teachers of four schools from England to participate in SDP. After baseline data were collected, the children allocated

to the intervention groups were divided into 8 groups of 7 or 8 similar-aged children. The intervention and control groups were similar in size, were half Caucasian, eight to nine years of age, approximately half were male, approximately one-third were receiving extra agency supports in the school, and the majority were not medicated. The SDP intervention was implemented by one of three holistic therapists who received SDP training. The intervention group practiced the elements of sensory awareness, touch therapy (e.g., peer massage), yoga, breathing techniques, relaxation, and communication in 12 weekly sessions for 45-minutes. General self-esteem, social competence, and behavior were defined as self-confidence, social confidence with peers/ teachers, communication with peers/teachers, self-control in school, concentration and attention skills, contribution in class, and eye contact. The outcome variables were measured with author created behavior profiles, which consisted of nine items regarding cognitive and behavioral actions (e.g., self-talk, use of massage and breathing techniques, effective listening, fidgeting, and pausing before responding). The Strength and Difficulties Questionnaire (SDQ) measured emotional, conduct, hyperactivity, and peer problems, along with a total difficulties score.

The results from Powell et al.'s (2008) were positive. The behavioral profiles showed that the intervention group improved significantly in the areas of self-confidence, social confidence with teachers, communications with peers and with teachers, and in contributing in the classroom as compared to the control group. The intervention groups post-intervention mean change score of Total Difficulties on the SDQ was significantly greater than the control groups with a medium effect size. The intervention group was also reported to engage in self-talk, enhanced listening skills, use of massage techniques

and breathing techniques at a significantly greater percentage than the control group. Although the study's findings are limited by a lack of random assignment, a lack of information of extraneous variables impact on outcome measures leading to potential Type I/II errors (i.e., extra agency support in school, no information on activities that control group participated), and a lack of information on the development of the behavioral profile measure, Powell et al.,'s (2008) findings show that yoga may be an intervention that improves desirable behaviors in the classroom and social/self-confidence.

Berger, Silver, and Stein (2009) also explored how yoga affects self-concepts of at-risk children. The purpose of the study was to explore how yoga affects children's well-being, specifically self-perception of self-worth and physicality. The research design was a non-randomized pre-post test and the participants were inner-city fourth and fifth grade children who were faced with significant stressors. The yoga intervention group consisted of 39 students who were on free and reduced lunch who were mostly female and Hispanic with a mean age of 10.4 years. The control group consisted of 32 students with similar demographics. The yoga intervention group practiced physical postures, breathing, meditation, and relaxation for one hour a week for 12 weeks in an after school program. The outcome measures included emotional well-being, physical well-being, and behavioral effects of yoga. Emotional well-being was described as self-esteem, perceptions of flexibility, balance, strength, and coordination, and perceptions of coping mechanisms, self-regulation techniques, and attitudes. This outcome was measured with 12 items from Harter's Self-Perception Profile for Children, subscales of Physical Appearance and Global Self-Worth, and 25 items created by the authors



including Perceptions of Physical Health and Yoga Teachings with subscales of Negative Behaviors, Positive Behaviors, and Focusing/Relaxation. Physical well-being was defined as flexibility of the lower hamstrings and back and balance was measured using two exercises: the “V-sit and Reach Test” and the “One-leg Standing Test”. The behavioral effects of yoga on well-being were assessed as direct behaviors (e.g., strength, attention, liking self, behavior in class) and indirect behaviors (e.g., getting along with others, tests, stress and worry). Sixteen items were created by the authors to assess if well-being outcomes were better, the same, or worse since intervention.

Berger et al.’s (2009) study had some positive results. The yoga group reported significantly better scores on the Yoga Teachings Negative Behaviors subscale and One-leg Standing Test as compared to the non-yoga group. The majority of the yoga group also reported 50 – 80% improvement on direct behaviors while indirect behaviors were reported as mostly the same or worse. There were also no significant differences between groups on outcomes of global self-worth or physical appearance post-intervention. The mixed results could be a product of the limitations of the study, such as the short length of intervention, and imperfect attendance and low intensity, which may affect the effectiveness of the intervention. The use of an author created scale that may not be an appropriate measure for this population or outcome and the lack of random assignment to groups also serve as limitations that may affect the validity of the findings. However, given these limitations, it is promising to see that yoga may be an effective intervention for at-risk children’s perception of negative behaviors, balance, and direct behaviors that include attention and classroom conduct.

One other study by Mendelson et al., (2010) explored the feasibility of and effects of yoga on at-risk children's overall adjustment. The purpose was to examine the acceptability and feasibility of a mindfulness based program and to explore the programs' ability to improve overall adjustment in 4th and 5th graders, who are susceptible to stress due to the transition to middle school and the critical period of development of self-regulation and inhibition (Windle et al., 2008). The research design was a randomized control trial with a pre-post outcome measure. Participants were 97 randomly selected fourth and fifth grade students from four low income, high violence Baltimore neighborhood elementary schools. The participants were between the ages of nine and ten, mostly female and African-American, with 51 in the intervention group and 46 in the control group. The mindfulness based yoga program was conducted in collaboration with Baltimore-based Holistic Life Foundation and was provided in a school gym for 45 minutes a day during resource time, four days a week for 12 weeks. Yoga postures that focused on muscle strength and flexibility were taught along with the health benefits of the poses. Breathing techniques that advanced from a beginner level to a more complex level were used as a way to calm and center the participants' minds. A didactic explanation of stressors, stress response, cultivating relationships, and overall health was also taught and integrated with the mindfulness technique of focusing on sending out positive energy or paying attention to the breath. The outcome variable was overall adjustment as a reduction in physiological and cognitive patterns in chronically stressed youth, with overall adjustment being conceptualized as including cognitive, affective, social-emotional, and behavioral components. The outcomes were measured before and after the intervention by trained research assistants who read the following measures

aloud in a group setting: 1) The Involuntary Engagement Coping Scale (IECS) from the Responses to Stress Questionnaire (RSQ) as cognitive measure of involuntary stress response; 2) The Short Mood and Feelings Questionnaire – Child Version as an affective measure of depressive symptoms; 3) The Emotion Profile Inventory as a measure of positive and negative affect; also, the People in my Life scale subscales of Trust in Friends, Communication with Friends, Teacher Affiliation, and Dissatisfaction with Teachers as a measure of social relationships for the social-emotional component; and 4) student and teacher reports of behavior change during focus groups.

Mendelson et al.'s (2010) results found the yoga program to be feasible, acceptable, and effective in improving the cognitive adjustment component of involuntary or temperamental responses to stressful situations. Attendance as an acceptability measure was supportive as well as positive feedback on feasibility and acceptability according to the student focus group, which reported positive behavior and cognitive change. The teacher focus group also provided positive feedback that indicated overall support due to the programs potential to have a positive impact on behavior, attention, and activity level, and most reported seeing these changes in students (although one was unsure and one did not see change). As for cognitive adjustment, the intervention group reported significant improvement on the overall RSQ Involuntary Engagement Coping Scale and the subscales of Rumination, Intrusive Thoughts, and Emotional Arousal as compared to the Control group post-intervention. Although the study is limited by possible sample bias due to including only volunteers (which may prevent generalization of the findings), the uni-modal assessment issue of self-report biases of social desirability, and a lack of treatment fidelity assessment, Mendelson et

al.'s (2010) findings show that yoga is an acceptable and feasible intervention for at-risk children's cognitive adjustment.

Although all of the studies on yoga and children reviewed have had various levels of positive results ranging from improving executive function skills, attention, self-concepts, and well-being in children-risk for attention deficits, the body of research is inundated with inconsistent use of multiple methodologies. The overall limitations of yoga research with children may be preventing the intervention from reaching evidence-based status.

**Limitations of research on yoga and children.** The methodologies of research reviewed on yoga and children are invariably inconsistent. This is seen in a summarization of the methodologies reviewed, which consists of: 1) populations that range from one gender to both; in the age ranges of six- to 13 year-old children who are identified as stressed, having attention deficits, at-risk based on disadvantaged backgrounds, or severe educational problems; and who are from rural to inner-city areas, in residential homes, or at summer camp programs; 2) outcomes including planning, memory, attention regulation and deficit symptoms, self-concepts, time-on-task, visuo-spatial abilities, abstract thought, classroom impact, social skills, and well-being; all of which have been measured by a multitude of surveys, observations, and assessments, which are hardly used across more than one study (with the exception of the Conner's Behavior Rating Scale, which was used for three studies); 3) designs that range from single subject design to comparison groups (which is the most popular) to longitudinal, randomized control groups; and 4) variations of yoga dosage, ranging from durations of 15 to 90 minutes across a maximum of 12 weeks from three to seven days a week; that

consist of a range of one component to all components of yoga, either implemented alone or as an intervention package that also includes other activities such as didactic information, reflection, art, cooking, and substance abuse prevention.

Researchers agree that the body of yoga literature is inundated with methodological issues (Birdee, Yeh, Wayne, Phillips, Davis, & Gardiner, 2009; Greenberg & Harris, 2012). Greenberg and Harris (2012) recently conducted yoga reviews that indicate that yoga studies are inconclusive due to inadequate reports of important research aspects such as implementation, methodology, and data analysis. The lack of replication across studies thwarts the intention of research to discover evidence-based practices that lead to empirical interventions. Instead of following the trend in the field of research and push for large sample, longitudinal, randomized-control group studies, it may be best to strip down the methods that explore how yoga affects children by creating a simple methodology that can be easily replicated in order to explore the various outcomes that yoga appears to positively affect.

### **Problem Statement**

In order to improve the body of research on yoga and children's executive function and selective attention, a more easily replicable intervention was designed for the current study. The following chapter will describe how a mixed method approach using a single subject research design will examine if a traditional yoga practice improves children's executive function and selective attention using theoretically sound and easily attained measures. This method could be used in almost any setting and is hypothesized to be feasible in the school setting (Koenig, Buckley-Reen, & Garg, 2012; Steiner, Sidhu, Pop, Frenette, & Perrin, 2013; Telles, Singh, Bhardwaj, Kumar & Balkrishna, 2013).

It is important to examine how yoga is affecting separate executive function skills, to go beyond accepting that yoga improves attention and to examine which cognitive components may or may not be affected by yoga. It is apparent through the research reviewed that executive function deficits affect learning and development; several theorists believe that basic executive function skills are the foundation for developing more complex executive function skills later in life (Barkley, 1997; Diamond, Barnett, Thomas, & Munro, 2007; Plude et al., 1994) and without executive function skills, learning is hindered (Norman & Breznitz, 1992; Tipper, Bourque, Anderson, & Brehaut, 1989). Therefore, this study examined how yoga affects children's executive function and selective attention skills in a school setting.

## Chapter 2: Methodology

The purpose of the study is to determine the effects yoga has on children's executive functioning and selective attention. The proceeding chapter has reviewed the current research literature on the variables of executive function, selective attention, and yoga and the population of children at-risk for or with attention deficits. The current chapter outlines the methodology to test the following hypotheses:

1. Yoga will have a positive effect on children's selective attention in an academic setting. Research has found that after performing yoga in school, children identified as having attention deficits improve time-on-task (Peck, Kehle, Bray, & Theodore, 2005) and reduce symptoms of inattention, hyperactivity, and impulsivity (Abadi, Madgaonkar, & Venkatesan, 2008).
2. Teachers will report an improved change in a child's executive functioning in the classroom after practicing yoga. Research has found that after performing yoga, children's executive functions of attention (Hopkins, & Hopkins, 1979; Jensen, & Kenny, 2004), memory and planning improve (Manjunath, N., & Telles, S., 2001; 2004).
3. Yoga will be a socially acceptable intervention to teachers and students. Research has found that yoga is a feasible and acceptable intervention to use in the school setting by teachers and students (Klatt, Harpster, Browne, White, and Case-Smith, 2013; Mendelson, Greenberg, Dariotis, Ghould, Rhoades, & Leaf 2010).

The methods described in this chapter include: a) research design, b) participants, c) setting, d) instrumentation, e) procedures, f) data analysis, and g) study significance.

## **Research Design**

A sequential, complementary, mixed method, multiple probe across participants single (MPAP) subject research design was used for the study. A sequential data collection method is appropriate as data is not being collected concurrently and was instead collected at different points in time (Small, 2011). The motivation for choosing a complementary data collection method is to improve the strength of the findings by collecting data in multiple forms. Multiple forms of data collection compliment the weakness of one methods' ability to provide limited knowledge with additional methods that provide different but related types of knowledge (Small, 2011). This design provides a more comprehensive picture of the effects of yoga on children's selective attention and executive function, lending greater validity to the findings and improving the research base of yoga and children.

Single subject research design was chosen due to being an empirical, experimental research approach that is practical to use in the school setting as a way to intersect practice and research (Horner, Carr, Halle, McGee, Odom, & Wolery, 2005). Gast (2010a) explains that this design requires participants to serve as their own control, following the principle of baseline logic where the participant is exposed to a control or baseline condition followed by an intervention condition. The target behavior is repeatedly measured across conditions and participants. This data is presented on a graph to aid in decision making regarding maintaining or changing the current condition via analysis of the stability, trend, and level of visual data (Gast, 2010a).

Specifically, the multiple probe design (days) across participants (MPAP) method of single subject research design was used for current study (Gast & Ledford, 2010). The



MPAP design requires intermittent collection of data for at least three days prior to the introduction of the intervention across several participants who display the same behavior under similar conditions. The design is appropriate for applied research due to measuring program efficacy, not withdrawing an intervention, and the ease of implementation and conceptualization of the research. It requires a sequential and staggered introduction of the intervention across a minimum of three participants, measuring the target behavior until the last three to five data points in a data series be analyzed for level stability, trend stability, and contra-therapeutic trend direction before deciding to intervene. Once this occurs, the intervention is introduced to one participant while continuing baseline data collection for other participants until the target criterion is reached for the first participant. The intervention is then introduced to the second participant, and this sequence is repeated across all participants within each setting.

Due to the rigorous procedures and data analysis of single subject research design, it is one of the most recent empirical experimental designs added to the repertoire of research methodology (Horner et al., 2005). It is also one of the most logical methods to use in the school setting due to the Response to Intervention (RTI) movement, making the design practical to apply in a setting where a similar form of data collection and analysis (RTI) is being used that is familiar to students, teachers, and administrators (Gast, 2010d). Assessment for RTI requires collecting data for a certain amount of time on specific outcomes, allowing for continuous review of performance that permits prompt adjustment and support to student. In essence, these are also the broad goals of single subject research design: to visually analyze data to determine the effectiveness of

interventions on outcomes and to be able to adjust those interventions for the participant accordingly (Gast, 2010a).

### **Participants**

Six student participants were identified by fifth grade teachers at a public elementary school in a central Southern states urban city in the United States. Inclusion criteria for the selection of the school required at least half of the students be receiving free and reduced lunch based on eligibility through Title 1. The inclusion criteria was chosen as a larger at-risk population of students may be susceptible to more stress and distractions than students who do not receive these benefits. The participating school met the inclusion criteria by having 81% of the student population receiving free/reduced lunch. The student population is diverse and was comprised of 11% Caucasian students, 39% Hispanic students, 44% African American students, 5% other students, and 1% Asian students, with 15.61% of the population being Special Education students and 26.93% being English Language Learners.

Inclusion criteria for the selection of students consists of students that: (a) have been identified as having an attention-based issue within the classroom, (b) are physically able to participate in the yoga intervention, (c) have the cognitive ability to follow the procedures, (d) are able to discriminate between colors, (e) are in the fourth or fifth grade, (f) give assent to participate in the intervention, and (g) have parents or caregivers that give consent for their child to participate in the intervention. Exclusion criteria include students that are on medication for attention-deficits and/or were receiving interventions targeting attention.

Four of the six identified students' parents signed informed consents giving permission for the child to participate. The students also assented to participate. Due to a change in the time of day that the intervention took place, one student dropped out of the study. The remaining three participants completed the intervention. Demographics of the students included an average age of 9.7 years old, two females, two males, three African American students, one Caucasian student, one student in foster care, one student living with biological parents, and two students who lived at home with biological parents part-time and in an aunts household part-time. Specific information will be given on the four participants including age, gender, grade, math grade level, home environment, attention deficits as specified by the classroom teacher that identified the student for recruitment during the pre-intervention semi-structured interview, and special education service eligibility.

Denise was an 11 year-old, 5<sup>th</sup> grade, Caucasian female who was on or above level for 5<sup>th</sup> grade math and was not receiving special education services. She resided with both of her younger biological siblings and in a foster care placement with a married African American couple and their two children. Denise and her siblings had an upcoming evaluation to determine if they would remain together in the current residential placement, and she reported being hopeful that she would get to be reunited with her biological mother.

According to Denise's teacher, Denise's attention-based problems in the classroom were keeping focus for an appropriate amount of time, especially during quiet or independent work time. Denise was reported to be off-task 50% of the time with the teacher's expectation of her to be on-task 90% of the time, and the function of her

behavior was speculated to be attention seeking. Denise's teacher used the strategy of verbal reminders to increase her attention in the classroom and reported that if Denise's problematic attention behavior were to be reduced her grades would likely improve.

Shawn was a 9 year old, 5<sup>th</sup> grade, African-American male who was on level for 5<sup>th</sup> grade math grade and received special education services for a learning disability in reading. Shawn's classroom teacher did not give specific information about his disability and access to educational records was not part of data collection, so his IEP was not reviewed. He resided with his biological parents and his twin sister (participant Sharon) part-time, and with his aunt and her two children part-time. Shawn stated that he enjoyed staying with his aunt and cousins because he slept better at that home and got to play outside more.

Shawn's teacher reported that his attention-based problems in the classroom were not having the attention span for an appropriate amount of time, especially during independent or language, reading, or writing tasks. Shawn was reported to be off-task 75% of the time with the expectation that he be on-task 90% of the time, and the function of Shawn's behavior was speculated to be task avoidance. His teacher used the strategies of verbal and visual cues to redirect his attention and reported that if his attention-deficit were to be reduced, his grades would likely improve.

Sharon was a 9 year-old, 5<sup>th</sup> grade African-American female who was on level for 5<sup>th</sup> grade math in addition and subtraction and on level for 3<sup>rd</sup> grade math for multiplication and division. She was not receiving special education services. Sharon had the same home environment as her brother Shawn and preferred to stay at her

parent's home so she could play with her dog. Sharon expressed concern that she may have to move to a larger neighboring city with her mother near the end of the school year.

Sharon's teacher reported that her attention-based problems in the classroom were task avoidance and losing focus on the current task, especially during group work. Sharon was reported to often have trouble completing her assignments while her teacher expected that she complete her assignments 100% of the time, and the function of her behavior was speculated to be task avoidance. Her teacher used the strategies of chunking of assignments, redirection, and differentiated work to improve her attention and increase task completion. Sharon's teacher reported that if her attention-deficits were reduced, her grades would improve and she would have to be redirected less.

Robby was a 10 year-old, 5<sup>th</sup> grade, African American male who was on level for 5<sup>th</sup> grade math. He resided at home with his biological parents as an only child. Robby wanted to grow up and be an artist like his father.

According to Robby's teacher, his attention-based problems in the classroom included hyperactivity, fidgeting, talking to self, making noises, and drawing as an off-task behavior. She reported that his attention-deficit behaviors caused him to not complete tasks and to fall behind when not paying attention to directions. Robby was reported to be on-task less than 50% of the time while he was expected to be on task 70% of the time, and the function of his behavior was speculated to be self-stimulation/entertainment. His teacher used the strategies of preferred seating near her and a student buddy to improve his attention in class. She also reported that if his attention-deficit were reduced, he and other students could concentrate more, hear more clearly, and that he would have improved grades. When the intervention was switched

from after to school to during the Specials block, Robby did not re-assent to participate because he did not want to miss Art, Music, or Gym during the rotation block.

Three teachers also participated in the study. All were fifth grade classroom teachers of the student participants and helped to identify the participants based on the inclusion criteria. Teacher participant demographics include being female with an average age of 41.8 years old. One teacher identified her racial identify as African American and two as Caucasian. All teachers signed informed consents to participate in the study. Data was only collected from two of the teachers once Robby dropped out.

### **Setting**

All data were collected at a Title I public elementary school in a central Southern state in the U.S. that had 81% of its diverse body of students receiving free/reduced lunch. Baseline data were collected in the STEM Specials classroom or the Reading/Math Intervention classroom during the 30-minute breakfast period of the day before school. The observers, the student and the teacher of the classroom were present in the room during the baseline data collection. The door was shut to reduce distractions and the data collection typically lasted 15 minutes per student. At times, two pairs of observers and student participants worked together to collect data. Other times, one observer worked alone with one student.

The original intervention setting within the elementary school was a small classroom used by the Speech Pathologist. The room had two desks, two bookshelves, and four chairs that were easily moved aside to provide room for two people to do yoga. The door window was covered by paper and the door was closed during the intervention

to reduce distraction. The intervention and data collection occurred for approximately an hour after school.

After the second participant entered intervention, the setting was changed to a shared Reading/Math Intervention classroom during the first hour of the school day. The modification was approved by the IRB, which occurred due to the school administration's request because the participant's parents were having trouble providing transportation after school. The first hour of the day was a Specials rotation class (Art on Mondays, STEM on Tuesdays, Gym on Wednesdays, etc.) and because the student participants would miss classroom content, new assents and parental consent was obtained explaining the procedure changes. One student dropped out of the study at this point because he did not want to miss the Specials classes.

The room for the yoga intervention changed because the Speech Pathologist held groups during the new time. The yoga intervention then took place in the Reading/Math Intervention room where some baseline data collection occurred. The Interventionist teachers held groups during the last 30 minutes of the Specials block, so the yoga intervention and data collection had to be completed in a 30-minute period. The classroom had more furniture and décor but there was ample room for two people to do yoga. During the intervention, the Interventionist teachers remained in the room and worked quietly without causing distractions.

**Interventionists, observers, and training.** Two yoga instructors implemented the intervention that had at least 200 hours of training certification and an interest (if not previous experience) in working with children. One alternate yoga instructor was recruited and trained in case one of the main instructors had an emergency. The

instructors were provided with materials for the participants' use and worked one-on-one with three students. Yoga instructors and observers were trained to administer the manual TOT math worksheets and Stroop Color-Word Task, while the observers were also trained in collecting procedural fidelity data.

The yoga instructors were trained during a 2-hour session to collect the selective attention performance data via the Stroop Color-Word Task before the intervention was introduced and then administered the task at the end of the yoga sessions during intervention. During training, the yoga instructors reviewed and/or practiced the yoga lessons. They also practiced completing the measures as an administrator and took turns being the participant to get a realistic idea of the task difficulty. This was practiced multiple times during the session and as homework. Other training sessions were conducted for the observers who were undergraduate students enrolled in an Independent Psychology Research course. The observers attended two 1-hour training sessions that were similar to the yoga instructor training session for the Stroop Color-Word Task and two other observation forms.

The undergraduate observers were also trained on the yoga intervention procedural fidelity form and the TOT form. During training, the observer's practiced completing procedural fidelity when observing some of the yoga lesson plans then comparing the forms with other observers and asking questions for clarification. Observers also practiced completing the TOT form while observing another observer or the PI role-play completing the math worksheets during the training session. Homework was given to become familiar with the yoga poses on the procedural fidelity forms if needed, practice the Stroop and TOT tasks, and to contact the PI with any questions.



During the course of data collection, emailed and in-person procedural reminders were given to interventionists and observers regarding procedures to avoid observer or procedural drift.

### **Instrumentation**

Multiple measures were used due to the mixed methods design of the study and include: (a) the semi-structured interview, (b) the Children's Acceptability of Yoga Scale (CAYS), (c) the Child and Adolescent Mindfulness Measure (CAMM), (d) the Behavior Rating Inventory of Executive Function – Teacher Form (BRIEF), (e) Time-On-Task (TOT), (f) the Stroop Color-Word Task, and (g) the observer forms for procedural reliability.

**Social validity measures.** Social validity is an important component of single subject research design. Social validity refers to the social significance of intervention goals, the social acceptability of intervention procedures to attain the goals, and the evaluation of the social importance of the effects resulting from an intervention (Lane & Beebe-Frankenberger, 2004) Teacher and student perception of social validity was examined through the a semi-structured interview, the CAYS, and student reports of enjoyable and challenging aspects of each yoga sessions that was kept as a running record.

*Semi-structured interview.* In order to assess teacher's acceptance of yoga as an intervention for improving children's executive function and selective attention, an interview was created based on the work of researchers Kathleen Lynne Lane and Margaret Beebe-Frankenberger's *School-Based Interventions: The Tools You Need to Succeed* (2004). The purpose of the interview is to conduct a functional behavioral

analysis to ensure that each participant displays a similar behavior that has a similar function. The interview also purposefully includes the school staff in evaluating school-based interventions (Lane & Beebe-Frankenberger, 2004). The social validity measure is a semi-structured interview (see Appendix A) in which sections were conducted before the intervention began with the teachers to recruit appropriate participants. A final section was conducted post-intervention with the teachers of the student participants.

*Children's Acceptability of Yoga Scale.* The Children's Acceptability of Yoga Scale (CAYS; Rogers, unpublished; see Appendix B) was used to determine the social validity and student participant acceptability of the yoga intervention. The CAYS was created by the author and displayed good internal consistency when piloted with 26 children participating in a group yoga program (Cronbach alpha = .843). Changes to the scale were made to reflect the purpose of this study, deleting two items ('My parents like it when I do yoga' and 'Yoga helps me make friends') and adding two items ('Yoga helps me to pay attention', 'Yoga helps me behave in class'). Six items were rated on a three-point scale (i.e., Yes, Not Sure, and No). An example item is "Yoga teaches me important skills." Open-ended items are included to give the student participant the opportunity to give individual feedback on what they did and did not like about yoga.

**Dependent variable measures.** The dependent variables of mindfulness as an aspect of executive functioning, executive functioning, time-on-task, and selective attention were examined through multiple measures. Each measure will be described.

*Child and Adolescent Mindfulness Measure.* It is expected that yoga will have an effect on student's overall attention and executive function due the intervention's ability to enhance self-awareness (Simpkins & Simpkins, 2011). To examine this, the Child and

Adolescent Mindfulness Measure (CAMM; Greco, Baer, & Smith, 2011; See Appendix C) was administered before and after the yoga intervention with permission from the first author, Ms. Greco. The CAMM is a self-report scale that assesses the ability to be in the present moment and to engage in awareness without judgment. It has adequate reliability, validity, and correlations as expected with similar measures (Greco, et al., 2011). In a further validation study, Bruin, Ziljstra, and Bögels (2013) found that the Dutch version yielded the main factor of non-judgmental mindful awareness as well as factors of cognitive and emotional suppression in children and attention difficulties in adolescents. The CAMM is appropriate for children at least nine years of age. A sample item is “I stop myself from having feelings that I don’t like” which is scored from 0 (Never True) to 5 (Always True).

*Behavior Rating Inventory of Executive Function – Teacher Form (BRIEF).* In order to gain a multi-modal form of evaluation of the change in the participants’ executive functioning, the student’s teacher was asked to complete a pre-post measure of the child’s executive functioning. The Behavior Rating Inventory of Executive Functioning – Teacher Form (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2012) was administered before and after the yoga intervention. The BRIEF is appropriate for children ages five – 18 and consists of 86 items under the categories of Inhibition, Shifting, Emotional Control, Initiating, Working Memory, Plan/Organizing, Organization of Materials, and Monitoring. The first three categories comprise a Behavioral Regulation Index while the others comprise a Metacognition Index and the indices are summed to obtain a Global Executive Functioning Composite. Theoretically, each of the subscales is representative of the indices of behavior regulation and meta-cognition,

which are both techniques that are representative of executive functioning and are enhanced by yoga practices (Gioia, et al., 2012; Simpkins & Simpkins, 2011). This measure takes approximately 15 minutes to administer which is feasible for an elementary teacher, and test-retest reliability has been reported at .88 for past studies (Gioia, et al., 2012). Using the BRIEF as a quantitative component allows examination of non-observable variables of emotions, inhibition, and behavioral reports from teachers that will be otherwise difficult to gather during the intervention.

*Time-On-Task.* In order to obtain a practical measure of the dependent variable of selective attention in a school setting, time-on-task (TOT) was evaluated. Peck et al., (2005) used TOT in the only other study that has examined yoga and attention in children using Single Subject Research Design and defined TOT as the percentage of intervals of eye contact with the teacher, task, or performed assignment during ten minute observations with 10 second intervals using momentary time sampling. In order to begin the process of replication of designs for the children's yoga body of research, this method of data collection was used in the current study with the slight modification of a reduced observation period of five minutes instead of ten.

Data collection of TOT occurred during the baseline condition and after the Stroop Task data collection directly at the end of each yoga session in the intervention condition. A trained observer worked with the participant on a third grade level math sheet (see Appendix D for sample). Third grade math was chosen to avoid introducing a level of academic difficulty for the fifth graders, allowing the participant to more easily focus on completing items. A total of 16 worksheets were created using Intervention Central's Math Worksheet Generator website

(<http://www.interventioncentral.org/teacher-resources/math-work-sheet-generator>).

Addition, subtraction, multiplication, and division worksheets were randomly ordered for completion and assigned to a specific baseline and intervention session. While the order was randomized so that skill building does not confound the results, all participants completed the same worksheet after the assigned session so that order effects would not confound the results.

The participant was instructed to complete as many math items as possible while the observer set a timer for five minutes, looking up at the student every 10 seconds, and recording whether he or she was on-task on an observation sheet (see Appendix E). In this study, ‘on-task’ was defined as completing items, working items out on paper or with hands, counting to self, or asking the observer math related questions. ‘Off-task’ behaviors included looking away from the worksheet or observer, staring off into the distance, or engaging in any other activity or with any other person. After the five-minute interval ended, the observer checked the worksheet for incorrect items to discuss with the participant and allow for corrections. The data was delivered to the PI to be graphed in Microsoft Excel® for visual analysis.

*Stroop Color-Word Task.* Measures of attention based on executive functioning tasks are often examined using Stroop-like activities. The Kochanska research team have developed versions of the original Stroop Color-Word Task and found them to be reliable based on item-total correlations, correlations with parent reports and related concepts such as emotionality, and longitudinally stable findings across the early years of development (Spinrad, Eisenberg, Gaertner, 2007). Stroop-based tasks require individuals to shift attention from irrelevant to relevant information and measures

resistance to interference (Golden, 1978), selective attention (Lezak, 1995), and attention focusing (Mirsky, 1996). Advantages of using the Stroop Color-Word Task to measure selective attention include the sound theoretical findings for the task as an appropriate measure of attention (Lezak, 1995) and that it was administered individually outside of the classroom, controlling for interfering internal and external factors (i.e., aptitude for and interest in class content, classroom activity, classmate interaction, and teacher effects).

The Stroop Color-Word Task was administered by asking the participant to read lists of words printed in different colors of ink to measure selective attention (Golden, 1978). Stroop Color-Word Tasks require participants to name the primary stimulus (ink color) as fast as possible while ignoring the secondary stimulus (word meaning). Two trials are conducted that use a congruent then an incongruent meaning and ink color word lists (see Table 1 for an example set of Congruent Trial 1 and Incongruent Trial 2). In the first congruent trial, the participant was asked to identify the primary stimulus by reading a list of words as fast as possible without errors (e.g., blue, red, yellow, brown, and green printed in the congruent color repeated in varying order). Next, the incongruent trial took place where the participant was asked to name the color of ink (primary stimulus) that a list of words were printed in as fast as possible without errors, ignoring the word meaning (secondary stimulus; e.g., the word “green” printed in blue ink would be considered accurate if responded as “blue”).

Table 1

*Example of Congruent Trial 1 and Incongruent Trial 2 of Stroop Effect Task Word Lists*

Set 1 Congruent	BROWN	ORANGE	GREEN	GREEN	RED
	GREEN	YELLOW	BROWN	RED	BROWN
	YELLOW	BLUE	ORANGE	BLUE	ORANGE
	BLUE	GREEN	RED	BROWN	GREEN
	RED	RED	YELLOW	ORANGE	YELLOW
	ORANGE	BROWN	BLUE	YELLOW	BLUE
Set 1 Incongruent	BROWN	ORANGE	GREEN	GREEN	RED
	GREEN	YELLOW	BROWN	RED	BROWN
	YELLOW	BLUE	ORANGE	BLUE	ORANGE
	BLUE	GREEN	RED	BROWN	GREEN
	RED	RED	YELLOW	ORANGE	YELLOW
	ORANGE	BROWN	BLUE	YELLOW	BLUE

Recording the time it takes to read the congruent and incongruent lists allowed for a time difference score to be calculated between the two trials. Counting the number of words read correctly in each trial allowed for calculation of an error difference score (see Appendix F for an observation and calculation form). Findings have shown that the reaction time and accuracy of naming the primary stimulus was faster when compared to the secondary stimulus of non-color words or symbols, indicating that the secondary stimulus causes interference in the visual selection of filtered attention (MacLeod, 1991; Plude et al., 1994; Stroop, 1935).

**Procedural fidelity measures.** The effectiveness of an intervention can be compromised if not implemented as intended. Therefore, trained observers collected data on the implementation of the yoga intervention, the administration of the Stroop Color Word-Task, and the Time-On-Task measure (TOT). Inter-Observer agreement (IOA)

between two trained observers was calculated to insure that the data is reliably representing the behavior of the participant. The Point-By-Point Agreement method was used to calculate the Momentary Time Sampling data collection of Time-On-Task while the Gross Calculation method was used for the Event Recording data collection of Stroop Task time difference and errors. During data collection, all data and observations were recorded by two observers for at least 33% of the total sessions, or until IOA indicated 80% agreement (Ayers & Gast, 2010). The formula for calculating procedural fidelity is to divide the number of observed behaviors by the number of planned behaviors and multiplying by 100 (Gast, 2010b). The procedural fidelity data was used to determine IOA which is calculated by dividing the smaller procedural fidelity calculation by the larger one and multiplying by 100 (Ayers & Gast, 2010). Three unique observation forms were created for use with each participant. One is the data collection sheet for the Stroop Color-Word Task (see Appendix F).

The second observation form is the procedural fidelity checklist for the yoga curriculum. The researcher and a yoga instructor consultant jointly created 12 yoga lesson plans for the intervention that include specific breathing, posture, and relaxation meditative yoga practices. Brief versions of the lesson plans were created as fidelity measures to indicate whether the instructors and participants were following the curriculum (see Appendix G). The third observation form is the TOT data collection sheet (see Appendix E). The observers collected the TOT data during data collection and provided five minutes of math tutoring to the participant.



## **Procedures**

Ethical considerations are a crucial aspect of conducting research and will be outlined. This section describes the: (a) internal review board approval process, (b) pre-intervention assessment, (c) yoga curriculum, and (d) ongoing and post-intervention assessment.

**Internal review board process.** The Assessment Specialist for the county public school system gave verbal approval for the researcher to work with School Psychologists on the project to recruit Principals from Title I elementary schools. A letter of support (see Appendix H) from the elementary school principal was obtained as well as approval from county public schools Interval Review Board Director (see Appendix I). All documents were included in the application for the university Internal Review Board approval to conduct non-medical human subject research within the community.

**Pre-intervention assessment.** Consultations with the director of the after school program and teacher participants occurred to complete the social validity assessments and to identify student participants. Teacher participant consents, parental informed consents and participant assents were obtained (see Appendix J). Before the intervention, the teacher participants were asked to complete the BRIEF to assess baseline level of the students' executive functioning. During this time the participant completed the baseline CAMM, the baseline TOT, and Stroop tasks.

**Independent variable.** In order to reflect a true yoga practice and to blind the participant to the dependent variables, the yoga instructor told the student participant that they were working together to practice yoga to assess what children like and do not like about the practice. Therefore, there were no didactic aspects of the practice, which better

served the goal of attempting to reveal the underlying mechanisms of how yoga effects executive functioning and selective attention in children, as well as allowing for easier replication in future studies.

Participants attended a 30-minute yoga session two times a week for six weeks, resulting in a maximum of 12 sessions. Each session consisted of a structured yoga practice that included: (a) breathing exercises, (b) warm-up yoga poses such as simple stretches, (c) active beginner-level yoga poses that are more challenging compared to the warm-up poses (three spinal movements: forward, backward, and side-bend or stretch), (d) cool-down poses that involved stretching and resting, and (e) a relaxation meditation, in that respective order. Besides select common inversion poses that are part of most practices (i.e., downward facing dog), this type of pose was avoided due to potential harmful effects such as visual strain and dizziness in adults (White, 2009). Finally, as part of the required meditation, a reflection of the practice was made to judge the usefulness of and reaction to the exercises.

**Dependent variables.** During the yoga intervention, visual analysis of the data collected was conducted using the evaluative techniques previously outlined for single subject research design. In this design, the intervention is introduced to one participant after the intermittently collected baseline data is determined to be stable or contra-therapeutic (Gast & Ledford, 2010). Once a change in the data trend and level become stable after yoga begins, the intervention is introduced to the second participant, and once the second participants' data is stable, then the third and so on. Once the baseline data is determined stable for the first participant, the yoga curriculum outlined above was introduced. This procedure was replicated for all participants.

*Selective Attention.* Directly after each yoga session, the participant's performance on the attention-based Stroop Color-Word Task was measured and recorded by the yoga instructor and delivered to the researcher. Once the intervention was moved to the morning in the Reading/Math and Intervention room, the observers administered the Stroop task to reduce the likelihood of distracting the groups that were held in the room (i.e., the yoga instructor had packed up his or her materials and left the room by the time the teachers who shared their space with started their groups).

*Time-On-Task.* After the yoga intervention, the participant then completed the TOT math worksheet. This only occurred for the first participant because analysis of her TOT data during intervention and the other participants' baseline TOT data showed that they were all on task 70 – 100% of the time. Therefore, the PI decided to drop the TOT measure because it was not an efficient in producing the expected data. The IRB approved this modification and the removal of the measure was included in the new assents and parental consents that were obtained explaining the procedure changes.

*Executive Function.* After the intervention, the teacher participant who filled out the pre-intervention BRIEF completed the post-intervention BRIEF. The average time between completing rating scales was 4.67 weeks. The student participants also completed the post-intervention CAMM at this time.

**Social validity.** The final section of the semi-structured interview was completed with the teachers who completed the BRIEF and the students completed the CAYS to conclude the social validity assessment. At the conclusion of the intervention, the participants were given yoga mats, blocks, and straps as a gift for participation..

## **Data Analysis**

The data collected in the study were analyzed visually, quantitatively, and qualitatively. The results from the Time-On-Task and Stroop Color-Word Task data were graphed and visually analyzed; CAMM, BRIEF, and CAYS data underwent quantitative analysis; and the semi-structured interview and CAYS data was analyzed qualitatively.

**Visual analysis.** The effects of the yoga intervention on selective attention was determined through visual analysis of data using the Microsoft Excel® program. Spriggs and Gast (2010) explain that this enables formative evaluation of an intervention based on the organization and summary of data, which allows analysis of functional relations between research variables. Cooper, Heron and Heward (2007) explain the process of examining data for experimental control via a functional relation in Multiple Baseline designs (MBD). The authors describe a functional relation as manipulating the independent variable to control the change in the performance on the dependent variable while showing that the change was not likely caused by confounding variables. Analyzing the functional relation between variables aids in evaluating whether experimental control was obtained and is done so through prediction, replication, and verification of data patterns. When a stable baseline data pattern is found in the first tier (i.e., behaviors, settings, or subjects), a prediction can be made that the pattern would continue if no intervention is introduced and the environment is held constant. Verification occurs when another tier's baseline data pattern follows the predicted pattern of the first baseline. Once the first tier is introduced to the intervention and a stable data pattern is found, replication of an independent variables' experimental effect occurs when

the second tier changes in a similar fashion as the first. This process is conducted for all tiers and across all conditions throughout the experiment, searching for evidence for experimental control through prediction, replication, and verification of data patterns once the independent variable is introduced.

In MBD, the intervention is not removed for ethical reasons or because it cannot be unlearned. Therefore, the intervention is introduced in a staggered fashion so experimental control can be examined. Baer, Wolf, and Risley explain how MBDs allow for evaluation of maintaining experimental control (1968). Experimental control is established when an experimental variable is introduced to one baseline behavior to see what change occurs as compared to the other baselines. The experimental variable is then introduced to another unchanged baseline and if a similar change occurs, support is gathering to show that the experimental variable is effective and the change is not occurring simply by chance. If this pattern of behavior change occurs only when the experimental variable is introduced to other unchanged baselines, the researcher is showing that the experimental variable is producing a reliable and valid effect.

In order to evaluate for experimental control, the design and procedures were chosen to control internal threats to validity. For example, stacked, staggered baseline and intervention conditions were plotted and analyzed for indication of an increase in the desired behavior due to the intervention for each participant. Staggering the introduction of the intervention across participant's aids in controlling the internal validity threats of history and maturation (Gast & Ledford, 2010). Prevention of other internal validity will be examined through visual analysis of the data when evaluating experimental control.

Visual analysis was used to examine the first hypothesis that yoga has a positive effect on children's selective attention in an academic setting. This was examined through the data recording of the percentage of TOT data and the Stroop Color-Word Task time difference in duration of completion and error scores to determine the effectiveness of yoga in improving selective attention. If an abrupt, therapeutic change is not seen immediately after yoga is introduced, single subject research design data analysis techniques such as trend estimation and level stability will be utilized (Gast & Spriggs, 2010). If the independent variable of yoga shows effectiveness for the dependent variables of at least three of the students, the conclusion will be made that yoga is improving the participants' ability to selectively attend to the pertinent stimulus.

**Quantitative analysis.** Quantitative analysis was used to examine the second hypothesis that teachers will report an improved change in a child's executive functioning in the classroom. This type of data analysis was also used to test part of the third hypothesis that children find yoga to be a socially acceptable intervention.

Teacher reports of participant's executive functioning in the classroom were measured by completing the BRIEF. The pre-post data analysis of the BRIEF Global Executive Composite score, Indices and subscales was analyzed to determine if there were any significant differences in the group's executive functioning after practicing yoga. The analyses were calculated using the Wilcoxon Signed-Rank Test, which is appropriate for examining the same group before and after an intervention when working with ordinal data (Gravetter & Wallnau, 2016). Any differences found at the probability level at or below .05 beyond chance were considered significant in that the participant's executive functioning skills improved after practicing yoga.

The CAMM was also analyzed for significant differences to determine if the participants reported increased mindfulness after practicing yoga as a reflection of executive functioning. Lastly, the CAYS measured participant reports of whether yoga was socially valid. Descriptive statistics such as item means were analyzed from the CAYS. No other statistical analyses were conducted with the CAYS data due to the limited number of participants.

**Qualitative analysis.** Qualitative analysis was used to examine the third hypothesis that yoga is a socially acceptable intervention to staff, teachers, and students. Social validity of yoga as an intervention for improving student selective attention and executive functioning was examined through a semi-structured interview (see Appendix A) that was conducted before and after the intervention by the teacher participants. Open-ended items on the CAYS allow students to provide input on the acceptability of yoga. By allowing staff, teachers, and students to provide open-ended feedback in addition to visual and quantitative data analysis, the findings of the study may be strengthened through the multi-modal approach.

### Chapter 3: Results

Chapter 3 will present the results of the study. Inter-observer reliability and procedural fidelity will be reviewed then data will be presented by hypothesis.

#### **Inter-Observer Reliability**

Inter-observer reliability of participant responses on measures was calculated as the percentage of inter-observer agreement (IOA) for all participants across both baseline and intervention phases. Second observers scored 42% of all baseline probes and 47% of all intervention probes. Overall IOA was 95% across all participants during baseline and intervention probes (average of 97% IOA for Stroop Time Difference scores, 100% for Stroop Error scores and 87% TOT).

**Baseline.** Second observers evaluated 40% of Denise's baseline data. For Shawn, second observers evaluated 44% of his baseline data. Sharon had 38% of her Stroop time difference and error baseline data evaluated by second observers, while only 33% of her TOT baseline data were evaluated due to dropping the measure. Second observers evaluated 44% of Robby's baseline data.

**Intervention.** Second observers evaluated 50% of Denise's intervention data across all three variables. Shawn and Sharon's intervention data only included the Stroop Time Difference and Error data because the TOT measure was dropped before entering intervention. Second observers evaluated 40% of Shawn's intervention data and 44% of Sharon's. Robby withdrew from the study during baseline so there was no intervention data evaluated for him.



## **Procedural Fidelity**

Procedural fidelity was evaluated for 45% of Stroop Time Difference and Errors across both conditions and all participants. Time on task was assessed 50% of the time during the baseline phase across all participants and during the intervention phase for Denise only. Implementation of 43% of yoga session protocols was evaluated for procedural fidelity. Second observers used a checklist for each procedure to monitor the administration of the measures and intervention to establish reliability. The second observers reached 100% IOA for implementation of Stroop task and TOT measures and 96% IOA for yoga sessions protocol implementation.

## **Hypothesis One**

The first hypothesis was that yoga would have a positive effect on children's selective attention in an academic setting. Results were tested through visual analysis of data and examination of select items from the Children's Acceptability of Yoga Scale (CAYS).

**Visual analysis of data.** Graphs for each participant were analyzed for the primary dependent variable (Stroop time difference) and two secondary dependent variables (Stroop error difference and time-on-task) that measured selective attention in an academic setting. Probes were collected intermittently across baseline phases for all three participants. The fourth participant (Robby) withdrew from the study when the timing of data collection was changed from after school to the morning Specials Block, therefore his baseline data collection was stopped and he did not enter intervention. It was hypothesized that participant's data for the Stroop Task variables would decrease after intervention, therefore showing a stable or deteriorating level and a stable or

accelerating trend during baseline, then show a decrease in level and a stable or decelerating trend once the yoga intervention was introduced. The opposite hypothesis was made for the trend and level of data of the TOT variable because the behavior was expected to increase after yoga. Intervention was introduced to the first participant once her baseline data showed an accelerating/contratherapeutic or stable trend. To maintain experimental control, baseline data was to be collected intermittently for the remaining participants until data were stable or accelerating and the intervention showed an effect for the previous participant.

***Stroop time difference variable.*** Figure 1 shows the time difference calculated between participants' reading of a congruent and incongruent word meaning and ink color Stroop task. The time difference score was the primary dependent variable and determined the start of the intervention condition. Within-condition analysis and between-conditions analysis (explained below) were conducted to examine demonstrations of experimental control.

***Within-condition analysis.*** Table 2 shows the Stroop time difference analysis to determine each participant's level and trend stability within baseline and intervention conditions. Within Denise's baseline condition, the time difference data showed a stable level and trend after five probes. Evidence of a stable level was determined by 80% of the data falling within a 20% stability envelope range of the median value. Shawn, Sharon, and Robby's baseline levels were variable and improving, while the trends were variable and decelerating based on stability envelope and relative change analysis.

Denise's within intervention condition analysis showed a variable, deteriorating

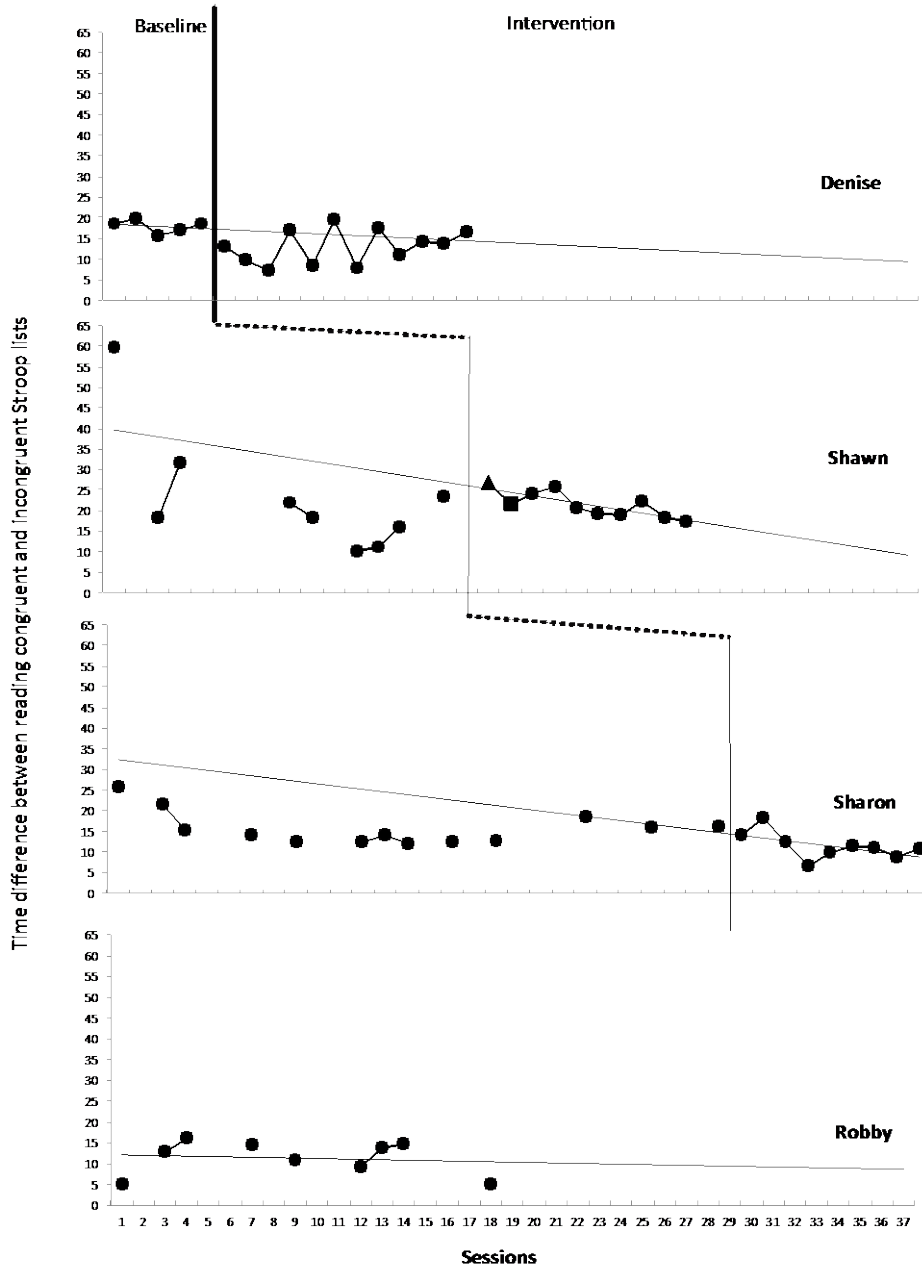


Figure 1. Time Difference Between Reading Congruent and Incongruent Stroop Lists for Denise, Shawn, Sharon and Robby. Triangle = time of day change to morning; Square = setting change to Interventionist classroom; Solid vertical line = the introduction to intervention; Solid horizontal line = overall trend.

level and variable, accelerating trend as evidenced by the relative change and stability envelope calculations. Although Denise’s relative level change in baseline improved when it was expected to deteriorate, and the trend was decelerating when expected to

accelerate, the stability envelope analysis was used in determining when to introduce the intervention.

Table 2

*Stroop Time Difference Baseline (A) and Intervention (B) Within-Condition Analysis for All Participants*

	<b>Denise</b>		<b>Shawn</b>		<b>Sharon</b>		<b>Robby</b>
<i>Condition</i>							
Sequence	A	B	A	B	A	B	A
Length	5	12	9	10	13	9	9
<i>Level</i>							
Median	18.38	13.36	18.33	21.11	13.98	10.95	12.65
Mean	18	12.9	23.42	21.45	15.62	11.39	11.31
Range	15.7- 19.9	7.1- 16.8	10.15 - 59.78	17.42 - 26.7	12.1 - 25.78	6.53 - 18.08	5.18 - 16.08
Stability <sup>a</sup>	Stable	Variable	Variable	Variable	Variable	Variable	Variable
20% Median	3.7		3.7		2.8		2.5
Envelope	16.24- 19.94	11.08- 14.78	16.06 - 19.76	18.75 - 22.45	11.7 - 14.5	9.6 - 12.4	12.4 - 14.9
% Data In Envelope	80	33	33	50	54	56	44
Relative $\Delta^b$	19.16- 17.79 Impr.	11.27- 14.04 Deter.	26.87- 13.53 Impr.	24.05- 18.85 Impr.	14.58- 14.38 Impr.	13.15- 10.81 Impr.	13.56 - 11.4 Impr.
<i>Trend</i>							
Accelerating/ Decelerating	Decel.	Accel.	Decel.	Decel.	Decel.	Decel.	Decel.
Improving/ Deteriorating	Impr.	Deter.	Impr.	Impr.	Impr.	Impr.	Impr.
Stability	Stable	Variable	Variable	Variable	Variable	Variable	Variable
% Data In Envelope	80	50	33	70	66	77	33

*Note.* <sup>a</sup> = A stable level is determined if 80% or more of the data in the condition falls within the stability envelope; <sup>b</sup> = Relative  $\Delta$  is calculated by subtracting the median of the second half of the condition data from the median of the first half of the same condition data; Impr. = Improving; Deter. = Deteriorating; Accel. = Accelerating; Decel. = Decelerating.

Once yoga was introduced, a delayed decrease in level of Denise's data occurred. After three intervention sessions the trend of the data had an improving deceleration trend as expected. However, the trend was temporary as the data began having cyclical variability with every other session, raising back to baseline level then dropping back to an expected level change. From the ninth to the twelfth and final yoga session, the data had a deteriorating acceleration trend although the data was still at a lower level than most of the baseline data. Shawn, Sharon, and Robby's intervention levels were variable and improving, while the trends were variable and decelerating based on stability envelope and relative change analysis.

In examining Denise's stable baseline data, it is likely that her intervention data and the subsequent participants baseline data would perform similarly if the environmental variables were held constant. In examining the patterns of Shawn, Sharon and Robby's baseline data, a verification of this predicted pattern of responding was not made.

*Between-conditions analysis.* Table 3 shows the Stroop time difference task data analysis to determine each participant's trend and level stability across baseline and intervention conditions. When the intervention was introduced to Denise, yoga had a negative effect on her Stroop time difference performance as evidenced by a change in trend direction from positive (decelerating, improving) to negative (accelerating, deteriorating) and the trend stability changing from stable to variable. Denise's percentage of non-overlapping data (PND) was high, indicating a greater intervention impact, and her level improved in the direction expected. However, due to the trend variability and direction change, it appears that yoga did not improve her time difference

Table 3

*Stroop Time Difference Task Between Baseline (A) and Intervention (B) Conditions  
Analysis for All Participants*

	<b>Denise</b>	<b>Shawn</b>	<b>Sharon</b>
<i>Variables Changed</i>	Yoga	Yoga, Time of Day, Setting	Yoga
<i>Change in Trend</i>			
Direction	+ to -	No change	No change
Effect	Negative	Neutral	Neutral
Stability Change	Stable to Variable	Variable to Variable	Variable to Variable
<i>Change in Level</i>			
Relative Change <sup>a</sup>	11.27 – 17.79 = (-)6.52 improving	24.05 – 13.53 = 10.52 deteriorating	13.15 – 14.38 = (-)1.23 improving
Median Change (B-A)	13.36-18.38 = (-)5.02 improving	21.11 - 18.33 = 2.78 deteriorating	10.95 - 13.98 = (-)3.03 improving
<i>Data Overlap</i>			
% Non-overlapping	67	0	67

*Note.* <sup>a</sup> = Relative Change calculated by subtracting the median of the second half of the baseline condition data from the first half of the intervention condition data.

on the Stroop task.

Shawn's between-conditions analysis in Table 3 showed a neutral effect on his Stroop time difference performance as evidenced by a continued deteriorating level and trend of variable data in the stability envelope and relative change calculations. His PND was zero, indicating that yoga had no impact on his performance. This may be a valid representation of the data when considering Shawn's first intervention session occurred when yoga was moved from after school to the morning Specials Block and during Shawn's second session, the intervention was moved from the Speech Pathologists room to the Reading and Math Interventionist's classroom. Therefore, more variables changed for Shawn than the other participants, decreasing the opportunity to demonstrate experimental control. Sharon's between-condition analyses also showed a neutral effect

once yoga was introduced as evidenced by a continued improving level and trend of variable data. Although her PND was high, it is not possible to infer that yoga caused her improved Stroop task performance.

When examining the slope of the data across conditions for Denise, the overall trend decelerated which aligns with the intervention condition data producing lower means, medians, and data ranges when compared to the baseline condition data (see Table 3). Similar to Denise's across conditions data, Shawn's data showed a slope with an overall decelerating trend that produced a lower intervention mean and smaller range of data as compared to the baseline condition. When comparing the data across Sharon's conditions, the slope of the trend is decelerating overall and the intervention condition produced lower means, medians, and data ranges as compared to the baseline condition. However, when examining Denise, Shawn, Sharon, and Robby's intervention data, the pattern of responding did not replicate the previous participants pattern due to variability in the level and trends for all participants. Therefore, although it appears there was an overall improvement in the Stroop task performance across participants, experimental control was not demonstrated with the primary dependent variable, and the true cause of the improved times cannot be determined based on the data collected.

***Error difference variable.*** Figure 2 shows the difference in the number of errors that occurred when participants read the congruent versus incongruent word meaning and ink color Stroop task word lists. As mentioned, the participant's data was expected to accelerate in a deteriorating trend during baseline, then a decrease in level change and a

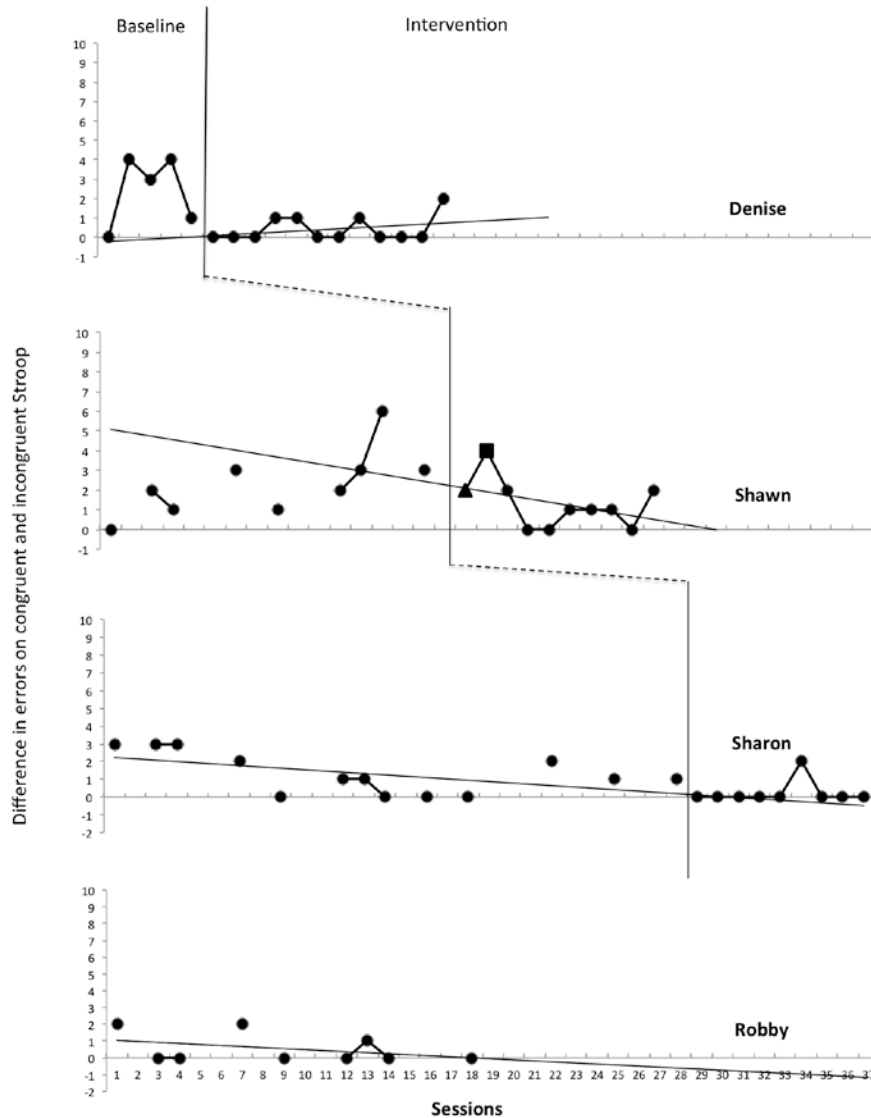


Figure 2. Error Difference Between Reading Congruent Versus Incongruent Stroop Lists for Denise, Shawn, Sharon and Robby. Triangle = time of day change to morning; Square = setting change to Interventionist classroom; Solid vertical line = the introduction to intervention; Solid horizontal line = overall trend.

decelerating trend was expected during intervention. Stroop error difference was a secondary dependent variable and was collected simultaneously with the primary dependent variable. Therefore, intervention was introduced based on the primary DV baseline performance. Within-condition analysis and between-conditions analysis was conducted to examine demonstrations of experimental control.



*Within-condition analysis.* Table 4 shows the level and stability analysis within the baseline and intervention conditions for the Stroop error difference task. All participants had variable levels and trends during baseline according on stability envelope calculations. According to relative change in level calculations, Denise, Shawn, and Sharon's baseline data had deteriorating levels while Robby's baseline level was improving. Denise and Shawn had accelerating baseline trends while Sharon and Robby's were decelerating. When comparing the error difference baseline data, Denise, Shawn, Sharon and Robby verified the prediction of the previous participant's patterns.

In the intervention condition Sharon was the only participant who had a stable level and trend based on stability envelope calculations. However, she had no relative change in level or change in trend direction during intervention. All other participants had variable levels and trends. Denise and Shawn had improved their relative change in level, Denise had no change in trend direction, and Shawn had a decelerating trend.

*Between-conditions analysis.* Table 5 shows the Stroop error difference task data analysis to determine each participant's trend and level stability across baseline and intervention conditions. Trend analysis shows a positive effect for Denise and Shawn once yoga was introduced as evidenced by a therapeutic trend change, while Sharon's data show a negative effect with a contra-therapeutic trend direction after yoga was introduced. Relative change in level analysis showed that all participants' data had an improved level after yoga was introduced. Although all participants had a PND of zero, indicating that the intervention had no effect, each participant showed a replication of effect for the previous participants' intervention condition response pattern. It appears that the error difference data is more supportive of yoga having an effect on improve

Table 4

*Stroop Error Difference Baseline (A) and Intervention (B) Within-condition Analysis for All Participants*

	Denise		Shawn		Sharon		Robby
<i>Condition</i>							
Sequence	A	B	A	B	A	B	A
Length	5	12	9	10	13	9	9
<i>Level</i>							
Median	3	0	2	1	1	0	0
Mean	2.4	.4	2.33	1.3	1.31	.22	.56
Range	0-4	0-2	0-6	0-4	0-3	0-2	0-2
Stability <sup>a</sup>	Variable	Variable	Variable	Variable	Variable	Stable	Variable
20% Median	.6		.4		.2		0
Envelope	2.9 – 3.5	(-).1 - .5	1.8 – 2.4	.8 – 1.4	.9 – 1.1	(-) .1 - .1	-
% Data In Envelope	20	66	22	33	31	89	67
Relative $\Delta^b$	2 – 2.5 Deter.	.5 – 0 Impr.	1.5 – 3 Deter.	2 – 1 Impr.	2.5 - .5 Deter.	0 – 0 No change	1 – 0 Impr.
<i>Trend</i>							
Accelerating/ Decelerating	Accel.	Zero cel.	Accel.	Decel.	Decel.	Zero cel.	Decel.
Improving/ Deteriorating	Deter.	No change	Deter.	Impr.	Impr.	No change	Impr.
Stability	Variable	Variable	Variable	Variable	Variable	Stable	Variable
% Data In Envelope	20	66	44	50	15	88	11

*Note.* <sup>a</sup> = A stable level is determined if 80% or more of the data in the condition falls within the stability envelope; <sup>b</sup> = Relative  $\Delta$  is calculated by subtracting the median of the second half of the condition data from the median of the first half of the same condition data; Impr. = Improving; Deter. = Deteriorating; Accel. = Accelerating; Decel. = Decelerating; Zero Cel. = Zero-celerating.

performance than the time difference data based on level analysis, overall improved trends across the conditions for all participants, and replication of effect for all participants. However, the data was not stable during baseline, and trend and PND

analysis was not supportive across all participants of yoga having a therapeutic effect; therefore it is not plausible to attribute yoga as the sole cause of the improvement in performance of error reductions.

Table 5

*Stroop Error Difference Task Between Baseline (A) and Intervention (B) Conditions Analysis for All Participants*

	<b>Denise</b>	<b>Shawn</b>	<b>Sharon</b>
<i>Variables Changed</i>	Yoga	Yoga, Time of Day, Setting	Yoga
<i>Change in Trend</i>			
Direction	- to zero	- to +	+ to zero
Effect	Positive	Positive	Negative
Stability Change	Variable to Variable	Variable to Variable	Variable to Stable
<i>Change in Level</i>			
Relative Change <sup>a</sup>	.5 – 2.5 = (-2) improving	2 – 3 = (-1) improving	0 - .5 = (-.5) improving
Median Change (B – A)	0 – 3 = (-3) improving	1 – 2 = (-1) improving	0 – 1 = (-1) improving
<i>Data Overlap</i>			
% Non-overlapping	0	0	0

*Note.* <sup>a</sup>= Relative Change calculated by subtracting the median of the second half of the baseline condition data from the first half of the intervention condition data.

***Time on task variable.*** Figure 3 shows the percentage of time that the participants were on task when completing third grade level math worksheets. For this variable, the participant’s data was expected to be stable or to decelerate in a deteriorating trend during the baseline condition, then to have an increase in level change and a stable or accelerating, improving trend during the intervention condition. As with the Stroop error difference variable, the TOT was a secondary dependent variable that was collected alongside the primary dependent variable (Stroop time difference), which

determined the introduction of intervention. Within and between-condition analyses was conducted for level and trend stability to examine experimental control.

*Within-conditions analysis.* Table 6 shows the TOT within-condition analysis for all participants. Denise, Shawn, and Sharon's TOT baseline and intervention data had stable levels and trends as evidenced by stability envelope calculations. Robby's TOT data level and trend during baseline and intervention were variable. Shawn, Sharon, and Robby had improving relative changes in level and accelerating trends during baseline as expected, while Denise's was level was deteriorating with a decelerating trend.

*Between-conditions analysis.* Table 7 shows the TOT between-conditions analysis for all participants. Denise's between-conditions analysis shows that yoga had a neutral effect on her TOT performance as evidenced by a continued decelerating trend, the data trend becoming variable in intervention, having a deteriorating relative change, and a PND of 50%.

While Denise was in intervention, the TOT measure was discontinued because the participants were mostly on-task during data collection. All participants' data was at or above 70% on task, with most of the data showing above 90% on task behavior (see Table 6 for means, medians, and data ranges). The TOT measure was not capturing the expected behavior and was determined to not be a good utilization of time during the intervention, especially after the time allotted was reduced when the procedures were moved to the morning Specials Block.

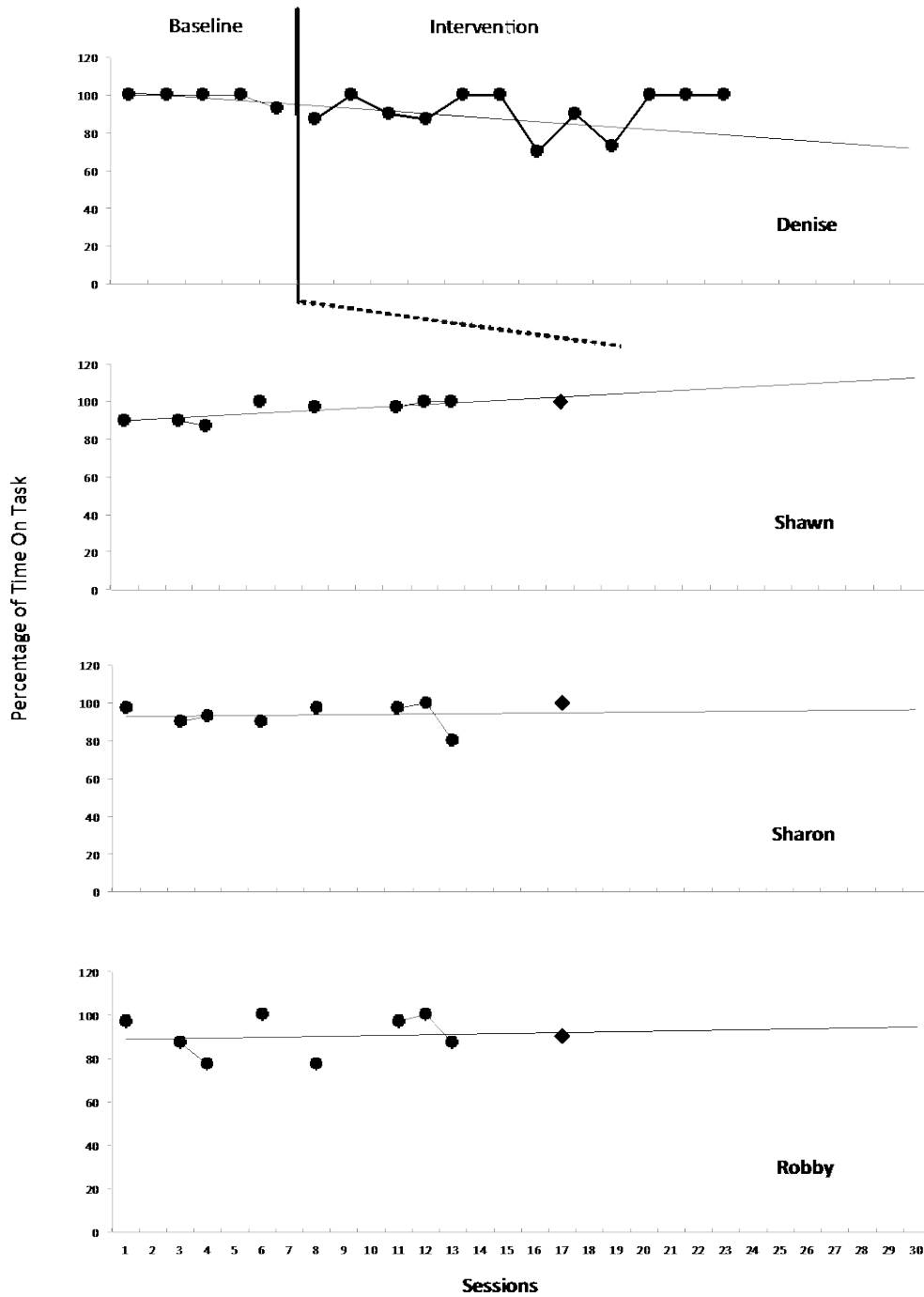


Figure 3. Time On Task While Completing Math Worksheets for Denise, Shawn, Sharon, And Robby. Diamond = math TOT discontinued due to all participants approaching or reaching a ceiling.

Table 6

*Time On Task (TOT) Baseline (A) and Intervention (B) Within-condition Analysis for All Participants*

	<b>Denise</b>		<b>Shawn</b>		<b>Sharon</b>		<b>Robby</b>
<i>Condition</i>							
Sequence	A	B	A	B	A	B	A
Length	5	12	9	-	9	-	9
<i>Level</i>							
Median	100	95	97	-	97	-	90
Mean	98.6	91.4	95.7	-	93.8	-	90.2
Range	93–100	70– 100	87- 100	-	80- 100	-	77- 100
Stability <sup>a</sup>	Stable	Stable	Stable	-	Stable	-	Variable
20% Median		20		19.4		19.4	18
Envelope	90- 110	70- 100	86-105.4	-	85-104.4	-	85- 103
% Data In Envelope	100	83	100	-	89	-	78
Relative $\Delta^b$	100- 96.5 Deter.	95 – 95 No change	90 – 98.5 Impr.	-	91.5 – 98.5 Impr.	-	92 – 93.5 Impr.
<i>Trend</i>							
Accelerating/ Decelerating	Decel.	Decel.	Accel.	-	Accel.	-	Accel.
Improving/ Deteriorating	Deter.	Deter.	Impr.	-	Impr.	-	Impr.
Stability	Stable	Variable	Stable	-	Stable	-	Variable
% Data In Envelope	100	75	100	-	88	-	77

*Note.* <sup>a</sup> = A stable level is determined if 80% or more of the data in the condition falls within the stability envelope; <sup>b</sup> = Relative  $\Delta$  is calculated by subtracting the median of the second half of the condition data from the median of the first half of the same condition data; Impr. = Improving; Deter. = Deteriorating; Accel. = Accelerating; Decel. = Decelerating.

Table 7

*Time On Task Between Baseline (A) and Intervention (B) Conditions Analysis for All Participants*

	<b>Denise</b>	<b>Shawn</b>	<b>Sharon</b>
<i>Variables Changed</i>	Yoga	-	-
<i>Change in Trend</i>		-	-
Direction	- to -	-	-
Effect	Neutral	-	-
Stability Change	Stable to Variable	-	-
<i>Change in Level</i>		-	-
Relative Change <sup>a</sup>	95 – 96.5= (-)1.5 deteriorating	-	-
Median Change (B-A)	95 – 100 = (-)5 deteriorating	-	-
<i>Data Overlap</i>		-	-
PND	50	-	-

*Note.* <sup>a</sup>= Relative Change calculated by subtracting the median of the second half of the baseline condition data from the first half of the intervention condition data;

**Children’s Acceptability of Yoga Scale (CAYS).** Two items from the CAYS asked student participants if yoga helped him or her with selective attention in class. Two of three participants thought yoga helped them pay attention, while one participant thought it helped her behave in class.

**Summary of Data Interpretation for Hypothesis One.** Overall, the visual analysis of participant’s intervention Stroop Color Word Task data showed the expected improvements when compared to baseline data. Although more variability existed in the data than anticipated, overall trends for the Stroop task measures were decelerating while the participants were doing yoga. Unfortunately the TOT task variable did not perform

as was predicted, and therefore was dropped from the study. Specifically, the participants' on-task behavior ranged from 70 – 100% during probes, leaving little room for improvement, so the decision was made to eliminate the task. In examining the selective attention items on the CAYS, two-thirds of the students reported improved attention due to yoga, and one-third reported improved behavior in the classroom due to yoga.

The Stroop time difference data pattern prediction was not verified by subsequent participants nor was the intervention data replicated. The Stroop time difference baseline data was also variable for most participants and supporting evidence of a causal effect was not found with additional analysis. Due to the inability of visual analysis results to support that yoga caused the improved performance, it cannot be concluded that yoga has a positive causal effect on improving reductions in time when reading congruent and incongruent Stroop task color word lists. This result generalizes to the secondary dependent variables of Stroop error difference and TOT due to the nature of introducing intervention based on Stroop time difference performance. Therefore, experimental control was not established for the dependent variables that were visually analyzed.

### **Hypothesis Two**

The second hypothesis was that teachers would report an improved change in a child's executive functioning in the classroom after practicing yoga. Results were quantitatively analyzed for significant group differences on the pre-post Behavior Rating Inventory of Executive Function –Teacher Form (BRIEF). The self-reported total score for the Child and Adolescent Mindfulness Measure (CAMM) was also analyzed. Table 8 shows the Wilcoxon Signed Ranks Test results and descriptive statistics of the



Table 8

*Compared group differences before and after yoga on the BRIEF and the CAMM*

Variable	Pretest			Posttest			z	p <sup>b</sup>
	Mdn <sup>a</sup>	M	SD	Mdn <sup>a</sup>	M	SD		
Inhibition	64.00	62.00	16.09	57.00	56.00	10.53	-.447	.655
Shift	77.00	71.67	16.65	71.00	72.33	8.08	.000	1.00
Emotional Control	68.00	71.00	18.52	69.00	66.33	8.32	-1.069	.285
Behavioral Regulation Index	75.00	70.00	19.00	71.00	67.00	8.71	-.545	.593
Initiate	73.00	71.00	8.19	50.00	56.33	10.97	-1.604	.109
Working Memory	85.00	75.67	18.82	61.00	66.67	12.50	-1.069	.285
Plan/Organize	83.00	75.67	15.37	58.00	61.00	16.703	-1.342	.180
Organize Materials	80.00	75.00	26.85	63.00	69.67	11.55	.000	1.00
Monitoring	70.00	65.00	14.18	59.00	59.33	14.50	-.535	.593
Metacognitive Index	84.00	75.00	17.35	58.00	63.00	14.18	-1.069	.285
Global Executive Composite	83.00	75.00	19.29	61.00	65.67	10.79	-.816	.414
Mindfulness <sup>c</sup>	27.00	22.67	9.29	11.00	15.67	10.79	-1.633	.102

Note: <sup>a</sup> = 50<sup>th</sup> percentile; <sup>b</sup> = 2-tailed significance; <sup>c</sup> = CAMM Total Score.

CAMM Total score and the BRIEF subscales, indices, and composite score before and after intervention.

Results from the group comparison of pre-posttest scores show that there were no significant differences on the BRIEF-TR or the CAMM after practicing yoga. However, a comparison of medians shows that most scores lowered after intervention as expected, with the exception of the Emotional Control subscale on the BRIEF-TR, which increased after the yoga intervention.

### **Hypothesis Three**

The third hypothesis was that yoga would be a socially acceptable intervention to teachers and students. Teacher responses on the pre-intervention interview on social acceptability of procedures and the post-intervention interview on the social importance of effects were qualitatively analyzed. Student participant responses on the Children's Acceptability of Yoga Scale (CAYS) and reflections of what he or she enjoyed and thought was challenging about each yoga session were also qualitatively analyzed.

**Teacher acceptability of the yoga intervention.** The pre-intervention interview assessed how teachers viewed the procedures of the study and included questions about the following: (a) what aspects of the project were liked the most and least, (b) what aspects were thought to be most and least difficult to implement, (c) any potential negative effects that may result from the intervention, and (d) if the intervention was likely to be effective in reducing the students difficulty with attention in class. Although the teachers did not have responses for all questions, there was an indication that the intervention procedures were positively viewed. Teacher responses are detailed in Table 9.

The first teacher had two of the student participants in her class. She stated that the aspect of the procedures she liked the most was the one-on-one instruction and individual attention during the administration of measures and the implementation of the yoga intervention. She did not report any aspect that she liked the least. She also believed that the time-on-task measure would be the most difficult to implement and that "actually doing and completing the yoga" would be the least difficult. The first teacher thought there would be no negative effects from the yoga intervention and although she

did not report on how yoga would affect her students' attention problems, her overall responses implied an acceptance of the procedures.

The second teacher only reported on what she liked about the intervention, potential negative effects, and how it would affect her students' attention difficulties. She reported that the aspect of the intervention she liked the most was that the intervention would "give (the student) strategies to use in the classroom to help her focus." She believed the intervention presented no potential negative effects for her student and she stated that the yoga would likely be effective because "hopefully this will give (the student) strategies to help her not avoid tasks." Again, although responses were limited, the second teacher implied that the yoga intervention procedures were acceptable.

The social importance of effects of the yoga intervention assessed teachers' perceptions of how the yoga intervention affected the student, satisfaction with the outcomes, belief about generalization of effects to other students, possibility of recommending the intervention to others, and what changes would be needed. Table 9 lists the questions and teacher responses about the importance of the effects of the intervention. To summarize, teachers reported that the intervention was socially important for the following reasons: (a) the intervention improved the students behavior; (b) the student participants behavior could be more like the average student in class but home environment issues were complicating the behavior; (c) they were satisfied with the outcomes; (d) that the intervention would work with other similar students; (e) they would recommend it to other teachers; and (f) the intervention could only be improved by adding more students or having longer sessions.

Table 9

*Teacher's beliefs about social importance of yoga intervention effects*

<b>Difference in behavior?</b>	<b>Is behavior more like average student after yoga?</b>	<b>Satisfaction with outcomes?</b>	<b>Would this work with other similar students?</b>	<b>Recommend to other teachers?</b>	<b>Needed changes?</b>
T1 Little calmer, less on edge, more able to correctly deal with things that annoy her	More like other students although she has added stresses in her life due to the fact that she is in foster care	Very pleased with intervention, all people involved were professional, on time, caring, and knowledgeable	Yes, all kids and adults need ways to learn to relax, exercise, and center themselves through yoga or similar methods	Yes, for many reasons (as listed in satisfaction item) but for children in stressful situations or who have difficult home lives I feel this intervention is a good fit	It would have been nice to include more students in the study
T1 He didn't have any meltdowns while receiving intervention nor did he sleep in class as much as usual	No, his home life has been a little off the normal so I think this may effect how he has been acting lately however, with home life being more stable I do believe the intervention would be more effective	Moderately satisfied, my student is a child with multiple issues especially attention deficit, it would take more time to correct issues	Yes, I saw some positive aspects of this project, in that someone was taking the time to teach the children a life skill that they could use forever	Yes I think the health benefits both physically and emotionally are needed in today's stressful world, even kids feel pressure these days, so any exercise would in my opinion be helpful	None - possibly longer sessions
T2 She seemed to be more focused for lengthy assignments	Continued use could possibly cause her behaviors to be more similar to her peers	Satisfied because it helped her focus better	Possibly	Yes	None

Note: T1/2 = Teachers one and two.

**Student acceptability of the yoga intervention.** Students completed the CAYS measure after the yoga intervention. The CAYS had two open ended items that asked the students what was liked and not liked about the yoga sessions. On reporting what the students liked most about yoga, one student described, “I like that you can forget about all the stress that has happened in the past.” Another student said, “(Yoga) makes me more flexible, it's a good workout, I got to have (yoga instructors names) to do yoga with” and the third student stated, “It gives me a lot of energy.” When asked what the students did not like about the yoga sessions, the students replied: “I love yoga! Everything is fun!”, “I liked everything about yoga”, and “Some of the steps are hard.” Students also reflected on what was most enjoyed and most challenging after each yoga sessions. Themes that emerged included all aspects of the intervention being enjoyable and that balance poses, leg pain/stretchers, having a fear of the unknown, and inversions (i.e., down-dog variations) were challenging. The student’s responses are presented in Table 10.

Table 10

*Student reflections on most enjoyed and challenging components of yoga sessions*

	<b>S1</b>	<b>S2</b>	<b>S3</b>
<b>Sessions</b>	<b>Enjoyed</b>		
1	Mind control, express self, strong, confident	Hand motions	Down dog
2	Partner bicycle, being flexible	Concentration on motions	-
3	Partner tree	Meditation	Meditation
4	Partner boat	All of it	Meditation
5	Nature	-	Cooked noodle
6	Warrior 3	Meditation	Meditation, warrior poses
7	Bicycle	Sun salutation	-
8	Wheel	Upward dog	Wheel
9	Meditation (body sensing)	Leading sun salutation	Sun salutation
10	Warrior	-	Tree
11	Partner poses	Partner twist	-
12	Meditation	Partner chair	Everything
<b>Sessions</b>	<b>Challenging</b>		
1	Left knee pain	Leg stretches	Scared at first
2	Warrior 2	Leg stretches	-
3	Warrior 3	Triangle	Warrior 3
4	Boat	Partner boat	Eagle
5	Side plank	-	Crooked tree
6	Boat	Boat pose, warrior 3	Walking the dog
7	Superman	Reverse plank	-
8	None	Eagle	Nothing
9	None	Coughing (ill)	Dolphin
10	Triangle	-	3 legged dog
11	Partner poses	Nothing	-
12	Warrior 3	Partner chair	Half moon

## **Chapter 4: Discussion**

The purpose of the study was to determine the effects of yoga on children's executive functioning and selective attention. Although not significant, results showed some improvements in outcomes across quantitative and qualitative measures. Children's selective attention improved after practicing yoga by reducing the time lapse and errors made when reading congruent and incongruent color-word lists. Some children reported improved behavior and attention in class. Student's executive functioning improved based on teacher reported medians for all subscales on the BRIEF except for Emotional Control. All participants also reported increased mindfulness on the CAMM. Finally, teachers and students viewed yoga as a socially acceptable intervention. The findings are somewhat consistent with other studies in the field on yoga, attention and cognitive functioning (Abadi, Madgaonkar, & Venkatesan, 2008; Chaya, Nagendra, Selvam, Kurpad, & Srinivasan, 2012; Hopkins & Hopkins, 1979; Peck, Kehle, Bray, & Theodore, 2005). Results are aligned with findings from other studies on acceptability and feasibility of yoga interventions in schools (Khalsa, Hickey-Schultz, Cohen, Steiner, & Cope, 2012; Mendelson et al., 2010; Noggle, Steiner, Minami, & Khalsa, 2012; Smith & Mendelson, 2014). The results will be described in detail, followed by limitations and future recommendations for the field of research on yoga with children.

### **Yoga and Selective Attention**

The current study found no functional relation between yoga and selective attention as measured by the Stroop time difference task. Although there was no causal relationship between yoga and selective attention based on Stroop time task performance, student performance showed improvements when comparing baseline and intervention

means, medians and data ranges. The findings align with similar research results. One study compared young children who participated in yoga or 30 minutes of reading for 6 weeks and found no significant differences between the groups but improvements in parent reports of executive functioning (Beattie, 2015). Another study by Drossman (2015) found insignificant results when children endorsed the Child Acceptance and Mindfulness Measure after seven months of yoga practice which was attributed to variability in students' scores although the authors reported that the children benefitted overall from yoga. Other researchers have found significant results when examining attention and executive functioning in children after practicing yoga (Harrison, Manocha, & Rubia, 2004; Peck et al., 2005; Razza, Bergen-Cico, & Raymond, 2015). The mixed results in the field of research on yoga and children's executive function calls for more in-depth analysis of the related components of the intervention and cognitive skills. Although results vary, it appears that researchers are finding that children benefit from yoga even when data analysis does not confirm causal relationships or significant statistical results. The current study indicates that yoga may make a difference in children's executive function and attention, but that individual factors that may confound results should be considered.

For example, in analyzing Denise's data pattern, a stable level and trend was found during baseline but they were unexpectedly improving, which indicated the need for continuing baseline data collection until a relative change in level and the trend direction showed more stability. This may have allowed for subsequent prediction and verification of her data pattern from other participants. An interesting finding unique to Denise was the pattern of her data variability in Stroop time difference performance



during intervention. Her data improved well below baseline as expected on the days she worked with the female yoga instructor, but it returned to baseline levels on the days she worked with the male yoga instructor. This may be an indication that the gender of the person implementing the intervention had a detrimental effect on Denise's performance and should be considered in future studies. This pattern was not found with other participants, who had less cyclical variable data patterns during baseline and intervention.

There was also no functional relation found between yoga and Stroop error difference although a mean analysis showed improvements after yoga. Overall, the lack of relationship does not allow a causal inference about the effect of yoga on the Stroop error difference performance and is evidence that all extraneous variables were not controlled. The presence of potentially confounding variables related to SES or individual traits that have been found in other studies (i.e., stress, parental education, mental health) likely caused participants' data to be variable across conditions (Bibbey, Carroll, Roseboom, Phillips, & de Rooij, 2013; Markela-Lerenc, Kaiser, Fiedler, Weisbrod, & Mundt, 2006; Raver, Blair, & Willoughby, 2013; Tillman & Granvald, 2015; Ursache, Noble, & Blair, 2015). Variability may have also resulted from not following baseline logic by relying on the primary dependent variable's performance for intervention introduction. However, students' Stroop error difference data did show verification of the predicted data pattern as well as replication of the data paths across participants. When considering the mean and median analysis improvement alongside the prediction, verification, and replication pattern of data, it denotes that if the Stroop error difference had been chosen as the primary dependent variable, a functional relation may have been determined. Another factor that may have influenced the error difference

results could include practice or testing effects that have been found in prior studies (Edwards, Brice, Craig, & Penri-Jones, 1996; Hopkins & Hopkins, 1979; Reisberg, Baron, & Kemler, 1980; Roe, Wilsoncroft, & Griffiths, 1980). Test effects in the current study will be discussed in the Limitations section.

Moreover, there was no functional relation found between yoga and the Time On Task (TOT) measure while completing math problems. The lack of relationship was due to the task being removed from the procedures because all participants were performing well above the expected criteria. Most students were performing at 90% on-task during baseline probes, and all were above 70% while the TOT data was collected. Factors that may have influenced the above-average performance include the fact that two of the students reported that math was their favorite subject, the unnatural setting, and the Hawthorne Effect. Having a sense of self-efficacy in an academic subject can improve the motivation and performance on related tasks (Schunk, Meece, & Pintrich, 2012). The setting was also likely a factor that improved concentration. The children were working in quiet isolation without a classroom full of students, which may produce distractions at times. Previous research shows that children who complete math and reading tasks in the presence of distractors tend to be less productive (Cool, Yarbrough, Patton, Runde, & Keith, 1994). The Hawthorne Effect probably affected the student's performance as well because it seems their performance was not representative of their natural behavior due to knowing they were participating in a research project (Gast, 2010) and has been found to be present in other research studies examining executive function of children with attention deficits (Rapport, Orban, Kofler, & Friedman, 2013). In future studies, it may

be beneficial to utilize more practical measures that can be observed in the classroom such as time on task during work completion to gather accurate data (Peck et al., 2005).

Even though the TOT measure was eliminated due to uncontrolled factors and its influence on performance, data collected on the TOT was analyzed for exploratory purposes. Three students' TOT baseline data were stable and the one student who was administered the measure during intervention showed variable data. The latter student's visual analysis and descriptive data showed overall improvements in TOT performance once she began yoga, although it cannot be determined that yoga was the cause due to not establishing a functional relation. Had the TOT data been collected in a more natural setting without the participants knowing it would be used for data collection, it could have potentially supported the hypothesis that yoga helps students attend to academic activities. This notion has been demonstrated in prior studies such as Peck et al.'s (2005) Single Subject Research Design methodology that found that children identified as having attention deficits in the elementary school setting improved TOT performance after practicing yoga. Peck's study was conducted in the classroom utilizing observations of students TOT when engaging in classroom work and provides support for further exploring how the setting of academic tasks affects performance.

Other data collected to evaluate yoga effects included the student's perception of whether yoga helped them behave and pay attention in class. Two of the three students agreed that it improved attention and one student agreed that it helped her behave. It is important to note that "attention" and "behave" were not defined in any particular way for the students and could have been open for subjective interpretation. This was noted for one student who responded that he did not think it helped him behave in class because

he still daydreamed about TV shows that he watched even after doing yoga. It may have been beneficial to give the students concrete examples of paying attention and behaving in class, or to discuss their interpretation of these terms in order to collect more accurate information.

The current findings on yoga and children's selective attention support existing research such as Chaya et al., (2012) who examined the effect of yoga on a sample of children from a disadvantaged socioeconomic community and found that attention improved when compared to physical exercise. Improvements in children's selective attention and TOT after yoga lend support to the growing body of research and encourage continued examination of yoga as an intervention in the academic setting

### **Yoga and Executive Functioning**

In addition to measuring children's selective attention after practicing yoga, executive functioning performance was examined due to being the umbrella domain for attention (Berger, 2011; Biederman et al., 2007; Carter, Krener, Chaderjian, & Northcutt, 1995; Norman & Breznitz, 1992; Plude, Enns, & Brodeur, 1994; Ridderinkhof & van der Stelt, 2000). Although the Behavior Rating Inventory of Executive Functioning, Teacher Form (BRIEF) and Child and Adolescent Mindfulness Measure (CAMM) did not show significant group differences after the students practiced yoga, there were improvements on the scales.

Group medians lowered on all BRIEF subscales except for Emotional Control, which indicates that some influencing variable assisted the students in inhibiting responses, shifting tasks, initiating tasks, working memory functioning, planning and organizing, organizing materials, and monitoring themselves. It is possible that teachers

or parents fostered these executive functioning skills during the intervention. However, teachers did not report that participants were receiving other interventions for executive functioning skills. The uncontrolled factor of the unstable home environment may have affected the increased score of emotional control for the participants. Previous studies have found that environmental stress can dysregulate executive function in children (Raver et al., 2013; Ridderinkhof & van der Stelt, 2000) and bolsters the importance of examining individual contexts when analyzing executive functioning performance.

When examining BRIEF subscale improvements for each participant, individual differences were noted. Denise's teacher-reported subscale scores were all in the dysfunctional range at baseline. After the yoga intervention, Planning/Organizing and Monitoring improved to the functional range while all other improved to the borderline range. This may indicate that Denise's behavior regulation may have benefited the most after practicing yoga with some improvement in metacognitive skills.

All of Shawn's subscale scores except Inhibit were in the clinical range at baseline. After the intervention, his scores lowered on most subscales but were still within the clinical range. His inhibition score and planning/organizing score both elevated, surprisingly. The lack of marked improvement in Shawn's executive functioning skills may have been a product of his unstable home environment, which was mentioned by the student and his teacher. It is interesting to note that Sharon, Shawn's sister, also showed a similar pattern of teacher-reported executive functioning skills. Most of her subscale scores remained in the borderline range before and after yoga although most scores improved. Sharon and her teacher also talked about how she was affected by her unstable home life. Additional converging information was obtained on

the CAMM: Shawn and Sharon both showed improvement in mindfulness by one point on the scale. Denise's mindfulness score showed a marked improvement, jumping 19 points. The impact of home environment and family stressors may have hindered Shawn and Sharon's ability to benefit from the yoga intervention as fully as Denise in the area of executive functioning.

The reasoning for participants' differences in teacher-reported executive functioning after yoga is unclear and diverges from previous findings that yoga as a form of exercise helps improve the executive functioning skills of working memory, inhibition, selective attention, relaxation, and overall mental-health function (Guiney & Machado, 2013; (Tompsonski, Lambourne, & Okumura, 2011). All three children are from disadvantaged SES communities and, to some degree, disruptive home environments (Denise is in foster care, Shawn and Sharon live part-time with parents and an aunt). This lends to considering that internal factors may influence the level of benefit one receives from a yoga intervention in improving executive functioning and is supported by research by Raver et al. (2013). Raver et al. examined poverty-stricken children's executive functioning trajectories from four years of age and found that chronic poverty, maternal financial strain, and higher reactive child temperaments impacted executive functioning over time when compared to children with lower reactive temperaments in similar poverty and financial strain situations. This suggests that Denise may have more internal protective factors than Shawn and Sharon, such as a controlled temperament or more resiliency, that allow her to benefit more from interventions that affect executive functioning. This notion aligns with findings by Diamond and Lee (2011) who found that children with low executive functioning development improve executive function skills

when introduced to interventions that foster emotional and social development, and named yoga as one such intervention. Although the current studies' findings did not show significant group mean differences or marked individual differences for all participants after practicing yoga, the improving data trends align with the existing body of research that considers yoga as an intervention that warrants further exploration in improving executive functioning.

### **Social Acceptability of Yoga**

Student and teacher participants reported on the acceptability of the yoga intervention in the school setting. Teachers were interviewed about the interests and concerns about the methods as well as how they perceived the yoga intervention. Students indicated what aspects of the yoga intervention were enjoyable and challenging after each session, as well describing what they liked and did not like about the yoga intervention. Most responses were positive and, taken together with the procedural fidelity and high implementation of the intervention, support the social acceptability of the yoga intervention. This aligns with existing research about the feasibility and acceptability of yoga interventions in the academic setting (Khalsa et al., 2012; Mendelson et al., 2010; Noggle et al., 2012).

Before the intervention began, teachers reported on interests and concerns about the methods. Interest was shown in the students benefiting from individual attention provided by the research and yoga personnel and that the students would be learning strategies through that would help them to focus in class and reduce task avoidance. The supportive theme that emerged focused on student gains that would assist them in class. Concerns about the intervention included the difficulty of the time-on-task measure and

engaging in and completing the yoga intervention. The apprehensive theme focused on student engagement of different methods used in the study. The overall theme focused on student engagement and benefit and indicates that the teachers were student-focused when considering the intervention from the beginning of the project.

Teachers also reported on the social importance of the intervention effects at the end of data collection. Teachers reported that students behaved differently after the intervention by being calmer, not having any “meltdowns”, sleeping less in class, and being more focused on lengthy assignments, indicating the intervention was perceived to positively affect student’s externalized and internalized behavior in class. Teachers reported that the students were approaching engaging in more typical behaviors that other students exhibit in class and that some made progress in this area. The teachers attributed the lack of progress to home environment stressors, which indicates that awareness existed of how the student’s behavior at school is affected by extraneous circumstances. Teachers also stated that they were moderately to very satisfied with the intervention due to the professionalism and investment of the research personnel as well as the intervention outcome of improving the students’ focus and aligns with previous research by Price (2008) who found that teachers were pleased with their interactions with the yoga training team on that project. An implication of this data is that the teachers not only appreciated the beneficial outcome for the students, but also valued working with competent and caring research personnel. Teachers reported that the intervention would generalize to other students in gainful ways due to learning the lifelong skills of how to relax, exercise, and center themselves. They were also asked what would need to be



changed about the project and responses included involving more students and having longer sessions.

These findings are supported by the research of Steiner, Sidhu, Pop, Frenette, and Perrin (2013) who found that a school-based yoga intervention was 100% acceptable to teachers who found that their students were benefitting from relaxation, improved concentration, and self-awareness from yoga and expressed interest in continuing the program for more students of greater age ranges. The current study's teachers also stated that they would recommend the intervention to other teachers due to the physical and emotional benefit it provides in a stressful world that makes children feel pressured, especially for children with "difficult home lives" which is supported by previous research from Chaya et al., (2012) who found that yoga benefitted children who experienced stress from living in a disadvantaged socioeconomic community. The data from these two questions indicates that teachers could see the reach of the project and how beneficial it could be for students in other settings or situations throughout life.

The findings from the current study also align with previous studies that assessed feasibility and acceptability of school-based yoga interventions. Abadi, et al., (2008) conducted a study with a brief yoga intervention that found teacher's reported improved attention and impulsivity in children. Price (2008) reported that teachers who were trained to implement yoga in their classrooms saw the students using yoga for stress reduction and burgeoning life skills. An implication from this data is that the methods were acceptable and should be conducted on a larger scale.

Students also reported on the social acceptability of the yoga intervention. The Children's Acceptability of Yoga Scale (CAYS; Rogers, unpublished) asked the students

what they liked and did not like about yoga. The students indicated they liked the stress reduction, flexibility, exercising, working with the yoga instructors, and having fun. The only response to what was not liked was that some of the steps were hard. Students also reported on aspects of yoga lessons they enjoyed the most and felt was challenging. Student's reported enjoying self-expression through yoga, improved self-esteem, mind control, the poses, partner poses, meditation, mudras, being able to lead poses, and relaxation poses. Aspects of the yoga lessons that students said were challenging were balance poses, leg pain/stretching, fear of the unknown, and inversion poses (all down-dog variations, according to one student). Overall themes of student social acceptance of yoga included engaging in physical activity and leadership while also improving self-regulation and confidence, which aligns with previous research. Steiner et al.'s (2013) examination of a school-based yoga intervention revealed that students reported benefits by engaging in physical exercise, increased energy and the ability to relax. Mendelson et al. (2010) also examined student outcomes of a school-based yoga intervention and found that the participants reported improved self-regulation. Overall themes of what was less acceptable included physical discomfort from exercise, the novelty of the practice, and difficulty of some poses. The student acceptability findings imply that yoga was perceived to be suitable for improving character development incorporated with enjoyable exercise while some aspects of the practice were physically and mentally challenging.

### **Limitations**

The current study is not without limitations, particularly external, internal, and ecological validity threats that are specific to multiple probe single subject research

designs. External validity is how generalizable the results are to other populations, settings, or research teams and is strongest when systematic replications of effects are found with different studies that vary in multiple ways (Gast, 2010c). Due to the original mixed methods approach and specialized yoga curriculum created for the current study, the external validity is threatened until the design is replicated successfully and findings are corroborated by different studies. The quantitative findings from the study will also be limited to generalization due to the small number of participants in the study. Having a small sample effects the power of the results and was likely to be one cause of the insignificant statistical findings.

Gast and Ledford (2010) describe possible internal validity threats to multiple baseline design studies. Those that apply to the current study include threats from data instability, history, maturation, attrition, and instrumentation. Data instability is a large amount of variability in the data seen over time and should be controlled for by continuing to collect data until stabilization occurs or identifying and manipulating the cause of the variability. This internal validity threat may have been the most impactful on the current outcomes since there was a temporal limitation in the amount of time available to collect data due to working on an academic calendar in a school setting, decreasing the ability to continue probes until data stabilized. This is related to violating the multiple baseline design assumptions of: a) not applying the intervention too soon to subsequent behaviors and b) selecting baselines that are independent yet functionally similar in order to demonstrate a functional relation between the dependent variable(s) and the intervention (Cooper, Heron, & Heward, 2007). Introducing the intervention too soon due to temporal limitations and data instability violated the first assumption. The

latter assumption was believed to be satisfied based on the semi-functional behavior analysis conducted with the teachers to determine if students and attention deficits were independent yet similar. Other differences that may have been present in the students were a lack of engagement in the intervention and various impacts of home environment stressors. However, in future studies, it will be important to assess the dependent variable in alternate ways if data instability occurs (i.e., practical Time-On-Task measures) in order to prevent a violation of the first assumption of baseline logic.

Another prominent threat was history, which consists of events that occur during the duration of the intervention that may affect the study outcome. An attempt to control history was made by having a relatively short intervention (ideally, six weeks) that was introduced in a staggered fashion. However, the qualitatively and anecdotally reported impacts of the student's home environments were out of the realm of control for this study and should be considered for analysis in future studies.

Maturation threats may have also played a prominent role in participant's response to the intervention. Maturation occurs when a participant's behavior changes over time naturally due to the duration of the intervention and is more likely to occur with longer designs. Session fatigue is a common result of maturation threat, which was attempted to be prevented by having a short duration of sessions, limiting the intervention to four to six weeks, and by considering the participants' attention span and age. However, participants may not have fully engaged in or fully enjoyed the practice over the duration of the intervention, which maybe likely for the participants due to the home environment stressors.

Also, as with any study that has a small number of participants, attrition is a threat to internal validity (Gast, 2010). Attrition is the loss of subjects for uncontrollable reasons and can limit the generality of the findings of the independent variable. Attrition did occur with the fourth student when the intervention was moved from after school to the Specials block. This was not a fatal threat to the study because three participants are required for the chosen design, but had more than three participants been included, the likelihood of finding verification of predicted data patterns and replications of effect would have been greater.

Another internal validity threat that was likely present were issues with instrumentation and testing effects, with the latter occurring when participants are repeatedly presented with the same test. Student's completed a new variation of the Stroop task for each probe across conditions, and although that prevented memorization of materials, the frequent practice may have created a facilitative effect where the student's performance improved with exposure to the task. The testing effect is thought to be partially responsible for student's improved data levels and decelerating, improving trends during the baseline condition when the opposite patterns were expected. Instrumentation bias is also considered a threat to the teacher ratings of executive functioning and reports of social validity because they were not blind to knowing which students were receiving intervention. One other aspect of the Stroop task that may have posed a threat to the outcomes is use of the Stroop task itself. Some researchers have critiqued the use of the Stroop task with children who may have not developed the cognitive abilities to perform on the task as intended (Tipper, Bourque, Anderson, & Brehaut, 1989). Tipper and colleagues posited that it may be too complex for children

who may not have fully developed inhibition due to the distractor stimuli being present with the target stimuli in the Stroop task. Tipper et al. also critique the Stroop task as an ecological validity threat due to not being a practical task that children are exposed to. Therefore, other measures of attention should be considered for future studies that are more practical and do not present issues such as facilitative effects or potentially complex demands, such as collecting Time-On-Task data within the classroom.

Other ecological threats to validity may exist in the current study. This type of validity refers to the relevance and reliability of practically implementing the intervention. Although the proposed design was created based on current practices that occur within the school (i.e., interviews with staff regarding student behavior, functional behavior assessment, Response to Intervention practices of on-going data collection and assessment for needed change, teacher rating forms of student behavior, physical activity), there may be aspects that are not easily implemented by school staff. Particularly, teachers are not likely to implement a yoga intervention with one student in an isolated setting. It is more likely that a teacher might request that yoga instructors implement individual interventions, or that a teacher would implement the proposed yoga intervention with the whole class. It is also unlikely that a teacher would administer the Stroop task after yoga sessions to determine if there is an effect on selective attention. A school psychologist or other similar staff would more easily administer this instrumentation, but a teacher could collect similar data in the classroom such as time-on-task or number of redirects to measure the variable of attention.

Finally, other factors seemed to have affected the outcomes of the current study. These include not defining terms on the CAYS, a possible effect of the gender of the

yoga instructor, and potentially the chosen research design. Choosing a different single research design may have changes the outcome, such as Delayed Multiple Baseline design (DMB), which also staggers the introduction of the intervention, but differs from the current design because baseline probes are delayed instead of being continuously collected. In the current study, delaying baseline probes may have reduced the impact of testing and data instability effects that were found to affect the outcomes.

The limitations found in the current study are not completely unique and are inherent within the body of research on yoga and children. For example, Birdee et al. (2009) found that most of the 24 studies included in the team's systematic review of clinical applications of yoga with children had small sample sizes, which limits the power needed to find significant results and can become fatal if attrition occurs (Jensen & Kenny, 2004; Manjunath & Telles, 2001; Manjunath & Telles, 1999; Telles, Narendran, Raghuraj, Nagarathna, & Nagendra, 1997). Testing or practice effects have also been found in yoga and child studies that repeatedly use a version of a measure (Hopkins & Hopkins, 1979). Other studies have not clearly defined aspects of measures, therefore potentially not capturing the data intended or found such variability in data that results were not found to be significant (Drossman, 2015). Although the current study was designed to prevent internal validity threats such as history and maturation, it is impossible to control every threat when attempting to exhibit experimental control in single subject research design due to variables that may confound results and are uncontrollable for ethical or practical reasons, e.g., stress from unstable home environments (Gast, 2010).

Although the current study has many limitations, strengths are present as well. First, the mixed methods design allows for greater conceptualization of how students perform on attention tasks and how teachers perceive the students' executive functioning after practicing yoga. Second, the study found the intervention to be socially acceptable and feasible from both teachers and students. Third, the study utilized a novel, specialized, and replicable yoga intervention to the field of research. Finally, it was interesting to find that some students mastered new methods of self-regulation that pushed them outside of their comfort zones and resulted in building character such as increasing self-confidence and leadership.

### **Future Recommendations**

The current findings lend suggestions for future studies in the field of research on yoga and children's selective attention and executive functioning. Suggestions include assessing for extraneous variables, considering other measures, and considering the application of the results. An important suggestion from the current results is accounting for extraneous variables such as home environment stressors, which could be collected as descriptive data to be examined through quantitative statistical analysis. A didactic component could also be added to the yoga curriculum to encourage the participants to practice skills learned from the intervention to cope with individualized stressors.

Another recommendation involves measures used in future studies. Adding a parent rating scale of executive functioning may provide convergent data that would strengthen results by avoiding the construct validity threat of mono-method bias and blinding teacher raters to which students receive intervention may prevent reporting bias, as well (McMillan & Schumacher, 2014). Use of more practical measures should also be



considered for assessing on-task behavior and selective attention. Practical on-task measures could be collected in the classroom with recording technology, using secondary data collected by the teacher, or by use of a blind researcher to observe students in the classroom. Selective attention may be better measured by cognitive ability subscale tests such as coding, cancellation, and symbol search from the Wechsler Intelligence Scales for Children, Fifth Edition. These tap into attention deficits via processing speed, which measures accurate filtering of irrelevant stimuli similarly as the Stroop task (Weiss, Saklofske, Holdnack, & Prifitera, 2015). It would be important to evaluate the likelihood that the students would be exposed to this content for other purposes, such as special education evaluation, and it may be best to use ancillary subscales that are not used as frequently in administration. The results of the current study also suggest that measuring error reduction in performance on attention-based tasks may be more meaningful than elapsed time differences after practicing yoga. Lastly, future studies should consider applying the current study's methodology to groups of students, possibly with Delayed Multiple Baseline design, in order to act upon the current studies' findings that more children should be included in the benefits from yoga interventions.

The findings of the study could be helpful to teachers, school psychologists, students, and schools. One application of the findings could be providing teachers with an easily implemented intervention that can be used individually, in small groups, or class-wide to improve student executive function, which is related to improved attention and academic success (Norman & Breznitz, 1992; Peck, Kehle, Bray, & Theodore, 2005). School psychologists may be more willing to recommend yoga as an intervention when consulting with teachers or school administrators due to the current findings that yoga

seemed to improve, even if not at a significant level, selective attention and executive function. Students with attention deficits may benefit from yoga by having an adjunct intervention that he or she can practice when needed, which is in the students control, and has less negative side effects as more standard forms of interventions such as medication (Rojas & Chan, 2005). The findings from this study could also be used in further exploring if yoga should be applied as a systemic, school-wide intervention for academic settings with a higher demographic of at-risk populations. Lastly, the findings are informative for school personnel that yoga is acceptable and feasible to teachers and students.

For scientific purposes, the results may help determine what underlying mechanisms appear to be affected in children when practicing yoga, thus contributing to the body of research on yoga interventions. It seems that selective attention, as measured in the current study as differences in time duration when completing the Stroop task, was not significantly changed for the participants involved. If the results are replicated, this could be evidence that selective attention is not the executive function mechanism effected by yoga, which is helpful in ruling out variables in an attempt to discover how yoga impacts attention and executive function. Improving this field of research is important due to the lack of corroboration of methodology and findings produced by studies to date (Galantino, Galbavy, & Quinn, 2008; Greenberg & Harris, 2012). The lack of replicated methodologies in the yoga literature does not allow for an understanding of how yoga is affecting children because yoga is often examined as part of an intervention package (e.g., Powell, Gilchrist, & Stapley, 2008; Sale, Weil, & Kryah, 2012), or only one component of yoga is examined in isolation (e.g., Jensen, Stevens, &

Kenny, 2012). A lack of replication of findings prevents understanding what underlying mechanisms of executive functioning are being affected by yoga in children. The attempt to understand the covert functions of yoga in improving a child's executive functioning skills is partially in response to the call from current researchers to improve the body of work (Galantino, Galbavy, & Quinn, 2008; Greenberg & Harris, 2012; Lowry, 2011).

### **Summary**

The current study examined the effects of yoga on children's selective attention and executive function. Specifically, the methodology explored if fifth grade students would: 1) show improved selective attention on time-on-task and Stroop Color-Word task time of completion and error reduction; 2) if teachers would report that the students executive functioning improved on the Behavior Rating Inventory of Executive Functioning and if students would report improved mindfulness on the Child and Adolescent Mindfulness Measure; and 3) if teachers and students report that the yoga intervention was socially valid. Results indicate that there were no functional relations found between Stroop time, error, or time-on-task and yoga; no significant results were found on pre-post measures of executive function or mindfulness; and teachers and students found the yoga intervention to be socially acceptable and feasible. Descriptive statistics showed improvements in students' selective attention tasks and most aspects of executive function. The findings indicate that yoga is an intervention that warrants further study to determine if it can be used in the school setting to help students improve focus and skills that enhance the ability to stay on-task in the classroom, as well as increasing self-awareness and mindfulness.

Appendix A: Staff Social Validity Interview  
Adapted from Lane and Beebe-Frankenberger (2004, p. 100)

A. *Social Significance of Goals (Pre-Intervention School Psychologist/Special Educator)*

1. What attention-based behavior is most problematic for \_\_\_\_\_?
  - a. Specific definition of agreed upon target behavior
2. What other classroom behavior is most problematic for \_\_\_\_\_?
  - a. Specific definition of agreed upon target behavior
3. How are these behaviors a problem in the classroom (when, where, how intense, and how often is the behavior occurring)?
4. What are the antecedents and consequences for the behaviors?
5. What is the discrepancy between the current level of behavior and the desired level of performance?
  - a. What is the appropriate and attainable goal criterion of improvement?
6. What interventions are in place to increase or decrease the behaviors?
7. Based on the information you know, what outcomes do the behaviors achieve for \_\_\_\_\_ (what is the function of the behavior)?
8. If this problematic behavior was decreased or eliminated, how would it affect \_\_\_\_\_? Other students? Teaching performance?

B. *Social Acceptability of Procedures (Pre-Intervention School Psychologist/Special Educator)*

9. Which aspects of the intervention do you like most and least? Why?
10. Which aspects of this intervention would be the most and least difficult to implement? Why?
11. What, if any, potential negative effects might this intervention have on \_\_\_\_\_?
12. Do you think this intervention is likely to be effective in solving \_\_\_\_\_'s problem? Why? Why not? What are some ways we could determine whether or not the intervention had solved \_\_\_\_\_'s problem?

C. *Social Important of Effects (Post-Intervention Teacher)*

13. What behavior changes did you observe in \_\_\_\_\_? Did these changes make a difference in \_\_\_\_\_'s behavior in your classroom? In other school settings?
14. Is \_\_\_\_\_'s behavior more similar to the average student in your classroom now? If not, do you think that continued use of the intervention would accomplish this goal? Why or why not?
15. How satisfied are you with the outcomes of the intervention? Why?
16. Do you think this intervention would work with similar students who have attention or behavioral problems in the future? Why or why not?
17. Would you recommend this intervention to other teachers? Why or why not?
18. What aspects of this intervention would you change before recommending it to other teachers?

Appendix B: Children's Acceptability of Yoga Scale (Rogers, unpublished)

Script: *Today, I would like to ask you some questions about the yoga you have been doing. I will read a sentence out loud, and then I need you to circle the statement that represents how you feel. Then write in your answer to the last two questions.*

- |   |     |          |    |
|---|-----|----------|----|
| 1. I like to do yoga.   | Yes | Not Sure | No |
| 2. Yoga teaches me important skills.                            | Yes | Not Sure | No |
| 3. Yoga is one thing I would tell other kids about.             | Yes | Not Sure | No |
| 4. Yoga helps me to pay attention.                              | Yes | Not Sure | No |
| 5. Yoga helps me behave in class.                               | Yes | Not Sure | No |
| 6. Yoga help me to be more aware of myself and my surroundings. | Yes | Not Sure | No |
| 7. What do you like about yoga?                                 |     |          |    |
| 8. What do you not like about yoga?                             |     |          |    |

Appendix C: Child and Adolescent Mindfulness Measure (Greco, Baer, & Smith, 2011)

We want to know more about what you think, how you feel, and what you do. **Read** each sentence. Then, circle the number that tells **how often** each sentence is true for **you**.

	Never True	Rarely True	Sometimes True	Often True	Always True
1. I get upset with myself for having feelings that don't make sense.	0	1	2	3	4
2. At school, I walk from class to class without noticing what I'm doing.	0	1	2	3	4
3. I keep myself busy so I don't notice my thoughts or feelings.	0	1	2	3	4
4. I tell myself that I shouldn't feel the way I'm feeling.	0	1	2	3	4
5. I push away thoughts that I don't like.	0	1	2	3	4
6. It's hard for me to pay attention to only one thing at a time.	0	1	2	3	4
7. I get upset with myself for having certain thoughts.	0	1	2	3	4
8. I think about things that have happened in the past instead of thinking about things that are happening right now.	0	1	2	3	4
9. I think that some of my feelings are bad and that I shouldn't have them.	0	1	2	3	4
10. I stop myself from having feelings that I don't like.	0	1	2	3	4

# Appendix D: Sample Math Worksheet for Time-On-Task Measure

Student Curriculum-Based Assessment Single-Skill Math Probe

<http://lefthandlogic.mmaweb.net/servlet/mathProbe>

## Curriculum-Based Assessment Mathematics Single-Skill Computation Probe: Student Copy

Student:

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

$$\begin{array}{r} 263 \\ \times 1 \\ \hline \end{array}$$

$$\begin{array}{r} 121 \\ \times 1 \\ \hline \end{array}$$

$$\begin{array}{r} 134 \\ \times 2 \\ \hline \end{array}$$

$$\begin{array}{r} 877 \\ \times 1 \\ \hline \end{array}$$

$$\begin{array}{r} 865 \\ \times 1 \\ \hline \end{array}$$

$$\begin{array}{r} 557 \\ \times 1 \\ \hline \end{array}$$

---

$$\begin{array}{r} 241 \\ \times 2 \\ \hline \end{array}$$

$$\begin{array}{r} 634 \\ \times 1 \\ \hline \end{array}$$

$$\begin{array}{r} 988 \\ \times 1 \\ \hline \end{array}$$

$$\begin{array}{r} 121 \\ \times 2 \\ \hline \end{array}$$

$$\begin{array}{r} 324 \\ \times 1 \\ \hline \end{array}$$

$$\begin{array}{r} 114 \\ \times 2 \\ \hline \end{array}$$

---

$$\begin{array}{r} 320 \\ \times 3 \\ \hline \end{array}$$

$$\begin{array}{r} 211 \\ \times 2 \\ \hline \end{array}$$

$$\begin{array}{r} 201 \\ \times 1 \\ \hline \end{array}$$

$$\begin{array}{r} 572 \\ \times 1 \\ \hline \end{array}$$

$$\begin{array}{r} 324 \\ \times 2 \\ \hline \end{array}$$

$$\begin{array}{r} 132 \\ \times 1 \\ \hline \end{array}$$

---

$$432$$

$$122$$

$$418$$

$$433$$

$$121$$

$$706$$

## Appendix E: Time-On-Task Data Collection Observation Form

Observer: \_\_\_\_\_  
 Participant: \_\_\_\_\_  
 Behavior: attention to math worksheet task  
 Data Collection Method: momentary time sampling 10s intervals for 5 minutes

**Instructions:** Complete the information at the top of the sheet and record the data in the rows by placing a (+) for intervals where the student is on-task and a (-) for intervals where the student is off-task. Indicate session in which intervention is introduced by placing an \* in the cell along with data.

**ON-TASK:** completing items, working items out on paper or with hands, counting to self, or asking the observer math related questions

**OFF-TASK:** looking away from the worksheet or observer, staring off into the distance, or engaging in any other activity or with any other person

Session	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10s															
20s															
30s															
40s															
50s															
60s															
1m 10s															
1m 20s															
1m 30s															
1m 40s															
1m 50s															
2m 00s															
2m 10s															
2m 20s															
2m 30s															
2m 40s															
2m 50s															
3m 00s															
3m 10s															
3m 20s															
3m 30s															
3m 40s															
3m 50s															
4m 00s															
4m 10s															
4m 20s															
4m 30s															
4m 40s															
4m 50s															
5m 00s															



Appendix F: Stroop Effect Task Data Collection Form

Observer: \_\_\_\_\_

Participant: \_\_\_\_\_

**Instructions:** 1) Tally uncorrected errors as the student reads the ink color of Congruent Trial 1 in column A. 2) Using a stopwatch, record the time elapsed it takes the student to read the ink color of Congruent Trial 1 in column B. 3) Repeat for Incongruent Trial 2. 4) Calculate the difference scores.

Session	Congruent Trail 1		Incongruent Trial 2		Difference score of Trial 1 & Trail 2	
	A: # Errors	B: Time	A: # Errors	B: Time	TA2 – TA1: # Errors difference	TB2 – TB1: Time difference
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

## Appendix G: Yoga Lesson 1 Procedural Fidelity Checklist

### Procedural Fidelity for Lesson 1—Intro to Yoga

Instructor/participant/observer: \_\_\_\_\_/\_\_\_\_\_/\_\_\_\_\_

**Instructions:** Place a (+) in the box if the item is completed or a (-) if it is not completed by the **instructor**. Place an **X** next to the box if the **participant** does not complete item and make anecdotal notes about behavior next to item (i.e., why student isn't engaging, temperament, etc.).

- OM** (Let the student ring the bells)

**Breath awareness:**

- Crocodile
- Easy Pose
- Turtle mudra
- OPTIONAL: Balloon Breath*

**Poses:** (15-20 mins.)

- Mountain
- Tall Mountain
- Half Moon:
- Milk Shake
- OPTIONAL: Yawn and Flop:*
- Monkey arms
- Forward Fold
- Lunge
- Downward Facing Dog: (lunge other side then back to DDog)
- Forward Fold
- Plank:
- Cobra:
- Child:
- Down Dog: (extended leg; both sides then back to DDog)
- Sun Salutations
- Triangle
- OPTIONAL Chair*
- OPTIONAL Squat*
- OPTIONAL Butterfly:*
- OPTIONAL Soaring butterfly*
- Crooked tree branch
- Knee Squeeze
- Dead Bug
- Corpse Pose
- Meditation:** Enjoyment Inner Resource Meditation. (3 mins.)
- Art Project:** Draw your special place. Share.
- Reflection:** reflection form.

Appendix H: Elementary Principal Letter of Support

☞ ^Á Æ&@ [ | - edited for confidentialityD

(School address and contact)

September 9, 2014

From: Principal (name and school)  
To: Research Approval Board  
Re: Participation in Jill Rogers' dissertation research

Members of the Research Approval Board,

This letter is being written to give my approval and consent for (school) to participate in Jill Rogers' dissertation research titled "An Examination of Yoga and Elementary School Students' Selective Attention and Executive Function in the School Setting" at The University of Kentucky.

I agree to allow Jill and her research team to work with my staff and students at (school) during the after-school program to collect data for her dissertation. This includes interviewing the School Psychologist or other appropriate staff and teachers, administering a teacher-rating form to teachers, administering two yoga and mindfulness-based surveys to students, implementing an individual 30-minute yoga intervention with those students for 12 sessions across approximately three months, and administering two attention based tasks after each yoga session.

Parents will have to give permission for their child's participation by signing an informed consent which will explain in detail what yoga and attention-based activities his or her child will engage in during the project. The student will have to give permission to participate as well.

Please accept this letter of support in determining the decision to approve Jill's research.

Sincerely,

(signature)  
(Principal name)  
(school)

Appendix I: Fayette County Public Schools Research Director Tentative Letter of  
Approval



TO: Jill Rogers  
University of Kentucky

From: Michael Owen  
Fayette County Public Schools  
Office of Data, Research, and Evaluation

Subject: Research Request Tentative Approval

Date: April 7, 2014

This letter is to notify you that the Fayette County Public Schools Office of Data, Research, and Evaluation has evaluated your research application and has granted tentative approval your study. Full approval will be given when you receive IRB approval.

This approval is good for one calendar year from the date on this letter. If any changes are made during the course of the study, you will be required to submit a new application for re-approval.

If you have any questions about this process you may email me at [michael.owen@fayette.kyschools.us](mailto:michael.owen@fayette.kyschools.us)

Congratulations and good luck.

*Michael Owen*  
Administrative Data Strategist  
Fayette County Public Schools  
Office of Data, Research, and Evaluation

**AN EQUAL OPPORTUNITY SCHOOL DISTRICT**

Board of Education: John Price, Chair • Melissa Bacon, Vice Chair • Amanda Ferguson • Douglas Barnett • Daryl Love  
Superintendent Tom Shelton, Ph.D.

701 East Main Street, Lexington, Kentucky 40502 • Phone: 859.381.4100 • [www.fcps.net](http://www.fcps.net)

**Mailing Address:** 1126 Russell Cave Rd., Lexington, Kentucky 40505

## Appendix J: Informed Consents and Assent

Protocol 14-0562-F4S

### **Parental Consent to Participate in a Research Study**

#### **An Examination of a Yoga Intervention on Elementary Student's Selective Attention and Executive Function in a School Setting**

##### **WHY ARE YOU BEING INVITED TO TAKE PART IN THIS RESEARCH?**

Your child is being invited to take part in a research study about whether yoga can improve his or her attention and self-regulation of behavior in the classroom. Your child is being invited to take part in this research study because he or she is a student at a Fayette County Public School with 50% or more of the student body on free or reduced lunch (which may indicate that some students may have more stress in their lives that affects their attention and behavior) and has been identified by a school teacher, staff, or administrator as a good candidate for this study. If you volunteer your child to take part in this study, you will be one of about 8 people to do so.

##### **WHO IS DOING THE STUDY?**

The person in charge of this study is Jill Rogers, M.S. (*Principal Investigator, PI*), doctoral candidate and graduate student of University of Kentucky, Department of Educational, School, and Counseling Psychology in the College of Education. She is being guided in this research by Dr. Alicia Fedewa with the Department of Educational, School, and Counseling Psychology in the College of Education at the University of Kentucky. There may be other people on the research team assisting at different times during the study.

##### **WHAT IS THE PURPOSE OF THIS STUDY?**

The purpose of this study is to explore how yoga may affect children's ability to improve attention and executive function in the school setting. By doing this study, we hope to learn how yoga benefits students ability to focus attention and improve executive function in school setting.

##### **ARE THERE REASONS WHY YOU SHOULD NOT TAKE PART IN THIS STUDY?**

Your child should not participate in this study if you feel he or she is not physically able to participate in yoga as a form of exercise. The yoga poses that were chosen for this study are basic beginner poses that do not require irregular strength or flexibility beyond that of the average child of nine and ten years old. However, if your child has any

physical issues that prevent them from participating in a normal physical education class, you should not give permission for your child to participate in this study. Also, if your child cannot discriminate between colors (for example, has some form of color blindness), you should not give permission for your child to participate in this study.

### **WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST?**

The yoga sessions and attention-based tasks will be conducted at your child's after-school program. Your child will work individually with a certified yoga instructor while being observed for one-third of the sessions. Your child will attend the yoga sessions in the school 12 times during the study. Each of those visits will take about 40 minutes. The total amount of time your child will be asked to volunteer for this study is about 10.5 hours over the next three months.

### **WHAT WILL YOU BE ASKED TO DO?**

Your child will be asked if they would like to participate in yoga for six weeks during the after-school program to help the researchers discover what kids his or her age like and do not like about yoga. It is necessary to be deceptive with your child about the purpose of the study so that he or she does not intentionally change his or her behavior to accommodate the researchers, yoga instructor, or his or her teachers, and possibly invalidate the results.

If you and your child agree to participate, he or she will complete the Child and Adolescent Mindfulness Measure to see how self-aware and mindful he or she is before beginning yoga. Once your child begins the intervention, he or she will spend 30 minutes twice a week doing individual yoga with a certified yoga instructor. The session will begin with about five minutes of breathing exercises to help relax or energize your child (whichever he or she and the instructor agree is needed). Then, the yoga instructor will guide your child through about 15 minutes of yoga poses that include a forward bend, a back bend, and a side bend. Finally, the yoga instructor will guide your child through an approximate five to ten minute relaxation meditation that involves visual imagery of an imaginary scene and breathing exercises while lying in a comfortable position. Each session, this agenda will be followed with the breathing, posture, and relaxation activities based on your child's need and the yoga instructors' choice.

Directly after the yoga session has ended, the yoga instructor will ask your child to participate in a Stroop Color-Word Task of selective attention. The purpose of this task is to see if yoga has an effect on your child's ability to attend to the color of ink that a list of words is printed in instead of the meaning of the word. In this task, your child will first be timed naming the ink color of color-words (red) printed in the same color ink (red) with any errors noted (red being the correct response). Next, your child will be timed naming the ink color of color-words (red) printed in a different color of ink (blue) with any errors noted (blue being the correct response). The difference of the number of errors and times between the two lists will be calculated and graphed to determine if yoga

is effecting your child's ability to selectively attend to the ink color instead of the word meaning.

After the yoga session and Stroop Effect Task, your child will be escorted back to the after-school program by a UK research personnel assigned to this project to perform another attention task. This time, your child will work on a third grade level math worksheet for five minutes. During the five minutes, the research personnel will observe whether or not your child is on-task (for example, working on the math problems) every ten seconds. After the five minutes, the research personnel will help your child correct any mistakes he or she may have made and tutor him or her for another five minutes on additional math problems.

After the twelfth and last yoga session, your child will be asked to complete the Child and Adolescent Mindfulness Measure again to compare with the pre-test to see if yoga has helped improve his or her self-awareness and mindfulness. Your child will also complete the Children's Acceptability of Yoga Scale. This scale has eight questions that reflect on whether or not your child liked yoga and if he or she believes yoga improved his or her attention in the classroom.

Before and after your child begins and ends the yoga sessions, one of his or her teachers will complete the Behavior Rating Inventory of Executive Functioning – Teacher Form. This assessment will compare how your child's executive function has changed since participating in yoga and reflects on aspects such as emotion control, planning and organizing, inhibition of behavior, and monitoring his or her behavior.

### **WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?**

To the best of our knowledge, the things you will be doing have no more risk of harm than you would experience in everyday life. The possible risks and discomforts that your child may experience by participating in yoga are minimal and are of no greater risk or discomfort than what your child may experience in a typical physical education class. This includes rare or occasional soreness of muscles from stretching and strength building.

Another possible risk is that your child may rarely miss after-school program activities that may be enjoyable to him or her.

In addition to the risks listed above, your child may experience a previously unknown risk or side effect.

### **WILL YOU BENEFIT FROM TAKING PART IN THIS STUDY?**

There is no guarantee that your child will get any benefit from taking part in this study. However, some people have experienced the ability to relieve stress, manage their own behavior, and build muscle strength and increase flexibility when participating in yoga. You and your child's willingness to take part, however, may, in the future, help society as

a whole better understand this research topic. If monetarily possible, your child will be given a yoga mat, block, and strap at the end of the intervention so that he or she may continue practicing yoga.

### **DO YOU HAVE TO TAKE PART IN THE STUDY?**

If you decide to take part in the study, it should be because you really want to volunteer your child to do so. You and your child will not lose any benefits or rights you or he or she would normally have if you choose not to volunteer him or her. Your child can stop at any time during the study and still keep the benefits and rights he or she had before volunteering. If you decide not allow your child to take part in this study, your decision will have no effect on the quality of education your child will receive, and will have no effect on his or her academic status or grade in the school.

### **IF YOU DON'T WANT TO TAKE PART IN THE STUDY, ARE THERE OTHER CHOICES?**

If you do not want to be in the study, there are no other choices except not to take part in the study.

### **WHAT WILL IT COST YOU TO PARTICIPATE?**

There are no costs associated to you or your child to participate in this study.

### **WILL YOU RECEIVE ANY REWARDS FOR TAKING PART IN THIS STUDY?**

You or your child will not receive any rewards or payment for taking part in the study. If monetarily possible, your child will be given a yoga mat, block, and strap at the end of the intervention so that he or she may continue practicing yoga.

### **WHO WILL SEE THE INFORMATION THAT YOU GIVE?**

We will make every effort to keep confidential all research records that identify you and your child to the extent allowed by law.

Your child's information will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered. You or your child will not be personally identified in these written materials. We may publish the results of this study; however, we will keep your and your child's name and other identifying information private.

We will make every effort to prevent anyone who is not on the research team from knowing that you or your child gave us information, or what that information is. This includes assigning individual numbers to all documents so that you and your child's name do not appear on any records (BRIEF, CAYS, CAMM, Stroop Effect data



collection forms, observation forms, demographic information, staff interview). Electronic files of graphed data from the Stroop Effect Task and Time-On-Task while completing math problems will also be recorded under the assigned individual numbers and saved on a password protected jump drive that only the PI has access to.

We will keep private all research records that identify you to the extent allowed by law. You should know, however, that there are some circumstances in which we may have to show you or your child's information to other people. For example, the law may require us to show your information to a court. Also, we may be required to show information which identifies you or your child to people who need to be sure we have done the research correctly; these would be people from such organizations as the University of Kentucky.

### **CAN YOUR TAKING PART IN THE STUDY END EARLY?**

If you decide to allow your child take part in the study you or he or she still have the right to decide at any time that you no longer want your child to continue. You or your child will not be treated differently if you or your child decide to stop taking part in the study.

The individuals conducting the study may need to withdraw your child from the study and the study intervention. This may occur if your child is not able to follow the directions given to him or her, or if they find that your child being in the study is more risk than benefit to him or her.

### **WHAT HAPPENS IF YOU GET HURT OR SICK DURING THE STUDY?**

If you believe your child is hurt or gets sick because of something that is due to the study, you should call Jill Rogers at 859-420-3366 immediately. Jill Rogers will determine what type of treatment, if any, is best for you at that time.

It is important for you to understand that the University of Kentucky does not have funds set aside to pay for the cost of any care or treatment that might be necessary because your child gets hurt or sick while taking part in this study. Also, the University of Kentucky will not pay for any wages you may lose if your child is harmed by this study.

Medical costs that result from research related harm cannot be included as regular medical costs. Therefore, the medical costs related to your child's care and treatment because of research related harm (such as muscle soreness), will be your responsibility.

### **WHAT IF NEW INFORMATION IS LEARNED DURING THE STUDY THAT MIGHT AFFECT YOUR DECISION TO PARTICIPATE?**

If the researcher learns of new information in regards to this study, and it might change your willingness to allow your child to stay in this study, the information will be provided to you. You may be asked to sign a new informed consent form if the information is provided to you after your child has joined the study.

**WHAT ELSE DO YOU NEED TO KNOW?**

There is a possibility that the data collected from you may be shared with other investigators in the future. If that is the case the data will not contain information that can identify you or your child unless you give your consent or the UK Institutional Review Board (IRB) approves the research. The IRB is a committee that reviews ethical issues, according to federal, state and local regulations on research with human subjects, to make sure the study complies with these before approval of a research study is issued.

**Contacting Research Subjects for Future Studies**

Do you give your permission to be contacted in the future by Jill Rogers, M.S. regarding your willingness to participate in future research studies about the effects of yoga?

Yes                       No                      \_\_\_\_\_ Initials

**WHAT IF YOU HAVE QUESTIONS, SUGGESTIONS, CONCERNS, OR COMPLAINTS?**

Before you decide whether to accept this invitation for your child to take part in the study, please ask any questions that might come to mind now. Later, if you have questions, suggestions, concerns, or complaints about the study, you can contact the investigator, Jill Rogers, M.S. at 859-420-3366. If you have any questions about your or your child’s rights as a volunteer in this research, contact the staff in the Office of Research Integrity at the University of Kentucky between the business hours of 8am and 5pm EST, Mon-Fri. at 859-257-9428 or toll free at 1-866-400-9428. We will give you a signed copy of this consent form to take with you.

\_\_\_\_\_  
Signature of person agreeing to take part in the study

\_\_\_\_\_  
Date

\_\_\_\_\_  
Printed name of person agreeing to take part in the study

\_\_\_\_\_  
Name of (authorized) person obtaining informed consent

\_\_\_\_\_  
Date

**Teacher Consent to Participate in a Research Study**

**An Examination of a Yoga Intervention on Elementary Student's Selective Attention and Executive Function in a School Setting**

**WHY ARE YOU BEING INVITED TO TAKE PART IN THIS RESEARCH?**

You are being invited to take part in a research study that is examining whether yoga can improve fifth grade students' attention and executive function in the classroom. You are being invited to take part in this research study because you can help evaluate whether yoga improves your student's executive function in the classroom and give feedback on the socially acceptability of the intervention. If you volunteer to take part in this study, you will be one of up to six people to do so.

**WHO IS DOING THE STUDY?**

The person in charge of this study is Jill Rogers, M.S. (*Principal Investigator, PI*), doctoral candidate and graduate student of University of Kentucky, Department of Educational, School, and Counseling Psychology in the College of Education. She is being guided in this research by Dr. Alicia Fedewa with the Department of Educational, School, and Counseling Psychology in the College of Education at the University of Kentucky. There may be other people on the research team assisting at different times during the study.

**WHAT IS THE PURPOSE OF THIS STUDY?**

The purpose of this study is to explore how yoga may affect children's ability to improve attention and executive function in the school setting. By doing this study, we hope to learn how yoga benefits students ability to focus attention and improve executive function in a school setting.

**ARE THERE REASONS WHY YOU SHOULD NOT TAKE PART IN THIS STUDY?**

You should not participate in this study if you are not a teacher of he student participant at Booker T. Washington Intermediate Academy who is familiar enough with him or her to complete a rating scale on school-based executive function.

**WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST?**

The research procedures will be conducted at Booker T. Washington Intermediate Academy with Fayette County Schools. Your requested participation requires a total of about 30 minutes per student participant that is involved in the study (at least one student and no more than six). Participation will begin by September 25<sup>th</sup> and end by December 19<sup>th</sup>.

**WHAT WILL YOU BE ASKED TO DO?**

You will be asked to complete the Behavior Rating Inventory of Executive Functions-Teacher Form before the student participant begins the intervention and after, approximately four weeks apart. You may be asked to complete multiple rating

inventories if you have more than one student participant in your class. The rating inventory takes approximately 15 minutes to complete, requiring a total of about 30 minutes of your participation per student participant in your class. The rating forms will be given to you at school, where you will also return them to the PIs school contact, Ms. Zinser.

**WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?**

To the best of our knowledge, the things you will be doing have no more risk of harm than you would experience in everyday life.

**WILL YOU BENEFIT FROM TAKING PART IN THIS STUDY?**

You will not get any personal benefit from taking part in this study.

**DO YOU HAVE TO TAKE PART IN THE STUDY?**

If you decide to take part in the study, it should be because you really want to volunteer. You will not lose any benefits or rights you would normally have if you choose not to volunteer. You can stop at any time during the study and still keep the benefits and rights you had before volunteering.

**IF YOU DON'T WANT TO TAKE PART IN THE STUDY, ARE THERE OTHER CHOICES?**

If you do not want to be in the study, there are no other choices except not to take part in the study.

**WHAT WILL IT COST YOU TO PARTICIPATE?**

There are no costs associated with taking part in the study.

**WILL YOU RECEIVE ANY REWARDS FOR TAKING PART IN THIS STUDY?**

You will not receive any rewards or payment for taking part in the study.

**WHO WILL SEE THE INFORMATION THAT YOU GIVE?**

We will make every effort to keep confidential all research records that identify you and the student the extent allowed by law.

The information you provide will be combined with information from other people taking part in the study. When we write about the study to share it with other researchers, we will write about the combined information we have gathered. You or the students will not be personally identified in these written materials. We may publish the results of this

study; however, we will keep your and the students' names and other identifying information private.

We will make every effort to prevent anyone who is not on the research team from knowing that you gave us information, or what that information is. This includes assigning individual numbers to all documents so that your name does not appear on any records. Electronic files of the semi-structured interview will also be recorded under the assigned individual numbers and saved on a password protected jump drive that only the PI has access to.

We will keep private all research records that identify you to the extent allowed by law. You should know, however, that there are some circumstances in which we may have to show your information to other people. For example, the law may require us to show your information to a court. Also, we may be required to show information which identifies you to people who need to be sure we have done the research correctly; these would be people from such organizations as the University of Kentucky.

### **CAN YOUR TAKING PART IN THE STUDY END EARLY?**

If you decide to take part in the study you still have the right to decide at any time that you no longer want to continue. You will not be treated differently if you decide to stop taking part in the study.

The individuals conducting the study may need to withdraw you from the study. This may occur if you are not able to follow the directions they give you, if they find that your being in the study is more risk than benefit to you, or if the agency funding the study decides to stop the study early for a variety of scientific reasons.

### **WHAT ELSE DO YOU NEED TO KNOW?**

There is a possibility that the data collected from you may be shared with other investigators in the future. If that is the case the data will not contain information that can identify you unless you give your consent or the UK Institutional Review Board (IRB) approves the research. The IRB is a committee that reviews ethical issues, according to federal, state and local regulations on research with human subjects, to make sure the study complies with these before approval of a research study is issued.

### **Contacting Research Subjects for Future Studies**

Do you give your permission to be contacted in the future by Jill Rogers, M.S. regarding your willingness to participate in future research studies about the effects of yoga?

Yes

No

\_\_\_\_\_ Initials

**WHAT IF YOU HAVE QUESTIONS, SUGGESTIONS, CONCERNS, OR COMPLAINTS?**

Before you decide whether to accept this invitation to take part in the study, please ask any questions that might come to mind now. Later, if you have questions, suggestions, concerns, or complaints about the study, you can contact the investigator, Jill Rogers, M.S. at 859-420-3366. If you have any questions about your rights as a volunteer in this research, contact the staff in the Office of Research Integrity at the University of Kentucky between the business hours of 8am and 5pm EST, Mon-Fri. at 859-257-9428 or toll free at 1-866-400-9428. We will give you a signed copy of this consent form to take with you.

\_\_\_\_\_  
Signature of person agreeing to take part in the study

\_\_\_\_\_  
Date

\_\_\_\_\_  
Printed name of person agreeing to take part in the study

\_\_\_\_\_  
Name of (authorized) person obtaining informed consent

\_\_\_\_\_  
Date

**PARTICIPANT ASSENT FORM**

**Acceptability of Yoga**

**An Examination of a Yoga Intervention on Elementary Student’s Selective Attention and Executive Function in a School Setting**

You are invited to be in a research study being done by Jill Rogers, a graduate student, from the University of Kentucky. You are invited because a teacher or staff at your school thought you would benefit from this study.

If you agree to be in the study, you will be asked to complete two surveys, do yoga, read word lists, and complete some math problems for about 50 minutes twice a week for six weeks, or 12 times total. This will let us know what you like and do not like about yoga and how it affects reading word lists and completing math problems.

Your family will know that you are in the study. If anyone else is given information about you, they will not know your name. A number or initials will be used instead of your name.

If something makes you feel bad while you are in the study, please tell (*yoga instructor – Tess or Shannon*). If you decide at any time you do not want to finish the study, you may stop whenever you want.

You can ask (*yoga instructor – Tess or Shannon*) questions any time about anything in this study. You can also ask your parent any questions you might have about this study.

Signing this paper means that you have read this or had it read to you, and that you want to be in the study. If you do not want to be in the study, do not sign the paper. Being in the study is up to you, and no one will be mad if you do not sign this paper or even if you change your mind later. You agree that you have been told about this study and why it is being done and what to do.

\_\_\_\_\_  
Signature of Person Agreeing to be in the Study

\_\_\_\_\_  
Date

\_\_\_\_\_  
Name of Person Obtaining Informed Assent

\_\_\_\_\_  
Date

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Curriculum Vitae

***EDUCATION***

**University of Kentucky, Lexington, KY**

Master of Science, School Psychology, December 2009

**Eastern Kentucky University, Richmond, KY**

Bachelor of Science, Psychology, December 2007

**Bluegrass Community and Technical College, Lexington, KY**

General Undergraduate Coursework, December 2005

***ACADEMIC EXPERIENCE***

**Teaching**

Teaching Assistant, University of Kentucky Department of Academic Enhancement  
Lexington, Kentucky, August 2012 – May 2014

Team Member, Curriculum Mapping, University of Kentucky Academic Enhancement  
Lexington, Kentucky, January 2014 – May 2014

Teaching Assistant, University of Kentucky Department of Academic Enhancement  
Lexington, Kentucky, August 2012 – May 2014

Adjunct Instructor, Eastern Kentucky University Department of Psychology  
Richmond, Kentucky, August 2009 – December 2009

**Research**

Dissertation topic: *An Examination of Yoga and Elementary Student's Selective Attention and Executive Function in the School Setting* - A mixed methods experiment utilizing single subject research design of fifth grade students performance on the Stroop Color-Word Task and Time-On-Task before and after a unique yoga intervention; teacher rated executive functioning and student rated mindfulness will also be examined. Proposal accepted June 2014. Defense May 2016 for an August 2016 degree.

Graduate Assistant, University of Kentucky Disability Resource Center, August 2014-  
August 2015

Research Assistant, University of Kentucky Department of Psychiatry, September 2008 –  
June 2012. *Focused on intimate partner violence*

Research Assistant, University of Kentucky Graduate Studies for School Psychology Program, October 2008 – 2009. *Focused on creating NASP approval renewal portfolio*

Research Assistant, Eastern Kentucky University, 2006 – 2007. *Independent studies focused on data collection, management and analysis for relational and personal goal study; data analysis for cognitive analysis study*

### ***PROFESSIONAL EXPERIENCE***

Field Worker and Transcriptionist, Collaborative Center for Literacy Development  
Literacy Grant Grant, Lexington, KY, January 2014 – June 2014

Clinical Interviewer, University of Kentucky NIH/NIMHD grant investigating “Does Violence Against Women result in disparities in cancer?”  
November 2012 – February 2013

### ***INTERNSHIP EXPERIENCE***

Pre-Doctoral Internship Clinical Therapist, Assessment Team Member, and Research Assistant at the Center on Trauma and Children (CTAC), Child and Adolescent Trauma Treatment and Training Institute (CATTTI) and Comprehensive Assessment and Training Services (CATS) programs, University of Kentucky, Lexington, KY. August 2015 – July 2016

School-based internship at a diverse public high school in Fayette County, KY.  
August 2014 – June 2015

### ***PUBLICATIONS***

Follingstad, D.R., & Rogers, M.J. (2014). The nature and prevalence of partner psychological abuse in a national sample of adults. *Violence and Victims, 29*(1), 3-23. doi: 10.1891/0886-6708.09-160

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Follingstad, D. R., Rogers, M., & Duvall, J. L. (2012). Factors predicting relationship satisfaction, investment, and commitment when women report high prevalence of psychological abuse. *Journal Of Family Violence, 27*(4), 257-273. doi:10.1007/s10896-012-9422-8

Follingstad, D.R., Rogers, M.J., Welling, S.N., & Priesmeyer, F.J. (In press). Decisions to prosecute battered women's homicide cases: An exploratory study. *Journal of Family Violence*.

Gore, J. S. and Rogers, M. J. (2010). Why Do I Study? The moderating effect of attachment style on academic motivation. *Journal of Social Psychology, 150* (5), 560-578.  
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Rogers, M., & Follingstad, D. (2011). Gender differences in reporting psychological abuse in a national sample. *Journal Of Aggression, Maltreatment & Trauma, 20*(5), 471-502.  
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Rogers, M. J. & Follingstad, D. R. (2014). Women's exposure to psychological abuse: Does that experience predict mental health outcomes? *Journal of Family Violence 29* (6). 595-611.  
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### ***HONORS***

Recipient of the Arvle and Ellen Turner Thacker Research Fund Mini-Dissertation Grant, 2013  
Recipient of the Eastern Kentucky University Presidential Scholarship, 2007, 2006  
Recipient of the Hindeman Professional Career in Psychology Scholarship, 2007  
Outstanding Senior Award, Eastern Kentucky University, 2007