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Socioeconomic Status, Family Environment, and Executive Functions During
Middle Childhood

By

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A thesis submitted in partial satisfaction of the
requirements for the degree of
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Abstract

Executive functions encompass an important set of skills that develop throughout childhood and adolescence vis-à-vis experiences and opportunities. Executive functions include skills involved in self-regulation and goal-directed behavior. Higher socioeconomic status (SES) is associated with stronger executive function skills, which are associated with future life success and positive health outcomes. Well-described socioeconomic differences in executive functions begin in childhood and are thought to contribute to health disparities and intergenerational transmission of poverty. How the environment may facilitate development of executive functions has yet to be elucidated. This exploratory analysis investigated associations between SES, executive functions, and the home environment. Participants included 60 parent-child dyads with children aged 7-12 years. Several indicators of SES were compared. The home environment was described using a latent class analysis (LCA) of items from the Home Observation for Measurement of the Environment for Middle Childhood (HOME-MC). LCA revealed three classes of home environment: High Overall, Medium Scaffolding with Low Father Involvement, and Low Scaffolding with Medium Father Involvement. Higher SES was associated with greater odds of membership in the High Overall class compared to the other two classes. Children from families in the Low Scaffolding with Medium Father Involvement class had lower scores on executive function tasks compared to the High Overall class. These findings suggest that home environment, specifically the presence of parental scaffolding, may be protective against the adverse effects of low SES on executive functions. Future research should investigate whether interventions focused on scaffolding could enhance the development of executive functions, positively alter developmental trajectories, and improve future life outcomes, particularly for low SES children.

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Part 1: Literature Review

Differences in Parenting: A Story from Personal Experience

Parenting is a ubiquitous and nearly universal activity. However, there are as many different ways to parent, as there are people who have children. Everyone has notions of good and bad parenting, likely emulating or reacting to their own experiences. My ideal image of parenting was the parenting I had received from my own parents. I considered their style the gold standard of parenting. Not until I saw parenting in a very different context did I realize that there could be alternatives equally relevant and unchallenged as the parenting I had experienced.

The summer after my sophomore year in college, I was a teacher at an academic enrichment program in New Haven. Although I was half a mile from Yale's ivory towers, my summer classroom felt worlds away. The majority of my pupils lived in the nearby low-income public housing and received the free breakfasts and lunches at school. Although they were all eager learners, many were one or two years behind grade-level in reading and math. Lighters and dimebags littered the playground behind the school building. This was the social context that surrounded my students' daily lives.

One day, two of the seven-year-old girls in my group got into a fistfight. I explained to one of the girl's mothers that her daughter was being suspended from school for the next day; she seemed surprised that her daughter was being punished for defending herself. I explained that in the future I would want her daughter to walk away from the fight and come to one of the counselors. (My parents had taught me that violence was inexcusable in any situation.) "No, I taught my daughter to stick up for herself," was the mother's response.

This was the first time that I had considered that the rules and ideals that my parents had instilled in me were not universal truths. This mother had a different sense of the person she wanted her daughter to become than my mother had for me. As I have become more versed in neurobiology and child development, I have begun to wonder how and when these parenting differences influence the brain and its developmental trajectory. How does parenting inform wiring of the brain and ultimately the person you become?

Introduction and Outline

To understand how parenting makes a difference in the developmental course of a child, this paper borrows three core concepts from the seminal publication on the neuroscience of child development, *From Neurons to Neighborhoods* (Shonkoff & Phillips, 2000). The first core concept describes the transactional-ecological model of development. This model understands the child as an active participant in his or her development who interacts with the social and physical environment. Recently this model has been refashioned as the biodevelopmental model (Shonkoff, 2010). In addition, the life-course perspective

of health disparities helps to illustrate a case of diverging destinies¹ that begin in childhood and continue across generations (Braveman & Barclay, 2009). These two theoretical models are further described in section III and provide the basis of the research questions outlined in section XI. While these models emphasize the importance of *early* childhood, I argue that certain neurobehavioral processes continue to develop later in childhood and are important areas of research.

The second core concept highlights the important developmental goal of self-regulation. Shonkoff and Phillips define self-regulation as a child's ability to control bodily functions, manage powerful emotions, and maintain focus and attention (Shonkoff & Phillips, 2000). Self-regulation involves multiple processes. As the study of self-regulation blooms in multiple disciplines from personality psychology to public health, different fields have adopted different definitions and measurements of this construct. Nonetheless, "self-regulation", although defined and measured differently in various studies, has demonstrated important associations in different life outcomes. In a recent study, Moffitt et al. found that self-regulation was as predictive as I.Q. and family socioeconomic status of many indicators of life success (Moffitt, et al., 2011). Researchers are beginning to appreciate the importance of self-control in academic achievement, social functioning, and health outcomes (Duckworth, 2011; Mischel, Shoda, & Rodriguez, 1989). The importance and complexities of self-regulation are discussed in section IV.

The field of neuroscience is one discipline where self-regulation has become an important area of investigation. Researchers have begun to ask questions about the biological underpinnings of complicated self-regulatory tasks. Previous studies implicate executive functions, mediated primarily by the frontal and prefrontal cortices of the brain, as the biological substrate responsible for self-regulatory behavior (Blair & Ursache, 2011). In addition, research has clarified the timeline of executive function development (Anderson, 2001; Welsh, Pennington, & Groisser, 1991). The components and development of executive functions are discussed in section V.

As studies of its developmental course demonstrate, middle childhood is an important period for the burgeoning of executive function (Maccoby, 1984). However, the literature on middle childhood is sparse compared to research on early childhood and adolescence. The important and unique developmental activities of middle childhood, especially the changing relationship to caregivers, are discussed in section VI.

The third core concept borrowed from *Neurons to Neighborhoods* emphasizes the important role of human relationships in the biodevelopmental approach to development (Shonkoff & Phillips, 2000). Especially important are

¹ McLanahan coined the phrase "diverging destinies" to describe transgenerational trends of increasing disparities in resources children receive from parents (McLanahan, 2004). I use the term to describe increasing disparities specifically across the life course rather than between generations.

the child’s most proximal and influential social contacts and teachers—parents². The literature, both academic and popular, on “parenting” is immense. Section VII describes the construct of parenting and research methods.

While psychologists and neuroscientists are expanding what is known about self-regulation, executive functions, and parenting, researchers interested in social disparities have found that these constructs vary significantly by socioeconomic status (SES) (Bornstein & Bradley, 2003; Hackman & Farah, 2009; Raizada & Kishiyama, 2010). SES is a concept that incorporates material wealth and indicators of social prestige. Education, occupation, and income are common components of or proxies for SES (Stewart, 2009a, 2009b; Stewart, Burgard, & Schwartz, 2003). However, SES is not completely contained in these “objective” measures. A new and promising measure of SES is subjective social status (Singh-Manoux, Marmot, & Adler, 2005). The advantages and disadvantages of multiple SES indicators are compared in section VIII. Previous studies documenting socioeconomic disparities in parenting and executive function are described in sections IX and X.

This review of literature on SES, parenting, executive function, and self-regulation demonstrates theoretical support for parenting as a link between SES and executive function. However, the literature lacks sufficient empirical evidence to unequivocally support what is suspected theoretically. The analysis component of this thesis hopes to contribute to existing understandings of the relationships between SES, parenting, and executive function during the understudied developmental period of middle childhood. Parenting as a mechanism for socioeconomic disparities in executive function and future researcher questions are summarized in section XI.

The Biodevelopmental and Life-Course Models

Two theories that inform thinking about child neurodevelopmental processes are described in this section. The first is the biodevelopmental framework, an update of the transactional ecological model described in *Neurons to Neighborhoods* (Shonkoff & Phillips, 2000). This model emphasizes the interaction of the child and the interpersonal and physical environments in an iterative but linear trajectory. The second theory is the life-course model (Braveman & Barclay, 2009). This model pays attention to the cumulative effects of various advantages and disadvantages over the lifetime and their influence on the advantages and disadvantages of subsequent generations. These two models are extremely compatible in their emphasis on childhood experiences and multiple sources of influence. Together they provide a theoretical framework to understand how disparities in child development come about and lead to disparities in adult learning, behavior, and health outcomes and are transmitted across generations.

² Although the term “parents” will be used in this paper, it does not strictly refer to biological parents, as a proximal caregiver does not need to be a biological relative to be an important influence.

Shonkoff describes the biodevelopmental framework of development as the “dynamic interplay among the cumulative burden of risk factors and the buffering effects of protective factors that can be identified within the individual, family, community and broader socioeconomic and cultural contexts” (Shonkoff, 2010, p. 358). As development occurs across the lifespan, several domains contribute to a successful or maladaptive course. Responsive and nurturing relationships, healthy physical environments and healthy nutrition can promote healthy development. Conversely, neglectful or abusive relationships, dangerous or health-threatening physical environments, and poor nutrition can hinder future development. The biodevelopmental model is illustrated in Figure 1.

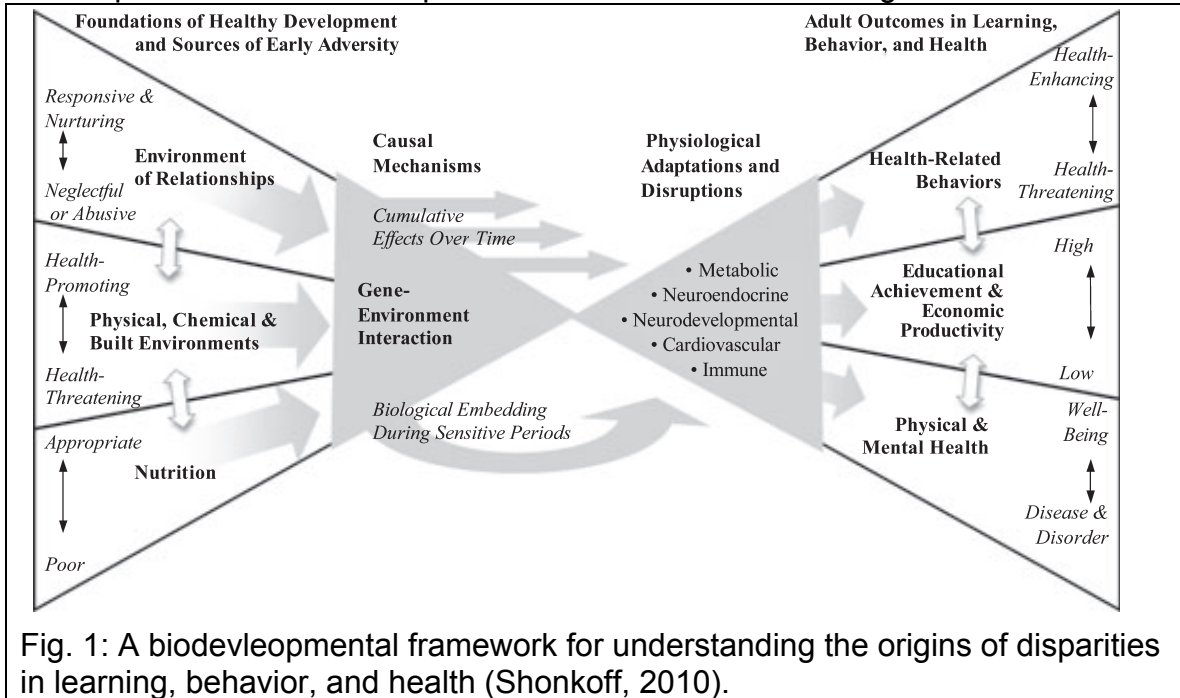


Fig. 1: A biodevelopmental framework for understanding the origins of disparities in learning, behavior, and health (Shonkoff, 2010).

Figure 1 presents the interactions of protective and risk factors that occur early in development. These influences provide the foundations of healthy or suboptimal development. The effects of these early events accumulate over time or are biological embedded during sensitive periods. The end result is physiological adaptation and disruptions that lead to adult outcomes in learning, behavior, and health. Childhood experiences interact across domains of development and summate over time and influence later life outcomes. Most relevant to the research described in this review is the impact of the “Environment of Relations” depicted in the upper left-hand corner.

The specific role of relationships within the biodevelopmental framework can be described as proximal processes. Proximal processes are enduring, reciprocal interactions between children and people in their immediate environment (Bronfenbrenner & Ceci, 1994). Parents are essential proximal process players. Bronfenbrenner postulated that the family may be the most influential system for fostering and sustaining child development (Bronfenbrenner, 1974). As such, parents may be the most effective targets for intervening on the developmental course.

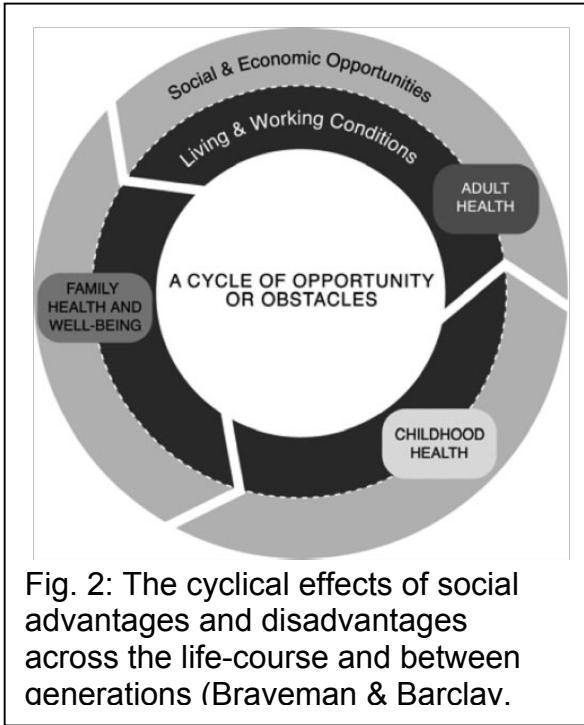


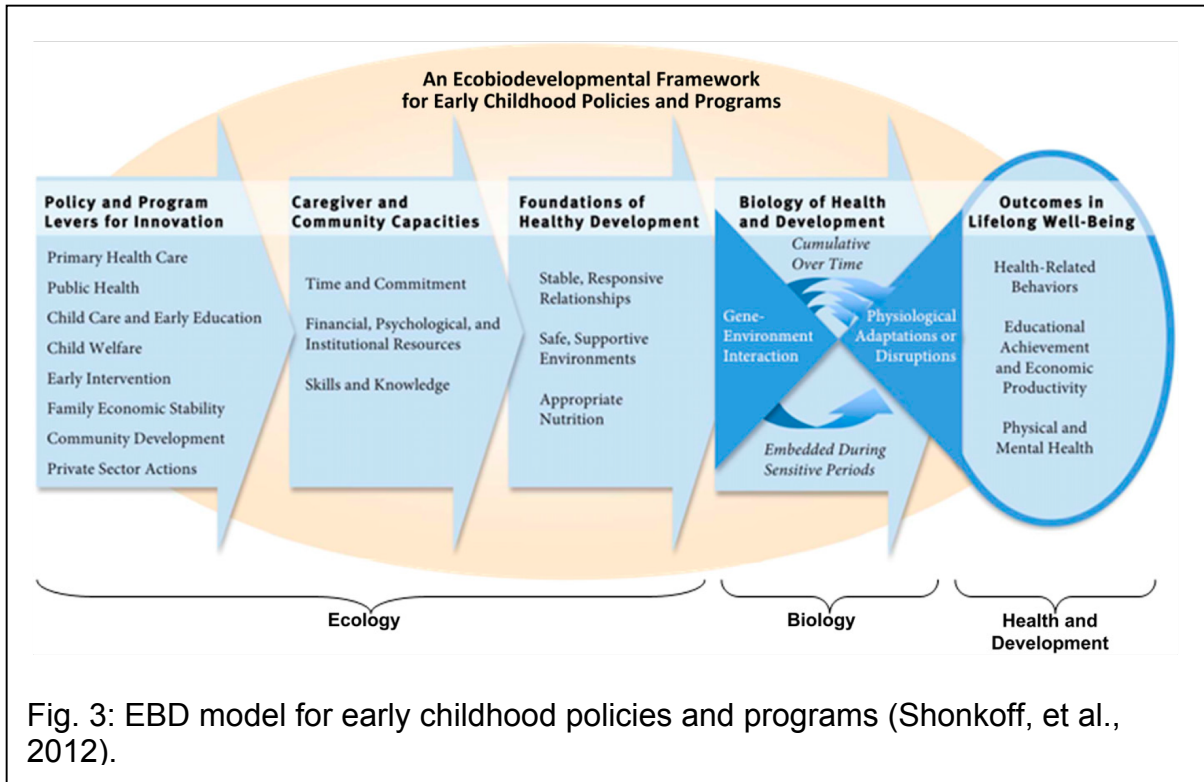
Fig. 2: The cyclical effects of social advantages and disadvantages across the life-course and between generations (Braveman & Barclay, 2009).

Reaching optimal development of a development stage requires healthy development of preceding stages. Poor or suboptimal development at multiple stages can compound over time to generate poorer and poorer health, learning, and behavior outcomes. The life-course perspective of health disparities emphasizes this point. This framework understands health disparities as the result of compounding effects throughout life followed by the transmission of social advantages and disadvantages between generations (Braveman & Barclay, 2009). Figure 2 illustrates how the compounding of advantages and disadvantages over the life-course is a cyclical process that

influences the development of future generations.

While the biodevelopmental model describes a linear trajectory of development across the lifetime of an individual, the life-course model describes a cyclical intergenerational pattern. Various influences, such as SES and parenting, during childhood may contribute to adult outcomes in one lifetime. However, the implication of these findings is made more significant by the cycle described in the life-course model. Adult outcomes of a previous generation influence the developmental trajectory of the next and the next. It is through the cyclical intergenerational pattern described by the life-course model that the biodevelopmental model describes social inequalities. Reducing inequality requires interrupting this cycle.

These models provide a theoretical structure to understand how parenting and SES contribute to positive and suboptimal development. These two theoretical frameworks have recently informed the ecobiodevelopmental (EBD) framework (Shonkoff, et al., 2012). This model emphasizes the importance of strengthening the foundations of health and well-being during early childhood through policy. In addition, this model proposes that reductions in chronic disease and disease disparities could be achieved across the life-course by decreasing the quantity and severity of adverse experiences that threaten the well-being of young children and supporting the protective relationships that mitigate the harm of these adverse experiences. Figure 3 summarizes the EBD.



In order to break the cycle described by the life-course model, we need to know what will be an effective target for intervention. As illustrated in the Figure 3, stable, responsive relationships provide the foundation of healthy development. Distal components of the child’s environment, such as early interventions (far left of the diagram) can influence caregiver capacities to provide this foundation. Although proximal factors, such as relationships with caregivers, have the most direct influence on child development, proximal forces can be influenced by more distal policies and interventions. While these models support a theoretical target of parenting skills and promotion of supportive parent-child relationships, empirical data describing specific positive influences and risk factors are necessary to fashion interventions likely to be effective.

Furthermore, while The EBD model emphasizes the important period of early childhood, this is not the only significant developmental period during childhood. The same components of ecology (e.g., caregiver capacities) influence the developmental trajectories during middle childhood. However, child-parent interactions during middle childhood appear different and may work towards different goals than the interactions of other developmental periods. For example, during middle childhood, the child is less dependent on their caregiver for moment-to-moment physical and emotional needs, but relies on the parents to facilitate other developmental tasks during this period (discussed further in section VI). Although originally articulated to emphasize early childhood, the EBD model remains relevant in other periods of childhood. The specific component of caregiver capacities and its effects on developmental outcomes of self-regulation and executive function during middle childhood is relevant to investigation proposed here.

The Self-Fulfilling Prophecy of Self-Regulation

The second borrowed core concept from *Neurons to Neighborhoods* describes self-regulation as a major task of development (Shonkoff & Phillips, 2000). In other words, the main goal of development is increasing independence of the child to do what originally is the responsibility of the parent. Throughout development the child takes on increasing amounts of responsibility and functions more independently in personal and social contexts. The child continuously learns to self-regulate in multiple domains from physical regulation of bodily functions to regulating mood and emotional distress.

Self-regulation has been approached by many paradigms in different fields. As such, it has absorbed a variety of definitions and subconstructs. In a review of these different approaches, Karoly describes self-regulation as one's abilities to guide goal-directed activity over time and through challenges (Karoly, 1993). Self-regulation requires contributory skills of flexibility, attention, inhibition, and supportive metacognitions. A large body of evidence corroborates the position that self-regulation is a key component of development. In this section, studies that demonstrate the significance of self-regulation as a developmental task and predictor of future life outcomes are discussed.

"The Marshmallow Study" has taken on a folkloric presence in popular media (Brooks, 2006; Lehrer, 2009). This longitudinal study demonstrated the predictive power of a simple self-regulatory task conducted at age four years to life outcomes when children were adolescents and adults.

In the original study, preschool children were presented with the option of having a desirable treat now (e.g., one marshmallow) or waiting unsupervised for a more desirable reward later (e.g., two marshmallows). The length of time a child successfully delayed gratification was subsequently associated with higher parental ratings of verbal fluency and expression, use and response to reason, attentiveness and planning abilities, ability to deal effectively with stress, and self-assurance at age 14 years, 10 years after the original delay-of-gratification task. Seconds in delay time were also significantly associated with SAT scores when participants applied to college (Mischel, et al., 1989). The impressive power of a self-regulatory task at age four years (delaying having one marshmallow now versus two marshmallows later) to predict adjustment in adolescence highlights the salience of self-regulation across developmental periods and as a contributor to life success.

These effects last even later in life and have been visualized using brain imaging technologies. In a follow-up study, Casey et al. compared accuracy of participants from the "Marshmallow Study" cohort as adults in their forties on several variations of a go/no-go task (Casey, et al., 2011). In go/no-go tasks participants are presented with a series of cues and must respond (e.g., hit a button) on all but one cue (i.e., the no-go cue). Participants who at four years old were more impulsive in the marshmallow task were also more impulsive in a go/no-go task as adults. The marshmallow task and the go/no-go task are believed to tap similar skills of inhibition. These findings suggest some degree of

continuity of these skills over the life-course. However, it is not established whether this continuity may be malleable and, if so, how and when.

Using functional MRI techniques, researchers found high delayers had more activity in their inferior frontal gyri between go versus no-go stimuli compared to low delayers. Low delayers, on the other hand, had stronger recruitment of the ventral striatum when presented with no-go cue than high delayers. The inferior frontal gyrus is associated with cortical control regions, such as the prefrontal cortex, and conscious self-regulatory skills. The ventral striatum is associated with deeper brain structures, such as the basal ganglia, and is implicated in desire and reward processing. These findings suggest that early abilities in self-regulation may be physiologically based in an ability to recruit necessary components of the brain and can endure over the life-course. While early activity seems continuous or predictive of adult performance, methods to potentially influence early activity still need to be elucidated. However, the continuity suggests strong development of these skills early in life may carry through to adulthood and interrupt the life-course cycle of developmental disparities.

The small sample size of “The Marshmallow Study” limits its generalizability. A large longitudinal study was conducted with a New Zealand population sample. In this study the researchers used the term “self-control” and defined it as an interdisciplinary term that captures constructions such as self-regulation, delay of gratification, will power, and executive function (Moffitt, et al., 2011). Self-control was measured by a single composite variable based on reports from researcher-observers, teachers, parents, and children themselves at ages three, five, seven, nine and 11 years old. Adult outcomes were measured at age 32 years.

In concordance with Mischel et al., the authors found higher levels of self-control predicted better physical health, lower rates of substance dependence, more personal financial responsibility, and fewer criminal offenses in adulthood. The authors highlight disparities in childhood self-control predicted adult outcomes approximately as well as scores of intelligence and social class (Moffitt, et al., 2011). Furthermore, the authors contend that compared to the influences of intelligence and social class, self-regulation may be the most easily modifiable with intervention and policy changes. As such, targeting self-control may have tremendous efficacy in public health and social welfare promotion.

Early self-regulation may also play a role in the development of health and disease. Kubzansky, Martin, and Buka also found a strong association between childhood self-control and adult health (Kubzansky, Martin, & Buka, 2009). In a study of 569 subjects, authors found that attention—defined as ability to stay focused on a task and persistence in problem solving rated by a trained psychologist—at age seven years was associated with self-ratings of health and reports of adult illness at age 35 years. Individuals with high attention ratings in childhood had more positive self-ratings of adult health and reported fewer adult illnesses (e.g., heart disease, diabetes, cancer, asthma, arthritis, stroke, bleeding ulcer, tuberculosis, or hepatitis). These effects remained after controlling for relative SES at birth and childhood illnesses.

Strong evidence is accumulating that skills of self-regulation established early in life influence adolescent and adult outcomes in health, behavior, and prosperity. Considering the life-course model described previously, does this pattern contribute to social inequality? Looking specifically at social disparities, Evans and Rosenbaum (Evans & Rosenbaum, 2008) found that self-regulation contributed heavily to the academic and income-achievement gaps. In two different study populations, the researchers demonstrated that self-regulation mediated the relationship between family income and grades. Furthermore, they found that self-regulation varied independently of child's intelligence and parental investments in cognitive enrichments. This suggests self-regulation is an important contributor to social disparities in academic achievement and independent from intelligence and cognitive stimulation. The authors argued that poverty hurts academic success through the socioemotional problems associated with deficient self-regulation. Poor regulatory skills can lead to low levels of academic achievement, particularly in traditional school settings with few resources to cope with individual variation in self-control. Low levels of academic achievement contribute to adult-income earning power and intergenerational cycles of poverty. Socioeconomic disparities in self-regulation and executive function, the cognitive system most strongly associated with self-regulation, are discussed further in section X.

At the Helm of Self-Regulation: Executive Functions

Self-regulation represents different operations in a variety of fields from psychology to neuroscience to public health. In the field of neuroscience, the cognitive processes that are believed to be involved in self-regulation are called executive functions. Executive functions describe a set of interrelated but separate skills involved in goal-directed activity (Anderson, 2001). Duckworth & Kern identified four distinct approaches to measurement of self-control and conducted a meta-analysis to investigate the coherency across these constructs (Duckworth & Kern, 2011). Their analysis included delay-of-gratification tasks, self-report questionnaires, informant-report questionnaires, and neuropsychological tasks of executive function. The authors found evidence of convergent validity between these various measures of self-control. However, convergence was moderate suggesting much heterogeneity between measures of self-regulation and executive functions.

Empirical evidence suggests some overlap between definitions and measurement of the constructs of self-regulation in psychology and executive functions in neuroscience. Some researchers go further to describe executive functions as the primary biological substrate of self-regulation (Blair & Ursache, 2011). The construct of self-regulation is certainly multifaceted and warrants further exploration to discern definitions, components, and boundaries. The current model suggests that self-regulation includes broad behavioral characteristics and executive functions are neurological components that contribute to the behaviors of self-regulation.

Focusing on the neurobehavioral construct of executive function, several factor analysis studies demonstrate that executive function is also a multi-dimensional rather than unitary construct (Anderson, 2001; Blair, 2010). However, the precise dimensions housed within the umbrella term of executive function and their boundaries are still under investigation. One commonly accepted model of executive function consists of three dimensions: shifting, updating, and inhibition (Miyake, et al., 2000).

Miyake et al. set out to understand the structure of executive function. Specifically, these researchers wanted to determine if executive function was one-dimensional or multidimensional. Using a study sample of 137 undergraduate students and confirmatory factor analysis, Miyake found three latent variables that were clearly distinguishable but also demonstrated some underlying unity.

The first dimension identified was “shifting,” which requires alternating between multiple tasks, operations, or mental states. A task such as “plus-minus” task which required participants to alternate between addition and subtraction was found to tax “shifting” abilities. The dimension of “updating” is closely linked to the notion of working memory and requires active manipulation of information rather than simple storage. The “letter memory task” was one of the tasks used to tax “updating.” Participants were required to say out loud the last 4 letters of a random letter sequence by adding the most recent letter and dropping the fifth letter back. For example, if the sequence presented were “T, H, B, G, S,” then the first correct response would be “T, H, B, G” followed by “H, B, G, S” such that only the four *most recent* letters are said.

Finally, the dimension of “inhibition” describes the ability to deliberately inhibit automatic, dominant, or prepotent responses. The “Stroop task” was one of the tests used to tax this core function. In this task, participants are presented with the name of a color word printed in a different color (e.g. BLUE printed in the color green). The participant is required to verbally name the color of the word (“green”) and override the prepotent response of reading the text printed (“blue”). Although the three dimensional schema including shifting, updating, and inhibition is well accepted (Blair, 2010), the authors conclude that their selection of tasks was not exhaustive and other important and basic functions may need to be added to this list as evidence accrues.

In addition to understanding the underlying component-skills of executive function, other researchers have begun to investigate the developmental course of executive functions. The frontal and prefrontal cortices of the brain mediate executive functions. Because these portions of the cerebral cortex have the longest developmental timeline, continuing to mature into late adolescence, it is unsurprising that executive functions develop throughout childhood (Fuster, 2002).

To determine the developmental trajectory of executive function, Welsh et al. studied children ages three to 12 years and adult subjects (mean age of 22 years) (Welsh, et al., 1991). Rather than a continuous developmental progression, the researchers found a step-wise progression towards adult competence on several tasks of executive function. Adult competencies on

certain tasks were reached at ages six years, 10 years, and adolescence. By age six years, adult performance on visual search efficiency (time to find target items interspersed among distracter items) and simple planning on the three-disk Tower of Hanoi task (disk-transfer task evaluating ability to plan a sequence of legal moves to transform an initial state to the goal state) were indistinguishable from adult performance. By age 10, adult-level accuracy on the Matching Familiar Figures Test (selecting among six alternatives a matching picture requiring systematic visual search, hypothesis testing, and impulse control) and preservation on the Wisconsin Card Sorting Task (inferring the correct sorting strategies and flexible implementation of these strategies, preservation is considered persisting in responding to a particular category (e.g., color) when given negative feedback) were reached. These findings were consistent with what researchers described as the “five to seven year shift,” in which children of this age advance rapidly in their executive function skills.

Brocki & Bohlin found similar stages of executive function development in their sample of 92 children ages six to 13 years (Brocki & Bohlin, 2004). Their principal components analysis revealed three factors that they interpreted as “disinhibition,” “speed/arousal,” and “working memory/fluency.” They describe three stages of maturation early childhood (six to eight years), middle childhood (nine to 12 years) and adolescence.

Finally, Huizinga et al. found a similar course of development for executive functions. They investigated three components of executive function: working memory, shifting, and inhibition with several different tasks with participants in three age groups (seven years old, 11 years old, 15 years old, and 21 years old). Adult-level performance was not reached until age 15 years on two out of three tasks of working memory, three out of three tasks of shifting, two out three tasks for inhibition (Huizinga, Dolan, & van der Molen, 2006). Some tasks continued to demonstrate improvement into young adulthood. Findings for Huizinga et al. corroborate a multidimensional model of executive functions and demonstrate an extended period of development through middle childhood.

However, describing the timeline of development does not reveal how various components of the biodevelopmental model influence the developmental trajectory of executive functions. Intervention research conducted by Diamond et al., suggests that executive functions are not entirely inherited but can be learned and skills are malleable at least early in life (Diamond, Barnett, Thomas, & Munro, 2007). Diamond et al. randomized preschool students into either a classroom with curriculum focused on executive function (“Tools of the Mind”) or a classroom with curriculum focused on literacy. Children in the “Tools of the Mind” classroom scored higher on tests of executive function tasks and the more complicated the task (i.e., the more executive function required) the larger the difference between children in the two classrooms. In addition, better performance on the executive function was associated with higher academic achievement and literacy readiness. Children who participated in “Tools of the Mind” received an academic advantage even though their curriculum was not knowledge or literacy-focused. These findings suggest that development of executive function is influenced by environment. Situations that challenge current

executive function skills and provide opportunities to practice enhance their development. However, given that there was no pre-intervention data, it cannot be determined whether there were specific students for whom executive function training worked best. Furthermore, this study did not address whether parenting-based, rather than school-based, interventions might be effective.

A Bridge Between Transitions: The Importance of Middle Childhood

Investigations of the developmental course of executive function highlight the continuation of executive function development throughout middle childhood. Middle childhood is considered the developmental phase between school entry and adolescence. However, researchers disagree about specific boundaries. Middle childhood here will be defined as the largest window accepted generally in the literature and define middle childhood as the developmental period between ages six to 12 years.

Previous research has described middle childhood as a particularly active stage of development of executive function (Brocki & Bohlin, 2004). However, this period of development is severely understudied compared to its neighboring developmental periods, early childhood and adolescence (Nuru-Jeter, Sarsour, Jutte, & Boyce, 2010). While executive function is developing in important ways during early childhood and adolescence, much less is known about the development of executive function during the period that links these two developmental periods. Furthermore, the nature of the parent-child relationship is also transitioning during this period. During middle childhood, the parent provides less direct supervision and the child begins to self-regulate more independently. However, there is still a dependency and desire for proximity that remains during this period that distinguishes it from the independence that typically develops during adolescence. Focusing on the development of executive function and associations with parenting during this period may reveal important insight into the course of its development.

Psychoanalyst and developmental theorist, Erik Erikson described the developmental task of middle childhood as “industry versus inferiority” (Erikson, 1964). In previous developmental periods, the child relies almost completely on others to meet physical needs and socioemotional regulation. In middle childhood, self-regulation begins to take hold, new skills develop, and old skills are honed. Another conceptualization of middle childhood is “a transition within transition points” marking the transition from childhood to the more adult-like adolescent period. During this transition of transitions, children gradually assume larger proportions of responsibility for their own behavior while also learning to coordinate with parents, other adults, and peers (W. A. Collins, 1984).

An important contributor to the success of this developmental transition is cognitive abilities that allow for more flexible and intentional thought and planning (Huston & Ripke, 2006). Without doubt, the developmental foundation of infancy and the preschool years set lasting patterns of ability that continue for a lifetime. However, the developmental path followed during middle childhood contributes significantly to what occurs during adolescence and adulthood. The malleable

path that continues through middle childhood and less compelling peer pressures than those occurring during adolescence make middle childhood a window of opportunity to maximize child potential for positive growth through interventions that support and introduce opportunities to help children follow successful pathways to adulthood.

Developmentally, middle childhood includes increasing understanding of social roles, acquiring the ability to view the self from an outside (other-person) perspective and a decline in impulsivity (Maccoby, 1984). The rising of these skills during middle childhood allow the child to fit into larger society, and contribute to the child's ability to take on more personal responsibility and become more independent from the parent. Societal roles learned during middle childhood may carry through to adolescence and adulthood and inform interpersonal relationships and perceptions of self.

The period of middle childhood is marked by impressive changes to the parent-child relationship. As more sophisticated cognitive development takes place, the child is able to take on more self-responsibility with a decreasing need for direct parental supervision and co-regulation. Thus middle childhood involves a gradual transfer of power from parent to child (Maccoby, 1984). This transition of proximal oversight is an important goal of middle childhood.

However, the parent does not relinquish all power entirely. Rather, the parent begins to exercise general supervisory control while the child exercises moment-to-moment self-regulation (Maccoby, 1984). During middle childhood, co-regulation between parent and child takes on a different character than previous developmental stages: something between that of the constant supervision and physical proximity of the preschool years but not the degree of independence experienced in adolescence or adulthood. This new form of dependence allows the developmental tasks of middle childhood to take place. Parents' provision of greater support than may be necessary during adolescence without the overbearing attention of early childhood may be the delicate balancing act that parents must attempt during this period. Successful management of this balance may be the key for successful development of the more complex and stronger self-regulatory and executive function skills that children begin to expand upon during middle childhood. Scaffolding describes how parents may exhibit this balance and is discussed further in section VII.

The parent remains an important component of emotional life in middle childhood. Although the child is doing more for himself during this period, emotional availability and support from parents remains essential. Lieberman et al. compared parental availability and child dependency across late childhood and early adolescence. These authors found that while children's perception of parental availability remains stable and important across these age groups, perceived dependency on parental help and support decreases as children grow up (Lieberman, Doyle, & Markiewicz, 1999). This suggests that while physical proximity to the parent is less critical in middle childhood due to increased physical and mental capacities of the child, children may continue to rely on attachment figures as a secure base from which to explore and as a source of comfort in times of stress. Furthermore, the secure relationship experienced

during early childhood may be mirrored in the development of peer-relationships necessary for positive development and adult functioning.

Despite its important role in the developmental trajectory from early childhood to adolescence and adulthood, middle childhood is severely understudied. Investigations of the timeline of development of executive functions suggest that middle childhood is an important window of development for these skills (Brocki & Bohlin, 2004; Huizinga, et al., 2006; Welsh, et al., 1991). Many executive functions develop to adult-level function between ages six to 12 years. This research hopes to provide insight to the understudied developmental period of middle childhood. Specifically, this research will investigate associations between parenting, which takes on a unique flavor during middle childhood, and executive function, a family of important cognitive skills that develop rapidly during this period.

Building Blocks of Development: Scaffolding within Parent-Child Relationship

The third concept borrowed from *Neurons to Neighborhoods* states that relationships are the building blocks of healthy development (Shonkoff & Phillips, 2000). Arguably the most important relationship experienced by the developing child is the relationship with the parent or other primary caregiver. Attachment theorists emphasize the importance of this formative relationship as a mediator to successful future adaptation. Socialization theorists believe the developing child learns roles and expectations of society through this relationship.

Parents take on many important tasks that contribute to the success of child development. One important job of the parent is to provide scaffolding. Scaffolding describes quality assistance provided by the parent to help the child achieve tasks beyond what he or she can accomplish independently. Hartup describes this process as the following:

Thus, the mother sets goals for her child that are slightly advanced, breaks up the action into substeps that the child can barely assimilate, and monitors and advises the child during performance. This cognitive 'scaffolding' extends across many different areas of the child's development, especially during the preschool years. In this way, children are assisted by their caregivers in developing language, distinguishing between self and others, and in understanding others' motives and intentions (Hartup, 1989, p. 122).

In addition, parental scaffolding has been strongly implicated as a contributor to the successful development of executive function.

The developmental theorist Lev Vygotsky first described the notion of the zone of proximal development (Vygotsky, 1978). The zone of proximal development represents the difference between what the child can do independently and what they can achieve with the assistance of an adult. Vygotsky suggested that children's future independent performance depends on

the type of guidance the child received within their zone. Parents facilitate growth and development of new skills by providing assistance within the zone of proximal development. Scaffolding describes how parents, other adults, and eventually peers, can operate within the zone of proximal development. Several studies have demonstrated an association between scaffolding and the development of executive function and self-regulatory behaviors.

Parents may provide verbal scaffolding to children by giving prompts to direct child's attention and provide conceptual links. Landry et al. investigated the effects of verbal scaffolding when the child was three years old on developmental outcomes at ages four years and six years (Landry, Miller-Loncar, Smith, & Swank, 2002). They found that more verbal scaffolding at age three years was associated with better language, nonverbal, and memory skills at age four years. Language skills at age four years were associated with better executive processing skills of search and retrieval at age six years. These findings suggest that parents' verbal structuring of the world for their children early in life support basic skill development and provides a foundation for independent self-regulation and problem solving.

Elaborative instruction describes a parent's ability to see what the child is doing and provide context or help the child evaluate their current course of action. This type of instruction describes how parents can scaffold by following the child's lead and turn an experience into an opportunity for the child to learn from his or her own thinking and actions. Directive instructions, on the other hand, are task-oriented and direct the child to take a specific course of action. Bibok et al. compared the association of directive or elaborative instructive utterances to developmental outcomes among parent-child dyads with children ages 20 to 29 months. The researchers found that parents' use of elaborative utterances predicted children's performance on tasks that measure attention-shifting executive function. They then propose that elaborative utterances, in contrast to directive utterances that explicitly tell the child what to do, provide the child external resources that increase the size of the problem space the child is able to undertake. Therefore, scaffolding (in this case, described as elaborative rather than directive utterances) may provide opportunities to practice executive functions within the zone of proximal development with parental support and lead to development of skills of independence (Bibok, Carpendale, & Muller, 2009).

While there is clear evidence that parental scaffolding is associated with successful development of executive functions, how does the task of scaffolding compare to other characteristics of parenting? Hughes and Ensor compared four potential parenting-style contributors to development of executive function: global positive parenting, global negative background, imitation, and scaffolding (Hughes & Ensor, 2009). Parenting measures were taken at age 2 years and executive function was measured at age 4 years. Their findings suggest that scaffolding is a relevant (perhaps the most relevant) but not the only component of parenting that contributes to executive function development. Global negative background (including disorganization and unpredictability in family life) and imitation (degree to which the child had models of executive function at home) also predicted child performance of tasks of executive function.

Bernier et al. also found that scaffolding was a highly relevant to the development of executive function (Bernier, Carlson, & Whipple, 2010). These authors compared measures of maternal scaffolding to maternal sensitivity and mind-mindedness (use of metacognitive terms while talking to the child and thus providing verbal tools which the child can use to achieve self-regulation) at age 12 to 15 months. In this study, researchers went beyond measuring verbal scaffolding and included measures of nonverbal behaviors. They described four categories of scaffolding behaviors: (1) parent intervenes according to the infants' needs and adapts the task to create an optimal challenge with opportunity for success, (2) encourages pursuit of the tasks, giving hints and suggestions, using a tone that suggests parent is there to help, (3) takes the child's perspective and uses different strategies to help the child, (4) follows the child's pace, making sure the child plays an active role in completion of the task, allows the child to make decisions. Scaffolding was the aspect of parenting that was most robustly associated with child executive function at ages 18 and 26 months.

These studies provide support for scaffolding as an essential component of parenting that contributes to the development of executive function. Through scaffolding, parents provide children with the structure necessary to complete cognitively demanding tasks without completing the task for them. They provide assistance and guidance for the child with examples of how to plan, problem solve, and reflect while also allowing the child an opportunity to practice these very skills. The scaffolding provided by the parent eventually becomes the self-regulatory processes children use independently.

However, current studies have largely focused on parenting and executive function during early childhood. Since executive functions continue to develop through adolescence it is likely that parents continue to influence their developmental course. Further research on parenting and executive function of older children is required. Scaffolding, a known contributor to development of executive function in early childhood, is an especially relevant parenting task during middle childhood. During middle childhood, parents relinquish high intensity supervision while a strong degree of child dependence remains. The research outlined in section XI of this paper seeks to investigate the associations of parenting and executive function in middle childhood.

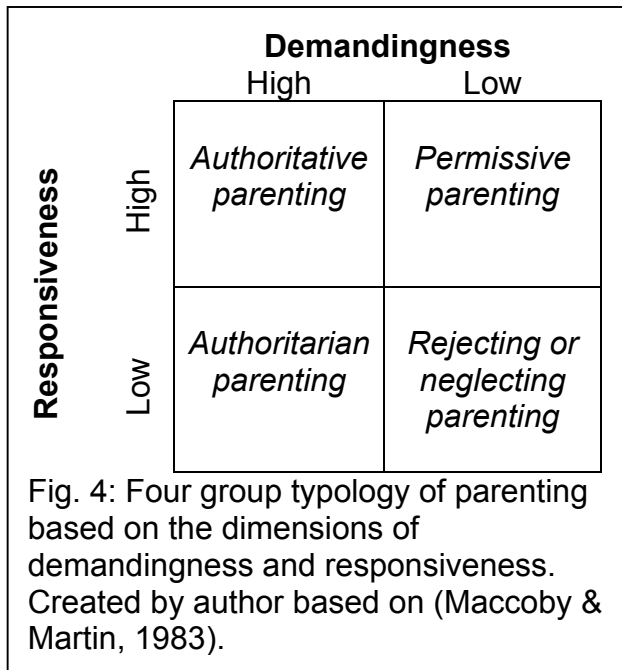
While the theoretical concept of parenting and how it influences child development is not hard to imagine, creating empirical measures of parenting is difficult. Some important considerations for the measurement of parenting include theoretical constructs of parenting, methodology, and consistency of parenting over time.

According to Darling and Steinberg, child development outcomes determined by parenting depend on both general parenting *style* and specific parenting *practices* (Darling & Steinberg, 1993). They define parenting style as a constellation of attitudes toward the child. These attitudes create an emotional climate in which the parent's behaviors are expressed, creating a milieu in which development occurs. Previous attempts to assess parenting style focused on the emotional relationship between parent and child and the parents' beliefs about

parenting. Parenting style describes a global quality that transcends different domains. Parenting practices, on the other hand, are seen as domain specific, describe specific activities or behaviors of parents, and may relate to specific socialization goals. Grouping by parenting style is a popular approach to measuring parenting.

Based in observational ethnography data, Maccoby and Martin describe a four-group typology of parenting style based on two dimensions: demandingness and responsiveness (Maccoby & Martin, 1983). For decades, this classification dominated academic understanding and clinical thinking about parenting and their influences on child development. Authoritative parents are described as high in both in what they expect of their children and their availability. Authoritarian parents are high in demandingness, but low in their responsiveness. Permissive or indulgent parents are described as highly available but not demanding. Rejecting or neglectful parents are low on both dimensions.

Figure 4 provides an illustration of these parenting typologies. Theoretically, all parents fall somewhere in this classification schema. However,



as research has expanded beyond samples of white, predominantly middle-class families, the severe limitations of this typology have become clear.

For example, McGroder used multiple observational and questionnaire measures of parenting beliefs, values, and behaviors in a sample of low-income African American single mothers with preschool-age children (ages three to five years) (McGroder, 2000). Her factor analysis revealed three main characteristics among mothers in her sample: aggravation/impatience; nurturance; and cognitive

stimulation. Furthermore, mothers fit into four clusters or combinations of these characteristics: aggravated but nurturing (most prevalent); patient and nurturing; low nurturance; and cognitively stimulating (least prevalent). For McGroder's non-white and non-middle class sample, Maccoby and Martin's four typologies do not fit.

In addition, McGroder investigated the associations between parenting category and child development. The author found that parenting pattern significantly predicted differences in children's cognitive development and school readiness better than child age, maternal education, and time on welfare. Children with cognitively stimulating and patient and nurturing mothers had the

highest mean scores on the cognitive development tests and measures of personal maturity.

Beyond issues of theoretical typologies of parenting not fitting all populations of families, there are also multiple methods by which one can measure parenting. Most methodologies can be described as parent-report questionnaires or interviews, naturalistic observations in the home environment, or structured observations. Zaslow et al. compared the ability of measurements in each of these modalities during early childhood to predict developmental outcomes in middle childhood. They found that structured observations provided the greatest predictive utility, but this approach was also the most burdensome in terms of training and required the most time of participants and researchers (Zaslow, et al., 2006).

Using the same sample of low-income African American families as Zaslow et al., Weinfield, Ogawa, and Egeland studied the consistency of parenting over time. They found that structured observations of parent-child interactions during early childhood predicted parent-child interactions in middle childhood on similar constructs adjusted for age appropriateness (Weinfield, Ogawa, & Egeland, 2002). This suggests that overall valence of parenting style are stable over time while specific parenting practices change with the developmental period. These findings imply measurements of parenting may be indicative of parenting from earlier developmental periods. In addition, interventions targeting parenting during early childhood may have sticking power to affect parenting throughout childhood and adolescence.

The Complex and Pervasive Nature of Socioeconomic Status

SES describes a constellation of variables that indicate a person's relative standing in society. Occupational prestige, wealth, income, and education are among the most common indicators used. While parenting is a very personal undertaking, there may be macrofactors that influence how individuals carry it out. One such macro-level influence is SES. This section will discuss the strengths and limitations of different SES measures.

Although more commonly used in studies from European countries compared to the United States, occupational status is often used as an indicator of SES. Occupational prestige is a favorable measure because it provides a summary of multiple components of SES in one measure including power, education requirements associated with the position, and income (Stewart, et al., 2003). In addition, it may better reflect income over the long run when moment-to-moment income can be volatile. However, since researchers must rate it, occupational prestige can be a highly subjective measure. Indeed many commonly used scales are outdated and fail to account for the large number of women in the work force.

Economic resources are also commonly used to describe SES. Income, describing a person's incoming financial resources, and wealth, describing a person's stable access to material, are the most common economic variables (Stewart, 2009a). In addition, these variables can be manipulated into variables

relative to standardized levels of poverty, such as income-to-needs ratios and percentage points above or below the federal poverty line. This allows researchers to take into account family size. Some may consider income the strongest and most robust predictor of health because the impacts of other SES variables are mediated through it. For example, wealth may describe a family's ability to sustain itself during economic emergencies and is therefore a better measurement of security and ability to pay for health care needs. However, since income and wealth are often collected by self-report they are subject to recall error. In addition, income can be an especially sensitive subject leading to participants not responding to income questions.

Finally, one of the most widely used indicators of SES for studies of health and mortality is education (Stewart, 2009b). One advantage is that an education status can be determined for all individuals whereas not everyone has an occupation or an income. Another advantage is that it is fairly stable beyond early adulthood. However, the economic return for a given level of education varies importantly by race and gender. In addition, the return for a given degree may vary by the educational institution attended and specific area of study.

Newer to the scene, subjective social status holds great promise as an additional measure of SES. Subjective social status asks participants to indicate where they feel their social status falls relative to others. This variable may allow the participant to consider more contributing factors past, present, and future that contribute to their personal sense of rank. The participant calculates these considerations in a way not captured by any "objective" measure. In their validation study, Adler et al. found that subjective social status was correlated to both objective measures of health (i.e., body fat distribution and heart rate) and subjective measures of health (self-rated health) in a sample of 157 healthy white women (Adler, Epel, Castellazzo, & Ickovics, 2000). Furthermore, subjective social status showed a stronger and more consistent relationship to psychological function and health-related factors.

Subjective status may be a more reliable predictor of health overtime. In another study, Singh-Manoux et al. demonstrated that overtime the relationship between objective measures of social status, such as income, and self-rated health diminished. The relationship between subjective social status and self-rated health, on the other hand, remained statistically significant overtime (Singh-Manoux, et al., 2005). This suggests that subjective status is an important predictor of health status longitudinally and carries predictive power over a longer period of time compared to objective measures. Potentially, subjective social status is a stronger indicator of intergenerational transference of risk compared to objective measures.

Yet another option in measuring SES is for researchers to generate a summary variable that condenses multiple measures of SES into one variable. While this combination of multiple measures may provide a way to consider SES holistically, important information about causality can be garnered when different indices of SES are used and compared to each other. While different variables of SES may co-vary and work in concert to create a picture of overall risk and resilience, each affects one's life differently and cannot be exchanged for

another.

Braveman et al. provides some important words of caution regarding the assumptions about SES (Braveman, et al., 2005). Too often researchers look at only one variable of SES or a single composite variable summarizing multiple components. Braveman et al. demonstrated that the relationship of various SES factors vary by race and ethnicity. For example, the mean income for a given level of education is not consistent between blacks and whites. Furthermore, individual measures of SES do not necessarily capture the influence of the socioeconomic conditions of the surrounding community. In considering developmental and health outcomes, the built and social environment of communities with varying degrees of prosperity can be just as relevant as individual income and education.

The relationship between SES and health outcomes is so strong, some researchers consider low SES a fundamental cause of health and illness (Link & Phelan, 1996). However, researchers must ask questions about the mechanisms by which SES affects health and consider plausible explanatory pathways through which SES may influence outcomes. An important component of understanding these mechanisms is investigating which components of SES confer the greatest risk or protection.

Duncan and Magnuson emphasize that different components of SES may affect development differently (Duncan & Magnuson, 2003). Recognizing the differential influence of various components of SES is a necessary step in developing effective interventions. Composite scores of SES may be a good “catch-all” but it is necessary to distinguish which components of SES are relevant (e.g. wealth or parent education) to specific outcomes in order to best tailor the appropriate intervention.

Nuru-Jeter et al. demonstrates that different components of SES are associated with different developmental outcomes (Nuru-Jeter, et al., 2010). The researchers compared the associations between nine different SES indicators and measures of health and well-being during middle childhood. The authors found that different domains of health and well-being were associated with different measures of SES and these relationships differed by race (white versus black). In the domain of child’s social functioning, higher perceived social status was associated with greater peer acceptance. The strongest association between SES and the domain of school and academic functioning existed for educational degree attainment by parents. In addition, the authors found, that categorical, rather than continuous variables, yielded stronger and more pervasive associations with health outcomes. The authors concluded that wealth and overall family educational attainment were the most relevant components of SES to health and well-being during middle childhood. However, the researchers only considered individual measures of SES and could not investigate neighborhood context.

Regardless, methodological decisions to collect and analyze various components of SES should not be made arbitrarily. Researcher should consider the question being investigated, feasibility and reliability of acquisition the data, and the population being studied (Bradley & Corwyn, 2002). Considering which

components of SES may influence parenting, and ultimately executive function and self-regulation, raises the question how do people learn to parent?

Parenting is a skill contextualized by cultural expectations of roles and desired outcomes. Navigating the zone of proximal development and scaffolding seem to promote development of executive function and require executive function and self-regulatory skills on the part of the parent. I hypothesize that education is the component of SES that is most relevant to the parenting skills that affect the development of executive function. Other studies discussed support this hypothesis (Noble, Norman, & Farah, 2005; Nuru-Jeter, et al., 2010). Academic success most directly indicates a parent's possession of executive functions required to help the child acquire executive function skills of their own. In the next section, previous research demonstrating socioeconomic differences in parenting are discussed.

Socioeconomic Differences in Parenting

The anecdote that introduced this paper illustrates that parents will always follow a course of parenting that is relevant for their family's environment and appropriate to achieve their goals for socialization. SES is an important component of a family's environment that may influence parenting practices. Thus SES informs parenting and developmental goals. While there have been clear observations of socioeconomic differences of parenting, there are multiple proposed explanations. One reason could be differences in the socialization goals and attitudes of families of different socioeconomic statuses. What is considered safe or appropriate parenting differs based on social context. In other words, there are culturally based expectations of both parents and children that inform parenting behaviors that may differ by SES. Another is that higher level of stress associated with lower SES that negatively impacts parent availability.

One important work that demonstrates socioeconomic differences in parenting is *Meaningful Differences in the Everyday Experience of Young American Children* by Betty Hart and Todd R. Risley (Hart & Risley, 1995). The researchers investigated the language environments of 42 families over the course of three years (ages seven months to 36 months) and children's language development. Parents on welfare spoke an estimated cumulative 13 million words to their children. Professional parents spoke an estimated 45 million words to their children in the same time. This difference created a "30 million word gap" by the time these children reached age four years and were about to enter primary school.

The number of words spoken directly to a child early in life was associated with his or her own language development and school performance in school at age nine years. Interestingly, the quality of language experienced did not seem to vary as much by SES as the sheer quantity of language experienced. Unfortunately, the authors failed to address why such an immense socioeconomic gap in the amount parents speak to their children exists in the first place.

In another publication, Hart and Risley investigated 10 parenting variables

(mostly based on language exchange between parent and child) and their associations with parent's SES and child's IQ (Hart & Risley, 1992). SES was measured with scores on an occupational prestige scale. Factor analysis of the 10 parenting variables revealed 3 underlying components of parenting style. "Amount of parent activity" reflected how much the parent oversaw and participated in the activities of the child. "Performance as a social partner" described whether a parent responded to the child and used child-initiated events to create episodes of social interaction. "Contentive quality of parents' utterances" illustrated whether the parent generally responded to the child positively (e.g., repeating, asking for elaboration) or negatively (i.e., with directives). Higher "amounts of parenting" (i.e., a parent's constant availability to the child) and more positive "contentive quality of parents' utterances" were significantly associated with higher SES and higher child IQ. Hart and Risley's research suggests a possible trajectory from SES to parenting to neurodevelopment during preschool. This investigation will follow this trajectory into middle child with attention to the specific developmental outcome of executive function.

The book *Unequal Childhoods: Class, Race, and Family Life* by Annette Lareau (Lareau, 2011) is another important publication on socioeconomic differences in childrearing. In this ethnographic study of 12 families with fourth and fifth grade children from different social classes and racial groups, Lareau describes two parenting rearing styles that typified the behavior she observed. For professional and middle class families, Lareau described an approach to childrearing she called "concerted cultivation." In this approach parents actively seek out activities to develop their children's talents. This leads to highly regimented days full of music lessons, soccer games, and carpools. Lareau describes the goal of these activities as providing not only skills in various sports and arts, but also providing children with the conversational, leadership, and intellectual skills parents thought were necessary. In these upper and middle class families, there was great emphasis on the perceived needs of the child and family life seemed to revolve around the schedules of the children. In addition, these children were encouraged to ask questions and negotiate with adults. Lareau suggest that this gives middle class children a sense of entitlement and skills to negotiate what they want.

Working class and lower class families, on the other hand, seemed to adopt an approach of "accomplishment of natural growth." In this style, parents were more likely to issue directives rather than negotiate as middle class and professional parents would. There were fewer organized activities and children were free to organize their own schedules. Thus children were more independent and creative in finding ways to entertain themselves. Although Lareau describes clear differences in parenting styles based on family socioeconomic status, the effect of different styles of parenting on development was not addressed.

While the two approaches described by Lareau are not a case of good versus bad parenting, the style of "concerted cultivation" seems to socialize children in a manner consistent with teacher's expectations. In other words, the school system seems to favor the approach of "concerted cultivation" over

“natural growth.” At school, students are expected to be able to focus their attention for long periods of time, clearly express their thoughts, negotiate with their peers, and ask questions—all skills emphasized in “concerted cultivation.” In addition, teachers expect parents to be full participants in their children’s education. Lareau observed that parents cultivating their children fulfilled this expectation. However, parents who took a hands-off “natural growth” approach, considered education something entirely in the domain of school rather than home.

In concordance with the biodevelopmental model described in *From Neurons to Neighborhoods*, Collins et al. write that parents mediate the relationship between social, cultural, economic, and historical context and children’s development (W. A. Collins, Maccoby, Steinberg, Hetherington, & Bornstein, 2000). Parenting research must consider the macro context of the family, looking beyond the parent-child dyad. Research should include the global components of a family’s situation, such as family SES. These components may affect development through their effects on the parent-child relationship and parenting practices.

McLoyd, writing specifically about low SES African American families, describes the additional influences of financial uncertainty on parenting (McLoyd, 1990). This has several potential effects on parents’ abilities to care for their children and may contribute to poorer developmental outcomes. Economic hardship diminishes the ability of parents to be supportive, involved, and consistent. Additionally, economic stress can affect the relationship between parents. The quality of the parent-child relationship depends on the quality of the relationships between parenting partners. The additional economic stress of lower SES families leads to more punitive and coercive parenting rather than the more time and energy consuming tactics of negotiation and reasoning characteristic of families of higher SES.

Socioeconomic Differences in Executive Functions

In addition to differences in parenting by SES, many studies have elucidated a gradient of executive function across the socioeconomic spectrum. These socioeconomic differences in executive function may contribute to the academic achievement gap seen between families of high and low SES. Furthermore, I suspect that socioeconomic differences in parenting may significantly contribute to these disparities. Executive function and their contributions to self-regulation are important baseline skills required for school-readiness and academic success (Blair, 2002). Disparities in these functions in childhood likely contribute to adult disparities that subsequently affect opportunities for future generations.

Mezzacappa investigated social disparities in multiple cognitive skills including executive function among seven-year olds (Mezzacappa, 2004). A child’s accuracy on a task when provided congruent cues (making the task easier, not an executive function task) to a child’s accuracy on the task when provided incongruent cues (making the task harder and requiring inhibitory

control and greater attention to the task) was considered a measurement of executive function. A smaller decrement in accuracy and smaller loss of reaction time across the two tasks was considered better executive functioning. The author found that children from higher SES families exhibited evidence of better executive functioning. The author concluded with the question, "How then might one begin to construct bridges between macro indexes of SES and micro indexes of young children's competence in basic attentional and executive functions?" There is strong reason to believe that parents and caregivers may mediate the relationship between the macro-level of SES and the micro-level of children's neurodevelopment.

The work of Noble, Norman, and Farah examined the relationship between SES and multiple neurocognitive measures, including executive function. In one of their studies, the researchers compared 30 low SES and 30 middle SES kindergarteners on various neurocognitive tasks related to school performance and achievement (Noble, et al., 2005). They found a main effect for SES when all tasks were averaged as a single outcome variable, but when investigated independently, *only* tasks related to language and executive function showed statistically significant effects of SES. In addition, within the SES constructs they used, which included education, occupation status, and income-to-needs ratio, parental education was the most predictive component of the SES construct. Child executive function varies by SES, and parent education in particular, but mechanisms that bridge the two have yet to be described. I purpose parenting as a possible mechanistic bridge between SES and executive function.

In a similar study, Farah et al. compared performance of 30 low SES to 30 middle SES African American children matched on age (ages 10 to 13 years) and gender on a battery of neurocognitive tasks (Farah, et al., 2006). SES was measured using a combination of occupational prestige and years of parent education. Only certain neurocognitive tasks showed differences based SES. Higher SES was associated with significantly better language ability and working memory, and borderline significant higher performance on tasks of cognitive control.

Importantly, family SES does not impact all neurocognitive systems equally. Now that relationships between specific cognitive functions have been elucidated, Farah et al. encourage future researchers to look beyond associations and investigate the mechanisms by which these disparities arise. The authors proposed reduced stress and higher environmental cognitive stimulation as possible mediators or moderators of the relationship between higher SES and better performance of neurocognitive tasks of language and executive function. My research will investigate parenting style as a potential mediator or moderator of the relationship between SES and executive function.

In another study, investigators looked at home and school environments as possible mediators of social disparities in cognitive skills (Noble, McCandliss, & Farah, 2007). The researchers used a variety of validated tasks assessing various neurocognitive systems, which included the executive functions of cognitive control and working memory. The authors found that SES accounted

for variance in executive function skills. As potential mediators, the authors looked at home environment (e.g., frequency of literacy-related activities, frequency of physical punishment, and number of hours/week child spent in preschool/daycare prior to kindergarten) and school environment (e.g., average attendance, average dollar allotment per student, and percent of students meeting New York State and City English Language Arts standards at the school attended). Home and school variables were found to account for 12.1% of the variance in the working memory composite. This suggests that home and school environment may mediate the relationship between SES and executive function. I hope to investigate parenting, an essential component of the home environment, as a mediator of socioeconomic disparities in executive function.

Using electroencephalograms to visualize the activity in the brain during neuropsychological tasks of executive function, Kishiyama et al. compared performance on neuropsychological tasks and electrophysiology among 13 low and 13 high SES children ages seven to 12 years (Kishiyama, Knight, Thomas Boyce, Jimenez, & Perry, 2009). SES group was determined by parental education, income, and income-to-needs ratio. Although performance (both accuracy and speed) did not differ between the two groups, expected electrical activity in the prefrontal cortex was reduced in the low SES group compared to the high SES group during neuropsychological tasks that taxed working memory and cognitive flexibility but no differences in inhibitory control.

Looking at potential mechanisms for these social disparities, Sarsour, et al. investigated mediating effects of home environment on the relationship between SES and three components of executive function (inhibitory control, cognitive flexibility, and working memory) (Sarsour, et al., 2011). These authors found that SES, as measured with a composite index combining income-to-needs ratio, family wealth, occupational status, and maternal education, predicted scores on all executive function tasks. The Home Observation for the Measurement of the Environment (HOME) questionnaire was used to evaluate physical and social aspects of the home environment using both a structured interview with the primary caretaker and observation. The tool focuses on the child as a recipient of material objects, events, and transactions occurring within the context of the family. Total scores on the HOME partially mediated the association between SES and inhibitory control but not cognitive flexibility or working memory. When components of the HOME were investigated separately, different subscales of the HOME were mediators of different executive functions and SES. The HOME subscales of responsiveness and family companionship mediated associations between SES and inhibitory control, and enrichment and family companionship mediated the association between SES and working memory. However, none of the HOME subdomains mediated the association between SES and cognitive flexibility. These findings support the notion that aspects of the parent-child relationship and parent-child interactions play an important role in the normal development of executive function.

Rhoades et al. studied the influence of demographic and psychosocial characteristics of mothers during children's infancy and executive function at 36 months (Rhoades, Greenberg, Lanza, & Blair, 2011). To measure executive

function, the authors used three tasks to assess working memory, inhibitory control, and attention flexibility. Adjusting for a number of sociodemographic variables (e.g. household income, marital status, mother's age at her first birth, maternal education, maternal mood problems, stress, and social support) the authors found that maternal poverty during her child's infancy remained the most significant predictor of executive function abilities at 36 months. In addition, the authors found that higher ratings of maternal positive engagement during 10 minutes of free play with the child during infancy was also associated with higher executive function skills. Authors suggest that the quality of parenting may affect child development through two mechanisms. First, when a mother responds to her infant, the child learns they can influence their environment. Having this sense of agency possibly increases children's motivation to learn new skills and practice skills of executive function. Second, with the support of a positive and secure relationship, infants feel confident to explore their environment and are more likely to engage in cognitively-stimulating materials.

These studies demonstrate the association between executive function and SES. Previous literature describes executive function as important neurologic components of broader self-regulatory skills. Given the demonstrated significance of self-regulation to future like success, it is likely that socioeconomic disparities in executive function contribute to academic and health disparities later in life. Socioeconomic disparities in executive function are well documented. What remains to be understood are the bridges that bring SES into a proximal process of child neurodevelopment. The next section describes my specific research questions.

Future Research Questions

The connections between SES, parenting, and developmental outcomes are complicated as demonstrated by Brody, Flor and Gibson. These researchers investigated financial resources, parental efficacy, parenting practices, and self-regulation in a sample of African American single-mothers living in rural Georgia with children age 6 to 9 years (Brody, Flor, & Gibson, 1999). The authors found that perception of financial adequacy reported by mothers was significantly related to perceived parental efficacy. Mothers who described their financial resources as adequate thought their parenting would be more effective. This sense of efficacy predicted higher developmental goals for children. Developmental goals, in turn, predicted mother's use of competence-building parenting practices such as predictable family routines, involvement in child's school, and a positive affect toward their child. Use of these positive parenting practices was associated with mother and teacher reports of better self-regulation (e.g., child described as thinking ahead of time about the consequences of his or her actions; planning ahead before acting; working toward goals; and sticking to what he or she is doing, even on long, unpleasant tasks, until finished) followed by higher academic and psychosocial functioning. These findings suggest that components of the socioeconomic environment (e.g., financial resources) affect parenting efficacy, goals, and practices. Parent's

parenting beliefs and actions are influenced by financial circumstances and, in turn, influence child's cognitive function and self-regulatory behavior.

The dual association of parent with both SES and executive function and the importance of parenting activities such as scaffolding to the development of executive function suggest that parenting may be an important mediator of the relationship between SES and executive function. In other words, components of SES influence parenting which in turn determines the development of executive function in children. Other investigations have studied parenting as a mediator between SES and other components of cognitive development, but less work has examined mediators between SES and executive function. In addition, mediators of this relationship during the specific developmental period of middle childhood remain largely unstudied despite the importance of this period for the development of critical executive function skills.

The transactional and biodevelopmental models of development emphasize the important role of the environment throughout the developmental process. These environmental factors, such as experiences of poverty and opportunities for cognitively stimulating activities, set the stage for development to occur. The life-course model emphasizes that earlier developmental experiences can influence future developmental potential. Previous negative experiences or positive opportunities can snowball and determine the trajectory of development and influence developmental trajectories of future generations.

Given the central importance of the development of self-regulation to future development and adult outcomes, it is important for researchers, clinicians, policy makers, and parents to understand what leads to the successful development of this multifaceted skill. In other words, how can we guide and support children down a trajectory of optimal development of self-regulation? Research suggests that executive functions may be a target in order to meet this goal. Given the pervasive socioeconomic disparities in the development of executive function (and by extension self-regulation), what may lead to these disparities and how can we alleviate them and alter risk factors?

A key may lie in the role of parenting and the relationship between the parent and child. Research suggests specific parenting behaviors such as scaffolding promote the development of executive functions and self-regulation. These parenting behaviors may exist on a socioeconomic gradient and contribute to disparate developmental pathways.

There is both theoretical and empirical support for the hypothesis that components of parenting mediate the socioeconomic gradient of executive function. However, to date few studies have investigated parenting as a mediator, fewer still have considered which specific components of socioeconomic status are relevant to this gradient. In addition, middle childhood remains one of the least studied periods of child neurodevelopment.

Using a sample of 60 children in middle childhood from a wide range of SES backgrounds, I will investigate the role of parenting in socioeconomic disparities in executive function during middle childhood. My first research question is: how do characteristics of parenting vary by socioeconomic status? I will use multiple variables of parenting style to describe those that are strongly

associated with different socioeconomic groups with special attention to variables used to describe SES. My second research question is: which parenting styles are associated with stronger executive function skills? Previous studies have investigated scaffolding as a component of parenting relevant to the development of executive functions, I hope to contribute to this growing understanding of parental influences on the development of executive function by exploring which characteristics of parenting are associated with performance on neuropsychological tests of executive function. Furthermore, by specifically looking at middle childhood I will provide insight into this understudied developmental period. Finally, in an effort to integrate the link between SES and the development of self-regulation and executive function into a model of transactional development, I will ask: does parenting play a mediating role in the relationship between socioeconomic status and executive function?

The goal of this research is to investigate parenting as a bridge between SES and executive function. The biodevelopmental and life-course models imply that interventions that target caregiver capacities may be effective in promoting positive neurodevelopment in children and serve to disrupt the cycle of social disadvantage that creates social disparities. However, understanding the components of parenting that are associated with executive function development during middle childhood will help direct interventions and policy effectively.

Part 2: Original Research

Introduction

Executive functions are broadly described as a set of neurocognitive skills involved in goal-directed behavior that allow for maintaining, manipulating, and processing task-relevant information. These functions are often conceptualized as the neural substrates that underpin goal-directed self-regulatory skills (Blair, 2010; Blair & Ursache, 2011). Together these skills are considered a cornerstone of development and have been associated with future positive health outcomes and life success (Heckman, 2008; Mischel, et al., 1989; Moffitt, et al., 2011; Shonkoff, Boyce, & McEwen, 2009; Shonkoff & Phillips, 2000). Executive functions are generally considered multidimensional with correlated but separate components including cognitive flexibility, inhibitory control, and working memory (Miyake, et al., 2000; Center on the Developing Child at Harvard University, 2011).

The timeline for the development of executive functions extends from infancy through adolescence (Center for the Developing Child at Harvard University, 2011; Davidson, Amso, Anderson, & Diamond, 2006; Fuster, 2002; Miyake, et al., 2000). The progression of development does not occur linearly. Rather, researchers have described a step-wise progression of executive function skills towards adult-level competence. Several studies have identified middle childhood, the heterogeneous developmental period between 6 and 12 years of age, as an important period for the development of executive functions (Brocki & Bohlin, 2004; Huizinga, et al., 2006; Welsh, et al., 1991). Despite the relevance of this period to their development, prior research has neglected research during this period. Middle childhood remains an important but understudied developmental period for executive functions (Huston & Ripke, 2006).

Numerous studies have demonstrated that higher socioeconomic status (SES) is associated with better performance on tasks of executive functions (Farah, et al., 2006; Kishiyama, et al., 2009; Mezzacappa, 2004; Noble, et al., 2007; Noble, et al., 2005; Sarsour, et al., 2011). However, previous studies used composite SES variables that combine connected but separate components of SES (e.g., occupation, income, and education). While a composite score may be a good overall summary of SES, it is likely that different components of SES have different effects (Duncan & Magnuson, 2003). Furthermore, understanding which components of SES contribute to particular disparities is relevant to designing appropriate and effective interventions.

Few studies investigating socioeconomic disparities in executive functions have investigated the construct of subjective social status. Subjective social status is a self-reported value that is thought to represent the cognitive average of standard, objective markers of SES (Adler, et al., 2000; Singh-Manoux, et al., 2005). Using multiple indicators of SES, including subjective social status, to investigate disparities in executive functions would add a new dimension to

current understanding and provide important information to guide future interventions (Hoffman, 2003; Lerner, 2003).

While socioeconomic disparities in executive functions are well described in the literature, researchers have yet to describe the mechanisms by which these disparities develop. Mezzacappa (2004, p. 1383) suggests that parents and caregivers may provide “bridges between macro indexes of SES and micro indexes of young children’s competence in basic attentional and executive functions.” Previous studies have demonstrated that specific patterns of parent-child relationships and environments may be relevant to cognitive development (McGroder, 2000; Rhoades, et al., 2011).

In other words, parenting is one pathway by which SES can affect child development (Hackman & Farah, 2009; Hackman, Farah, & Meaney, 2010). Specifically, scaffolding has been highlighted in previous studies as important in the development of self-regulatory skills (Bernier, et al., 2010; Bibok, et al., 2009; Eisenberg, et al., 2005; Hughes & Ensor, 2009; Landry, et al., 2002). Scaffolding describes context and assistance that adults provide children to help them exercise executive function skills as they develop.

Developmental psychologist Lev Vygotsky (1978) describes the space in which scaffolding occurs as the zone of proximal development, or the distance between what the learner can accomplish independently and what the learner requires assistance to accomplish. Parents and teachers can best assist a child in reaching new competencies by building bridges in this zone. The assistance must be sufficient for the learner to operate within the zone of proximal development without performing the tasks for the learner or leaving the learner behind. Adults, particularly parents, can provide support for the development of executive functions by establishing routines, providing cues, and breaking complicated tasks into manageable components. Parents who provide information and assistance in a supportive manner supplement a child’s immature executive function skills by lending their own. Through this scaffolding, children gradually learn to take on more regulatory responsibility and ultimately internalize the skills that will allow them to solve problems and regulate independently.

Other components of the family environment are associated with executive functions. Sarsour, Jutte, and Boyce (2011) found that single-parenthood moderated the positive associations between SES and executive functions such that children living in single-parent homes performed worse on executive function tasks compared to children of similar SES living in two-parent homes. Rhoades, Greenberg, Lanza, and Blair (2011) demonstrated that exposure to family poverty was a consistent predictor of poor executive functions. However, for the white families in their sample, marriage between parents conferred protection against the negative effects of low SES on executive functions. White children from unmarried families living in poverty performed significantly worse on tests of executive functions compared to children not living in poverty, but white children from married families living in poverty performed similarly to their non-impooverished peers (Rhoades, et al., 2011).

The role of the home environment in socioeconomic disparities in executive functions during middle childhood requires further research. This study uses data from the Wellness in Kids Study, utilized previously to explore associations between different measures of SES, the home environment, and executive functions in middle childhood (Kishiyama, et al., 2009; Nuru-Jeter, et al., 2010; Sarsour, et al., 2011; Sheridan, Sarsour, Jutte, D'Esposito, & Boyce, 2012). We begin by investigating composite, specific, and subjective measures of SES and their relationship to executive functions. Next, we use latent class analysis (LCA) to investigate the presence of a categorical latent home environment variable. Finally, we investigate associations between the LCA-generated categorical variable of the home environment, SES, and executive functions.

Methods

Study Sample

This study used a community sample of 60 families living in the San Francisco Bay Area. Families were recruited through advertisements at local parenting organizations, elementary schools, health clinics, and community centers. Family eligibility criteria included having a child seven to twelve years old and speaking English in the home more than 50% of the time. Exclusion criteria included target child having a serious handicap or chronic neurological disorder (such as epilepsy, cerebral palsy, or mental retardation), having a psychiatric disorder (such as ADHD or depression), or regularly taking psychotropic medication (such as stimulants or SSRIs).

Data were collected during two home visits. The primary caregiver completed the questionnaires (95% of the time the biological mother). Neuropsychological evaluations were conducted in a quiet room in the child's home. The UC Berkeley Committee for the Protection of Human Subjects approved the original research protocol.

Measures

Sociodemographic variables. The MacArthur Research Network on SES and Health Sociodemographic Questionnaire was administered to collect data on family SES (MacArthur Research Network on SES and Health, 2000). Self-reported family income was converted to income-to-needs ratio (ITNR) per established formulas using the 2004 federal poverty thresholds (Dearing, McCartney, & Taylor, 2001). Occupational prestige was assigned based on categories of the Hollingshead Index of Occupational Status (Hollingshead, 1975). Family wealth was measured with responses to the question, "Suppose you needed money quickly, and you cashed in all of your (and your spouse's) checking and savings accounts, and any stocks and bonds. If you added up what you would get, about how much would this amount to?" A measure of subjective social status was assessed using the MacArthur Network ladder (participants were asked to "place a large 'X' on the rung where you think you stand at this

time in your life, relative to other people in the United States” on a scale of 0 to 10) (Adler, et al., 2000).

A composite family SES z-score was calculated that included ITNR, wealth, occupational status, and maternal education. In addition to composite SES, several SES indicators were investigated separately. These included ITNR, number of years of education completed by the primary caregiver years of education, and subjective social status.

Executive Functions. Children completed three tasks to measure different executive functions during home visits. The three tasks represent important skills relevant to self-regulatory and goal-directed behaviors: cognitive flexibility, inhibitory control and working memory. Each task consisted of two sub-tests. The first sub-test performed was considered a test of lower order cognitive skills (basic non-executive function). The second sub-test was the more complex executive function task. Details for each test follow.

Trail Making. The Trail Making Test is a timed, paper-pencil test consisting of two parts (Trail A and B) that tests cognitive flexibility (Baron, 2004). Trail A is a connect-the-dots task requiring the child to draw lines between numbered circles in sequence scattered across the page. Trail A tests visual-spatial attention and is not considered an activity that taxes an executive function. Trail B requires the child to connect numbered and lettered circles in a sequence that alternates between numbers and letters (e.g., 1, A, 2, B, 3, C...). If an error was made the line was crossed out by the experimenter to indicate the error. The raw score for Trail A and Trail B was time in seconds to complete the task (i.e., connect all the circles). In analysis, the time to complete the task in seconds was used.

Stroop Color. Stroop Color is considered a test of inhibitory control (MacLeod, 1991). The task consists of three parts. In Stroop 1, the participant reads as many color names printed in black ink as possible in 45 seconds. In Stroop 2, the participant names as many color blocks as possible in 45 seconds. In Stroop 3, the names of color are printed in different color ink (i.e., the word “red” printed in blue ink). The participant names the color *ink*, inhibiting the perfunctory response of reading the word. Stroop 1 and Stroop 2 are not considered tests that tax executive function. Stroop 3 is considered a test of inhibitory control. In analysis, the raw score of the number of correctly read or color specified was used.

Digit Span. Digit Span is considered a test of working memory. It requires the participant to hold information in mind while also manipulating it (Baron, 2004; Hale, Hoepfner, & Fiorello, 2002). The test consists of two parts. In the first part, Digit Span Forward, the participant is required to repeat a series of numbers in the order presented. Trials continue until the child fails to recall two consecutive strings of numbers. Digit Span Forward is considered a test of auditory attention and not a test of an executive function. The second part, Digit Span Backward, consists of the participant recalling a series of numbers and then repeating in backwards order. This is considered a test of working memory. In this analysis, the length of the longest sequence recalled was used in analysis.

Home Environment. The Home Observation for Measurement of the Environment for Middle Childhood (HOME-MC) is a popular validated instrument used to assess components of the caring environment that contribute to child development (Bradley, Caldwell, Rock, Hamrick, & Harris, 1988). The HOME-MC consists of 59 binary scored items that measure aspects of the quantity and quality of social, emotional, and cognitive support provided in the home. Scores on the HOME-MC are associated with SES and are predictive of cognitive development (Bradley, Corwyn, Burchinal, McAdoo, & Coll, 2001; Bradley, Corwyn, McAdoo, & Coll, 2001; Totsika & Sylva, 2004).

The original authors designated 8 subscales: physical environment, enrichment activities, parental responsiveness, encouragement of maturity, emotional climate/acceptance, learning materials and opportunities, family companionship, and family integration (Bradley, et al., 1988). However, other researchers, using factor analysis, have clustered the items into different subscales (Bradley & Corwyn, 2002; Bradley & Corwyn, 2005; Elardo & Bradley, 1981; Han, Leventhal, & Linver, 2004). Rather than use a total score or factor analysis that assumes the existence of underlying continuous latent variables, this study employed Latent Class Analysis (LCA).

LCA is a latent variable methodology analogous to factor analysis. Instead of generating continuous latent variables, LCA assumes the presence of a categorical latent variable (L. M. Collins & Lanza, 2010). LCA investigates common and unique response patterns in order to place respondents into classes with similar responses. Rather than interpret the HOME as a linear indicator (from low to high score), we sought to investigate the presence of groupings (classes) of typical response patterns. For this exploratory analysis, an unconstrained LCA model was created. The specifics of this analysis follow in the next section.

Analysis

Multivariable linear regression analysis was used to assess the relationship between the composite SES z-score and the executive function tasks. In addition to a composite SES score, we also investigated ITNR, years of education completed by the primary caregiver, and subjective social status as unique contributors to socioeconomic disparities in executive functions. Given the small sample size we set the criteria for significance at $p < 0.1$.

We describe the home environment using an LCA approach to the HOME-MC. LCA begins with fitting a one-class model and adds an additional class until there is no further improvement in the model. In other words, additional classes are added until there is no empirical support for additional classes because the model would generate classes that would be very small or meaningless (Nylund, Nishina, Bellmore, & Graham, 2007). LCA estimates two important factors that are used in interpretation of the model: item probabilities and class parameters. Item probabilities are within-class parameters, which correspond to the probability of an individual in that class endorsing or receiving credit for an item. For example, an item probability of 0.90 means that parents in a specific parenting class would have a 90% probability of receiving credit for that item of

the HOME-MC. Class parameters describe the classes overall and provide the proportion of participants that would be classified in that class.

Given the small number of observations (i.e., participants) relative to the large number of parameters (i.e., estimations), all items from the HOME-MC could not be included in LCA modeling. A maximum of 11 items from the HOME-MC would allow for testing up to a 5-class model. A five-class model would have 4 class parameter estimates; five classes with 11 binary scored item parameters would require 55 item parameter estimates. This model would contain a total of 59 parameters and would be allowable to test with 60 observations. Thus, analysis parameters limited us to using a maximum of 11 items from the HOME-MC.

No previous literature has investigated or described a selection process for choosing items from a large panel of variables to use in LCA modeling. We employed a combination of quantitative and qualitative-based methods for item selection. First, we selected items based on item “difficulty.” Relatively rare items (true for <25% of families) and ubiquitous items (true for >75% of families) were eliminated. The remaining items had a range of “difficulty” (25-75%) that would allow differentiation between families and is considered reasonable from a psychometric point of view (Bradley, et al., 1988). This left 25 items to select from.

Our interest was primarily in the interpersonal and day-to-day components of parenting and the home environment. Therefore, we eliminated items focused on components of the physical rather than interpersonal environment and those emphasizing activities that occur sporadically (e.g., “Family member has arranged for child to take a trip on a plane, train, or bus within the past year.”). We eliminated an additional 3 items based on their emphasis or requirement of material possessions and one because we felt it emphasized child characteristics rather than parenting. We also eliminated two items because more than three participants were missing data. This left 10 items, which met the analysis parameters for a study population of our size. These items reflect observed parent-child responsiveness, studying area in home, extracurricular activities, and family configuration. Items selected and their response frequencies can be found in Table 1.

Once items were selected, model building began with a one-class model. Subsequently classes were added until the addition of a class was no longer parsimonious. We utilized five indices to determine best model fit. The Akaike Information Criterion (AIC), Bayesian Information Criterion (BIC), Adjusted BIC (ABIC), and Consistent AIC are all indices where smaller values indicate a better fitting model (Nylund, Nishina, et al., 2007). The Bootstrap Likelihood Ratio Test (BLRT) has been described as the most reliable indicator across different models, so we emphasized this criterion over others when determining the best fit model (Nylund, Asparoutiov, & Muthen, 2007). After determining the model with the appropriate number of classes, item probabilities were interpreted to describe the classes created by the model.

Participants were assigned to a class based on most likely class membership. Clark and Muthen (2009) state that auxiliary variables can be

analyzed in relationship to latent classes based on most likely class membership if the entropy of the model is 0.80 or greater. The entropy for our final model was 0.935. Ideally covariates would be included in the latent class model. However, inclusion of covariates significantly changed formation and interpretation of classes, so analysis of auxiliary variables was based on most likely class membership.

After class assignments had been made, multinomial logistic regression was used to determine if SES could predict or differentiate between the classes. Finally, multivariate linear regression and analysis of variance (ANOVA) was used to determine if there were differences in executive functions across classes. Latent class analysis was conducted in MPlus 6, and all other data analysis was conducted in Stata 10 (Muthen & Muthen, 2010; StataCorp, 2007).

Results

Demographic characteristics of the sample are described in Table 2. Forty three percent of the sample was black/African American and 33% white/Caucasian with the remainder predominantly self-identifying as multiracial/multiethnic. The majority of target children were female (68%). Ages ranged from 7 to 12 years with an average age of 9.9 years (SD=0.96). Thirty seven percent of primary caregivers had a high school education or GED or less (only one primary caregiver had less than a high school education or GED). Primary caregivers completed from 3 to 20 years of education (mean 15.1, SD=3.04). Mean ITNR was 2.98 (SD=1.79) and mean subjective social status was 5.7 (SD=2.2). Table 3 includes means and standard deviations of raw scores for the executive function tasks from the sample and population-based means for comparison.

Relationships between SES and Executive Functions

Summary of multivariable regressions of executive functions as functions of composite and individual SES characteristics can be found in Table 4. All executive function assessments were controlled for performance on corresponding non-executive function tasks and child's age. We found that the executive functions of cognitive flexibility and inhibitory control were associated with composite SES variable in the predicted directions. Higher composite SES score was associated with better cognitive flexibility ($\beta = -11.65$, $p = 0.028$) and inhibitory control ($\beta = 2.18$, $p = 0.030$), but not associated with working memory ($\beta = 0.19$, $p = 0.314$). Note that for cognitive flexibility, measured with the Trails test, a shorter time period signifies greater proficiency. Thus, the negative coefficient is consistent with an inverse association between SES and time to complete the trails.

When investigating separate components of SES, cognitive flexibility was associated with primary caregiver education ($\beta = -3.17$, $p = 0.031$), ITNR ($\beta = -5.19$, $p = 0.042$), and subjective social status ($\beta = -5.10$, $p = 0.010$). At a threshold of significance of $p < 0.10$, inhibitory control showed associations with primary caregiver education ($\beta = 0.54$, $p = 0.068$) and ITNR ($\beta = 0.88$, $p = 0.070$). Working

memory was not statistically related to any of the individual SES variables analyzed.

Results of Latent Class Analysis

Based on BLRT and other fit criterion, LCA of ten raw items from the HOME-MC revealed a best-fit model with three classes. We found that item 16 (“Parent is consistent in establishing or applying family rules.”) did not provide sufficient discrepancy between classes. This item was dropped and the analysis was run again. Table 5 contains a summary of the criterion indicators for each model. Model parameters were used to describe the characteristics of each class in the LCA model. The conditional item probabilities are contained in Table 6 and a plot for the three-class model is presented in Figure 1. The item probabilities describe the probability that a member of a given class would receive credit for the specific item in the HOME-MC questionnaire. An item probability of 1 indicates all class members received credit for the item; whereas a probability of 0 indicates no one received credit.

Examining the results of the LCA, Class 1 (blue diamonds in Figure 1) had high item probabilities for all items. Most families (46.57% by most likely class membership) were placed into this class. Class 1 was used as the baseline in additional analyses, and we labeled this class High Overall.

Class 2 (red squares in Figure 1), had item probabilities greater than 0.6 for items related to encouragement and responsivity (e.g., “Parent encourages child to contribute to conversation during visit.”). Families in Class 2 also had probabilities greater than 0.6 for items we interpreted as reflecting opportunities to practice and develop executive functions (e.g., “Child has free access to desk or other suitable place for reading or studying.” and “Family encourages child to develop or sustain hobbies.”). However, they had item probabilities less than 0.5 for items that were part of the Father Involvement subscale of the HOME-MC (e.g., “Spends time with father figure >4/week.”). This class was labeled Medium Scaffolding with Low Father Involvement (MS/LF).

Class 3 (green triangles in Figure 1), had low item probabilities (less than 0.6) for items related to responsivity, encouragement, and opportunity to practice executive functions. However, item probabilities were greater than or equal to 0.5 for family stability and the father-involvement item “Spends time with father figure >4 times/week.” This class was labeled Low Scaffolding with Medium Father Involvement (LS/MF). Item probabilities for each class are summarized in Table 6.

In general, families were very well classified. There was one family with 0.552 and 0.448 probability of being in the MS/LF and LS/MF classes, respectively. However, removal of this family’s most likely class assignments did not alter class relationships to auxiliary variables, therefore this family was included in the analysis as a member of the Medium Scaffolding with Low Father Involvement class. Otherwise, class assignments were made based on probabilities equal to or greater than 0.796.

Relationships between Home Environment Class and SES

Multinomial logistic regression was used to investigate the relationship between SES variables and class membership. Again, we used a composite variable and investigated different individual indicators of SES. In all logistic regressions with categorical outcomes, the High Overall class was considered the baseline class.

Using the composite SES z-score as a predictor of class membership, a one-unit increase in the SES composite variable was associated with a 3.81 decrease in relative log odds of being in the Medium Scaffolding with Low Father Involvement class compared to the High Overall class ($p < 0.001$). Similarly, a one unit increase in the variable of composite SES was associated with a 4.37 decrease in the relative log odds of being in the Low Scaffolding with Medium Father Involvement class compared to the high overall class ($p < 0.001$) (see Table 7). In other words, an increase in SES is associated with an increased likelihood of membership in the High Overall class compared to the MS/LF or LS/MF classes.

We saw similar patterns when specific indicators of SES were used as predictors of class membership. An additional year of education completed by the primary caregiver was associated with a 0.70 decrease in the log odds of being in the Medium Scaffolding with Low Father Involvement compared to the High Overall class ($p < 0.001$) and a 0.77 decrease in the log odds of being in the Low Scaffolding with Medium Father Involvement class ($p < 0.001$) (see Table 8). An additional unit increase in ITNR was associated with a 0.98 decrease in the log odds of being in the MS/LF class compared to the High Overall class ($p < 0.001$) and a 1.15 decrease in the log odds of being in the LS/MF class ($p < 0.001$) (see Table 9). An additional unit increase in subjective social status was associated with a 0.67 decrease in the log odds of being in the MS/LF class ($p = 0.001$) and a 0.57 decrease in the log odds of being in the LS/MF ($p = 0.005$) compared to the High Overall class (see Table 10).

Figures 2 through 5 demonstrate the probability of class membership as a function of the various SES indicators investigated. While each SES indicator distinguished High Overall class (blue line) from the other two classes (Medium Scaffolding with Low Father Involvement (red line) and Low Scaffolding with Medium Father Involvement (green line)), the SES indicators do not distinguish the MS/LF and LS/MF classes from one another. Furthermore, when the MS/LF class was used as the baseline class, we found no significant differences in log odds of class membership based on composite SES z-score, years of education completed by primary caregiver, ITNR, or subjective social status compared to the LS/MF class. This suggests that there are no socioeconomic differences between the Medium Scaffolding with Low Father Involvement and Low Scaffolding with Medium Father Involvement classes.

Relationships between Home Environment Class and Executive Functions

Next we investigated the associations between class membership and executive functions. A summary of regression and ANOVA of executive function tasks as functions of class membership can be found in Tables 12 and 13. For

cognitive flexibility (Trails), the overall F-test, which demonstrates whether values in various groups differ from one another, approached significance after adjustment for non-executive tasks and child's age ($F(2,55)=2.28$, $p=0.11$). The adjusted mean score for cognitive flexibility for members of the High Overall class, after controlling for age and non-executive function tasks, was 44.94, $SD=6.19$. The Low Scaffolding with Medium Father Involvement had a higher adjusted mean score of 68.26, $SD=8.56$ (for Trail Making a higher score indicates more time taken to complete the task, thus lower executive function). Scores on cognitive flexibility for the Medium Scaffolding with Low Father Involvement class (mean=55.45, $SD=7.96$) were lower, demonstrating better executive function, than the LS/MF class. However, the mean score of the MS/LF was not as low as the High Overall class.

For inhibitory control (Stroop), the overall F-test comparing scores between classes was significant ($p<0.10$) after adjustment for non-executive tasks and child's age ($F(2,53)=2.72$, $p=0.0750$). The adjusted mean score and standard deviation for inhibitory control for members of the High Overall class, after controlling for age and non-executive function tasks, was 27.95, $SD=1.17$. Members of the Low Scaffolding with Medium Father Involvement class had significantly lower scores (mean=23.05, $SD=1.68$) than the High Overall class ($p=0.024$). Scores on cognitive flexibility for the Medium Scaffolding with Low Father Involvement class did not differ significantly compared to the High Overall class (mean=26.10, $SD=1.46$, $p=0.329$).

For working memory (Digit Span), the overall F-test comparing scores between classes was significant ($p<0.10$) after adjustment for non-executive tasks and child's age ($F(2, 55)=2.65$, $p=0.0793$). The adjusted mean score and standard deviation for working memory for members of the High Overall class, after controlling for age and non-executive function tasks, was 4.05, $SD=0.20$. Members of the Low Scaffolding with Medium Father Involvement class had significantly lower scores (mean=3.29, $SD=0.26$) than the High Overall class ($p=0.033$), while the Medium Scaffolding with Low Father Involvement class (mean=3.94, $SD=0.24$) did not differ significantly compared to the High Overall class ($p=0.734$).

None of the multiple indicators of SES seemed to distinguish between the Medium Scaffolding with Low Father Involvement and Low Scaffolding with Medium Father Involvement classes. Both classes were associated with significantly lower SES than the high overall class. However, while children in the LS/MF tended to have significantly lower scores on executive function tasks compared to the children in the High Overall class, children from the MS/LF class did not perform statistically differently from the High Overall class. When the adjusted means were investigated, children from families in the LS/MF performed poorest on tasks of executive functions while children in families from the High Overall class received the highest scores.

Discussion

In concordance with previous studies, we generally found that there was an association between SES and executive functions with children from higher SES families having better scores on the executive function tasks. However, varying degrees of associations between specific indicators of SES (e.g. years of education completed by the primary caregiver, ITNR, and subjective social status) and executive functions suggest future studies should consider measures of SES carefully and investigate both composite and specific variables. Knowing which components of SES are associated with disparities in executive functions is important in targeting appropriate interventions.

Our latent class analysis utilizing individual items from the HOME-MC suggested three different classes family environment and function within our study population. One group, the High Overall class, had a high probability both for items related to positive scaffolding (responsivity, encouragement, and providing opportunities to practice self-regulation) and father involvement. The second class had relatively high item probabilities for items related to scaffolding but low item probabilities for father involvement (Medium Scaffolding with Low Father Involvement class). The third class was the reverse with low item probabilities for scaffolding, but relatively high item probabilities for father involvement (Low Scaffolding with Medium Father Involvement class).

Higher SES was associated with greater odds of membership in the High Overall class. This was true when considering SES as a composite variable or by separate indicators of SES. However, no matter the indicator examined, SES variables did not distinguish between the MS/LF and LS/MF classes. SES factors alone did not account for the family structural and functional differences noted between those two classes. Thus, these findings suggest that changes to SES (such as increased education, income, or social status) may not be required to increase the degree of scaffolding parents provide their children.

Critically, children in the Low Scaffolding with Medium Father Involvement class performed significantly below children in the High Overall class on tasks of executive functions. However, the performance of children in the Medium Scaffolding with Low Father Involvement class was not distinguishable from the high-performing High Overall class. These findings are intriguing and suggest that scaffolding may be more relevant to executive functions than family stability and father involvement. One explanation for these findings may be that although there is a strong association between SES and executive functions, home environment factors unrelated to education, income, wealth, and other socioeconomic factors may attenuate this relationship. In particular, the presence of parental scaffolding, not distinguished by SES in our study, may be protective against the damaging effects of low SES, even in the absence of father involvement.

This exploratory study has several shortcomings. First, the small sample size made it difficult to have enough power to fully investigate statistically significant relationships. That we were able to find significant associations in the expected directions with a higher threshold of $p < 0.1$ is encouraging that these

findings may be substantiated with a larger sample. Additionally, due to the small sample size we were unable to fully explore the presence of a latent categorical variable using the HOME-MC because all available items could not be utilized. Without a validated method of selection, we relied instead on empirical knowledge of parenting and the development of executive functions to select a subset of the overall items for analysis. Second, race and SES were strongly correlated in this sample. For example, the mean ITNR for black/African American families was 1.88 (SD=1.28) compared to a mean of 4.47 (SD=1.11) for white families. This makes it difficult to disentangle these two participant characteristics. Third, the cross-sectional study design means we cannot determine order of events, and, thus, the direction of causality cannot be determined.

Future research should include multiple measures of executive functions, beyond the three tasks utilized here. It may also be useful to employ measures that capture more applied uses of executive functions such as the Delay of Gratification Task and the Behavioral Inventory of Executive Function (BRIEF) (Gioia, Isquith, Guy, & Kenworthy, 2000; Mischel, et al., 1989). In addition, these tasks may change the motivating factors (i.e., greater reward versus success on a task) and better assess how well the child is able to utilize their executive function skills in practical rather than theoretical situations. Furthermore, understanding the role of motivation in executive functions and how families may foster motivation should be explored further.

Although the HOME-MC is a widely used measure of parenting and the home environment, to our knowledge this is the first analysis of the HOME-MC using LCA. These findings suggest that LCA may be a useful tool in characterizing parenting and home environment variables from previously validated instruments. Future studies with larger sample sizes should investigate whether use of LCA with the complete HOME-MC questionnaire reveals response patterns that are predictive of other childhood health and well-being outcomes.

Findings from this exploratory investigation of SES, family environment, and executive functions suggest several areas of further research. A longitudinal investigation of scaffolding and its association with executive functions over their prolonged course of development from infancy through adolescence with a larger sample would be able to explore associations and generalize findings to a broader population and demonstrate an operative timeline. Previous studies have demonstrated successful interventions to improve children's executive functions and parenting interventions to improve children's behavior problems and parental competencies (Day, Michelson, Thomson, Penney, & Draper, 2012; Diamond, et al., 2007; Fisher, Gunnar, Chamberlain, & Reid, 2000; Furlong, et al., 2012). The findings of this study suggest improving parents' responsiveness and scaffolding skills may be effective in improving children's executive functions. Furthermore, this should not necessitate interventions to change overall family SES. Designing and testing such interventions would allow for casual inference and, if successful, could be implemented more broadly.

However, these interventions must be seen as a first step in developing skills that will benefit children in other aspects of their lives and must continue to be fostered across the life course. While certainly not the only influence in the development of executive functions and self-regulation, parents and the home environment could serve to promote these important skills, provide protection against the risks of low SES, and ameliorate some of the influential factors in the intergenerational transmission of poverty.

Appendix A-Tables

Table 1. Items from Middle Childhood Home Observation for Measurement of the Environment used in Latent Class Analysis and Response Frequencies

Q#	HOME Question	N (%)	Subscale¹
5	Parent encourages child to contribute to conversation during visit.	41 (68.33)	EVR
7	Parent responds to child's questions during interview.	43 (71.67)	
16	Parent is consistent in establishing or applying family rules.	26 (44.07)	EM
23	Parent talks to child during visit (beyond correction and introduction).	39 (66.10)	EC
30	Child has free access to desk or other suitable place for reading or studying.	41 (68.33)	GF
35	Family encourages child to develop or sustain hobbies.	45 (75)	AS
37	Family provides lessons or organizational memberships to support child's talents (YMCA, YWCA, gymnastic lessons, music lessons, art lessons, membership to art center).	42 (70)	
49	Child sees and spends some time with father or father figure 4 days a week.	36 (60.00)	PI
50	Child eats at least one meal per day, on most days, with mother and father (or mother and father figures).	27 (45.00)	
51	Child has remained with this primary family group for all his life aside from 2-3 week vacations, illnesses, or parent visits from grandparent, etc. (A "yes" requires no changes in mother's, father's, grandparents' presence in the home since birth).	40 (66.67)	

EVR=Emotional and Verbal Responsivity, EM=Encouragement of Maturity, EC=Emotional Climate, GF=Growth-Fostering Materials and Experiences, AS=Provision for Active Stimulation, PI=Paternal Involvement

¹(Bradley, et al., 1988)

Table 2. Descriptive characteristics of sample

Study variables	N (%)
Child race	
Black/African American	26 (43)
Asian/Pacific Islander	2 (3)
White/Caucasian	20 (33)
Latino/Hispanic	2 (3)
Multiracial/Multiethnic	10 (17)
Gender	
Male	19 (32)
Female	41 (68)
Age in years (mean, SD)	9.9, 0.96
SOCIOECONOMIC STATUS	
Income-to-Needs Ratio (mean, SD)	2.98, 1.79
Primary Caregiver Years of Education (mean, SD)	15.1, 3.04
Subjective Social Status (mean, SD)	5.7, 2.2

Table 3. Mean and standard deviation of Neurocognitive Tasks

Task	N	Mean	SD	Means from population-based data or other studies
Trail Making Test A (seconds)	60	23.3	7.78	22.62, SD=9.3 ¹
Trail Making Test B (seconds)	60	53.75	38.60	50.84, SD=21.79 ¹
Stroop Word Reading	60	73.05	14.24	67.1, SD=16.2 ²
Stroop Color Recognition	60	50.63	10.53	54.3, SD=13.9 ²
Stroop Color Word Test	59	26.22	7.96	32.8, SD=7.0 ²
Digit Span Forward Length	60	5.97	1.32	6.36, SD=2.57 ³
Digit Span Backward Length	60	3.83	1.18	5.08, SD=2.59 ³

¹(Baron, 2004) ² (Golden & Golden, 2002) ³(Vakil, Blachstein, Sheinman, & Greenstein, 2009)

Table 4. Regression of Executive Function by SES

SES Indicators	Executive Function Tasks					
	Cognitive Flexibility (Trials)		Inhibitory Control (Stroop)		Working Memory (Digit Span)	
	b (SE)	t	b (SE)	t	b (SE)	t
Composite SES	-11.65 (5.16)	-2.26*	2.18 (0.98)	2.23*	0.19 (0.18)	1.02
Primary Education (years)	-3.17 (1.43)	-2.21*	0.54 (0.29)	1.86 [†]	0.06 (0.05)	1.31
ITNR	-5.19 (2.50)	-2.08*	0.88 (0.48)	1.85 [†]	0.08 (0.08)	0.89
Subjective Social Status	-5.10 (1.91)	-2.68*	0.43 (0.38)	1.12	-0.02 (0.06)	-0.24

[†] $p < .10$; * $p < .05$; All dependent variables were adjusted for child age and performance on non-executive task.

Table 5. Fit Indices of Latent Class Models with 1 through 4 Classes

Number of Classes	1	2	3	4
Number of Free Parameters	9	19	29	39
Log Likelihood	-338.717	-275.577	-258.700	-248.330
AIC	695.434	589.154	575.400	574.659
BIC	714.284	628.947	636.136	656.338
ABIC	658.976	569.187	544.923	533.673
BLRT	NA	<0.0001	<0.0001	0.1622
Entropy	NA	0.940	0.935	0.958

Table 6. Conditional Item Probability for Three-Class Model

	Class 1 (High Overall)	Class 2 (Medium Scaffolding with Low Father Involvement)	Class 3 (Low Scaffolding with Medium Father Involvement)
Class Membership Based on Most Likely Latent Class Membership (N (%))	28 (46.67%)	17 (28.33%)	15 (25%)
Item			
5-Parent encourages child to contribute to interview	0.930	0.684	0.248
7-Parent responds to child's questions during interview	0.896	1.000	0.112
23-Parent talks to child during visit	0.964	0.674	0.085
30-Desk	0.928	0.643	0.295
35-Encourages hobbies	0.964	0.615	0.512
37-Provides lessons	0.934	0.714	0.275
51-Remained in same family group	0.928	0.352	0.529
49-Spends time with father figure >4/week	0.963	0.073	0.500
50-One meal per day with both parents	0.925	0.000	0.074
Item probabilities ≥ 0.500 in bold for ease of interpretation			

Table 7. Relative Log Odds for Composite SES as a predictor of most likely class membership, High Overall as Base Outcome

Class	Relative Log Odds	SE	z
Medium Scaffolding with Low Father Involvement	-3.81	1.09	-3.48**
Low Scaffolding with Medium Father Involvement	-4.37	1.20	-3.66***

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 8. Relative Log Odds for Years of Education completed by Primary Caregiver as a predictor of most likely class membership, High Overall as Base Outcome

Class	Relative Log Odds	SE	z
Medium Scaffolding with Low Father Involvement	-0.70	0.19	-3.75**
Low Scaffolding with Medium Father Involvement	-0.77	0.20	-3.88***

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 9. Relative Log Odds for ITNR as a predictor of most likely class membership, High Overall as Base Outcome

Class	Relative Log Odds	SE	z
Medium Scaffolding with Low Father Involvement	-0.98	0.28	-3.53***
Low Scaffolding with Medium Father Involvement	-1.15	0.31	-3.72***

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 10. Relative Log Odds for Subjective Social Status as a predictor of most likely class membership, High Overall as Base Outcome

Class	Relative Log Odds	SE	z
Medium Scaffolding with Low Father Involvement	-0.67	0.20	-3.27**
Low Scaffolding with Medium Father Involvement	-0.57	0.20	-2.83**

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 11. Regression of Executive Function Tasks on Class Membership, High Overall as Comparison Group

Class	Cognitive Flexibility (Trails)		Inhibitory Control (Stroop)		Working Memory (DS Backward)	
	b (SE)	t	b (SE)	t	b (SE)	t
Medium Scaffolding with Low Father Involvement	10.51 (9.96)	1.06	-1.85 (1.88)	-0.99	-0.11 (0.32)	-0.34
Low Scaffolding with Medium Father Involvement	23.31 (10.96)	2.13*	-4.90 (2.10)	-2.33*	-.76 (0.35)	-2.19*

† $p < .10$; * $p < .05$; All dependent variables were adjusted for non-executive task and child's age

Table 12. ANOVA of Executive Function Tasks Across Class Membership, Adjusted Means, and Tukey's Post-hoc Tests

Task	Overall Test	High Overall Mean (SD)	Medium Scaffolding with Low Father Involvement Mean (SD)	Low Scaffolding with Medium Father Involvement Mean (SD)	Tukey's Post-hoc Tests
Cognitive Flexibility (Trails)	F(2,55) =2.28	44.94 (6.19)	55.45 (7.69)	68.26 (8.56)	1 v. 3*
Inhibitory Control (Stroop)	F(2,53) =2.72 [†]	27.95 (1.17)	26.10 (1.46)	23.05 (1.68)	1 vs 3* 2 vs 3*
Working Memory (Digit Span)	F(2,55) =2.65 [†]	4.05 (0.20)	3.94 (0.24)	3.29 (0.26)	1 vs. 3* 2 vs. 3*

[†] $p < .10$; * $p < .05$; All dependent variables were adjusted for non-executive task and child's age

Appendix B-Figures

Figure 1. Item response probabilities for classes

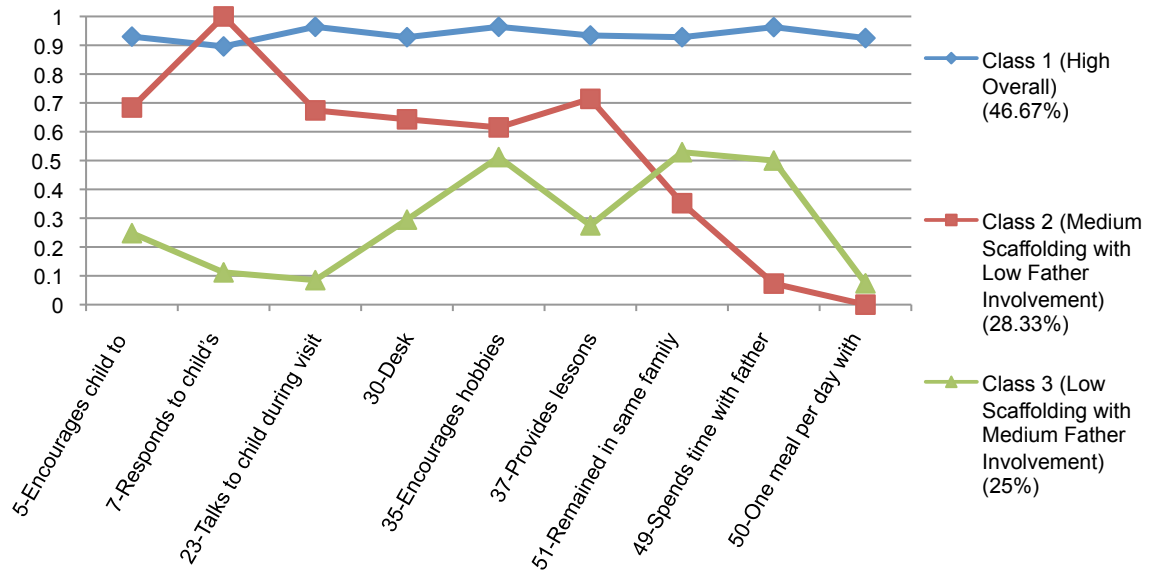


Figure 2. . Probability of Class Membership as a function of composite SES z-score

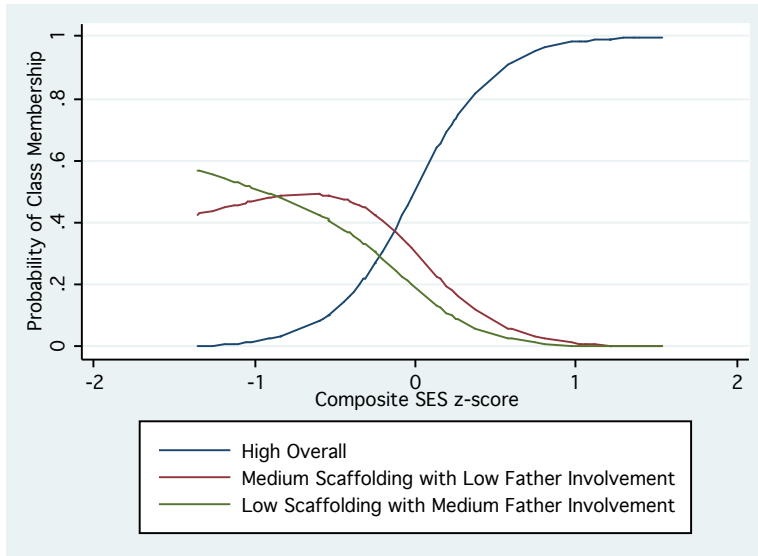


Figure 3. Probability of Class Membership as a function of Years of Education completed by Primary Caregiver

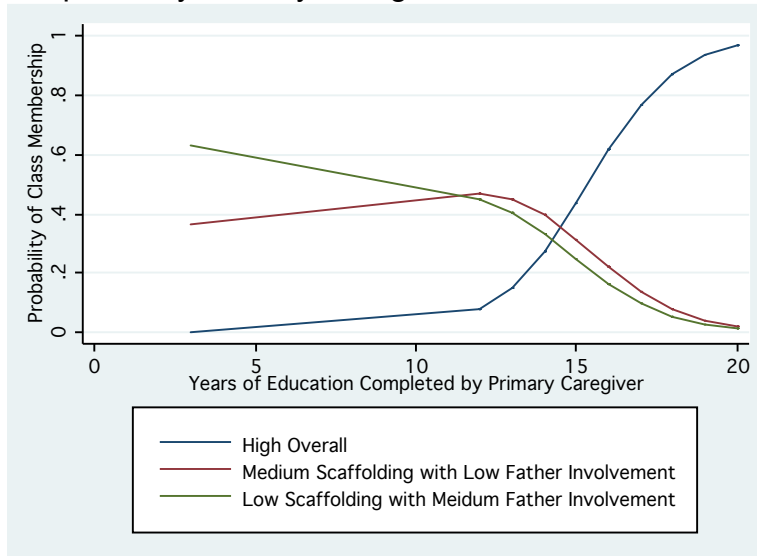


Figure 4. Probability of Class Membership as a function of ITNR

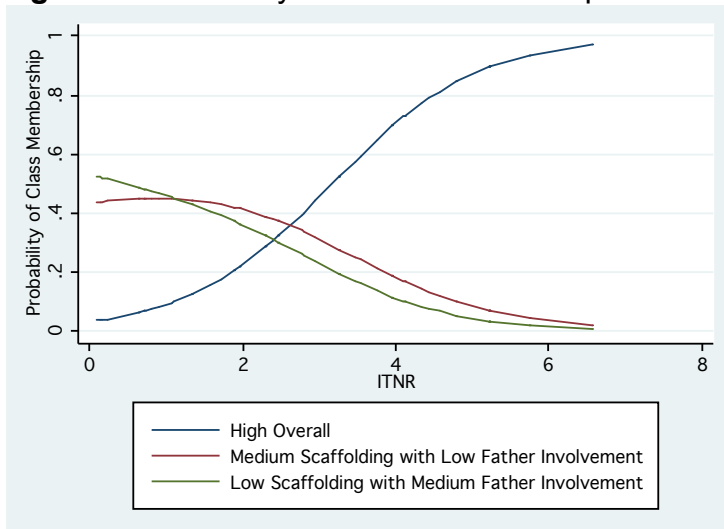
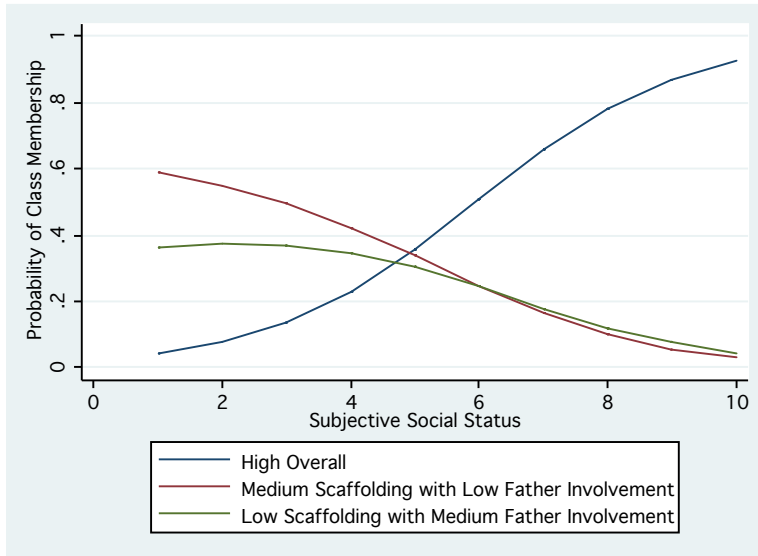


Figure 5. Probability of Class Membership as a function of Subjective Social Status



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