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EXECUTIVE FUNCTIONING AS A MODERATOR BETWEEN PRESCHOOL CLASSROOM QUALITY AND SELF-REGULATION FOR CHILDREN FROM HIGH AND LOW POVERTY BACKGROUNDS

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ABSTRACT

Classroom quality has been shown to be an important factor in promoting various aspects of self-regulation (SR). Moreover, researchers continue to examine and debate the overlapping nature of SR and executive functioning (EF). Measurement of SR also varies across studies, further complicating the relationship between EF and SR. This study examined the hypothesized moderating effect of EF on the relationship between preschool classroom quality and SR in the classroom context. Using multiple regression, the effect of classroom quality over and above EF and poverty status was examined to explore the relationship between poverty and classroom quality. Extant data from the Family Life Project (N = 877) was used. Exploratory factor analysis (EFA) was used to test the factor structure of a classroom SR variable using items from the Strengths and Difficulties Questionnaire, and a one-factor solution was supported. Regression analyses indicated that classroom quality statistically significantly predicted classroom SR and that EF and classroom quality predicted classroom SR to a statistically and practically significant degree when controlling for demographic information. EF did not moderate the relationship between classroom quality and SR; rather, classroom quality predicted SR over and above EF skills and poverty status. Limitations and suggestions for future research are discussed.

TABLE OF CONTENTS

LIST OF FIGURES

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Chapter I: INTRODUCTION AND LITERATURE REVIEW

This study explored the effect of classroom quality in preschool on children's classroom self-regulation processes while also investigating the moderating effect of executive functioning on that relationship. These relationships were examined with a sample of children from a rural and largely low socioeconomic status (SES) background using multiple regression analyses. Subsequent analyses examined the influence of classroom quality in relation to children's poverty status.

Rationale

Self-regulation (SR) and executive functions (EF) have recently gained recognition for their importance, particularly in the area of school readiness. A number of researchers have identified that EF is important for school readiness (Blair, 2002; Blair, Granger, & Razza, 2005; Riggs, Blair, & Greenberg, 2003). Furthermore, Diamond and Lee (2011) posit that EF is an important focus for improving school readiness and later academic success. Blair (2002) has noted that SR skills underlie many of the cognitive and emotional skills that are necessary for school readiness. Furthermore, these skills may predict school readiness as well as intelligence (Blair, 2002; Willoughby, Blair, Wirth, Greenberg, & the Family Life Project Investigators, 2012) and may be more important than simply having the academic knowledge commonly viewed as important for school readiness (Rimm-Kaufman, Pianta, & Cox, 2000). This relationship is not surprising given the importance of SR as a milestone of early childhood as it relates to self-monitoring of behavior (Kopp, 1982). SR as an overarching construct is also often thought to encompass the constructs of EF, emotion regulation, and effortful control that have been linked to many positive life outcomes including achievement and social competence (Blair, Berry, & Friedman, 2012) as well as risk factors such as low socioeconomic status (Wanless,

McClelland, Tominey, & Acock, 2011). Because of the positive benefits associated with higher SR skills, parenting interventions and preschool programs that build SR skills in children have also become the focus of recent research.

Conceptual Definitions of EF and SR

Although the relationship between SR and achievement is well documented in the literature, debate continues on the definition, components, and measurement of SR (Cole, Martin, & Dennis, 2004; Kochanska, Murray, & Harlan, 2000; McClelland & Cameron, 2012; Rueda, Posner, & Rothbart, 2004; Zelazo & Müller, 2002). In order to consider the variation in the definitions and components of SR, theoretical underpinnings to SR should be considered. Karoly (1993) envisioned SR abilities as generally regulating behavior, emotion, and cognition. Blair, Berry, and Friedman (2012) posit that SR is an overarching organizing construct, including purposeful and goal-directed cognitive and affective control and response, that affects academic and life success. Kopp (1982) has described the developmental course of SR and delineated the developmental stages in which SR appears to emerge taking into account historical definitions and the development of other skills and abilities across infancy and childhood. Historical definitions of SR include the ability to comply with requests; to start and stop behaviors based on circumstances and demands of a situation; to control verbal and motor actions with variation in intensity, frequency, and duration; to delay gratification; and to act appropriately based on internal control and without external monitoring (Kopp, 1982). According to Kopp, SR differs from precursors in earlier developmental stages in that it requires awareness and understanding of social norms and what is considered socially appropriate; thus, it is tied to the socialization of children. Furthermore, although there are antecedents to SR, Kopp inferred that true SR is not possible before the preschool age. Development of SR is tied to development in regulation of

children's arousal states, compliance to caregiver requests, impulse control, and the internalizing of social standards to which children have been exposed. It also requires a certain level of cognitive ability; children should be able to produce strategies and use conscious introspection in addition to the cognitive requisites for self-control. More specifically, the potential for control and self-control only develop when infants have enough self-awareness to see their own actions as separate from others which requires the ability to think representationally with symbols and recall memories. SR also builds on self-control as it is more than just compliance. It is comprised of initiation of behaviors, delaying behaviors, and controlling one's own behaviors via internal volition rather than via external sources (e.g., caregivers). Furthermore, self-control precedes SR developmentally because regulation implies greater flexibility and adaptability of behaviors based on the situation and circumstances. Ultimately, according to Kopp, what sets SR apart from other similar constructs is the ability to purposefully initiate and delay behaviors and to adapt one's behaviors based on situational demands.

Across disciplines, researchers conceptualize SR differently and definitions vary (see Table 1). SR researchers from different disciplines tend to view the concept differently (e.g., Blair, Berry, & Friedman, 2012; Bridgett, Oddi, Laake, Murdock, & Bachmann, 2013), either as effortful control in a temperament framework or through an EF framework with some researchers identifying the conceptual overlap and calling for an integrated approach (e.g., Zhou, Chen, & Main, 2012). Given the various conceptualizations and definitions, it is important to note that SR generally includes both emotional and cognitive processes used to manage emotions, behavior, and attention (Raver, Carter, McCoy, Roy, Ursache, & Friedman, 2012).

Table 1

Selected Published Definitions of Self-Regulation

Source	Definition
Blair, 2002, p. 112	"the regulation of emotion in appropriate social responding or the regulation of attention and selective strategy use in the execution of cognitive tasks"
Blair & Razza, 2007, p. 647	"the developmental integration of emotion and cognition in early childhood"
Karoly, 1993, p.25	"processes, internal and/or transactional, that enable an individual to guide his/her goal-directed activities over time and across changing circumstances (contexts)… implies modulation of thought, affect, behavior, or attention via deliberate or automated use of specific mechanisms and supportive metaskills"
McClelland, Cameron, Connor, Farris, Jewkes, & Morrison, 2007, p. 948	"several aspects of controlling, directing, and planning, including emotion regulation and behavioral regulation… relates to and involves elements of temperament such as effortful control and cognitive processing such as executive function"
Morrison, Ponitz, & McClelland, 2010, p. 203	"execution and manifestation of cognitive processes in overt behavior"
Raver et al., 2012, p.247	"ability to manage or modulate positive and negative emotions, to inhibit or control their behavior, and to shift and focus their attention"
Rothbart & Bates, 2006, p. 100 and p. 129	"processes such as effortful control and orienting that function to modulate reactivity" with *effortful control* defined as "the efficiency of executive attention—including the ability to inhibit a dominant response and/or to activate a subdominant response, to plan, and to detect errors"
Rueda et al., 2005, p. 573	"the many processes by which the human psyche exercises control over its functions, states, and inner processes"
Ursache, Blair, & Raver, 2011, p. 123	"primarily volitional management of arousal or activity in attention, emotion, and stress response systems in ways that facilitate the use of EF abilities in the service of goal-directed actions;" "a bidirectional system linking emotion with cognition"

For the current study, SR as a construct was defined as an overarching ability to monitor and control behavior, emotions, and attention or thoughts. It is relevant to consider the context of effortful control in discussions of SR because temperament encompasses both dispositions in emotional reactivity and responsiveness to external stimulation as well as tendencies in how individuals modulate or regulate that reactivity in terms of behaviors, emotions, social interactions, and cognitions (Morrison et al., 2010, Rothbart & Bates, 2006). In comparison to effortful control, EF is often directly assessed by observed responses indicative of cognitive processes. Structural equation modeling has lent evidence for the viewpoint that effortful control and EF are overlapping constructs, although the inhibition component of EF does not appear to be significantly related to effortful control (Bridgett et al., 2013). Others call for a distinction between EF and effortful control (e.g., Blair & Razza, 2007; Blair & Ursache, 2011; Liew, 2012). It may be better described as a skill that comes online after EF matures because effortful control can be described as inhibiting an automatic, dominant response to exhibit a less salient, non-automatic response, which is supported by neuroscience models and corresponding research (Rothbart & Bates, 2006).

Three aspects of EF have been identified: working memory, inhibitory control, and attentional or cognitive flexibility. Working memory relates to keeping information in one's mind and processing or operating on it. Inhibitory control is the action of stopping an impulsive response. Finally, attentional or cognitive flexibility, also sometimes referred to as attention shifting, is comprised of volitional focus and sustained attention, ignoring distractions, and shifting attention among related parts of a task when necessary (definitions adapted from Davidson, Amso, Anderson, & Diamond, 2006; Garon, Bryson, & Smith, 2008; McClelland & Cameron, 2012; Zelazo & Müller, 2002). Overall, this set of EF components are part of the

metacognitive processes that regulate thoughts and behaviors, and these aspects are both separate and distinguishable from each other as well as correlated components working as a unitary system (Miyake & Friedman, 2012; Miyake, Friedman, Emerson, Witzki, Howerter, & Wager, 2000). Namely, EF processes appear to use cognitive capacities in a goal-directed way to regulate behavior, such as by modifying automatic responses. However, it should be noted that the specific definition of EF and the complexities of how aspects of EF co-occur continue to be debated and researched (Jurado & Rosselli, 2007; Zelazo, Carter, Reznick, & Frye, 1997).

Regardless of the overlap between EF components and related constructs, EF is often viewed and researched as a cognitive aspect of the overarching construct of SR that emphasizes goal-directed actions through cognitive and affective control and information coordination (Blair, Berry, & Friedman, 2012). In contrast, others like Smith-Donald, Raver, Hayes, and Richardson (2007) conceptualize EF as the exhibition of attentional and planning skills that develop out of children's attentional SR processes. Given the variation in the ways these constructs are conceptualized and measured in conjunction with evidence that these concepts may overlap, more research is needed to clarify the relationships between these constructs.

Importance and Relation to Academic Achievement

Substantial research supports the notion that SR and related constructs, such as EF, in young children predict overall academic achievement in school (Monette, Bigras, & Guay, 2011; Valiente, Lemery-Chalfant, Swanson, & Reiser, 2008; Willoughby et al., 2012). Moreover, some research has delineated that academic achievement in the specific area of math can be predicted by aspects of SR and EF (e.g., Bull, Espy, & Wiebe, 2008; Clark, Pritchard, & Woodward, 2010; Espy, McDiarmid, Cwik, Stalets, Hamny, & Senn, 2004; Passolunghi, Mammarella, & Altoe, 2008). Research also supports this relationship with reading and literacy

(Altemeier, Abbott, & Berninger, 2008; Liew, McTigue, Barrois, & Hughes, 2008; Sesma, Mahone, Levine, Eason, & Cutting, 2009), and additional research findings have shown support for both math and reading (Best, Miller, & Naglieri, 2011; Blair & Razza, 2007; McClelland, Acock, & Morrison, 2006; McClelland, Morrison, & Holmes, 2000). In addition, SR is predictive of achievement even after controlling for initial achievement levels, EF, and IQ (Blair & Razza, 2007; McClelland et al., 2006; McClelland et al., 2007; McClelland et al., 2000; Van Suchodoletz, Trommsdorff, Heikamp, Wieber, & Gollwitzer, 2009; Welsh, Nix, Blair, Bierman, & Nelson, 2010). Similarly, even when accounting for demographic variables, such as gender, age, parent education, and ethnicity, SR remains correlated with achievement (Matthews, Ponitz, & Morrison, 2009; Ponitz, McClelland, Matthews, & Morrison, 2009).

Additional research has delineated that while EF skills specifically influence academic achievement, achievement does not seem to influence EF (Best et al., 2011; Bull et al., 2008). The individual components of SR and EF are also correlated with achievement. Working memory is related to math and reading in elementary school (Gathercole & Pickering, 2000; Kail, 2003) and related to English and math in middle school (St Clair-Thompson & Gathercole, 2006). Inhibitory control is related to math, letter knowledge, English, and science (Blair & Razza, 2007; St Clair-Thompson & Gathercole, 2006), and attention shifting predicts literacy and mathematics achievement throughout school (Duncan et al., 2007). Research has also demonstrated that classmates' SR skills better predicted other students' academic outcomes in literacy over students' own SR skills at the beginning of the year (Skibbe, Phillips, Day, Brophy-Herb, & Connor, 2012). Peer influence on SR clearly has implications for students' academic gains, further highlighting the relationship between SR and academic achievement as well as the context for developing both in students.

Measurement of EF and SR

It is important to keep in mind some known issues to consider in comparing different measures of SR and EF. First, the integration of EF components is a stronger predictor of achievement than individual measures of components, especially for preschoolers (Garon et al., 2008; Wiebe & Espy, 2008; Wiebe, Sheffield, Nelson, Clark, Chevalier, & Espy, 2011; Willoughby et al., 2012). Additionally, EF and SR overlap theoretically, and the question has been asked if whether both constructs are necessary in explaining the manifestations of these processes on behavior (Morrison et al., 2010). Indeed, not all studies measure all aspects of EF or SR overall given the definitional discrepancies in the literature and general framework used in the discipline. Furthermore, tasks designed to measure individual components of working memory and inhibitory control have been shown to measure the same abilities in some studies of preschool children (Wiebe, Espy, & Charak, 2008), providing evidence for potential overlap among constructs and abilities that may not yet have stabilized or matured. Ecological validity for an integrated concept of EF has been enhanced by studies like Willoughby, Wirth, and Blair's (2011) demonstrating support for a latent variable reflective of the integrative nature of EF in preschool. Additionally, Wiebe, Espy, and Charak's (2008) study evidencing the three components constituting one dimension support an integrated construct of EF. Smith-Donald, Raver, Hayes, and Richardson (2007) evaluated a measure of the broad, overarching construct of SR using both direct assessment and teacher reports. Analyses revealed support for domains of emotion, attention, and behavior regulation with significant overlap between the constructs of attention and behavioral regulation. Clearly, as previously mentioned, more research is needed that evaluates the relationships between EF and SR, as well as the relationships between these constructs and other variables.

Willoughby, Blair, Wirth, Greenberg, and the Family Life Project Investigators (2012) described and evaluated a battery of six executive function tasks with five-year-old children, which included Working Memory Span, Pick the Picture, Spatial Conflict Arrows, Something's the Same, Silly Sounds Stroop, and Animal Go No-Go. Using confirmatory factor analysis, they concluded that the task scores were best represented by a single latent factor regardless of whether the children were from a low-income background or not. This single latent factor identified from a battery of executive function tasks further provides evidence for the notion of an integrated concept of executive functioning at least in early childhood. Unfortunately, others have demonstrated that aggregates of EF may not be justified given low intercorrelations (Archibald & Kerns, 1999; Blair, 2003; Hongwanishkul, Happaney, Lee, & Zelazo, 2005; Lan et al., 2011). Furthermore, individual tasks often have poor internal consistency and low test-retest reliability (Denckla & Reiss, 1997; Miyake et al., 2000). Thus, Willoughby, Wirth, and Blair (2011) called for future studies exploring EF dimensions in early childhood to ensure that tasks measuring inhibitory control, working memory, and attention shifting have comparable reliability levels. EF and effortful control also are postulated to overlap to a large extent with modest correlations between certain measures of the constructs (Blair, 2003), leading to a call for an integrated approach to the study of SR (Zhou et al., 2012).

SR is difficult to measure directly, and some have chosen to conceptualize SR as emotional, behavioral, and cognitive manifestations of adaptive control that underlie more mature childhood behavior and adaptive functioning (Calkins & Marcovitch, 2010). It follows that SR processes are the result of complex, integrated sub-processes of emotional, behavioral, and cognitive control thus allowing more developmentally advanced skills, such as academic or social competence (Calkins & Marcovitch, 2010). Furthermore, given Kopp's (1982)

perspective that SR emerges out of developmental stages and that children do not fully reach the SR phase until preschool age, precursors may be measurable before such a time but may not fully encapsulate SR as a construct. Accordingly, aspects of regulation are typically measured in naturalistic contexts to identify the manifestations of skills and providing evidence for the relationship between early EF skills and behavioral outcomes (Morrison et al., 2010). Some researchers have explored measures of SR specifically through parent and teacher reports, allowing for an examination of such skills in context. The Strengths and Difficulties Questionnaire (SDQ; Goodman, 2005) is one such questionnaire that gathers reports of observed behaviors representing psychological attributes and adjustment. The SDQ includes items regarding emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and prosocial behavior; these attributes can be conceptualized as manifestations of SR processes in the classroom when ratings are provided by teachers.

Classroom Quality and Relation to EF and SR

Classroom quality is another construct related to SR and achievement. Higher quality instruction and closer teacher-child relationships are related to higher academic outcomes (Howes, Burchinal, Pianta, Bryant, Early, Clifford, & Barbarin, 2008). Higher quality preschool classrooms and childcare specifically are related to the ease with which children transition to kindergarten (Magnuson, Rhum, & Waldfogel, 2007). Moreover, instructional interactions predict academic skills, and emotional interactions predict social skills, which are important for academic success (Mashburn, Pianta, Hamre, Downer, Barbarine, Bryant, & Burchinal, 2008). In one study, print exposure did affect learning but, interestingly, overall classroom quality further impacted the gains students made (McGinty, Justice, Piasta, Kaderavek, & Fan, 2012). Overall, teacher-child interactions or emotional support, classroom organization and

management, and instructional support have been linked to academic achievement and are considered evidence for high quality classrooms (La Paro, Pianta, & Stuhlman, 2004). The Classroom Assessment Scoring System (CLASS; Pianta, La Paro, & Hamre, 2008) is one measure that was thus developed to assess classroom quality based on empirical support for these constructs.

Teacher-student relationships and effortful control have also been shown to be related to later achievement even when controlling for prior effortful control and achievement as well as clustering effects; furthermore, having positive teacher-student relationships has been shown to be a protective factor for achievement for students with low effortful control (Liew, Chen, & Hughes, 2010). Other specific aspects of classroom quality, including positive emotional tone, greater approval of behavior rather than disapproval of behavior, and instructional quality, are related to academic and SR gains (Fuhs, Farran, & Nesbitt, 2013). Teacher sensitivity (Rimm-Kaufman, et al., 2002) and clear and organized rules, procedures, and activities have also been shown to be related to behavioral regulation skills (Pressley, Rankin, & Yogkoi, 1996). SR may relate to higher academic engaged time, which is correlated with achievement even in preschool and elementary school (Carta, Greenwood, & Robinson, 1987; Greenwood, 1991), and to classroom quality and management, which is related to higher engagement as well as cognitive and behavioral self-control (Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009). Overall, high quality classroom indicators -- such as consistent behavior management, emotional support, and assistance that is supportive but not directive -- seem to be related to SR development and the successful implementation of those skills in school functioning (Morrison et al., 2010).

Some preschool and elementary programs have been designed specifically to reduce internalizing and externalizing behaviors and improve EF and SR skills in young children. This tactic is relevant given research indicating that SR skills are predictive of school readiness and early academic skills even when controlling for cognitive ability (Blair & Razza, 2007). The PATHS curriculum was designed to focus on self-control and social and emotional competence, and it has been associated with reduced problem behaviors across a number of populations as well as improvements in prosocial behavior and academic engagement when embedded in the Fast Track prevention program (Conduct Problems Prevention Research Group, 2010). Evidence for the PATHS curriculum also demonstrates that its effects are sustained over several years even for students with disabilities (Kam, Greenberg, & Kusche, 2004). The relationship between the intervention and behavior problems appears to be partially mediated by inhibitory control, thus lending support to the notion that intervention programs can improve at least some EF skills (Riggs, Greenberg, Kusche, & Pentz, 2006). Similarly, the Tools of the Mind curriculum, based on Vygotskyian theory of EF development, demonstrated improvements in EF in preschool children from low-income families (Diamond, Barnett, Thomas, & Munro, 2007). Specifically, children from schools who were randomly assigned to use the Tools of the Mind curriculum performed significantly better on tasks assessing inhibition, working memory, and cognitive flexibility than children attending schools assigned to continue with the established curriculum.

Other studies have more directly looked at the existing relationships between aspects of classroom quality, EF, and SR. Fuhs, Farran, and Nesbitt (2013) explored the relationships between certain qualities of classroom processes and preschool students' cognitive SR with a diverse sample (N = 803) of preschoolers. Fuhs et al. (2013) postulated that greater knowledge

about classroom occurrences is needed before definitive conclusions can be drawn that SR is not malleable in preschool classrooms. Consequently, they examined emotional climate, time spent in learning opportunities, and instructional quality to measure classroom processes in relation to children's cognitive SR gains, as measured by a battery of EF tasks, over the course of the preschool year. They found that teacher demonstrations of approval of student behavior were significantly related to cognitive SR gains in addition to overall instructional time and quality of instruction. These results demonstrated that classroom processes and quality are important for preschool students' cognitive SR skills using direct assessments of such skills. These findings add to the literature by demonstrating how preschool classroom variables are related to aspects of SR. Although the study used the term 'cognitive SR,' these skills were measured with a battery of EF tasks; consequently, interpretation and application of these results should be limited to this narrower conceptualization of EF. In addition, interpretations are also limited to specific teacher acts of behavior approving rather than overall classroom quality.

Rimm-Kaufman, Curby, Grimm, Nathanson, and Brock's (2009) study added to the literature on the relationships between classroom quality and SR through observations of overall classroom quality and aspects of SR assessed directly and via teacher reports. Rimm-Kaufman and colleagues attempted to capture the overall construct of SR in their study because they wanted to focus on how SR, and the interrelation of emotion, attention, behavior, and cognition, is important in the classroom during kindergarten. Thus, they also considered adaptive behaviors in the classroom that tend to require greater SR skills. The relationships between these constructs were tested with a sample (N = 172) of rural kindergarteners from low-SES backgrounds. Spaced over the course of the school year, five classroom observations were conducted using the CLASS (Pianta et al., 2008) as a measure of classroom quality. SR was

directly assessed at the beginning of the school year using a series of tasks designed to elicit behavioral, cognitive, and emotional self-regulatory skills. Additional aspects of SR and adaptive classroom behaviors (specifically behavioral and cognitive self-control) were measured through teacher-completed questionnaires at the end of the school year. Higher levels of directly assessed SR in the fall were related to higher rates of teacher-reported behavioral and cognitive self-control in the spring. Better classroom management, one aspect of classroom quality, was also related to greater behavioral and cognitive self-control. The researchers hypothesized that well-managed classrooms might encourage the development of SR over regulation by others. However, emotional support was not related to either of these adaptive classroom behaviors, while instructional support was negatively related to cognitive self-control. This negative relationship was surprising and was theorized to possibly being due to teachers having higher expectations or placing greater demands on students occurring in relation to providing more instructional support. Overall, some support emerged regarding classroom quality's relation to behavioral and cognitive aspects of adaptive behaviors in the classroom as being governed largely by SR processes. Although these researchers considered the emotional regulation aspect of SR when measuring SR in the beginning of the school year, they did not address the emotional regulatory abilities in relation to classroom quality. Furthermore, these relationships were examined with a sample of kindergarteners. Perhaps overall classroom quality or specific aspects of classroom quality (i.e., emotional support and instructional support) are more important for SR during preschool; thus, there is room for additional research to clarify these relationships.

Gunter, Caldarella, Korth, and Young (2012) also examined aspects of classroom quality and SR in preschool children. However, this study varied from Fuhs et al.'s (2013) and Rimm-

Kaufman et al.'s (2009) studies by focusing specifically on emotion regulation and student-teacher relationships. These authors explored the effects of the *Strong Start Pre-K* curriculum on preschool students' emotion regulation skills and internalizing behaviors with a sample of diverse preschoolers ($N = 84$). *Strong Start Pre-K* is a structured curriculum focusing on the cognitive, social, and emotional needs of children in order to increase social and emotional learning and prevent emotional and mental health problems. Classrooms were randomly assigned to the experimental condition in which this curriculum was implemented or to an unspecified control condition. Teacher-completed rating scales assessed students' emotion regulation and internalizing behaviors as well as student-teacher relationships. Although all students' emotion regulation increased over the 12-week implementation period, no interaction between time and treatment group was found. Internalizing behaviors decreased significantly more for students in the treatment condition, whereas student-teacher relationships increased significantly only when booster sessions were added to the treatment condition (Gunter, Caldarella, Korth, & Young, 2012).

Given the lack of differences in emotion regulation gains between treatment groups, growth for all children was attributed to classroom interactions with teachers and peers and typical development (Gunter et al., 2012). However, the decrease in internalizing behaviors in conjunction with better student-teacher relationships for students in the experimental condition could potentially indicate that classroom quality remains an important factor for emotional well-being. A number of limitations exist for this study and warrant further research in this area. Specifically, teachers both implemented the curricula and rated students, which could serve to bias the ratings (Gunter et al., 2012). In addition, the sample size for this study was relatively small and may not have been large enough to detect differences. Finally, the relationship

between student-teacher relationships and emotion regulation was not examined directly. The finding that both emotional well-being and student-teacher relationships increased may indicate that a relationship exists and should be explored further.

Given these various examples of the relationship between a number of aspects of classroom quality and a variety of SR skills, a relationship between the global constructs of classroom quality and SR seems likely. However, the relationship between early EF skills and SR in context should also be considered. The relationship between EF and manifestations of SR in context may be explained by a developmental hierarchical model whereby early EF skills are necessary for the development of SR abilities as early regulation in a toddler's life may lead to tendencies that form a child's intentional SR around school age (Calkins, 2007; Morrison et al., 2010). Given the theoretical and empirical relationship between EF and SR, it is possible that early EF skills may alter the influence of other factors that support or hinder the development and manifestation of SR in natural contexts, such as aspects of classroom quality.

Unfortunately, differences in EF often already exist for students from low-SES backgrounds, so the need for intervention or support for the development of SR may be even greater for these children. Children from low-SES backgrounds tend to have lower EF skills than their middle-SES counterparts (Noble, McCandliss, & Farah, 2007; Noble, Norman, & Farah, 2005). This relationship is mediated by differences in language ability, school environment, and home environment (Noble et al., 2007; Noble et al., 2005). Morrison and colleagues (2010) have theorized that teaching classroom expectations and providing time to practice regulatory skills will allow all students, but particularly those without strong EF or SR skills to begin with, to develop their skills for better adaptation and school-related outcomes.

Thus, more research is needed on the links between classroom quality, SR, and EF for children living in poverty.

Summary

To summarize, current evidence demonstrates that certain aspects of classroom quality have been linked to the various aspects of SR from effortful control overall (Liew, Chen, & Hughes, 2010), to cognitive SR (Fuhs et al., 2013), to cognitive and behavioral self-control (Rimm-Kaufman et al., 2009), and to emotion regulation (Gunter et al., 2012). Given the debate in the literature on the overlapping nature of EF and SR constructs and components and whether integrated constructs are warranted, it is prudent to explore the relationship between classroom quality and the constructs of EF and SR. Such an exploration would aid in the understanding of the relationship between EF and SR as well as the effect of classroom quality on student outcomes. Additionally, some studies have used direct assessments while others utilized reports from caregivers. Both methods of measurement have utility but may not capture the complex interrelationships. Conceptualizing the measurement of SR as a broad construct characterized by SR processes observable by caregivers may clarify the complicated relationships between EF and SR and other constructs like classroom quality. Such measurement would demonstrate how children handle challenges in applied, real-life school situations. This method of measurement differs from the commonly used direct assessment of EF skills in that it helps to reveal how children apply SR processes in observed daily life contexts. To elucidate these relationships, examining the relationship between classroom quality and SR and exploring whether EF affects that relationship is essential. In addition, it would be beneficial to compare this proposed moderating relationship between children from high or low poverty backgrounds to determine whether any differences are related to poverty. Previous research has shown that students from

low-SES backgrounds tend to have lower EF skills (Noble, McCandliss, & Farah, 2007; Noble, Norman, & Farah, 2005), so additional research exploring the difference that variations in classroom quality have for these children is warranted. This study explored the relationship between preschool classroom quality and manifestations of SR as observed by teachers in an attempt to identify whether EF moderates that relationship. This study next considered the association between classroom quality for children living in poverty by examining whether classroom quality affects children's SR over and above EF and poverty status.

Research Questions and Hypotheses

Given these areas in need of greater research, the first research question was as follows: (1) What is the association between preschool classroom quality on classroom SR skills? It was hypothesized that higher classroom quality in preschool would be related to higher classroom SR skills. This hypothesis is supported by research demonstrating higher levels of the various aspects of SR given higher levels of classroom quality aspects previously discussed (e.g., Fuhs et al., 2013; Gunter et al., 2012; Rimm-Kaufman et al., 2009). Subsequent to my first question, the second research question follows: (2) Do EF skills moderate the relationship between classroom quality and classroom SR skills? It was hypothesized that EF skills would moderate the relationship given the theoretical and empirical overlap in EF and SR; it follows from this overlap that EF skills would have an influence on outcomes related to observable SR functioning. Furthermore, the hierarchical model of SR proposed by Calkins (2007) in which EF skills influence SR abilities also lends credence to the moderating relationship of EF on classroom quality and classroom SR processes. The third research question focuses on children living in poverty: (3) Is the effect of classroom quality on SR skills significant over and above EF skills and living in poverty (i.e., is classroom quality related to SR skills when controlling for

EF skills and poverty status)? Unfortunately, a paucity of research exists on the relationship between changes in EF or SR skills in relation to classroom quality for children from low-SES backgrounds. Given evidence of lower EF skills for children from low-SES backgrounds that seems to be mediated by language ability, school environment, and home environment, it seems plausible that children who have the advantage of higher quality classrooms may also have higher classroom SR skills despite having originally lower EF skills than their higher-SES counterparts have. It was therefore hypothesized that classroom quality would be an especially important factor for children living in poverty over and above the effect of poverty status and EF skill. It was further hypothesized that the importance of classroom quality would be indicated by demonstrations of higher SR skills for children living in poverty who were also in higher quality classrooms.

Chapter 2: METHOD

Participants

Extant data from the Family Life Project, a longitudinal research study of rural family life and child development, was used for the current study. Participants were recruited at birth beginning in 2004, and 1,292 families from six rural counties in Pennsylvania and North Carolina have participated in the study. The data targeted for use in the current study were collected in the home and preschool settings when the children were 4 and 5 years old. Data were available from children (N = 877; 429 females, 448 males) who were enrolled in a preschool or center (94%), attended child care in a home setting (1.5%), received home-based care by a relative (2.2%), received home-based care in the child's home by a non-relative (e.g., nanny; .2%), or received home-based care by the child's mother (.8%); child care was missing or not indicated for four children (.5%). Students were observed in a total of 493 classrooms. Stratified random sampling was used to recruit families with an overrepresentation of low-income families and African American families in North Carolina children. Of the children included in this study, 55.5% were White, 43.1% were Black/African American, and 1.3% were from other ethnic groups. Of all the families, 33.5% of the sample were identified as in poverty, and 63.3% lived above the poverty threshold. Finally, 57.6% of the children were from North Carolina, and 42.4% were from Pennsylvania. Participant demographics are presented in Table 2. Missing data were identified for up to 218 participants with an average of 8% missing across variables; the data were analyzed for patterns. The cases were determined to be missing completely at random using Little's MCAR test, χ^2 (530) = 500.13, p = .820. Mean substitution was used to conservatively estimate missing values (Tabachnick & Fidell, 2007).

Table 2

Participant Distribution by State, Race, and Poverty Status (N =877)

	NC participants		PA participants		
Race	In Poverty	Not In Poverty	In Poverty	Not In Poverty	Subtotals
White	33 (7)	103 (20)	75 (20)	276 (74)	487 (56)
Black/African American	169 (33)	189 (37)	13 (3)	7 (2)	378 (43)
Other	3 (1)	8 (2)	1 (0)	0 (0)	12 (1)
Subtotals	205 (41)	300 (59)	88 (24)	283 (76)	877 (100)

Note. Parenthetical values are percentages.

Measures

Classroom Assessment Scoring System (CLASS). The preschool version of the Classroom Assessment Scoring System (CLASS; Pianta et al., 2008) is a measure of classroom quality based on teacher-student interactions (La Paro et al., 2004). Three domains are the focus of this measure: Emotional Support, Classroom Organization, and Instructional Support. These areas are judged based on range, frequency, intention, and tone of the behaviors of individuals and interactions while focusing mainly on the teacher. Means for the dimensions are calculated to create a composite across the two cycles, and then domain composites are calculated from means across dimensions falling under the domains. Specifically, the Emotional Support domain is comprised of the following dimensions: positive climate, reversed negative climate, teacher sensitivity, and regard for student perspectives. The Classroom Organization domain is comprised of behavior management, productivity, and instructional learning formats, and the Instructional Support domain is comprised of concept development, quality of feedback, and language modeling. The instrument has strong internal consistency reliability for the three

domains, ranging from .76 to .94 (Pianta et al., 2008). Strong interrater reliability during data collection was also established through a three-day training and reliability testing for research assistants; research assistants had to score within 1 of the master code on 80% of all codes and within 1 of the master code on each dimension for at least 2 out of 5 practice video segments. Criterion validity evidence has also been demonstrated via moderate to large correlations ranging from .33 to .63 with another commonly used measure of early childhood classroom quality, the Early Childhood Environment Rating Scale, Revised Edition (Cohen, 1992). In addition, scores from the CLASS have been shown to be associated with academic performance throughout preschool and at the end of preschool (Pianta et al., 2008). Some disadvantages of this measure have been identified, however. Specifically, examinations of structural validity indicate variability on best fitting models (i.e., variability of structures for different grade levels) examined in various studies (Sandilos, Shervey, DiPerna, Lei, & Cheng, 2016).

Executive Function Battery. The measures of EF came from an established battery of EF instruments intended to measure the inhibitory control, working memory, and attention flexibility or shifting aspects of EF (Willoughby et al., 2012). The battery consists of the following six tasks: a working memory span task (i.e., Operation Span), a working memory self-ordered pointing task (i.e., Pick the Picture), a spatial conflict inhibitory control task (i.e., Spatial Conflict Arrows), a task of flexible item selection and attention shifting (i.e., Something's the Same), a Stroop-like inhibition task (i.e., Silly Sounds Stroop), and a go/no-go inhibition task (i.e., Animal Go No-Go). Research by Willoughby, Blair, and the Family Life Project Investigators (2015) has indicated that an overall mean score created from the percent correct scores of the tasks of interest may best represent the EF variable (i.e., from this method the EF variable is defined or informed by performance across tasks, which is in contrast to typical

methods that use factor analytic strategies to reflect the EF construct – rather, task performance is reflective of the construct). Statistical analyses indicated that EF as a construct measured by these tasks at three years old accounted for large amounts of variance on cognitive ability tasks at three years old (i.e., 42% on Wechsler Preschool and Primary Scales of Intelligence [WPPSI-III] Block Design and 54% on WPPSI-III Vocabulary; Willoughby, Blair, and The Family Life Project Investigators, 2015). Furthermore, the EF construct accounted for large amounts of variance on academic achievement indicators in Kindergarten (ranging from 41-47%) on early reading and math subtests of the Woodcock-Johnson III tests of achievement and the early childhood longitudinal program kindergarten (ECLS-K) math assessment, thereby demonstrating criterion validity for use of these tasks in the measurement of EF. Finally, comparisons of model fit indicated better fit for EF tasks as formative indicators (e.g., means of percent scores correct) than as reflective indicators (e.g., factor score estimates) of the EF construct within models predicting IQ, achievement, and parent ratings of Attention-Deficit/Hyperactivity Disorder (ADHD; Willoughby et al., 2015).

Classroom Self-Regulation. The measure of classroom SR represented by observed classroom behaviors was drawn from items of the Strengths and Difficulties Questionnaire (SDQ; Goodman, 2005). The SDQ is a measure typically completed by parents or teachers designed to assess psychological attributes representing emotional symptoms, conduct problems, hyperactivity, peer problems, and prosocial behaviors in 3 to 16 year olds. These subscales, excluding prosocial behaviors, are combined to form a total difficulties score. This measure can be used to screen for and assess psychiatric symptoms, but it is broadly a measure of psychological adjustment. Although no previous research has been identified using this questionnaire explicitly as a measure of SR skills, items related to classroom behaviors

potentially indicative of SR in a classroom context were identified. Furthermore, parent ratings of self-regulation have been shown to predict teacher ratings of social behaviors as measured by the SDQ (Mathieson &Banerjee, 2010).

Responses to the 25 items are provided through a 3-point Likert scale with response options including *Not True*, *Somewhat True*, and *Certainly True*. Psychometric properties for the overall scale have been examined with various populations. A meta-analysis of 48 studies including children 4 to 12 years old (N = 131,223) provided evidence for internal consistency (.53 to .76 for parents; .63 to .83 for teachers), test-retest reliability (.65 to .71 for parents; .72 to .85 for teachers), and interrater agreement (.26 to .47) across subscales for parent and teacher reports (Stone, Otten, Engels, Vermulst, & Janssens, 2010). Furthermore, validity evidence comes from consistent documentation of a five-factor structure and correlations with other measures, such as the Child Behavior Check List (CBCL; r = .76), the ADHD-RS-IV (r = .50), the Child Depression Inventory (CDI-P; r = .73), and the Revised Children's Manifest Anxiety Scale (RCMAS-P; r = .72) on parent rating scales (Stone et al., 2010). Sixteen items were identified that coincided with the previously described construct of SR (see Appendix A). Items were selected from each subscale and were analyzed using factor analysis described in the Design and Data Analysis section below.

Income Related Information. To address the third research question, students were compared based on whether or not their families met the poverty status criteria. Household income was calculated based on the following: reported annual income of the primary caregiver and secondary caregiver, if available; annual contributions to the household of all others in the household; and other sources of income, including unemployment insurance, worker's compensation, Social Security retirement, other pension, cash income from welfare,

Supplemental Security Income, child support interest/dividend income rental income, alimony, regular help from relatives, regular help from friends, educational grants not intended to be paid back, and other income not otherwise noted. Then, poverty status was determined by income-to-needs ratio based on US Census Bureau poverty thresholds which vary based on size of family and ages of family members. In the current study, students whose families' ratios fell below the threshold were identified as in poverty, and those whose family ratios were above the threshold were identified as not in poverty.

Procedures

Home visits were scheduled with the children's families around the time the child was 4 years old. During these visits, children were given a battery of six EF tasks described above. These visits occurred regardless of whether the children were enrolled in preschool but typically occurred from the summer before the cohort prekindergarten academic year through the beginning of the prekindergarten academic year. Children's preschool classrooms were then observed in the fall of prekindergarten using the preschool version of the CLASS. The observations were modified slightly from typical usage by observing for two 30-minute cycles as opposed to the suggested four to six 30-minute cycles. However, correspondence between FLP researchers and researchers at the University of Virginia where it was developed confirmed that two cycles totaling 1 hour had been tested and concluded to be valid. During the observations, cycles consisted of 20 minutes of observing behaviors and note-taking followed by 10 minutes of coding scores. Preschool teachers also completed the SDQ in the spring of the prekindergarten school year around February through June.

Design and Data Analysis

Exploratory Factor Analysis (EFA). Exploratory Factor Analysis (EFA) was applied to 16 SDQ items (see Appendix A) potentially indicative of SR in a classroom context based on a theorized latent variable of classroom adjustment representing classroom SR. It should be noted that some items (i.e., 2, 5, 12, 15, 16, 18, and 22) were reversed to positively reflect self-regulatory skills in the classroom. According to Fabrigar, Wegener, MacCallum, and Strahan (1999), EFA may be preferable to use instead of confirmatory factor analysis when there is little empirical basis for assumptions on how many factors exist or the most plausible model(s). Although a latent process underlying classroom SR was theorized, previous research on the overall assessment incorporated all 25 items and supported a five-factor solution. As this study focused on 16 specific, targeted items, the use of EFA with subsequent CFA as deemed appropriate was selected to determine the most appropriate number of factors and pattern of factor loadings from the specified items.

Regression Analyses. Next, regression was used to examine the effect of classroom quality on classroom SR and determine whether higher classroom quality predicts higher classroom SR, controlling for demographic variables (participant state, race, and sex). Following this initial analysis, multiple regression analyses was used to test whether EF has a moderating effect on that relationship, controlling for the same demographic variables. The hypothesized relationship is presented in Figure 1. Multiple regression analyses were also used to test the third hypothesis exploring the influence of poverty status. Specifically, hierarchical regression was used to assess whether classroom quality has a significant effect on SR skills over and above poverty status when controlling for demographic variables and, in a second hierarchical

regression analysis, over and above EF skills and poverty status, again controlling for demographic variables.

Chapter 3: RESULTS

Exploratory Factor Analysis (EFA)

EFA was conducted on selected items from the SDQ to identify items potentially indicative of an SR construct. The sample size (N = 877) was determined to be adequate for factor analysis (Comrey & Lee, 1992). The underlying assumptions of normality, linearity, and multicollinearity were assessed. An examination of histograms indicated deviations from normality. An examination of skew (< |2|) and kurtosis (< |7|) values (Curran, West, & Finch, 1996) revealed most of the specified SDQ variables items approached normality, but the skew and/or kurtosis values for the following four items were above the minimum values: Item 8 (skew = 2.13), Item 12 (skew= -2.13), Item 18 (skew= -3.01, kurtosis= 8.86), Item 22 (skew = -7.09, kurtosis = 55.00). These items represent more severe social/emotional difficulties and behaviors (i.e., often worries, fights or bullies, lies or cheats, or steals) that are typically uncommon in early childhood, so these data likely reflect the population. As a result, no transformations were conducted. Upon inspection of scatterplots to assess for linearity, departure from linearity was observed; however, there was no evidence of curvilinearity. Mahalanobis distance test revealed four potential outliers. An examination of the data for these participants seemed to suggest higher ratings of negative behaviors. To include the range of the behavioral implications, the data were run with the cases included and with the cases removed. Assumptions were not improved by removing the four cases so additional analyses were not performed and further results are reported with inclusion of those four cases. Finally, no multicollinearity emerged when correlation matrices (<.90), tolerance levels (>.10), and variance inflation factors (<10; Field, 2009; Kline, 2011) were used. It should be noted that the generalizability of the results from this sample is limited because of the violation of linearity and

some violations to normality for some items (Field, 2009). Descriptive statistics for the 16 items are presented in Table 3.

After examining assumptions, a series of tests to examine factorability were conducted and EFA was determined to be appropriate: (a) Bartlett's Test of Sphericity (Bartlett, 1950) χ^2 (120) = 5835.77, $p < .01$; (b) Kaiser-Meyer-Olkin (KMO; Kaiser, 1974) = .91; (c) Determinant = .001. Next, a principal axis extraction method of EFA was conducted using SPSS version 23. Given the deviations from normality, principal axis extraction was used due to its relative tolerance for non-normality (Briggs & MacCallum, 2003). With the aim of determining the number of factors to retain, Parallel analysis (Horn, 1965), and Minimum Average Partial (MAP; Velicer, 1976), Scree test (Cattell, 1966), and percentage of variance explained were used for factor retention criteria. Visual examination of the scree plot indicated four factors, and Parallel analysis indicated retention of three factors and three factors accounted for 50% of the total variance. However, MAP indicated retention of one factor, which was consistent with the theorized latent structure. As a result, the three- and one-factor solutions were examined, using both Varimax and Direct Oblimin rotations for the three-factor solution, to achieve simple structure and for comparative purposes. Findings from both rotation methods yielded similar results.

A priori criteria were used for determining the final solution to interpret (Costello & Osborne, 2005): statistical significance, (b) practical significance, (b) minimum number of items with a salient loading on a factor, (c) no complex loadings, (d) minimum reliability estimate of scores for each factor, and (d) theoretical meaningfulness. Structure coefficients greater than or equal to |.17| were required for statistical significance (Norman & Steiner, 2000) and those greater than or equal to |.40| were determined to be practically significant (Tabachnick & Fidell,

2007). Complex loadings that were salient on more than one factor were rejected for simple structure (Thurstone, 1947). A factor solution was considered adequate if it had a minimum of three salient loadings for each factor, an internal consistency of scores equal to or greater than .70, and theoretical meaningfulness (Tabachnick & Fidell, 2007). The three-factor solution did not meet these criteria due to several complex loadings across factors and an insufficient number of practically significant loadings on the third factor. The one-factor solution did meet these criteria and was selected for interpretation.

Thirteen of the 16 selected SDQ items had salient loadings in the one-factor solution, which accounted for 38.86% of the total variance. Items 8, 16, and 22 did not meet a priori criteria for practical significance and Item 8 also did not meet criteria for statistical significance for saliency. Upon further examination, Items 8 and 16 seemed to relate more to emotional regulation (i.e., often worries and nervous in new situations), while Item 22 reflected the severe behavior of stealing that is rarely seen in children targeted in this sample. An examination of Item-Total correlations indicated that Items 8, 16, and 22 also had low correlations to the overall measure (-0.12, 0.16, and 0.27, respectively). As a result, the model was re-examined removing Item 8 and re-examined removing Items 8, 16, and 22. Removing these three items improved internal consistency estimates, and the subsequent one-factor solution accounted for an overall 46.78% of the total variance.

This final one-factor solution included thirteen items with salient structure coefficients ranging from .47 to .822 (*Mdn* = .67). The internal consistency for the scores was .90. These items were consistent with the theorized Self-Regulation factor. Communalities and structure coefficients for the one-factor structure are reported in Table 3. This one-factor solution is represented in Figure 2. Additional solutions examined are reported in Appendix B.

Table 3

Descriptive Statistics and Factor Structure Coefficients for Principal Axis Extraction of the Final Unrotated One Factor Structure with Selected Items from the Strengths and Difficulties Questionnaire (N = 877)

Item	Mean	Standard Deviation	Skewness	Kurtosis	Factor I	h^2
Item 1: Considerate of other people's feelings	1.48	0.56	-0.60	-0.49	**.695**	.482
Item 2: Restless, overactive, cannot stay still for long	1.48	0.72	-1.06	-0.28	**.683**	.466
Item 4: Shares readily with other children, for example toys, treats, pencils	1.49	0.58	-0.74	-0.29	**.675**	.456
Item 5: Often loses temper	1.72	0.57	-2.00	2.89	**.656**	.431
Item 7: Generally well behaved, usually does what adults request	1.58	0.59	-1.20	0.48	**.822**	.675
Item 8: Many worries or often seems worried	0.22	0.46	2.13	3.93	-	-
Item 12: Often fights with other children or bullies them	1.74	0.53	-2.13	3.61	**.700**	.491
Item 14: Generally liked by other children	1.73	0.48	-1.59	1.72	**.626**	.392
Item 15: Easily distracted, concentration wanders	1.33	0.73	-0.65	-0.84	**.639**	.408
Item 16: Nervous or clingy in new situations, easily loses confidence	1.63	0.59	-1.43	1.06	-	-

Item 17: Kind to younger children	1.61	0.52	-1.03	0.15	**.576**	.332
Item 18: Often lies or cheats	1.85	0.41	-3.01	8.86	**.511**	.261
Item 20: Often offers to help others (parents, teachers, other children)	1.47	0.60	-0.74	-0.30	**.474**	.224
Item 21: Thinks things out before acting	1.07	0.59	-0.04	-0.18	**.672**	.451
Item 22: Steals from home, school, or elsewhere	1.97	0.20	-7.09	55.00	-	-
Item 25: Good attention span, sees work through to the end	1.25	0.70	-0.43	-0.89	**.679**	.461
Eigenvalue					6.08	
Percent of variance					46.78	
α					.90	

Note. Salient factor loadings over .40 are indicated in bold; Items 8, 16, and 22 removed from final solution. α = Chronbach's alpha.

Descriptive Statistics

Descriptive statistics for the variables of classroom quality domains, EF battery, and poverty status are presented in Table 4. Reliability for the overall mean score EF variable created from the battery of six EF tasks was analyzed using Cronbach's alpha. The reliability coefficient for the EF task scores was .56. The reliability coefficient across the classroom quality domain scores was .78. The assumptions of normality, linearity, homoscedasticity, and multicollinearity were tested. An examination of histograms did not reveal deviations from normality. Maximum values of 2 for skew and 7 for kurtosis (Curran, West, & Finch, 1996) were used; the scores on all variables approach normality. Four outliers were again identified through an examination of standardized residuals, and, as previously discussed, retained for analyses.

Table 4

Intercorrelations and Descriptive Statistics for Targeted Variables (N =877)

Variable	1	2	3	4	5	6
1. Self-Regulation	-	.12*	.16*	.05	.27*	.14*
2. CLASS Emotional Support		-	.66*	.47*	.06	.04
3. CLASS Classroom Organization			-	.54*	.05	-.00
4. CLASS Instructional Support				-	.00	.04
5. Executive Function					-	.25*
6. Poverty Status						-
M	0.00	5.35	4.79	2.58	0.60	0.33
SD	0.96	0.69	0.86	0.93	0.12	0.94
Skew	1.13	-0.67	-0.52	0.89	0.04	-0.70
Kurtosis	0.84	1.13	0.44	0.81	-0.53	-1.51

Note. CLASS = Classroom Assessment Scoring System. * $p < .05$.

The assumptions of regression were then evaluated. The assumption of independent errors was met based on a Durbin-Watson value of 1.89. Scores were centered as recommended by Tabachnick and Fidell (2007), and no multicollinearity emerged. Examination of scatterplots indicated the assumption of linearity between the predictor variables and outcome variable was met. However, heteroscedasticity was evident; thus, generalizability of the sample is limited (Field, 2009). Variability between participants from PA and NC on the variables of race and poverty status were noted. As a result, regression analyses were conducted controlling for sample location in addition to race and sex. An a priori alpha level of .05 was used to determine statistical significance and an effect size of .10 (R^2) was used to determine practical importance.

Regression Analyses

A summary of the results for all regression analyses is presented in Table 5. To determine whether higher classroom quality predicts higher classroom SR, regression was used to examine the effect of classroom quality (emotional support, classroom organization, and instructional support) on classroom SR, controlling for the demographic variables of state (i.e., NC or PA), race, and sex. The demographic variable set accounted for 6% of the variance and significantly predicted classroom SR, F (3, 873) = 18.23, $p < .000$. The overall model accounted for approximately 8% of the variance and statistically significantly predicted students' SR, F (6, 870) = 13.22, $p < .000$. An examination of regression coefficients indicated positive relationships between classroom SR and emotional support ($b = 0.03$) and classroom organization ($b = 0.18$); however, a negative relationship between classroom SR and instructional support ($b = -0.04$) was identified. Although this hypothesis was partially supported with statistical significance of the overall model and positive relationship between aspects of classroom quality, practical significance did not meet a priori criteria.

Following this initial analysis, an additional regression analysis was used to examine whether EF has a moderating effect on that relationship. The demographic variable set, followed by classroom quality, EF, and an interaction variable (i.e., indicating classroom quality by EF) were regressed on classroom SR. The overall model was statistically significant, F (8, 868) = 16.95, $p < .000$. The model met practical significance, accounting for 14% of the variance. Further examination of the regression coefficients revealed that the individual variables of classroom organization, t (875) = 3.49 $p < .000$, and EF, t (875) = 7.17, $p < .000$ were significant predictors. However, the interaction was not significant, t (875) = -1.05, $p = .294$. Consequently, further analyses were not conducted.

Hierarchical regression analyses were then used to test the third hypothesis exploring the influence of poverty status. Specifically, classroom quality was hypothesized to predict SR skills over and above EF skills and poverty status. The first model regressed the variables of EF skills and poverty status on classroom SR, controlling for selected demographics. As previously reported, the demographic variables significantly predicted classroom SR, F (3, 873) = 18.23, $p < .000$ but were not practically significant, accounting for only 6% of the variance. However, the model including EF and poverty status accounted for 12% of the variance and significantly predicted classroom SR, F (5, 871) = 24.05, $p < .000$. The model with the addition of classroom quality was also significant, F (8, 868) = 17.99, $p < .000$. Moreover, the addition of classroom quality to the model was significant, F (3, 868) = 7.07, $p < .000$, $\Delta R^2 = .02$, predicting classroom SR over and above EF and poverty status. The new model also met a priori criteria for practical importance, accounting for 13% of the variance in classroom SR. To further address the hypothesis that classroom quality is particularly important for the SR of students living in poverty, an additional hierarchical regression analysis was conducted. The first model regressed

the demographic variables and poverty status on classroom SR. This model accounted for only 8% of the variance but significantly predicted classroom SR, F (4, 872) = 18.22, $p < .000$. When including classroom quality, the model was again significant and accounted for 10% of the variance, F (7, 869) = 14.09, $p < .000$. The addition of classroom quality also significantly predicted classroom SR over and above poverty status, F (3, 869) = 8.00, $p < .000$, $\Delta R^2 = .03$. Finally, when holding all other variables constant, including poverty status, the only classroom quality variable that was a significant predictor of classroom SR was classroom organization, t (875) = 3.76, $p < .000$. For children in poverty, overall classroom quality is important; however, when holding other variables constant, only classroom organization had a significant positive relationship with classroom SR ($b = 0.19$). Although emotional support had a positive relationship as well ($b = 0.01$), it was not statistically significant, t (875) = 0.21, $p = .833$; instructional support was neither significant, t (875) = -1.21, $p = .228$, nor positively related to classroom SR ($b = -0.05$).

Table 5

Percentage of Variance in Classroom SR Explained by Target Variables (N =877)

		Control Variable Set	% Variance Explained by Test Variable Set(s)					
Hypothesis	Variable	% Variance Explained	QUAL	QUAL, EF, QUALxEF	EF, POV	EF, POV, QUAL	POV	POV, QUAL
1	Demo	5.9*	8.4*	-	-	-	-	-
2	Demo	5.9*	-	13.5*	-	-	-	-
3	Demo	5.9*	-	-	12.1*	14.2*	-	-
3	Demo	5.9*	-	-	-	-	7.7*	10.2*

Note. Row entries for each criterion equal R2 (100) as derived from regression models. *Demo* = demographic variables (participant state, race, and sex); *QUAL* = Classroom Quality; *EF* = Executive Function; *POV* = Poverty Status

* p < .05.

Chapter 4: DISCUSSION

The purpose of this study was to examine the relationship between preschool classroom quality and self-regulation (SR), exploring executive functioning (EF) as a moderator to that relationship. It was hypothesized that higher classroom quality would predict higher classroom SR and that EF would moderate that relationship. It was further hypothesized that classroom quality would predict SR over and above poverty status and EF and that higher classroom quality would be associated with higher SR for children in poverty.

Exploratory Factor Analyses (EFA) were used to examine the factor structure of targeted items on the SDQ hypothesized to underlie students' classroom SR. The results of the analyses indicate that a one-factor solution including 13 of the 16 original items in the final solution had the best model fit. Internal consistency for the scores was high at .90. Items reflected a range of skills suggesting overall adjustment, emotional regulation, behavioral control, and social skills thought to underlie SR. Regression analyses were then conducted, and hypotheses were partially supported. Specifically, although classroom quality predicted classroom SR to a statistically significant degree, this positive effect did not meet a priori criteria for practical significance. EF and classroom quality significantly predicted classroom SR; however, results did not support EF as a moderator to the relationship between classroom quality and SR. Overall, these results suggest that EF should continue to be considered an important factor related to SR and achievement, but it does not moderate the relationship between classroom quality and SR. When classroom quality is held constant, EF does significantly predict SR. However, classroom quality, particularly classroom organization, predicted SR over and above EF skills and poverty status. Moreover, the results suggest further support for the importance of classroom quality at a young age and for the positive relationship between classroom quality and SR, and in particular,

SR skills that are utilized and observed in the classroom setting, such as behaviors indicative of emotional regulation, behavioral regulation, planning and effortful control, social skills, and overall adjustment. As this study focused on a sample of rural families, this study also added to the literature for rural populations, an often understudied population.

It is important to keep in mind several limitations to this research when drawing conclusions. Perhaps most notably is that this research did not follow a true experimental design. Data collection capitalized on current strategies as well as strengths and weaknesses of current school and classroom setups. Classroom quality was measured but not manipulated, nor were interventions manipulated or directly measured. Moreover, given previously demonstrated limitations in the structural validity of the classroom quality measure used in the current study, the data may not reflect differences in classrooms accurately. Differences in professional development, teacher experience, school-wide initiatives, and other school factors are all potential factors not captured in the current study. Moreover, other potentially important factors in the students' lives were not measured despite attempts to control or account for demographic information and poverty status (e.g., parent education level, early stressors or trauma, early interventions).

Given that early childhood was targeted in this study, it is also important to consider cognitive stability and aspects of EF measured at a young age. Neuroscience research has linked the development of the prefrontal cortex with EF, which is found to be emerging around school-age and not as stable as in adulthood (Luciana & Nelson, 1998). Moreover, EF may be malleable as research has documented the influence of individual experiences demonstrated by brain plasticity (Blair, 2002) as well as indicated a mixed impact of interventions (Miyake, 2012). It is possible that EF is necessary for and closely tied to SR but is not innately a precursor

to SR in development. Another drawback of the current study is the limited generalizability identified by assumption testing. Although these findings lend additional support to the concepts being studied, future research is needed to confirm and expand upon the results of this study. Randomized assignment incorporating interventions targeting classroom quality and repeated measurement of these constructs as children continue to develop would be ideal.

The context of these findings should also be considered in the context of research that has demonstrated how EF sub-skills are related to how students process information and are even tied to educational disabilities within special education law. A pattern of strengths and weaknesses (PSW) approach to identification of specific learning disabilities connects cognitive ability or processing weaknesses with academic skill or knowledge weaknesses and contrasts these two areas with cognitive ability or processing strengths (Flanagan, Fiorello, & Ortiz, 2010). EF sub-skills and attentional control fit within neuropsychological models of learning disabilities identified via PSW models. As the current study focused on preschool- through kindergarten-age children, conclusions cannot be generalized to school-age students. However, it may be possible that classroom quality in preschool may help to bolster SR irrespective of the early EF skills, which may have implications for understanding how some children may demonstrate appropriate SR skills in the classroom while concurrently demonstrating EF weaknesses and poor achievement in school. As such, future research should examine the relationship between these constructs taking into consideration disabilities and the method in which these disabilities were identified. Moreover, it may be that students' SR contributes back to classroom quality on a class-wide scale. For groups of students with higher initial adjustment and SR, classroom management may develop more readily. Furthermore, for students with low SR, classroom quality may be particularly important for helping to regulate emotions and behaviors. Taking

into account such individual and situational factors, especially with intervention methodology to account for directionality, would help to further illustrate the relationships between these variables and the importance of various factors and strategies in long-term outcomes for children.

The current study also suggests implications for social, emotional, and behavioral interventions in preschool to support students with low SR that warrant further research. As preschool classroom quality accounted for a great deal of the variance in classroom SR, class-wide supports are a natural option to consider. As previously mentioned, specific curricula that focus on self-control and social and emotional competence can reduce externalizing behaviors, improve SR skills, and increase academic engagement (Conduct Problems Prevention Research Group, 2010). Social and emotional learning (SEL) programming emphasizes self-awareness, emotional regulation, social awareness (i.e., perspective taking and empathy), social skills, and problem solving and decision-making skills. These skills align with SR skills, and research further substantiates the importance of these skills given their relationship with academic achievement and reduction of factors associated with poor mental health (Greenberg et al., 2003). Moreover, mindfulness-based interventions appear to be a promising area to increase SR skills in early childhood. Contemplative practices, such as mindfulness, purposely regulate attention and function as neural trainings of SR and EF skills; research on incorporating such practices and interventions in early childhood classrooms is becoming a new, growing area of research (Shapiro et al., 2014).

In conclusion, this study further added support to literature despite noted limitations. As current results indicated that classroom quality is positively related to SR, especially as measured by teacher-reported behaviors in the classroom, there may be room to support or boost SR through classroom interventions, especially for children living in poverty. Although EF did not

appear to moderate the relationship between classroom quality and SR, the current findings continue to indicate that EF does predict SR when classroom quality is held constant. Future research further evaluating these relationships in the context of school readiness as well as farther reaching implications of academic achievement, social competence, and mental health may help to start children early on a path to long-term wellness and success.

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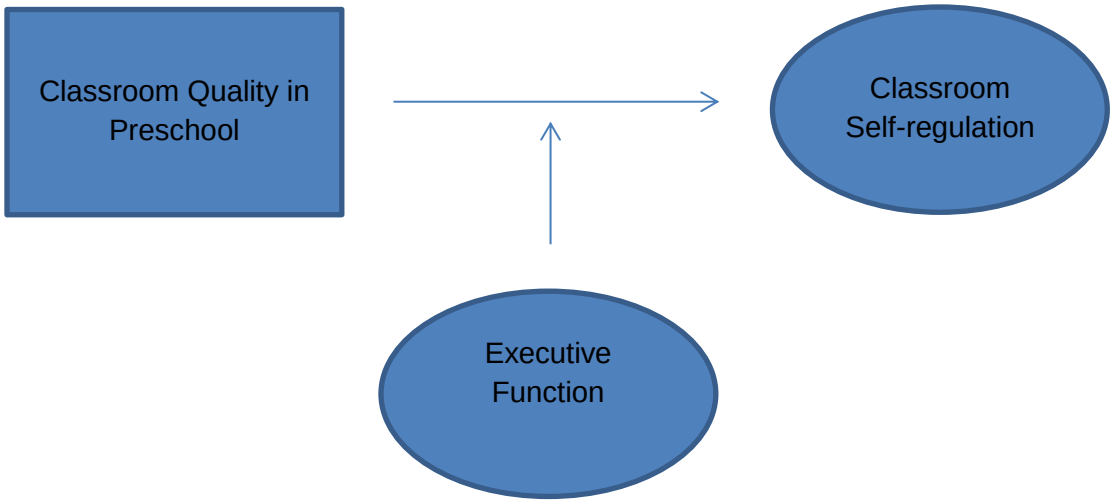

Figure 1. Hypothesized moderating relationship tested.

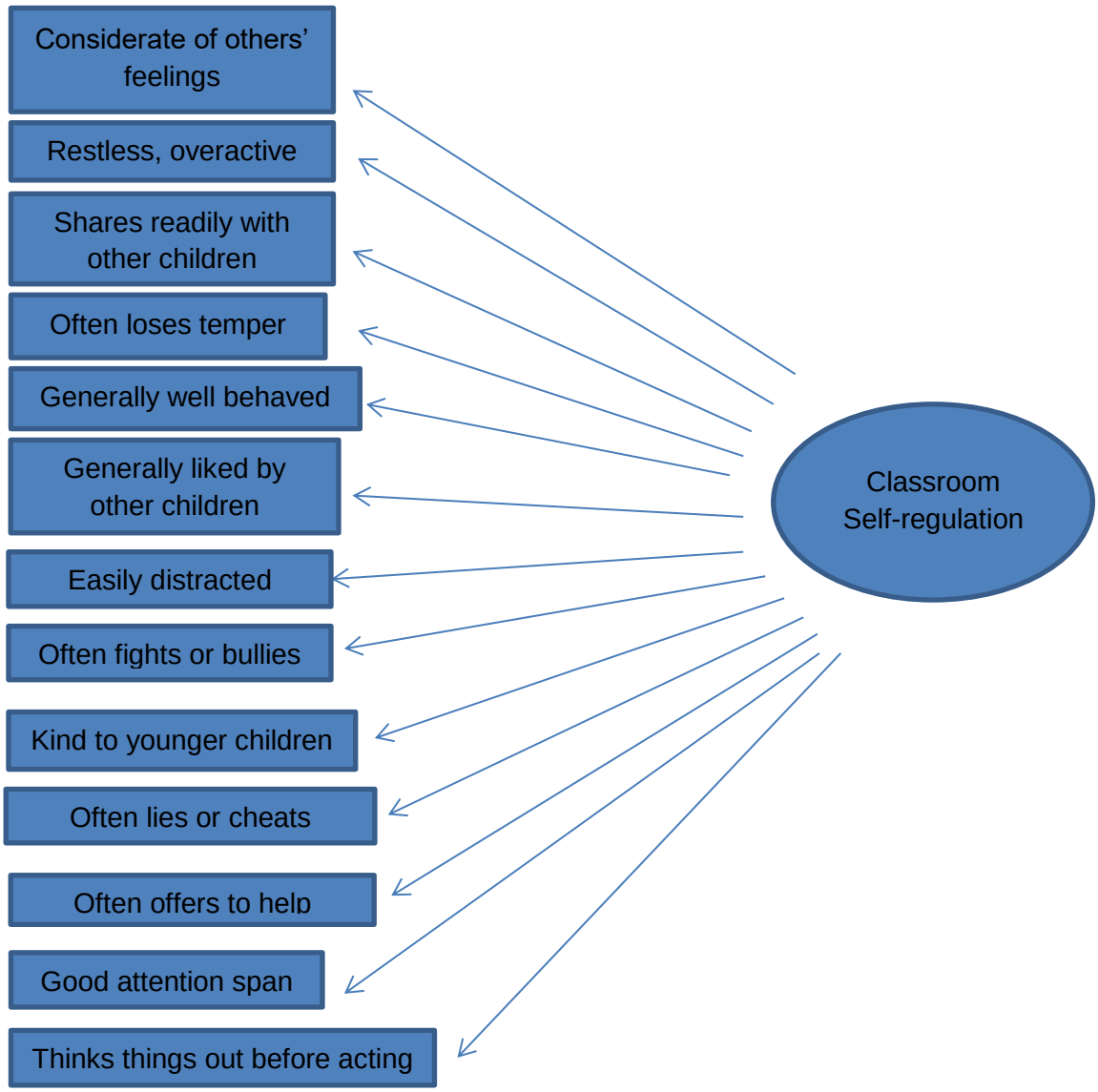

Figure 2. Final one-factor structure of classroom SR using items from the Strengths and Difficulties Questionnaire (SDQ). Circle represents latent variable, and rectangles represent measured variables.

Appendix A: Selected Items from the Strengths and Difficulties Questionnaire (SDQ)

Directions: For each item, please mark the box for Not True, Somewhat True or Certainly True. It would help us if you answered all items as best you can even if you are not absolutely certain. Please give your answers on the basis of the child's behavior over the last six months.

	Not True	**Somewhat True**	**Certainly True**	
1. **StrDif1**Considerate of other people's feelings	0	1	2	
2. **StrDif2**Restless, overactive, cannot stay still for long	0	1	2	
3. **StrDif3**Often complains of headaches, stomach-aches or sickness	0	1	2	
4**. StrDif4** Shares readily with other children, for example toys, treats, pencils	0	1	2	
5. **StrDif5** Often loses temper	0	1	2	
6. **StrDif6**Rather solitary, prefers to play alone	0	1	2	
7. **StrDif7**Generally well behaved, usually does what adults request	0	1	2	
8. **StrDif8**Many worries or often seems worried	0	1	2	
9. **StrDif9**Helpful if someone is hurt, upset or feeling ill	0	1	2	
10. **StrDif10**Constantly fidgeting or squirming	0	1	2	
11. **StrDif11**Has at least one good friend	0	1	2	
12. **StrDif12**Often fights with other children or bullies them	0	1	2	
13. **StrDif13**Often unhappy, depressed or tearful	0	1	2	
14. **StrDif14**Generally liked by other children	0	1	2	
15. **StrDif15**Easily distracted, concentration wanders	0	1	2	
16. **StrDif16**Nervous or clingy in new situations, easily loses confidence	0	1	2	
17. **StrDif17**Kind to younger children	0	1	2	
18. **StrDif18**Often lies or cheats	0	1	2	
19. **StrDif19**Picked on or bullied by other children	0	1	2	
20. **StrDif20**Often offers to help others (parents, teachers, other children)	0	1	2	

21. **StrDif21**Thinks things out before acting	0	1	2	
22. **StrDif22**Steals from home, school or elsewhere	0	1	2	
23. **StrDif23**Gets along better with adults than with other children	0	1	2	
24. **StrDif24**Many fears, easily scared	0	1	2	
25. **StrDif25**Good attention span, sees work through to the end	0	1	2	
26. **StrDif26**Feels bad or guilty when he/she does something wrong	0	1	2	
27. **StrDif27**Is good at keeping promises	0	1	2	
28. **StrDif28**Keeps the same friends	0	1	2	
29. **StrDif29**Is concerned about the feelings of others	0	1	2	
30. **StrDif30**Does not show feelings or emotions	0	1	2	
31. **StrDif31**Is concerned about how well she/he does in structured activities (like when playing games or during activities at daycare/preschool)	0	1	2	
	N0	Yes-minor difficulties	Yes-definite difficulties	Yes-severe difficulties
32. **StrDif32**Overall, do you think that your child has difficulties in any of the following areas: emotions, concentration, behavior or being able to get along with other people?	0	1	2	3
If you have answered "Yes," please answer the following questions about these difficulties:				
	Less than a month	1-5 months	6-12 months	Over a year
33. **StrDif33**How long have these difficulties been present?	0	1	2	3
	Not at all	A little	A medium amount	A great deal
34. **StrDif34**Do the difficulties upset or distress your child?	0	1	2	3
Do the difficulties interfere with your child's everyday life in the following areas…				
35. **StrDif35**Home Life?	0	1	2	3
36. **StrDif36**Friendships?	0	1	2	3

37. **StrDif37**Classroom Learning?	0	1	2	3
38. **StrDif38**Leisure Activities?	0	1	2	3
39. **StrDif39**Do the difficulties put a burden on you or the family as a whole?	0	1	2	3

Note. Items 1, 2, 4, 5, 7, 8, 12, 14, 15, 16, 17, 18, 20, 21, 22, 25 were used in the current study. Items 2, 5, 12, 15, 16, 18, and 22 were reversed.

Appendix B: Additional Factor Solutions Examined

Factor Structure Coefficients for Principal Axis Extraction of the Initial Unrotated One Factor Structure of the Strengths and Difficulties Questionnaire (N = 877)

Item	Factor I	h^2
Item 1: Considerate of other people's feelings	**.687**	.472
Item 2: Restless, overactive, cannot stay still for long	**.686**	.471
Item 4: Shares readily with other children, for example toys, treats, pencils	**.670**	.449
Item 5: Often loses temper	**.655**	.429
Item 7: Generally well behaved, usually does what adults request	**.815**	.665
Item 8: Many worries or often seems worried	-.098	.010
Item 12: Often fights with other children or bullies them	**.697**	.486
Item 14: Generally liked by other children	**.628**	.394
Item 15: Easily distracted, concentration wanders	**.647**	.419
Item 16: Nervous or clingy in new situations, easily loses confidence	.185	.034
Item 17: Kind to younger children	**.571**	.326
Item 18: Often lies or cheats	**.526**	.277

Item 20: Often offers to help others (parents, teachers, other children)	**.470**	.221
Item 21: Thinks things out before acting	**.672**	.452
Item 22: Steals from home, school, or elsewhere	.293	.086
Item 25: Good attention span, sees work through to the end	**.684**	.468
Eigenvalue	6.22	
Percent of variance	38.86	

Note. Salient factor loadings over .40 are indicated in bold. α = Cronbach's alpha.

Factor Structure Coefficients for Principal Axis Extraction of the Unrotated Three Factor Structure of the Strengths and Difficulties Questionnaire (N = 877)

Item	Factor I	Factor II	Factor III	h^2
Item 1: Considerate of other people's feelings	**.690**			.567
Item 2: Restless, overactive, cannot stay still for long	**.694**			.592
Item 4: Shares readily with other children, for example toys, treats, pencils	**.667**			.490
Item 5: Often loses temper	**.663**			.567
Item 7: Generally well behaved, usually does what adults request	**.809**			.681
Item 8: Many worries or often seems worried				.053
Item 12: Often fights with other children or bullies them	**.715**		**-.428**	.695
Item 14: Generally liked by other children	**.625**			.433
Item 15: Easily distracted, concentration wanders	**.677**	**-.440**		.724
Item 16: Nervous or clingy in new situations, easily loses confidence				.105
Item 17: Kind to younger children	**.581**			.495
Item 18: Often lies or cheats	**.532**			.401
Item 20: Often offers to help others (parents, teachers, other children)	**.484**			.446

Item 21: Thinks things out before acting	**.667**			.467
Item 22: Steals from home, school, or elsewhere				.134
Item 25: Good attention span, sees work through to the end	**.703**			.681
Eigenvalue	6.22	1.43	1.41	
Percent of variance	38.86	8.91	8.79	

Note. Only salient factor loadings over .40 are shown. α = Cronbach's alpha.

Factor Structure Coefficients for Principal Axis Extraction of the Three Factor Structure of the Strengths and Difficulties Questionnaire Using Varimax Rotation (N = 877)

Item	Factor I	Factor II	Factor III	h^2
Item 1: Considerate of other people's feelings		**.671**		.567
Item 2: Restless, overactive, cannot stay still for long	**.584**		**.456**	.592
Item 4: Shares readily with other children, for example toys, treats, pencils		**.551**		.490
Item 5: Often loses temper	**.677**			.567
Item 7: Generally well behaved, usually does what adults request	**.634**	**.494**		.681
Item 8: Many worries or often seems worried				.0533
Item 12: Often fights with other children or bullies them	**.753**			.695
Item 14: Generally liked by other children		**.551**		.433
Item 15: Easily distracted, concentration wanders	**.404**		**.721**	.724
Item 16: Nervous or clingy in new situations, easily loses confidence				.105
Item 17: Kind to younger children		**.678**		.495
Item 18: Often lies or cheats	**.604**			.401
Item 20: Often offers to help others (parents, teachers, other children)		**.638**		.446

Item 21: Thinks things out before acting		**.491**		.467
Item 22: Steals from home, school, or elsewhere				.134
Item 25: Good attention span, sees work through to the end			**.667**	.681
Eigenvalue	6.22	1.43	1.41	
Percent of variance	38.86	8.91	8.79	

Note. Only salient factor loadings over .40 are shown. α = Cronbach's alpha.

Factor Structure Coefficients for Principal Axis Extraction of the Three Factor Structure of the Strengths and Difficulties Questionnaire Using Direct Oblimin Rotation (N = 877)

Item	Factor I	Factor II	Factor III	h^2
Item 1: Considerate of other people's feelings	**.740**	**-.476**		.567
Item 2: Restless, overactive, cannot stay still for long	**.416**	**-.678**	**.545**	.592
Item 4: Shares readily with other children, for example toys, treats, pencils	**.670**	**-.498**		.490
Item 5: Often loses temper	**.484**	**-.727**		.567
Item 7: Generally well behaved, usually does what adults request	**.659**	**-.749**		.681
Item 8: Many worries or often seems worried				.053
Item 12: Often fights with other children or bullies them	**.523**	**-.800**		.695
Item 14: Generally liked by other children	**.630**	**-.468**		.433
Item 15: Easily distracted, concentration wanders	**.412**	**-.545**	**.784**	.724
Item 16: Nervous or clingy in new situations, easily loses confidence				.105
Item 17: Kind to younger children	**.703**			.495
Item 18: Often lies or cheats		**-.631**		.401
Item 20: Often offers to help others (parents, teachers, other children)	**.640**			.446

Item 21: Thinks things out before acting	**.606**	**-.480**	**.439**	.467
Item 22: Steals from home, school, or elsewhere				.134
Item 25: Good attention span, sees work through to the end	**.545**	**-.480**	**.743**	.681
Eigenvalue	6.22	1.43	1.41	
Percent of variance	38.86	8.91	8.79	

Note. Only salient factor loadings over .40 are shown. α = Cronbach's alpha.

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Levy, S. R. & Perry, R. K., (2015, March). *Cultivating the "Good Life": Positive Psychology and the Future of Positive Education*. Presented at AACPS Office of Psychological Services staff professional development, Annapolis, Maryland.

Perry, R. K., (2015, February). *Rurality and School Psychology.* Presented to AACPS Cultural Competency Workgroup, Annapolis, Maryland.