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Effect of Teacher-Child Interactions on Low-Income Children's Early Self-Regulation Development

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Effect of Teacher-Child Interactions on Low-Income Children's Early Self-Regulation Development

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Sandra Lynn Hong

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ABSTRACT OF THE DISSERTATION

Effect of Teacher-Child Interactions

on Low-Income Children's Early Self-Regulation Development

by

Sandra Lynn Hong

Doctor of Philosophy in Education

University of California, Los Angeles, 2012

Professor Carollee Howes, Chair

Early school-success is dependent on children's ability to function as a regulated member of a classroom, including appropriately managing emotions and behavior, and attending to relevant information and tasks (Peth-Pierce, 2000; Raver, 2002). This study examines the growth of self-regulation of low-income, largely Latino and dual language learning three to six-year-olds. Children improved in their performance over time on tasks from the Preschool Self-Regulation Assessment Battery (PSRA; Smith-Donald, Raver, Hayes, & Richardson, 2007). Non-linear growth modeling was used to model rapid growth on impulse inhibition tasks at age three, and approach to ceiling/floor on impulse control tasks by kindergarten (Grimm, Ram, & Hamagami, 2011). Spanish-English dual language learners performed similarly to their non-Latino peers on measures of impulse control and a conflict task whereas their monolingual English-speaking Latino peers performed worse, suggesting a cognitive advantage of bilingual

language acquisition on self-regulation skills (Blair & Raver, 2011; Li-Grinning, 2007). Finally, there were small predictive differences in executive function by the quality of teacher-child interactions. Implications are suggested for supporting low-income children's self-regulation development and ultimately influencing their school-readiness by supporting the simultaneous acquisition of their home language, and by providing sensitive, responsive, and instructionally supportive interactions with a caregiver or teacher.

The dissertation of Sandra Lynn Hong is approved.

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Book Chapters and White Papers

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Soliday Hong, Sandra (2009, April). *The push-down effect: The current state of play in kindergarten.* Poster presentation at the Biennial Meeting for the Society for Research in Child Development, Denver, Colorado.

Soliday Hong, Sandra (2008, June). *Are preschool curriculum statements related to classroom quality? Examining the association between philosophy and practice.* Presented a poster at the Head Start's Ninth National Research Conference, Washington, D.C.

Soliday Hong, Sandra & Howes, C. (2008, March). *Can emotional availability at home and child care experiences at age three predict relationships with teachers and peers in pre-kindergarten Mexican heritage children?* Presented a poster at the Biennial International Conference on Infant Studies sponsored by the International Society on Infant Studies, Vancouver, Canada.

Soliday Hong, Sandra (2007, April). *Language and Culture in a Korean American Preschool.* Poster presented at the Spencer Symposium on Immigration and Education at UCLA: "We Are Here": (Im)migrant Youth at the Center of Social Activism and Critical Scholarship, Los Angeles, California.

Effect of Teacher-Child Interactions on Low-Income Children's Early Self-Regulation Development

Self-regulation may play a protective role for children who are growing up in contexts that place them at-risk for school failure (Raver, 2002). While a lack of emotional, attentional, and behavioral skills may contribute to a lack of school-readiness and success, having strong skills in these areas may promote children's enjoyment of school, ability to function in the classroom setting, relationships with teachers and peers, task performance, and motivation (Cameron Ponitz, et al., 2008; Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009). Effective teacher-child interactions in early care and education settings also provide a relational context in which children develop skills that facilitate their ability to "be in school," such as, managing attentional demands while following directions, being able to wait their turn, and being able to regulate their behavior in a school-appropriate manner. Additionally, the ability to be a regulated member of a classroom is associated children's early academic knowledge and skills, such as math and verbal abilities (Smith-Donald, Raver, Hayes, & Richardson, 2007). Considering that children living in poverty and children learning English in school settings tend to start school more disadvantaged with regard to self-regulation and academic skills, it may be especially important for their development that they experience sensitive and responsive caregiving (Blair, 2002; Dearing, Berry, & Zaslow, 2006; Smith-Donald, Raver, Hayes, & Richardson, 2007).

In many ways, early school success is dependent on children's ability to function socially, attentionally, and behaviorally as a successful member of a classroom (Blair, 2002; Peth-Pierce, 2000; Raver, 2002). For example, impulse control and the ability to pay attention

are both concurrently and longitudinally associated with early math, verbal, and emergent literacy skills (Carlson & Meltzoff, 2008; Smith-Donald, Raver, Hayes, & Richardson, 2007). Children who have trouble regulating their impulses and emotions may also be difficult to teach because they are disruptive in group settings, and children who cannot wait their turn or share have difficulty forming peer relationships. Therefore, self-regulation has a central role in children's adjustment and self-competency in early schooling (Bierman & Erath, 2006; Blair, 2002).

Additionally, there is some evidence that the interactions adults have with children might support their growth in self-regulation (Barnett, et al., 2008; Bierman, Nix, Greenberg, Blair, Domitrovich, 2008). Initial studies examining the influence of curricula that intentionally support the development of self-regulation have found positive effects on social skills, and receptive and expressive language for children tested in English or Spanish (Barnett, et al., 2008). As such, self-regulatory interventions in early childhood settings, including early care and education, are promising for promoting young children's emotional development and school readiness for children facing poverty-related adversity (Barnett, et al., 2008; Raver, 2002; Raver 2004). Most of what is known about the development of self-regulation in early care and education contexts is based on intervention literature with the goal of improving self-regulation skills, but little is known about the effects of existing care practices on young children's self-regulation (Barnett, et al., 2008).

The purpose of this study is to describe changes in self-regulation skills leading up to and including entry into school for a group of low-income, linguistically diverse children. Modeling of self-regulation during this transition has posed a challenge as children tend to hit ceiling on measures of self-regulation by school-entry, and a goal of this study is to utilize an appropriate

modeling technique for self-regulation measures with a ceiling effect. This study also examines the influence of varying levels of teacher-child interactions on self-regulation task peformance.

Self-Regulation

Self-regulation is defined as "primarily volitional regulation of attention, emotion, and executive functions for the purposes of goal-directed actions" (Blair & Raver, 2012, p.3; Carlson & Meltzoff, 2008). Included in this definition are skills that are used to control, direct, and plan emotions, affect, cognitions, and behavior (Vohs & Baumeister, 2004; Cameron Ponitz, 2008). Individual child factors influence the development of self-regulation including gender, temperament, and child age. Girls tend to do better on self-regulation tasks at earlier ages than boys (McCabe, Cunnington, & Brooks-Gunn, 2004). Children's development of self-regulation is also influenced by temperament (McCabe, Cunnington, & Brooks-Gunn, 2004; Rothbart, Ellis, & Posner, 2004; Rothbart, Posner, & Kieras, 2006). Temperament includes "constitutionally based individual differences in reactivity and self-regulation, as seen in the emotional, motor, and attentional domains" (Rothbart, Posner, & Kieras, 2006). The focus of this study will be on the executive function component of self-regulation, which includes inhibition of a prepotent response, attention shifting and maintenance, and working memory (Bialystok, 2011; Blair, Zelazo, & Greenberg, 2005).

Regulatory processes require children to exercise control over themselves in a way that brings the child in line with the constraints of societal or cultural values and norms within which they are developing; this process results in an interplay between child-driven factors and externally imposed extrinsic factors, such as the behavior of caregivers and attachment relationships (Calkins & Hill, 2007; Raver, 2002; Vohs & Baumeister, 2004; Weisner, 2002). Young children are developing a behavioral repertoire to reduce, inhibit, amplify, and balance

different affective responses in a manner consistent with their cultural context (Calkins & Hill, 2007).

Self-regulation is a maturational process that is dependent on features of development such as physiological maturity and experience (Bierman & Erath, 2006; Raver, 2002). Research has shown that children's self-regulation skills grow and are stable over time, but may be influenced by risk (Li-Grinning, 2007; Raver, 2004; Rothbart, Posner, & Kieras, 2006; Smith-Donald, Raver, Hayes, & Richardson, 2007). Longitudinal studies on executive function suggest a high degree of continuity between delay of gratification in preschool to adult outcomes at age 30, and moderate stability over time in shorter-term studies (Li-Grinning, 2007; Rothbart, Posner, & Kieras, 2006). Additionally, there is a rapid period of growth in self-regulation skills during the preschool years (McCabe, Cunnington, & Brooks-Gunn, 2004). Early childhood measures of self-regulation have been used to assess aspects of working memory and inhibitory control as a part of the Preschool Self-Regulation Assessment Battery (PSRA), but are difficult to use to model growth past the preschool years due to ceiling and floor effects on the measures (Carlson & Meltzoff, 2008; Smith-Donald, Raver, Hayes, & Richardson, 2007).

Poverty and Self-Regulation

Children growing up in poverty face a number of poverty-related stressors that direct their development in pathways that are adaptive for their particular circumstances (Blair & Raver, 2012). For example, children facing poverty-related adversity may be more likely to experience family stress related to limited financial resources, food insecurity, housing instability, and neighborhood violence among many others. The natural biological response to stress is to increase the level of stress hormones that facilitate the child's ability to both detect and quickly respond perceived danger, including negative relational stimuli (Denham, 2006).

According to an experiential canalization framework of self-regulation development, this interplay between experience and biology serves a protective function for children at risk (Blair & Raver, 2012). An elevated stress response may also result in a developmental trade-off prioritizing survival in place of neurological development that supports cognition amenable to school-success (Blair & Raver, 2012).

The canalization of early adverse experiences related to poverty is of particular concern for low-income children because detrimental effects associated with poverty have a greater impact during early childhood on cognitive development and educational attainment (Barnett, et al., 2008; Bierman & Erath, 2006; Dearing, Berry, & Zaslow, 2006; Heckman, 2006, Mistry et al., 2010). Children who experience more cumulative risk due to family, social, and economic factors at earlier ages have lower school-readiness scores, including poorer self-regulatory functioning (Mistry, Benner, Biesanz, Clark, & Howes, 2010). Children growing up in poverty are more likely to have lower levels of assessed academic and social school-readiness skills, social-emotional problems, and lower performance on measures of self-regulation (Howes, et al., 2008; Li-Grinning, 2007; McCabe, Cunnington, & Brooks-Gunn, 2004; Mistry, et al., 2010). More cumulative risk is associated with greater psychological indices of stress and more difficulty with self-regulation for preschool and school-age children, particularly in executive control (Dearing, Berry, & Zaslow, 2006; Li-Grinning, 2007; Mistry, et al., 2010; Raver, 2004). Poor children are also more likely to display externalizing and internalizing social-emotional problems in early childhood (Dearing et al., 2006; Mistry, et al., 2010). Finally, there is a well-established link between SES and vocabulary acquisition and growth (Hart & Risley, 1995).

Poverty and high levels of stress may adversely affect children's social-emotional adjustment in school by interfering with children's ability to use optimal strategies in situations

that require self-regulation (Li-Grinning, 2007; McCabe, Cunnington, & Brooks-Gunn, 2004). Teacher-reported behavior problems were correlated with assessed self-regulation in low-income children, and reports of social-competency were associated with behavioral compliance and executive control (Smith-Donald, Raver, Hayes, & Richardson, 2007). Risk factors were also associated with individual differences in developmental patterns of delayed gratification, and lower levels of behavioral regulation in a school-appropriate manner (Cameron Ponitz et al., 2008; Li-Grinning, 2007; Wanless, McClelland, Tominey, & Acock, 2011). Higher levels of poverty were associated with higher rates of teacher-reported difficulty in school transition (Rimm-Kaufman, Pianta, & Cox, 2000). Poor children are more likely to display externalizing and internalizing social-emotional problems, resulting in classroom environments with more aggressive peers (Dearing, Berry, & Zaslow, 2006).

Language and Ethnicity

Based purely on a socioeconomic risk model, we would expect low-income children learning a second language in the context of school to perform more poorly on measures of self-regulation (Blair & Raver, 2012; Li-Grinning, 2007; Wanless, McClelland, Tominey, & Acock, 2011). However, there is some evidence to indicate that there is a moderating effect of bilingual language experience on self-regulation skills (Bialystok, 2009, 2011; Bialystok & Viswanathan, 2009; Carlson & Meltzoff, 2008; Costa, Hernandez, & Sebastian-Galles, 2008). Low-income children who are also learning a second language tend to perform better on self-regulation tasks than their low-income peers, and it appears that some aspect of early exposure to two languages may support young children's performance of measures of executive functioning (Bialystok, 2011; Carlson & Meltzoff, 2008). Children whose primary home language is not English are

exposed to the English language in the context of everyday life in the United States and particularly in the context of schooling, and will therefore be referred to as dual language learners in this paper (Genesee, Paradis, & Crago, 2004). Very little research has been done on dual language learner's performance on self-regulation tasks to examine differences by dual language exposure, ethnicity, and socioeconomic risk. Therefore, this study aims to address this gap in the literature by examining the effect of these demographic factors on self-regulation development across the early childhood years.

Dual language learners must be able to utilize working memory to hold two languages in their minds simultaneously, manage increased demands on their attentional networks to switch their attention between two languages, and inhibit the impulse to utilize their dominant language during interactions in their less dominant language (Costa, Hernandez, & Sebastian-Galles, 2008; Posner & Rothbart, 2000). There is also some indication that earlier and more extensive native exposure to a second language provides a stronger advantage on executive function, and that bilingual children develop greater cognitive flexibility and working memory skills (Blair, Zelazo, & Greenberg, 2005; Carlson & Meltzoff, 2008). Specifically, dual language learners performed better on tasks that utilize working memory require inhibition of prepotent and distracting responses, such as conflict tasks (Carlson & Meltzoff, 2008; Costa, Hernandez, & Sebastian-Galles, 2008).

In addition to differences between children of different language backgrounds, culturally-based home socialization practices may influence children's development of behavioral and cognitive aspects of self-regulation (Carlson & Meltzoff, 2008; Johnson, et al., 2003; Rogoff, Mistry, Goncu, & Mosier, 1993; Skinner & Weisner, 2007; Zucker & Howes, 2009). In studies of Latino families with a recent migration history, the idea of self-control or *educado*

summarizes this emphasis on behavioral regulation among other aspects of social functioning. *"Educado* is a culturally salient term used to describe children who are attuned to social relationships and respectfully attentive to the teaching, directions, and advice of elders" (Zucker & Howes, 2009, pg. 504). Parents of mostly Latino bilingual children were more likely to cite self-control as important to them than other parents in the study indicating a potential connection between familial culture and expectations and the development of self-regulation (Carlson & Meltzoff, 2008).

Teacher-Child Interactions as a Mediator of Poverty on Self-Regulation

Self-regulatory skills can be taught to children, and it is through warm and sensitive interactions, consistent routines, and provision of activities that scaffold the development of focused and sustained attention that teacher-child interactions facilitate growth in self-regulation skills (Barnett, et. al., 2008; Bierman & Erath, 2006; Rimm-Kaufman, Curby, & Grimm, Nathanson, & Brock, 2009). Interactions with adults within the context of early care and education settings can at least partially mediate the effect of poverty-related adversity on long-term development (Blair, 2002; Blair & Raver, 2012; Calkins & Fox, 2002). Classrooms that run efficiently and spend less time in transitions support self-regulation skills and provide consistent classroom routines that establish clear expectations for children's behavior (Bierman & Erath, 2006; Downer, Sabol, & Hamre, 2010). Cassroom organization is most successfully executed within a warm and supportive relationship between the teacher and the child in which the child can feel safe that the teacher will respect and show concern for their emotional state (Calkins & Hill, 2007). The hypothesized relation between teacher-child interactions and self-regulation is shown in Figure 1. As teachers engage in more effective, sensitive and responsive

interactions with children, teachers are able to scaffold children's growing self-regulation, including attention and impulse control.

Strategies teachers use to support the development of self-regulatory skills include modeling, role play, group discussion, and "games" that reward emotional and behavioral self-control & cooperation (Raver, 2002). For example, the games "mother may I" and "Simon Says" are used to support the development of inhibitory control (Rothbart, Posner, & Kieras, 2006; Smith-Donald, Raver, Hayes, & Richardson, 2007). Classroom management has been linked to self-regulation development in kindergarten, indicating that classrooms that run more effectively and efficiently support children's growing regulatory functions (Rimm-Kaufman, Curby, & Grimm, Nathanson, & Brock, 2009). Teachers may use a variety of strategies to support children's regulatory functioning, such as redirecting the child's attention, providing encouragement to persist at a difficult task, or planning and problem-solving with a child (Cole, Martin, & Dennis, 2004). Self-regulation interventions demonstrate potential effects of teacher-child interactions on self-regulation, but not much evidence exists that demonstrates if these effects take place in typical ECE settings for low-income children (Barnett, et al., 2008).

Interventions designed to support the development of self-regulatory skills have also shown promise for children who are learning English in the context of their early care and education setting (Barnett, et al., 2008; Raver, Jones, Li-Grinning, Metzger, Smallwood, & Sardin, 2008). Although these children stand to benefit most from teacher-child interactions that are sensitive and responsive, children from lower-income families experience less sensitive teacher-child interactions, and caregiving has been found to be detached and harsh in early care and education settings (Phillips, Voran, Kisker, Howes, & Whitebook, 1994). Teaching practices with bilingual children should systematically integrate the child's values, beliefs,

histories, and experiences and build the curriculum around mutual respect and trust (Espinosa, 2005). However, teaching practices that are not culturally sensitive or respectful, or even punitive toward children learning English can have negative effects for children's learning and motivation (Tabors, 1998). Supporting the development of young bilingual children in early care and education settings may support self-regulatory development, prevent academic underachievement and even promote later school success (Barnett, et al., 2007; Howes & Sanders, 2006; La Paro & Pianta, 2000; Lindsey, Manis, & Bailey, 2003). Although at least one intervention study has demonstrated the effectiveness of a self-regulation focused curriculum on teacher-child interactions and language outcomes for English language learners, almost no research has been done to examine the effect of language and ethnicity as a moderator of these interactions on self-regulation skills (Barnett, et al., 2008; Raver, 2004).

Study Aims

This dissertation examines the development of self-regulation skills in early childhood for low-income children, the predictive influence of dual language acquisition and ethnicity on the development of self-regulation, and the effect of teacher-child interactions on self-regulation skills in the context of early care and education settings (see Figure 2). A short-term, longitudinal growth model will be tested to examine growth in children's self-regulation skills over time in relation to socio-demographic and classroom variables. There is a gap in the research on the growth of self-regulation development over the course of more than one year in early development, especially for children who are low-income and language and ethnic minorities (Li-Grinning, 2007). Additionally, although a strong argument has been made that early care and education as an intervention has a strong rate of return for children at-risk, little work has examined the mechanisms of teacher-child interactions through which these

interventions have an effect on self-regulatory development for young Latino, Spanish-speaking children, which will be a primary focus of this dissertation (Heckman, 2006; Li-Grinning, 2007; Raver, 2004).

My research hypotheses are as follows:

1. Performance on self-regulation tasks improves during the preschool years.
2. Bilingual children's performance on self-regulation tasks is positively influenced by their background language experiences in English and Spanish.
3. Latino children will perform similarly to their non-Latino peers on delay of gratification tasks despite greater socioeconomic risk.
4. Children in classrooms with higher emotional and instructional climates will perform better on assessments of self-regulation.

Methods

The quantitative portion of this dissertation will be addressed by using the Los Angeles: Exploring Children's Early Learning Settings study (LAExCELS) a longitudinal dataset collected from 2004-2007. The sample includes a total of 296 children ages three through kindergarten-age, and 286 classrooms or family child care homes across three years of data collection.

Early learning settings included public preschool programs, private preschools or community early care and education, and licensed home-based family early care and education programs. In this study we conceptualize any of these types of out-of-home early education experiences as early learning settings. Although home-based family early care and education tends to be structurally different from center-based preschools and early care and education

programs in that children are not grouped into different classrooms, we use the term "classroom" to refer to units of children with their adult caregivers whether they are in a traditional center-based classroom or a single family early care and education program. Furthermore, we consider the adults in these settings to be early educators due to the fact that they are professionals providing child development services to the children in their care. Therefore, we use the term "teachers" or "early educators" to refer to the classroom teachers and family early care and education providers in the study.

Sample

The 296 target children represented in this analysis come from primarily low-income families (see Table 1), with diverse maternal education levels (ranging from 2nd grade to graduate degree; median = high school graduate). Although the sample was largely low-income, only about 15% of families reported receiving CalWorks or welfare subsidies during the study. Half of the children were Latino Spanish-English dual language learners and Latino, less than one-quarter were monolingual English-speakingLatino children, and the final third were non-Latino children who were assessed in English. The non-Latino children were African-American (12.24%), Caucasian (12.24%), Asian or Pacific Islander (2.45%), and Other or Multi-Racial (2.45%). The overall sample was seventy-percent Latino. When the children entered the study at age three or four, the majority were enrolled in some form of early learning setting (mostly private or public centers), and about a third were not enrolled in any formal care. Children started their preschool year at age three-and-a-half, and were four by the end of the year. In the spring of Pre-K, the children were five-years-old, and were six-years-old by the end of kindergarten. Latino dual language learners had the lowest income-to-needs ratio and assessed receptive vocabulary skills but the highest average maternal education levels of the three groups

(household income of about $21,900 not adjusted for household size). Monolingual Latino children had income-to-needs ratios that were double their Spanish-dominant peers (household income of about $31,100 at age three not adjusted for household size), and lower than their non-Latino peers, and the lowest maternal education levels. The non-Latino group had the highest average income-to-needs ratios (household income of about $43,100 at age three not adjusted for family size), but were still fairly low-income with an average income-to-needs ratio of two-and-a-half times the federal poverty threshold.

Sampling Procedures

Sampling method. A variety of early childhood education programs serving low-income children in Los Angeles County, California were selected to represent a range of diverse learning settings available to low-income children. The sampling procedure involved recruiting programs serving 3-year-olds in the first year of the study as well as recruiting a comparison group of children not attending a licensed early learning program at age 3. Target children from the study classrooms and comparison group children were all followed into any early learning program they attended the next year. These procedures resulted in two different samples of child care programs and classrooms—one set of 57 classrooms in year 1 representing the programs in which a set of 3-year-old children were initially sampled, and another set in year 2 representing the 106 classrooms where the study children ended up the following year. In some cases children stayed in the same program, but other children changed programs, and some of the children who were not in a program in year 1 entered a program in year 2. In the kindergarten year, children were in 127 classrooms.

In the first year of the study, three-year-old children were recruited in the three categories mentioned above (center-based programs, family child care, and no licensed early education

program). First, center-based and family child care programs were recruited, and teachers or child care providers distributed recruitment materials to the children in their programs. All selected classrooms and family child care programs agreed to participate. All parents of children enrolled in participating centers or family child care programs, and within the appropriate age group, gave permission to participate. Up to four children were selected from the volunteering families in each preschool classroom or family child care program. The comparison group of children was recruited in multiple ways, including solicitation of families on wait lists for the participating programs, a mass mailing to families on Los Angeles County's centralized eligibility list for subsidized child care, flyers in pediatric offices, and a radio announcement on Spanish-language radio. Children in the comparison group had to be three years old (age-eligible for kindergarten in two years) and not attending a licensed child care or preschool program.

Settings and locations in which the data were collected. The longitudinal design incorporated a repeated-measures model, with data collection occurring in early education settings and with individual children each year. The study was designed to collect observational data in children's early education settings annually in Year 1 (the three-year-old year), Year 2 (the four-year-old year) and Year 3 (kindergarten). Additionally, child-level data collection was planned for four time points: the fall of Year 1, spring of Year 1, spring of Year 2, and spring of Year 3. This design provided a baseline measurement of child characteristics when children were three years of age, and longitudinal follow-up across a three-year period through the end of kindergarten.

Procedure and Measures

Highly trained research staff visited each program for at least two days each year to collect observational measurements of children's experiences. These measures included measures of global quality of the interactions and academic experiences provided; emotional support, instructional support, and classroom organization; and time spent in various activity settings, academic activities, and interactions. In addition, teachers and child care providers completed questionnaires providing information about their own education background and experience, and the characteristics of their classrooms and child care programs. All programs, whether publicly or privately funded centers or family child care homes, were observed using the same set of tools. Children were assessed by trained assessors who determined the appropriate assessment protocol for children with Spanish language backgrounds using a decision-matrix taking into account teacher reports of child home language, the assessor's own experience speaking with the child during a rapport-building interaction, and children's initial scores on the language assessments in both languages.

SES Indicators. We included three measures of SES. Mothers' education level was a continuous variable representing years of schooling. Mothers also indicated their total household income for the prior calendar year. Income-to-needs ratios (INR) were calculated for each participant, by dividing total family income by the federal poverty threshold, adjusted for family size (i.e., number of adults and children in the home). Estimates from the four time points were averaged to create a composite INR. Finally, mothers indicated whether they had received CalWorks welfare cash assistance at each time point.

Child assessment measures and child language. For the purposes of the larger study, children were assessed using an extensive protocol including standardized tests of language, math, literacy and self-regulation skills; the proposed study examined only assessments of children's

self-regulation skills. Three different protocols were used, depending on the child's bilingual status. Children who had no Spanish spoken at home were given the English Only assessment, which included all measures in English only. If children had any Spanish spoken at home, they received one of two bilingual protocols, depending on their apparent level of English proficiency. The Spanish Bilingual assessment included assessments of expressive and receptive vocabulary in both Spanish and English, with Spanish-language assessments of math, literacy, and self-regulation skills. The English Bilingual assessment also included both Spanish and English language assessments, but measures of math, literacy, and self-regulation were conducted in English. Child assessment measures were conducted in the child's ECE program whenever possible, or in a quiet place in the child's home.

Spanish-English Dual Language Learners. For this study, children's initial receptive vocabulary scores were assigned based on the higher their standardized PPVT or TVIP scores (Smith-Donald, Raver, Hayes, & Richardson, 2007). Eighty-one children had higher Spanish-language receptive vocabulary scores as measured by the TVIP. Although there is some disagreement about the comparability of these two measures, this was an attempt to give the child credit for the assessment on which they had a higher standardized score. Average scores on the PPVT were similar to scores on the TVIP (see Table 1).

Latino children whose home language was identified as English and whose receptive vocabulary was assessed in English were identified as monolingual English speakers for the purposes of this study (n = 52). Children whose family identified Spanish as their primary home language (n = 125), and children whose family identified English as their primary home language, but children's receptive vocabulary scores were higher in Spanish (n = 6) were labeled

Spanish-English dual language learners (total n = 131). Finally, 85% of the parents of non-Latino children reported that English was their primary home language.

Child self-regulation measures. Children were assessed using three self-regulation tasks: pencil tap, toy sort, and gift wrap tasks (Smith-Donald, Raver, Hayes, & Richardson, 2007). These tasks were selected because they were easy to administer, were hypothesized to be linked to ecologically valid classroom experiences, and had been shown to yield useful data for preschool-age children in lab-based protocols (Carlson, 2005, Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009; Smith-Donald, Raver, Hayes, & Richardson, 2007). In the gift wrap task, the assessor tells the child that she has a gift for him, but needs to wrap it first. The child is instructed to sit facing away from the table and not to peek while the assessor noisily wraps the gift. After a timed 60-second interval, the child is allowed to see the gift, but then asked not to touch it while the assessor finishes some paperwork. A second 60-second interval is timed. The length of time (in seconds) that children were able to control their behavior (before peeking and touching, respectively) was measured. The pencil tap task, in which the child is directed to tap a pencil once when the assessor taps twice and to tap twice when the assessor taps once, was designed to assess children's executive control. The method of measurement in the pencil tap task was the percent of correct responses out of a total of 16 test trials. The toy sort task was included as an assessment of both executive control measured by latency (in seconds) to complete the clean-up task and a measure of effortful control measured by latency (in seconds) to begin the sorting task. Children were presented with a mixed-up pile of small and compelling toys and instructed to "clean them up" by accurately sorting them into bins in four categories.

Teacher-Child Interactions. The sensitivity, responsiveness, and effectiveness of teacher-child interactions in the classroom were measured using the CLASS and the Adult Involvement Scale (AIS).

Classroom Assessment Scoring System (CLASS) – Pre-K Version (LaParo, Pianta, Hamre, & Stuhlman, 2001; LaParo, Pianta, & Stuhlman, 2004). The CLASS is an observational instrument developed to assess instructional quality. Nine items are rated on a on a Likert scale from 1 to 7, with 1 and 2 indicating low levels; 3, 4, and 5 indicating mid-range levels; and 6 and 7 indicating high levels. Data collection in the preschool and prekindergarten years of this study was done before the 2004 version of the CLASS was finalized, so the 2001 version was used in this study. Individual items were summarized to create an overall composite score across the two versions of the measure. Each of the individual constructs in the scale is rated on a 7-point rubric. The constructs are rated multiple times throughout the program morning, after each 20-minute EAS cycle is completed. The EAS and CLASS observations were conducted during a single observation day at each site by the same observer. Training on the CLASS was done concurrently with training on the EAS, since these observations were conducted in concert during classroom observations in the field. Training included use of mastercoded video clips to provide examples of various levels (high, low, and moderate) of the CLASS dimensions. Requirements for certification on the CLASS were to code five reliability clips independently and score within one point on the master-coded videotapes on 80% of their scores averaged across the segments, and within one point on each dimension for over 50% of the dimensions. This is a standardized set of reliability tests developed by the publishers of the CLASS.

Snapshot Observations—Adult Involvement Scale (Ritchie, Howes, Kraft-Sayre, & Weiser, 2001). As described above, the Snapshot is a time-sampling procedure used to capture

aspects of adult-child interaction, teaching style, and the activities in which children are engaged. Over the course of a program morning, a minimum of 30 and up to 50 observations are collected for each child. Up to four target children are observed in sequence throughout the morning. To complete a Snapshot, the observer locates the first target child and spends a one-minute period observing and coding the child's activities and interactions. The observer then moves on to the next child on the list. This process is repeated in 4-minute blocks of time throughout the morning. For the purposes of this study, only the Adult Involvement Scale (AIS) will be used from the Snapshot measure. The AIS is a rating of the sensitivity and responsivity of teacher-child interactions experienced by the target child (as applicable), and is rated on a 7-point scale from ignores to intense. Data from each individual observation are aggregated to produce summary scores, at both the child and classroom level, of the percentage of the observation time spent in various activity settings and interaction types.

Training and reliability of observers. Each of the observational tools required extensive observer training and assessment of reliability. Training for each measure was initially conducted in the weeks prior to the beginning of their administration in the study (summer training for fall Snapshot and CLASS observations, winter training and administration of the ECERS observations). Training included initial group introductions and background readings for each measure, videotaped observations for practice purposes, in-the-field practice including debriefing with a certified trainer, and reliability testing done either in the field or via master-coded videotapes. The trainers were individuals with MAs or PhDs in child development or psychology who had been trained by and established interobserver reliability with the PIs and/or the developers of each measure and also had skills in training others on the measure. These trainers were considered to have achieved "gold standard' status on the measures.

Requirements for certification of observers before collecting data included successful completion of the training course as well as achievement of item-level scores of at least *kappa* (κ) greater than or equal to .65 with gold-standard trainers for the Snapshot measures. Kappas of .65 or higher are viewed as indicating good agreement (Landis & Koch, 1977). Requirements for certification on the CLASS were to code five reliability clips independently and score within one point on the master-coded videotapes on 80% of their scores averaged across the segments, and within one point on each dimension for over 50% of the dimensions. Re-training and reliability testing was repeated prior to each new year of observation.

Data collectors assessing children also were required to complete a rigorous training program to learn the complex administration rules for the PPVT, Woodcock-Johnson, and other measures used in the full assessment battery. Training for the assessor behavior ratings included videotape clips and group consensus discussions. Assessors could not begin fieldwork until they passed an assessment with an age-appropriate child with 100% accuracy on all technical aspects of the procedures, and achieved 90% reliability within one point on each of the behavioral ratings with the gold standard trainer on the assessor ratings items.

Results

I used Latent Growth Curve Modeling (LGC) to test my hypothesis that children's performance on measures of executive functioning grow over time, and that both the initial status and growth trajectory are predicted by the income-to-needs ratio of the family, mother's education, child's gender, the child and family language and ethnicity. Additionally, performance on executive function measures are predicted by the quality of teacher-child interactions within time points. Using LGC allows for estimating both inter and intra-individual variability in the intercept and slope, and predictors of developmental patterns in self-regulation

growth over time (Burchinal, Nelson, & Poe, 2006).

Growth curves were estimated for three self-regulation outcome measures: gift wrap task (effortful control), pencil tap task (inhibitory control), and toy sort (executive control & effortful control). These measures were repeated over four time-points which provided enough repeated assessments to allow estimation of individual growth curves (Burchinal, Nelson, & Poe, 2006). Baseline growth models were fit without covariates to test if there was enough developmental change in self-regulation skills to warrant further exploration Age was included as a time-varying variable in this analysis to control for the contribution that slight age differences can make in the maturation of self-regulation skills and to address the range of dates at which children were assessed. The latent growth modeling results were evaluated for goodness of fit using the Chi-square test, Comparitive Fit Index (CFI), and Root Mean Square Error of Approximation (RMSEA) statistic and RMSEA confidence interval.

Self-Regulation Tasks. Preliminary analyses of the self-regulation data were based on work by Smith-Raver et al. (2007) for the development of the Preschool Self-Regulation Assessment (PSRA). I created a composite variable for the Gift Wrap Task, which was the sum of each child's scores for the Toy Wrap (latency to first peek) and Toy Wait (latency to touch surprise) tasks. Across the four assessment time-points, this combined variable was more normally distributed than either peek or touch alone. Scores from the pencil tap task were converted to percent of correct responses out of 16 total trials. The toy sort task was calculated as the difference between the latency to complete the sort and the latency to begin the sort, and was an indication of whether or not the children played with the toys.

Additionally, a censoring effect was observed when some children hit ceiling or the highest score possible on the executive function measures (Rimm-Kaufman, Curby, Grimm,

Nathanson, & Brock, 2009). Censoring was from above for the gift wrap and pencil tap tasks, and from below for the toy sort. Fifty-seven percent of the children hit ceiling on the gift wrap task (waited 120 seconds without peeking or touching the gift wrapped gift) in the spring of pre-k, and a similar proportion hit ceiling in the spring of kindergarten. Only 28% percent of the children completed all of the pencil tap trials correctly by the spring of kindergarten. The mean amount of time children took to complete the toy sort at the floor was 62 seconds. Approximately 40% of the children completed the toy sort in this amount of time by the spring of pre-k and the spring of kindergarten.

Nesting of children within classrooms and programs. Up to four target children were randomly selected from those eligible in each participating classroom in year 1. In some classrooms, and particularly in the family child care programs, there were fewer than four children meeting age and parental permission requirements. In these cases, all eligible children with permission to participate were included in the study. The number of target child participants in each year 1 classroom therefore ranged from one to four children (one to three children in family child care homes). The average number of participants was 2.8 in public preschool classrooms, 2.9 in private preschool classrooms, and 1.6 in family child care programs (the modal number of children was four in both public and private classrooms and one in family child care). In the second year, when a number of children in our comparison group started early education for the first time and the other study children continued attendance in the same or different classrooms, the level of nesting of children within classrooms was decreased, while the number of classrooms observed increased. In public preschool classrooms, the number of target children per classroom ranged from one to seven (only one classroom with over four children) and averaged 1.7. In private preschool classrooms, the range was also one to seven (two

classrooms with over four target children), and the average was 2.0. For family child care programs, the range was unchanged from year 1 (one to three) and the average was 1.4 children. The modal number of target children per classroom in year two was one child for all three program types.

To evaluate the appropriate use of a multi-level modeling approach which would account for children nested within classrooms, intraclass correlations were computed to assess the similarity of child-level aggregates on the executive functioning measures within classroom groupings. Intraclass correlations were only calculated for classrooms with more than one child per classroom. Some of the intraclass correlations are low (less than .09) and some are high (as high as .41), with variability in the intraclass correlations within measures and across time. I also took into account the average cluster size in relation to the size of the intraclass correlation to get an estimate of the design effect on the results and did not get a result that was higher than a two, which has been suggested as a rough cut-point for multi-level modeling in previous publications (Muthén & Satorra, 1995). Due to the small amount of clustering within classrooms across years (54% of preschool classrooms observed only have one child per classroom, and an average of three children per classroom in the 46% of observed classrooms with multiple children), power issues with multilevel modeling, and statistical consultation, I did not use multi-level modeling for this study.

Missing Data and Attrition Analysis. Missing outcome data was addressed using full information maximum likelihood (FIML) estimation in the program Mplus (Muthen & Muthen, 2008). This type of estimation for missing data has been shown to be appropriate with longitudinal samples with moderate to large amounts of missing data due to attrition so long as factors related to attrition are included in the analysis, and data is ignorably missing (Burchinal,

Nelson, & Poe, 2006; Widaman, 2006). In our case, children from the comparison group were more likely to drop-out of the sample with data for only one time-point. Additionally, these children provide important information about growth in self-regulation skills over time when they have not been in early care settings in the year or two before kindergarten, and it is important to keep them in the sample even if they were more likely to drop-out of the study. Additionally, the preschool programs represented in this sample reflect the general trends of low quality seen in previous studies of early care and education (Howes, et al., 2008). There is no evidence that the types of programs that children who did not enroll in preschool at age three would be different from the preschool programs available to children who did enroll. Therefore, classroom quality data missing by design for the control group is assumed to be missing completely at random (Widaman, 2006).

Missing data on the predictors and covariates was addressed by creating phantom latent variables in Mplus (Rindskopf, 1984; Kline, 2011). Latent Growth Curve modeling in Mplus resulted in listwise deletion on cases with incomplete predictor or covariate data because FIML estmation is only applied to outcome (endogenous) variables. This indicated that a phantom variable solution might be used to address our complex sampling design because it can be used to fold the exogenous variables from the covariate side of the model to also be treated as outcome (endogenous latent phantom) variables to which FIML techniques were applied.

Socioeconomic Status. An analysis was conducted to examine the relation between maternal education, welfare receipt, and income-to-needs ratio since these are all factors that contribute to cumulative risk related to socioeconomic (SES) for young children (Mistry, et al., 2008). Maternal education was moderately correlated with the income-to-needs ratio ($r = .33$, $p<.001$). Although the sample overall is low-income, only 15% of respondents reported

receiving welfare benefits at any point across the three years of study data collection, and welfare receipt and income-to-needs ratio were actually negatively correlated ($r = -.17$, $p<.01$). Finally, maternal education and receiving welfare benefits were not significantly correlated ($r = -.10$, $p>.05$). Since maternal education and income-to-needs ratio are only moderately correlated and were associated with the executive function measures differently, both were included in the conditional models. Due to the low occurrence of welfare receipt, it will not be a focus in additional analyses. Additional models for calculating a risk score were considered and did not add additional variability representing the array of children's experiences related to socioeconomic risk (Mistry et al., 2010).

Descriptives. Descriptive statistics on self-regulation skills are presented in Table 1. Children's scores on self-regulation measures improved over time, and there was wide variability on all tasks. Children performed more accurately on the pencil tap task over time, completed the toy sort task more quickly, and took longer to peek or touch the toy in the gift wrap task. Since the same measures are used over time, the data are positively skewed at the first time points and negatively skewed at the last as the children improve in their self-regulation skills over time.

Overall, the AIS and CLASS scores were moderate (see Table 1). The scores in the preschool and pre-kindergarten years were similar across domains, but the scores either stayed the same or got lower in the kindergarten year indicating that children were experiencing less emotionally and instructionally supportive classrooms in their kindergarten year. Spanish dominant children had higher average AIS scores than the other two groups in preschool and pre-kindergarten.

Associations Between Self-Regulation Skills Over Time, Child Characteristics, and Teacher-Child Interactions.

To evaluate the possibility that self-regulation and effective interactions are related, I examined the bivariate correlations between self-regulation measures, child characteristics, and measures of classroom quality (see Table 2). Self-regulation tasks were intercorrelated within and between tasks. All three tasks had statistically significant associations with receptive vocabulary scores during at least one assessment point in the study. Receptive vocabulary was positively associated with scores on the gift wrap task and the pencil tap task and negatively associated with performance on the toy sort Task. The pencil tap task was positively associated with income-to-needs ratio in pre-kindergarten and negatively associated with the child being Latino, dominant in the English language, and their home language is English in the Fall of preschool. Child age was positively associated with income-to-needs ratio, and younger children were more likely to be boys. Receptive Vocabulary scores were also positively associated with income-to-needs ratio and maternal education, and negatively associated with being a Spanish-English dual language learner. AIS scores were positively associated with CLASS scores in preschool and pre-kindergarten. AIS scores in preschool were positively associated with AIS scores in pre-kindergarten and child age, and CLASS scores in preschool and pre-k. Higher AIS scores in pre-k were associated with higher CLASS scores in pre-k and kindergarten. CLASS scores were not correlated across years. Although an initial examination of the CLASS subscales showed significant associations with self-regulation task performance, there were no significant associations with overall scores on the CLASS or AIS.

Growth models. The plots in Figures 3-5 show that there is improved self-regulation skills as children grow older, with children taking longer to peek or touch in the gift wrap task, a higher proportion of correct responses on the pencil tap task, and faster times on the toy sort task. The shape of the growth models is linear for the pencil tap task and non-linear exponential

functions for the gift wrap and toy sort tasks. Models were run as linear and non-linear for all three tasks, and the model fit results followed the results of the visual inspection with better model fit for a linear growth model to predict scores on the pencil tap task, and exponential growth curves to represent growth toward ceiling on the gift wrap and toy sort tasks (Grimm, Ram, & Hamagami, 2011). Modeling growth as a multiplicative nonlinear latent curve allows us to examine variation across time and persons and allows for between-person differences in rates of change, timing of change, and total amounts of change. Additionally, since children largely reached the ceiling of the gift wrap task and floor of the toy sort task by the last time point, modeling growth on these tasks with an exponential function allows the ceiling and floor effects to be taken into account in the models due to the asymptotic nature of the exponential function. Exponential functions have a third growth term which describes children's approach to the asymptote or ceiling/floor on the measure. Baseline unconditional growth models were fit followed by models with child-level control variables, covariates of interest, and classroom-level variables added in blocks to test if these variables added substantially to predicting models of change in self-regulation skills over time. Interactions among these variables were also tested, and interactions between language and ethnicity are presented in Tables 5 and 6.

Baseline Growth Curve Models.

Unconditional or baseline linear growth models were fit for each of the 3 self-regulation tasks (see Table 3). The assessments were assigned uneven intervals in the model to reflect the pre and post-test timing of the tasks within the first year of the study, and yearly assessment thereafter through kindergarten. Model fit statistics were evaluated for a non-significant chi-square statistic, CFI above .95, RMSEA less than or equal to .05, and RMSEA confidence interval range not above .10. Akaike's information criterion (AIC) and Bayesian information

criterion values examined to draw comparisons between the baseline and subsequent models and lower values indicated better model fit (Allan & Lonigan, 2011; Raftery, 1993). The model fit statistics were good for the gift wrap task and toy sort task baseline models, and did not meet thresholds for good model fit for the pencil tap task.

Gift Wrap Task

The variance of the random initial status and linear slope coefficients were statistically significant indicating that children varied in their performance on the gift wrap task at entry into the study, and the total amount of change from entry into the study to ceiling on the measure. The mean function describes a child who waited 78.61 seconds before peeking and/or touching the gift at entry into the study, and a total amount of change from the fall of preschool to ceiling of 32.49 seconds (linear slope). The rate of approach toward the ceiling of the task changed across the time intervals with more growth within the first year than the subsequent two years indicating that many children hit ceiling on the measure during their pre-k year. Growth between the spring and fall of the preschool year was of 6.14 seconds on average, 2.63 seconds from the spring of preschool to the spring of pre-k, and .63 seconds from the spring of pre-k to the spring of kindergarten. There was also a negative relationship between initial status, and linear slope indicating that children who started out waiting longer before peeking or touching the gift in the gift wrap task had a smaller amount of change between their first assessment and hitting ceiling on the measure. There were no significant associations between initial status and rate of growth, or total amount of change and rate of growth on the task.

Pencil Tap

The average child correctly performed 18.7% of the pencil tap trials at entry into the study, and was able to complete 27.6% more pencil tap trials for each year they were measured.

There was a significant amount of individual variation in the initial status and rate of growth for individual children on the pencil tap measure, indicating that preschoolers are a heterogeneous group in terms of their pencil tap task performance two years before kindergarten. There was a statistically significant negative relationship between initial status and growth rate on the pencil tap task measure showing that children who entered the study with higher scores on the pencil tap task had slower rates of change across the study, indicating that peers were performing more similarly over time.

Toy Sort Completion

Children also varied in their performance on the toy sort completion task at entry into the study, and the total amount of change from entry into the study to ceiling on the measure, but not the exponential rate of change. The mean function describes a child who completed the toy sort task in 85.51 seconds at entry into the study, a total amount of change from the fall of preschool to the floor of the measure of -23.34 seconds indicating that on average children were completing the toy sort task in an average of 62.17 seconds at the floor of the measure. The average rate of approach toward the floor of the task of -4.62 seconds between fall and spring of preschool, -2.16 seconds between the spring of preschool and the spring of pre-k, and -.56 seconds between the spring of pre-k and the spring of kindergarten. There was a statistically significant negative relationship between initial status, and linear slope indicating that children who initially completed the toy sort task more quickly had a smaller amount of change between their first assessment and hitting ceiling on the measure. There were no significant associations between initial status and rate of growth, or total amount of change and rate of growth on the task.

Conditional models with child and family control variables.

Gift Wrap Task

On average, children with higher receptive vocabulary scores at entry into the study waited longer before peeking at or touching the wrapped gift, but did not differ in their rate of growth suggesting that these differences are maintained over time. For every one unit change in receptive vocabulary scores children waited .39 seconds longer on average. See Table 4. Children's average performance on the gift wrap task at initial status or rate of growth did not differ by income-to-needs ratio, maternal education, child gender, or age at entry into the study. Children who began the study with longer wait times had a lesser overall amount of change over time. After controlling for receptive vocabulary, the rate of change in the overall model increased between the fall to spring of preschool to 9.58 seconds, 2.78 seconds between spring of preschool to the spring of pre-k, and .45 seconds from the spring of pre-k to the spring of Kindergarten.

Pencil Tap

Average performance on the pencil tap task did not differ by income-to-needs ratio, maternal education, or child gender at entry into the study or rate of growth. The initial status for older children was significantly higher than their younger age peers, but their rate of growth was somewhat slower. Additionally, children who entered the study with higher receptive vocabulary scores performed more trials correctly on the pencil tap task at entry into the study, but had a similar rate of growth to the rest of the sample after controlling for child and family characteristics. Children who entered the study successfully completing more pencil tap trials had a slower rate of change.

Toy Sort Completion

Income-to-needs ratio, child gender, and receptive vocabulary scores were not correlated on average with performance on the toy sort completion task in initial status or rate of growth.

See Table 4. Younger children took longer to sort the toys than older children at entry with an average of .71 seconds for every one month difference, and did not vary in their rate of change. Additionally, maternal education approached significance, and children of more educated mothers took longer to complete the toy sort task. After controlling for these child and family factors, the rate of change in the overall model increased between the fall to spring of preschool to -8.04 seconds, -10.75 seconds between spring of preschool to the spring of pre-k, and -7.99 seconds from the spring of pre-k to the spring of Kindergarten.

Language status and ethnicity predicting self-regulation outcomes through kindergarten.

Gift Wrap Task

On average, Spanish-English dual language learner status was not correlated with performance on their gift wrap task over time when controlling for receptive vocabulary scores at entry into the study. However, English dominant Latino children grew two fewer seconds in their rate of change over time than their non-Latino and DLL peers. Receptive vocabulary remained the only statistically significant predictor of initial performance on the gift wrap task. After controlling for dual language learner and Latino status, children with higher initial receptive vocabulary scores waited longer before peeking at or touching the gift wrapped present at entry into the study than children with lower scores, but their rate of change was similar.

Pencil Tap

Consistent with the previous model, older children and children with higher receptive vocabulary scores did slightly better on the pencil tap task in the fall of preschool than younger children or children with lower receptive vocabulary scores. Younger children had slightly higher rates of growth than older children. Monolingual-English Latino children performed

eleven percent fewer pencil tap trials correctly than their non-Latino peers in the fall of preschool and did not differ in their rate of growth implying that differences remained over time.

Toy Sort

On average, maternal education level at entry into the study remains the only predictor of initial performance on the toy sort task to approach significance after the addition of dual language learner status and child ethnicity to the model. Children with more educated mothers took slightly longer to complete the toy sort task than children with less educated mothers at entry into the study. No statistically significant differences for Spanish-English dual language learner and Latino status children on their toy sort task performance were found over time when controlling for income-to-needs ratio, child gender, child age, and receptive vocabulary.

Teacher-child interactions predicting self-regulation outcomes at each time point.

Finally, classroom covariates were added to the model to better account for some of the variance in the self-regulation measures at specific time points. Due to the sample size, there was not enough power to add classroom covariates to the exponential growth curve models for the gift wrap task, or the toy sort task. Therefore, classroom covariates were only tested for the pencil tap task linear growth model.

Pencil Tap Task

Patterns of results on the child level covariates held with the addition of classroom-level teacher-child interaction covariates to the model. Older children and children with higher receptive vocabulary scores performed slightly better on the pencil tap task in the fall of preschool, and older children had slightly lower rates of growth over time. Monolingual English Latino children performed an average of 12.4% fewer pencil tap trials correctly than their non-Latino and DLL peers in the fall of preschool. Overall CLASS scores positively predicted

performance on the pencil tap task in the spring of preschool and spring of kindergarten with every point increase on the CLASS associated with a 17.6% increase in performance on the pencil tap task in preschool, and a 7.8% increase in kindergarten. AIS scores negatively predicted performance on the pencil tap Task in the spring of preschool and spring of kindergarten, with a one point difference predicting an average drop of 15.8% on the pencil tap task score in the spring of preschool, and 7.2% drop in the spring of kindergarten. Significant results on classroom covariates only emerged after including both the CLASS which has an observational focus on the teacher, and the AIS which has an observational focus on the child in the model.

Discussion

Growth in Self-Regulation Tasks

The short-term longitudinal growth models show growth in self-regulation skills over time, and similar to previous studies of self-regulation that growth is particularly rapid at younger ages (Li-Grinning, 2007; Raver, 2004; Rothbart, Posner, & Kieras, 2006; Smith-Donald, Raver, Hayes, & Richardson, 2007). However, previous studies have also observed a censoring effect of these tasks as children approached school-entry (Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009). To account for the restricted range in outcomes for some of the tasks used in this study, non-linear Latent Growth Curve Modeling was used to allow us to ask how quickly children reached ceiling on these measures, and appropriately account for this censored effect in the data (Grimm & Ramm, 2011). Additionally, a strength of this study is that the same self-regulation assessments are measured using the same assessments across four time-points in children's early development (Burchinal, Nelson, & Poe, 2006).

Performance on self-regulation tasks was predicted by child age and receptive vocabulary but not any of the other sociodemographic characteristics included in the analyses (Allan & Lonigan, 2011; McClelland, et al., 2007; Smith-Donal, Raver, Hayes, & Richardson, 2007). Receptive vocabulary in English and Spanish in the fall of preschool was predictive of children's impulse control and executive function at entry into the study, and younger children performed worse on executive function tasks at entry into the study, but had slightly higher rates of growth over time (Allan & Lonigan, 2011; Carlson & Meltzoff, 2008; Li-Grinning, 2007; McClelland, et al., 2007; Smith-Donal, Raver, Hayes, & Richardson, 2007). No differences were observed related to socioeconomic status, including maternal education and income-to-needs ratio. The lack of findings related to SES may be due to the truncated range of SES indicators in this largely low-income sample in comparison to other studies that found differences in self-regulation by income (Cameron Ponitz et al., 2008; Carlson & Meltzoff, 2008; Wanless, McClelland, Tominey, & Acock, 2011). It is also noteworthy that we did not find gender differences despite prior literature suggesting the opposite (McCabe, Cunnington, & Brooks-Gunn, 2004).

Language Acquisition and Self-Regulation

One main purpose of this study was to examine if the development of self-regulation skills over time was predicted by children's language experiences and ethnic background for a largely low-income and predominantly Latino sample of young children. Similar to a previous longitudinal study of minority children, there was variability at entry into the study and growth over time for all three self-regulation tasks (Li-Grinning,2007). Spanish-English dual language learners were economically disadvantaged overall, and English-dominant dual language learners had lower receptive vocabulary scores than their peers despite having higher levels of maternal

education. However, dual language learners performed similarly to their non-Latino peers on the pencil tap conflict task indicating that they are doing more cognitively despite experiencing greater poverty-related adversity (Blair & Raver, 2011; Li-Grinning, 2007). Despite having more educated mothers, the monolingual Latino children in our study performed worse on the conflict task than their Spanish-English speaking peers at age three.

Additionally, dual language learners and their monolingual English Latino peers performed similarly to their peers on delay of gratification tasks which tap into impulse inhibition. This finding is consistent with our expectations that Latino children grow up in cultural communities, which value self-control or the behavioral manifestation of impulse control (Carlson & Meltzoff, 2008; Johnson, et al., 2003; Zucker & Howes, 2009). However, it also stands in contrast to the results of other studies which identified worse performance on behavioral regulation tasks by dual language learners (Cameron, Ponitz, et al., 2008; Wanless, McClelland, Tominey, & Acock, 2011). This finding might be accounted for by the English dominant dual language learner's lower assessed receptive vocabulary scores which were not controlled for in at least one of these previous studies. Also, the overall low-income sample in our study might due to restricted variability in our sample of low-income children. Additionally, studies which included response suppression task measures more similar to our measures of inhibitory control showed enhanced performance of dual language learners on these tasks (Bialystok & Viswanathan, 2009).

It also important to consider that receptive vocabulary was positively related to performance on the pencil tap task above and beyond the effect of dual language learner status and child age. This task was the most challenging of the PSRA (Smith-Donald, Raver, Hayes, & Richardson, 2007) for children to complete in this study, and has been linked in previous studies

of young children to academic skills like math performance, gains in language and emergent literacy skills, adaptive classroom behaviors, and increased social competence (Allen & Lonigan, 2011; Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Rimm-Kaufman, Curby, Grimm, Nathanson, & Brock, 2009; Smith-Donald, Raver, Hayes, & Richardson, 2007). The pencil tap task requires children to follow the verbal directions of the assessor very closely and might be more similar to decontextualized tasks that children are asked to perform in school settings. Therefore, it might be measuring something unique and important about children's verbal ability as it relates to school-functioning above and beyond executive function, and verbal ability should be considered in future studies utilizing this measure.

Teacher-Child Interactions and Self-Regulation

As indicated in previous studies, children in classrooms with higher emotional and instructional climates performed better on the conflict task in preschool and kindergarten indicating that despite the truncated range in teacher-child interactions in this sample, more sensitive and instructionally supportive classroom practices predicted better self-regulation performance (Barnett, et al., 2008; Downer, Sabol, & Hamre, 2010; Rimm-Kaufman, Curby, & Grimm, Nathanson, & Brock, 2009). A unique feature of this study is the inclusion of the Adult Involvement Scale, a snapshot measure of teacher warmth and sensitivity measured with the child as the focal participant (Ritchie, Howes, Kraft-Sayre, & Weiser, 2001). Above and beyond general interactions between the teacher and all of the children in her classroom, the Adult Involvement Scale captures variability in the teacher-child relationship that is more dependent on the individual child. In our study, more sensitive and intense teacher-child interactions predicted lower performance on the pencil tap task. It is likely that children who were more unregulated precipitated increased attention and scaffolding from their teachers pointing to the bidirectional

nature of this relationship which should be taken into account in future studies (Blair & Raver, 2012). The predictive nature of teacher-child interactions on children's self-regulation development, even within the low range of programs observed in this study shows promise for children growing up in contexts influenced by poverty (Blair & Raver, 2012). The sample of early care and education programs was also diverse, and included center and licensed family child care programs which might be equally able to provide developmentally supportive early care and education services to low-income children. Based on descriptive analyses, the Spanish-English dual language learner group was not participating in care that was of lower-quality than their monolingual Latino and non-Latino low-income peers.

In summary, my study contributes to current thinking about the development of self-regulation in early childhood and how those skills are predicted by children's cognitive development related to language learning, ethnicity and experiences in early care and education. Additionally, this work extends the use of self-regulation tasks to a sample of low-income, largely Latino children. We were also able to utilize non-linear growth models to take into account children's rate of approach toward ceiling and floor on the impulse control tasks which allowed for examination of growth in these skills through kindergarten.

Limitations

Due to the timing of this study, an older version of the CLASS was available for the first two of the three years of the study. Due to changes in the measure and statistical power issues due to sample size, we were not able to examine individual components of the CLASS measure which might lend to a greater understanding of specific teacher-child interactions that are predictive of self-regulation task performance (Downer, Sabol, & Hamre, 2010). Additionally, since this study examined naturalistic classroom settings where low-income children receive

early care and education services, and not model programs, the range of teacher-child interaction quality was relatively low (Fuligni, Howes, Huang, Hong, & Lara-Cinisimo, 2012). Finally, the effect of poverty-related adversity might not have been as salient in this study due to the truncated range of value on socioeconomic status markers due to the largely low-income sample.

Implications

Early self-regulation skills grow throughout the early childhood years, and the ability to wait and focus attention on a cognitive task in the face of distracting and appealing opportunities grows particularly quickly at the earlier end of the preschool period. Despite experiencing greater economic adversity, Latino dual language learners in this study performed similarly to their less-disadvantaged non-Latino peers on the pencil tap task which required the use of working memory, and managing attentional demands. Additionally, this study has shown associations between the emotional and instructional climate aspects of teacher-child interactions and self-regulation in early care and education settings. Future research may focus on investigating specific aspects of teacher-child interactions that promote the development of self-regulation skills, and since an association between the effects of teacher-child interactions and self-regulation development was only seen after including a measure of teacher-child interactions with the child as the observational focus, future research should include measures that capture the individual experiences of children with their teachers. Finally, early dual language acquisition may play a protective role for the cognitive development of low-income children and supporting early bilingual language acquisition in classroom environments should be considered (Burchinal, Field, Lopez, Howes, & Pianta, 2012).

Table 1. Descriptives of participants, self-regulation tasks, and classroom measures.

	Overall			Spanish-English DLL & Latino			Monolingual English & Latino			Non-Latino		
	n	mean	(SD)	n	mean	(SD)	n	mean	(SD)	n	mean	(SD)
	296	100%		131	46.95%		52	18.64%		96	34.41%	
Covariates												
Latino	183	65.59%										
Income-to-Needs	275	1.70	(2.04)	129	1.07	(.56)	52	1.96	(1.45)	90	2.46	(3.16)
Maternal Ed.	265	12.65	(3.18)	131	14.06	(2.73)	50	12.86	(2.57)	89	14.35955	(2.80)
Male	132	44.60%		57	43.51%		23	44.23%		46	47.92%	
Child Age	295	42.87	(4.35)	131	42.99	(4.22)	52	43.13	(4.46)	96	42.53	(4.32)
Receptive Vocabulary	285	92.21	(17.45)	131	88.79	(18.69)	52	92.87	(15.50)	89	97.81	(15.77)
PPVT	204	91.89	(17.36)	58	82.33	(17.75)						
TVIP	73	93.93	(17.91)	73	93.93	(17.91)						
Children's Outcomes												
Gift Wrap Task												
Fall PS	173	79.66	(36.09)	82	79.38	(38.12)	29	84.83	(31.34)	56	76.38	(35.51)
Spring PS	250	99.21	(29.83)	117	98.51	(30.31)	50	93.16	(31.11)	74	103.39	(28.72)
Spring PK	212	110.49	(21.80)	97	113.54	(17.12)	41	109.02	(24.12)	68	107.94	(24.39)
Spring K	193	109.63	(24.07)	88	108.51	(24.02)	39	111.28	(24.55)	62	109.50	(24.80)
Pencil Tap Task												
Fall PS	181	17.37%	(21.67%)	84	18.68%	(21.53%)	30	10.42%	(16.11%)	59	19.49%	(24.26%)
Spring PS	252	34.40%	(26.97%)	117	32.16%	(25.32%)	50	29.88%	(24.49%)	76	42.52%	(30.10%)
Spring PK	212	57.05%	(32.07%)	97	50.39%	(32.12%)	41	56.55%	(31.15%)	68	65.44%	(30.86%)
Spring K	193	88.67%	(18.53%)	88	88.85%	(16.09%)	39	84.46%	(24.37%)	62	91.63%	(17.16%)
Toy Sort Task												
Fall PS	177	96.32	(22.71)	77	96.12	(21.77)	26	89.92	(23.36)	48	99.88	(23.79)
Spring PS	251	78.01	(27.19)	109	80.87	(27.64)	48	78.19	(29.62)	70	73.10	(25.02)
Spring PK	211	64.47	(26.55)	93	70.41	(26.58)	39	61.23	(26.07)	68	58.01	(25.63)
Spring K	191	63.63	(26.22)	86	64.58	(26.93)	35	64.46	(22.09)	60	62.65	(28.04)

Table 1 (continued). Descriptives of participants, self-regulation tasks, and classroom measures.

	Overall			Spanish-English DLL & Latino			Monolingual English & Latino			Non-Latino		
	n	mean	(SD)	n	mean	(SD)	n	mean	(SD)	n	mean	(SD)
Classroom Characteristics												
AIS												
Preschool	150	5.15	(.44)	62	5.20	(.43)	20	5.06	(.55)	62	5.11	(.40)
Pre-K	153	5.04	(.72)	60	5.13	(.56)	27	4.93	(.88)	59	4.96	(.78)
Kindergarten	148	4.83	(.48)	71	4.86	(.44)	33	4.76	(.36)	37	4.88	(.65)
CLASS												
Preschool	153	4.71	(.44)	62	4.75	(.43)	21	4.75	(.61)	62	4.65	(.39)
Pre-K	153	4.72	(.45)	60	4.78	(.39)	27	4.81	(.46)	59	4.61	(.50)
Kindergarten	148	4.19	(.53)	71	4.20	(.50)	33	4.14	(.49)	37	4.24	(.62)

Table 2. Interrelations between child and classroom measures.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	Gift Wrap																									
1	Fall PS	1	.28**	.24**	.09	.06	.10	.05	.11	-.05	-.08	.03	.09	.00	-.09	.07	.08	.13	.03	.08	-.03	-.17	-.03	-.06	-.14	.02
2	Spring PS		1	.22**	.22**	.25**	.29**	.21**	.26**	-.18*	-.06	-.05	.01	.08	-.03	.01	.05	.17**	-.03	-.10	.09	.04	.14	.02	.03	.12
3	Spring PK			1	.16*	.07	.07	.09	.16*	-.05	.03	-.02	.09	.05	-.03	-.02	.08	.17*	.09	-.04	-.15	-.04	-.11	-.11	-.12	-.15
4	Spring K				1	.08	.08	.11	.12	-.16	.23	.07	.03	.02	-.04	.03	.10	.01	-.04	.04	-.06	-.06	-.02	-.11	-.06	-.12
	Pencil Tap																									
5	Fall PS					1	.40**	.36**	.17	.02	-.05	-.16	.04	.03	-.03	-.08	.14	.20	.04	-.16*	.15	.08	.08	.00	.03	-.08
6	Spring PS						1	.40**	.27**	-.12	-.03	-.13	-.03	.12	.10	.01	.21	.22	-.11	-.10	.07	-.03	.10	.09	-.09	-.01
7	Spring PK							1	.31**	-.06	-.12	-.16	-.08	.17*	.11	-.08	.07	.37**	-.17*	-.01	.07	.03	-.04	-.07	.01	-.01
8	Spring K								1	-.06	-.05	-.02	.04	.07	-.01	.05	.05	.31**	.01	-.12	-.00	.07	-.03	-.05	.04	.05
	Toy Sort																									
9	Fall PS									1	.11	.03	-.12	-.03	.14+	.04	-.16	-.08	.01	-.12	-.03	-.17	-.03	-.06	.15	.02
10	Spring PS										1	.20**	.13	-.10	.01	.00	-.08	-.16	.07	.00	.09	.04	.14	.02	.03	.12
11	Spring PK											1	.18	-.08	-.03	.05	-.11	-.14*	.16*	-.07	-.15	-.04	-.11	-.11	-.12	-.15
12	Spring K												1	-.10	.06	.04	.03	-.07	.04	.02	-.06	-.06	-.02	-.11	-.06	-.12
i3	Income-to-Needs													1	.36**	-.09	.16**	.33**	-.31**	.06	.01	.11	.06	.03	.05	.08
14	Maternal Education														1	.15*	.01	.23**	-.43**	.03	-.10	.05	.16+	-.08	-.03	.16+
15	Child Gender															1	-.12*	-.09	.04	-.02	-.04	-.02	-.02	.04	-.04	.03
16	Child Age																1	.05	-.01	.02	.16	.17*	.03	.15	.13	.06
17	Receptive Vocab.																	1	-.22**	.00	.15	.10	.15	.08	.10	.05
18	DLL-Latino																		1	-.49**	.14	.13	.02	.10	.12	-.03
19	English-Latino																			1	.08	-.07	-.11	.04	.09	-.07
	AIS																									
20	Spring PS																				1	.28**	.01	.78**	.28**	.00
21	Spring PK																					1	.29	.16	.74	.30
22	Spring K																						1	-.03	.28**	.65**
	CLASS																									
23	Spring PS																							1	.30	.00
24	Spring PK																								1	.19
25	Spring K																									1

Note: Numbers in table are Pearson Product Moment Correlations; *$p \leq .05$, **$p \leq .01$.

Table 3. Baseline latent growth curve model statistics.

	Gift Wrap Task Exponential		Pencil Tap Task Linear		Toy Sort Task Exponential	
n	290		293		293	
Model Fit						
Chi-Square	2.47		9.54**		8.53	
CFI	.99		.92		.96	
RMSEA	.03		.09		.02	
90% C.I.	.00-.12		.03-15		.00-.07	
	Estimate	(s.e.)	Estimate	(s.e.)	Estimate	(s.e.)
Estimates of Fixed Effects						
Intercept	78.61***	(2.73)	18.7%***	(1.4%)	85.51***	(2.70)
Slope	32.49***	(2.83)	27.6%***	(.9%)	-23.34***	(3.34)
Alpha: f→ sp ps	6.14***	(1.21)	--	--	-4.62***	(1.24)
Alpha: ps→ pk	2.63+	(1.41)	--	--	-2.16	(1.44)
Alpha: pk→ k	.63	(.55)	--	--	-.56	(.61)
Estimated Variance of						
Intercept	930.12***	(154.02)	2.7%***	(.5%)	797.49***	(169.62)
Slope	988.30***	(246.11)	.6%**	(.2%)	1012.36***	(279.27)
Alpha	7.56	(9.83)	--	--	16.25	(12.52)
Covariance						
Intercept with Slope	-876.16***	(167.07)	-.01**	(.00)	-842.69***	(190.09)
Intercept with Alpha	40.58	(154.09)	--	--	28.86	(29.39)
Slope with Alpha	-67.42	(36.08)	--	--	-28.99	(31.78)

Note: +p < .10, *p < .05, **p < .01, ***p < .001. PS indicates preschool, PK indicates pre-k, K indicates Kindergarten.

Table 4. Conditional latent growth curve model statistics with child and family characteristics.

	Gift Wrap Task Exponential		Pencil Tap Task Linear		Toy Sort Task Exponential	
n	296		296		296	
Model Fit						
Chi-Square	19.33		38.71**		8.07	
CFI	.90		.85		1.00	
RMSEA	.03		.06		.00	
90% C.I.	.00-.06		.03-.09		.00-.03	
Estimates of Fixed Effects	Estimate	(s.e.)	Estimate	(s.e.)	Estimate	(s.e.)
Intercept	78.97		19.2%		96.04	
Linear Slope	31.79		2.65%		-24.07	
Exponential Slope						
Alpha: f→ sp ps	12.29	(7.75)	--	--	-8.04***	(2.29)
Alpha: ps→ pk	5.45	(4.55)	--	--	-10.75***	(1.94)
Alpha: pk→ k	1.34	(1.34)	--	--	-7.99**	(2.41)
	β	(s.e.)	β	(s.e.)	β	(s.e.)
Initial Status Regression						
Income-to-Needs	-.57	(1.72)	.1%	(.8%)	-1.16	(1.16)
Maternal Education	-.63	(.90)	.2%	(.5%)	1.13+	(.59)
Male	-6.14	(5.18)	.1%	(2.8%)	3.79	(3.57)
Child Age	.73	(.65)	1.2%**	(.3%)	-.71*	(.34)
Receptive Vocab.	.39*	(.16)	.3%**	(.1%)	-.17	(.11)
Growth Rate Regression						
Income-to-Needs	.87	(1.88)	.0%	(.4%)	-.06	(.14)
Maternal Education	.20	(1.00)	-.2%	(.2%)	.08	(.08)
Male	5.34	(5.74)	-1.1%	(1.5%)	.53	(.46)
Child Age	-.37	(.73)	-.4%*	(.2%)	-.03	(.03)
Receptive Vocab.	-.25	(.19)	.1%	(.0%)	.01	(.01)
	Estimate	(s.e.)	Estimate	(s.e.)	Estimate	(s.e.)
Estimated Variance/ Residual Variance						
Intercept	879.92***	(148.61)	2.2%***	(.5%)	79.62	(187.34)
Slope	972.59***	(250.37)	.6%	(.4%)	1912.74	(3522.63)
Alpha	2.29	(3.55)	--	--	12.30	(22.33)
Covariance						
I with S	-832.92	(162.78)	-.7%**	(.2%)	-46.25	(138.13)
I with A	16.17	(27.86)	--	--	.42	(23.89)
S with A	-32.36	(25.66)	--	--	140.45	(259.41)

Note: +p < .10, *p < .05, **p < .01, ***p < .001. PS indicates preschool, PK indicates pre-k, K indicates Kindergarten.

Table 5. Conditional latent growth curve models with child-level covariates.

	Gift Wrap Task Exponential		Pencil Tap Task Linear		Toy Sort Task Exponential	
n	296		296		296	
Model Fit						
Chi-Square	13.33		42.51*		12.10	
CFI	1.00		.87		1.00	
RMSEA	.00		.05		.00	
90% C.I.	.00-.04		.02-.07		.00-.04	
Estimates of Fixed Effects	Estimate	(s.e.)	Estimate	(s.e.)	Estimate	(s.e.)
Intercept	78.44		19.2%		96.20	
Slope	31.05		26.6%		-27.65	
Alpha: f→ sp ps	7.15***	(7.37)	--	--	-8.70***	(1.24)
Alpha: ps→ pk	4.54*	(4.51)	--	--	-10.34***	(2.23)
Alpha: pk→ k	1.60	(1.55)	--	--	-6.82*	(2.93)
	β	(s.e.)	β	(s.e.)	β	(s.e.)
Initial Status Regression						
Income-to-Needs	-.19	(.93)	.0%	(.8%)	-1.27	(1.17)
Maternal Education	-.35	(.58)	-.1%	(.5%)	1.16+	(.64)
Male	-2.46	(3.34)	-.3%	(2.8%)	3.19	(3.61)
Child Age	.51	(.32)	1.2%***	(.3%)	-.55	(.34)
Receptive Vocab.	.10	(.11)	.3%**	(.1%)	-.15	(.11)
Latino & DLL	4.41	(4.32)	-4.8%	(3.6%)	-1.62	(4.59)
Latino & Monoling.	7.63	(5.11)	-11.3%**	(4.1%)	-5.56	(5.27)
Growth Rate Regression						
Income-to-Needs	.12	(.19)	.0%	(.4%)	-.10	(.14)
Maternal Education	-.01	(.11)	-.1%	(.3%)	.04	(.08)
Male	.17	(.66)	-.9%	(1.5%)	.48	(.47)
Child Age	.03	(.05)	-.5%**	(.2%)	-.01	(.04)
Receptive Vocab.	.03	(.02)	.1%	(.0%)	.02	(.01)
Latino & DLL	-.69	(.88)	1.4%	(1.9%)	-1.02	(.63)
Latino & Monoling.	-2.02*	(1.01)	2.8%	(2.1%)	-.98	(.70)
	Estimate	(s.e.)	Estimate	(s.e.)	Estimate	(s.e.)
Estimated Variance/ Residual Variance						
Intercept	904.97***	(149.00)	2.1%***	(.5%)	46.93	(163.23)
Slope	1219.55**	(370.04)	.5%	(.4%)	1031.84	(1725.12)
Alpha	8.39	(7.03)	--	--	7.42	(11.90)
Covariance						
I with S	-903.58***	(181.59)	-.7%**	(.2%)	-2.29	(18.61)
I with A	18.33	(27.72)	--	--	-33.20	(117.64)
S with A	-64.06	(24.01)	--	--	78.64	(125.14)

Note: +p < .10, *p < .05, **p < .01, ***p < .001. PS indicates preschool, PK indicates pre-k, K indicates Kindergarten, DLL indicates dual language learner.

Table 6. Conditional latent growth curve models with child and classroom-level covariates.

	Pencil Tap Task Linear	
n	296	
Model Fit		
Chi-Square	59.75	
CFI	.93	
RMSEA	.03	
90% C.I.	.00-.05	
	β	(s.e.)
Estimates of Fixed Effects		
Intercept	19.2%	
Slope	26.6%	
	β	(s.e.)
Initial Status Regression		
Income-to-Needs	-.4%	(.9%)
Maternal Education	-.1%	(.5%)
Male	-.3%	(2.7%)
Child Age	1.2%**	(.3%)
Receptive Vocab.	.3%**	(.1%)
Latino & DLL	-5.1%	(3.7%)
Latino & Monoling.	-12.4%**	(4.1%)
Growth Rate Regression		
Income-to-Needs	.1%	(.4%)
Maternal Education	-.1%	(.3%)
Male	-.7%	(1.4%)
Child Age	-.5%**	(.2%)
Receptive Vocab.	.1%+	(.0%)
Latino & DLL	1.7%	(1.9%)
Latino & Monoling.	3.4%	(2.1%)
CLASS		
Preschool	17.6%*	(6.7%)
Pre-Kindergarten	-5.7%	(5.9%)
Kindergarten	7.8%*	(3.7%)
AIS		
Preschool	-15.8%*	(6.2%)
Pre-Kindergarten	4.4%	(5.2%)
Kindergarten	-7.2%+	(3.9%)
	Estimate	(s.e.)
Estimated Variance of		
Intercept	2.1%***	(.5%)
Slope	.6%	(.4%)
Covariance		
I with S	-.6%**	(.2%)

Note: +p < .10, *p < .05, **p < .01, ***p < .001. PS indicates preschool, PK indicates pre-k, K indicates Kindergarten, DLL indicates dual language learner.

Figure 1. Effective teacher-child interactions and children's self-regulation skills.

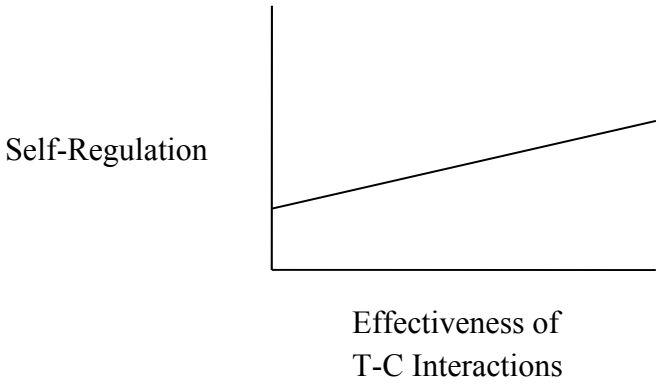


Figure 2. Conceptual model.

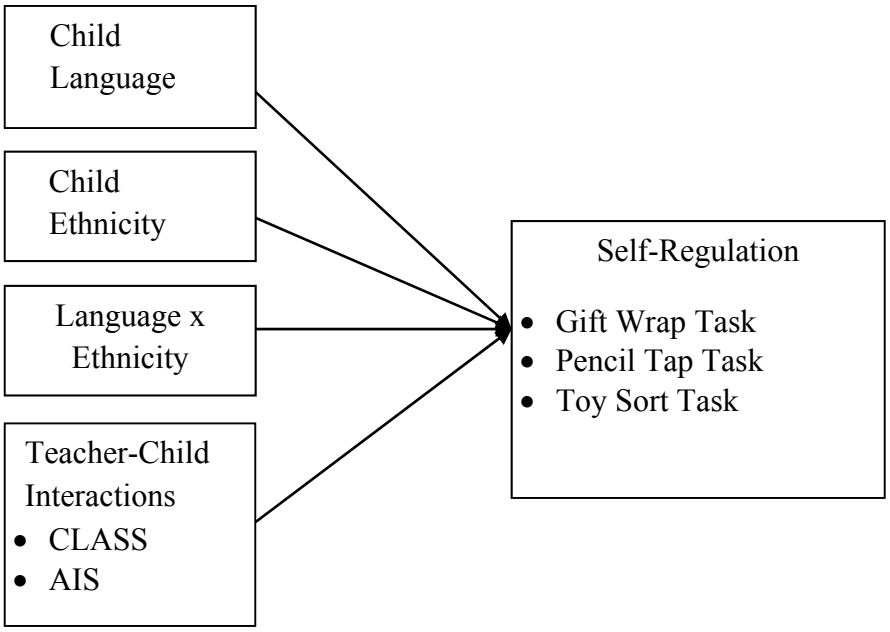


Figure 3. Change in impulse control over time (amount of time until peeked + amount of time until touched).

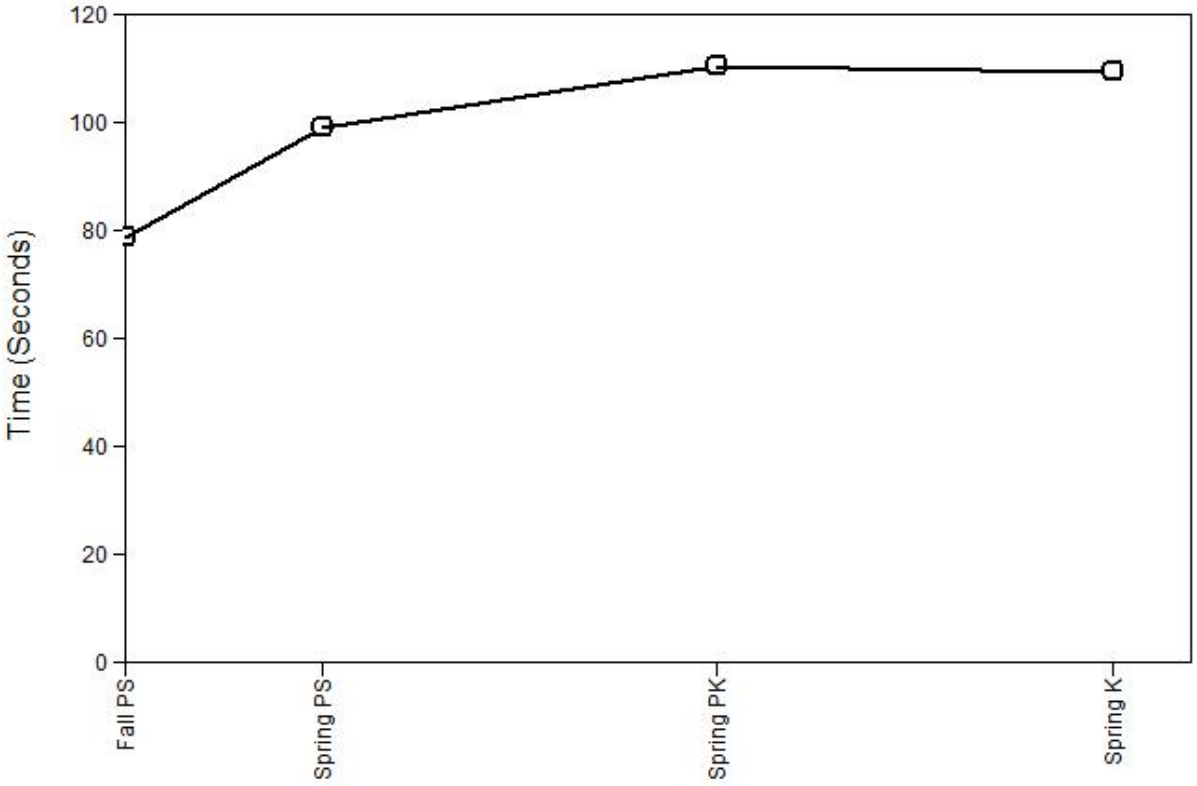


Figure 4. Change in executive control over time (% of Pencil Taps correct).

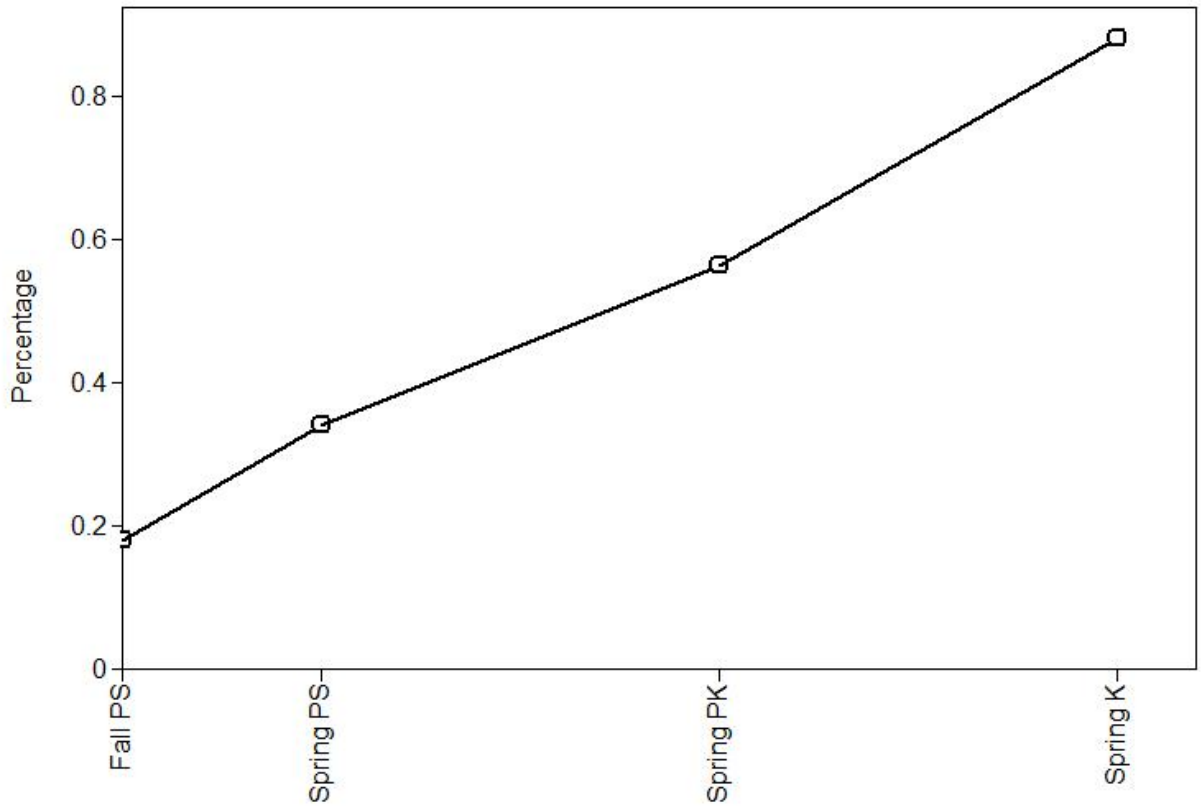
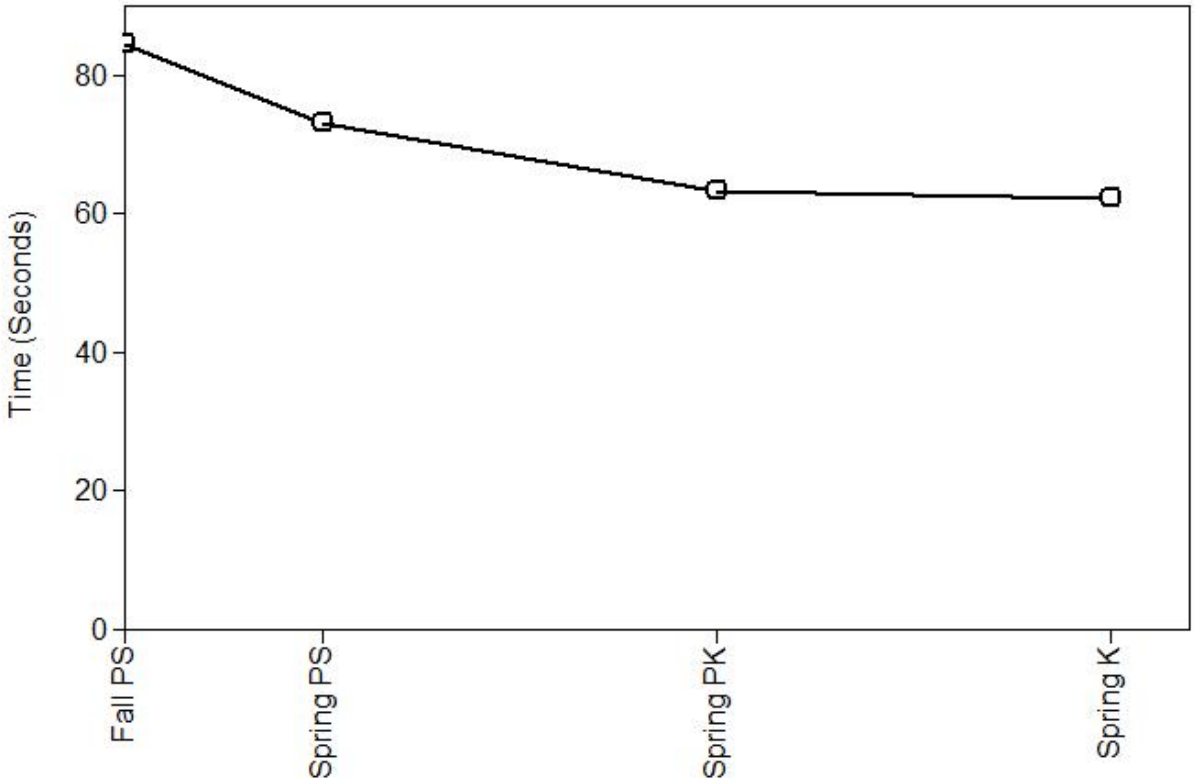


Figure 5. Change in executive control over time (latency to complete sort).



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