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Income and the development of effortful control as predictors of teacher reports of preschool adjustment☆

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ABSTRACT

This study examined the relations of income and children's effortful control to teacher reports of preschoolers' social competence and adjustment problems. This study tested whether changes in effortful control accounted for the effects of income on children's adjustment. A community sample (N = 306) of preschool-age children (36–40 mos.) and their mothers, representing the full range of income (29% at or near poverty, 28% at or below the local median income), was used. Path analyses were used to test the prospective effects of income on rank-order changes in two aspects of effortful control, executive control and delay ability, which in turn, predicted teacher-reported adjustment problems and social competence. Lower income predicted smaller rank-order change in executive control, but did not predict changes in delay ability. Smaller rank-order change in delay ability predicted greater adjustment problems above the effect of income. Larger rank-order change in executive control predicted greater social competence and fewer adjustment problems above the effect of income. These findings provided some support for the hypothesis that disruptions in the development of effortful control related to low income might account for the effects of low income on young children's adjustment. Effortful control is potentially a fruitful target for intervention, particularly among children living in low income and poverty.

Children living in poverty are at elevated risk for problems in social, emotional, and behavioral adjustment. Such children have a greater likelihood of learning and academic problems, school dropout, emotional and behavior problems (Barbain et al., 2006; Brooks-Gunn & Duncan, 1997; Evans, 2003; Kim, Conger, Elder, & Lorenz, 2003; McLoyd, 1998; Mistry, Vandewater, Huston, & McLoyd, 2002; Petterson & Albers, 2001). In addition, children living in low-income environments tend to demonstrate lower self-regulation, a core aspect of which is effortful control. Effortful control develops early in childhood, underlies a wide range of children's socioemotional outcomes, and has both immediate and long-term effects on adjustment (Raver, 2004). Children living in low-income environments tend to demonstrate lower levels of effortful control when compared to children living in higher-income environments (Eisenberg, Cumberland, et al., 2001; Eisenberg, Gershoff, et al., 2001; Howse, Lange, Farran, & Boyles, 2003; Lengua, 2002; Mezzacappa, 2004). Further, young children living in low-income environments tend to develop their self-regulatory capacities at a slower rate than their more privileged peers (Lengua, Honorado, & Bush, 2007; Li-Grining, 2007). Disruptions to the development of effortful control might represent a pathway of the effect of low income on children's adjustment (Meich, Essex, & Goldsmith, 2001) and account for the marked and enduring implication of early experiences of poverty (Brooks-Gunn & Duncan, 1997; Duncan, Ziol-Guest, & Kalil, 2010). This study builds upon existing research on the impact of income on children's self-regulatory capacities and adjustment by testing whether changes in effortful control account for the effects of low income on preschool-age children's social competence and adjustment problems in the classroom.

1. Effortful control

Effortful control is defined as the ability to inhibit a dominant response for a preferred non-dominant response in conflict situations (Kochanska, Murray, & Harlan, 2000). Effortful control, originally referred to as the anterior attention network, refers to the ability to shift attention from irrelevant or distracting stimuli and focus on relevant stimuli (Kochanska et al., 2000; Rothbart, Ahadi, & Evans, 2000). Effortful control is also related to planning tasks, as it facilitates self-monitoring, flexibility, response inhibition, and resistance to interference (Kochanska, Murray, Jacques, Koenig, & Vandegeest, 1996). Taken together, effortful control can

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be thought of as a central aspect of self-regulation and includes dimensions of executive attention, inhibitory control, and ability to delay. As the name suggests, effortful control is a self-regulatory mechanism involving the voluntary, self-guided regulation of one's attention and behavior (Rothbart et al., 2000).

Measures of effortful control often combine the executive attention and inhibitory control dimensions with reward delay dimensions. However, from a biological perspective, the attention and inhibitory control aspects of effortful control may stem from different brain regions than the ability to delay in reward contexts. Imaging studies have begun to illustrate separateness in brain activation between a cognitive or an emotional attention task (Bush, Luu, & Posner, 2000). Whereas the attention and inhibitory control dimensions may point to activity in areas of the prefrontal cortex, the reward delay dimension may also call upon motivational systems embodied in mesolimbic dopaminergic pathway. The interaction of these brain regions (prefrontal and mesolimbic) may be key to successful delay of gratification (Dixon, 2010). Beyond differences in underlying brain regions, emerging research has also illustrates differences in developmental course (Carlson, 2005; Li-Grining, 2007), correlations with dimensions of temperament (Hongwanishkul, Happaney, Lee, & Zelazo, 2005) and relations to adjustment and academic outcomes (Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Gusdorf, Karreman, van Aken, Dekovic, & van Tuijl, 2011; Nigg, 2000) with regard to these dimensions of effortful control. Therefore, in this study, we examined the reward delay component of effortful control separately from the executive attention and inhibitory control components (which we refer to as "executive control") to assess the possibility of differential vulnerability to the effects of income, as well as differential relations to preschool social competence and adjustment problems.

1.1. *Effortful control predicts social competence and adjustment problems*

Effortful control is consistently and robustly related to children's social competence and adjustment problems (Kochanska et al., 1996; Lengua, 2003), supporting the Posner and Rothbart (2000) assertion that effortful control is crucial to understanding both adaptive functioning and psychopathology. Within the realm of social and emotional competence, executive control may facilitate the inhibition of a dominant response in favor of a more socially acceptable, albeit non-dominant behavior. Self-monitoring, an important component of executive attention, may foster self-monitoring of one's impact on others, as well as alerting a child to social norms in early school settings. Indeed, inhibition and attention focusing are related to more concurrent social competence (Ciairano, Visu-Petra, & Settanni, 2007; NICHD Early Child Care Research Network, 2003; Rudasill & Konold, 2008). This link between attention and more social competence has also been demonstrated in a sample of low-income preschool children (Raver, Blackburn, Bancroft, & Torp, 1999). Executive attention has also been shown to prospectively predict greater social skills and fewer social problems in school-age children (Gewirtz, Stanton-Chapman, & Reeve, 2009; Mintz, Hamre, & Hatfield, 2011; Nigg, Quamma, Greenberg, & Kusche, 1999). Effortful control is related to greater empathy (Rothbart, Ahadi, & Hersey, 1994), restraint (Kochanska et al., 2000), internalization of rules (Kochanska, 1997), and more socially appropriate behavior and popularity (Eisenberg, Fabes, Guthrie, & Reiser, 2000; Eisenberg et al., 2003; Spinrad et al., 2006).

Executive attention and ability to delay gratification also predict adjustment problems. Executive attention may afford the capacity to direct one's attention to attenuate distress, inhibit antisocial behaviors, and modulate anger and acting out behaviors, while delay of gratification may promote the space in which children consider the consequences of their actions before acting (Kochanska, 1997; Posner & Rothbart, 2000; Rothbart et al., 2000). Executive dysfunction (Hughes & Ensor, 2009) and lack of attention and impulsivity (NICHD Early Child Care Research Network, 2003; Zahn-Waxler, Schmitz, Fulker, Robinson, & Emde, 1996) have predicted more externalizing problems. Further, the inability to regulate attention has been shown to predict greater conduct problems (Eisenberg et al., 1995; Lengua, 2003; Pope, Bierman, & Mumma, 1989). Poor inhibitory control has also been consistently related to more externalizing problems (Gusdorf et al., 2011; Hughes, White, Sharpen, & Dunn, 2000; Nigg et al., 1999; Riggs, Greenberg, Kusche, & Pentz, 2006) as well as ADHD behaviors (Gewirtz et al., 2009; Gusdorf et al., 2011). Finally, poor delay of gratification has been consistently linked to greater behavior problems such as aggression and conduct problems (Ayduk, Rodriguez, Mischel, Shoda, & Wright, 2007; Gusdorf et al., 2011).

Components of executive attention have also been found to predict internalizing problems (Eisenberg, Cumberland, et al., 2001; Eisenberg, Gershoff, et al., 2001). The attention regulation aspect of effortful control has been identified as important in regulating internal emotional states (Eisenberg et al., 2000) and both the attention regulation and shifting components of effortful control are negatively related to negative affectivity. Given that individuals better at directing their attention can attenuate their distress (Posner & Rothbart, 2000), individuals higher in effortful control may be less prone to developing internalizing problems (de Boo & Kolk, 2007; Eisenberg, Cumberland, et al., 2001; Eisenberg, Gershoff, et al., 2001; Kiff, Lengua, & Bush, 2011; Lengua, 2003, 2006; Muris, van der Pennen, Sigmond, & Mayer, 2008).

Taken together, there is some evidence to support specificity in the relations of executive control and delay of gratification to social competence and adjustment problems, with executive control relating to both social competence and adjustment problems (Nigg et al., 1999), and delay of gratification relating to adjustment problems. Unfortunately, there is a widespread tendency to examine either executive attention or delay of gratification, but not both components simultaneously when examining the relation of these aspects of effortful control to social competence and adjustment problems. For example, Eisenberg, Gershoff, and colleagues (2001) found that greater child self-regulation predicted both greater externalizing behavior problems and social competence. However, their measure of self-regulation tapped executive function (attention focusing, shifting, and inhibitory control) but not delay of gratification ability. Relatedly, one study found a measure of effortful control that combined executive attention and delay dimensions to be related to greater externalizing behaviors, but did not test for potential specificity of executive function and delay in predicting adjustment (Kochanska & Knaack, 2003). Further, few studies have tested whether developmental changes in effortful control account for children's adjustment. It is conceivable that children who develop effortful control at a faster rate can navigate their increasing autonomy and the greater demands of their contexts more effectively. Thus, not only a higher level of effortful control, but also a greater increase in effortful control may be relevant to children's social-emotional and behavioral adjustment, as has been found in older children (King, Lengua & Monahan, 2013). The present study seeks to clarify potential specificity in the effects of executive control and delay of gratification on social competence and adjustment problems in preschool-age children. Based on extant research on the unique predictive values components of effortful control (Gusdorf et al., 2011) and the relations of executive control and delay of gratification to adjustment, we predict that greater relative changes in executive control will predict higher levels of preschool social competence and lower levels of adjustment problems, whereas smaller relative changes in delay ability will predict higher levels of preschool adjustment problems.

1.2. Low income and effortful control

Children from low-income families tend to demonstrate lower levels of self-regulation when compared to children from higher-income families (Lengua, 2002; Mezzacappa, 2004; Mistry, Benner, Biesanz, Clark, & Howes, 2010; Noble, Norman, & Farah, 2005). Specifically, socioeconomic status has been related to executive function (Hughes & Ensor, 2005; Hughes, Ensor, Wilson, & Graham, 2010), inhibitory control (Wanless, McClelland, Tominey, & Acock, 2011), delay of gratification (Evans & English, 2002; Evans & Rosenbaum, 2008), and attention (Howse et al., 2003; Mistry et al., 2010), including alerting, orienting, and executive attention (Mezzacappa, 2004). The association between income and aspects of self-regulation is often striking. For example, in a study of income and delay ability, (Evans and English, 2002) noted differences in the latency to delay between low- and middle-income children, but also that 32% of middle-income children were able to successfully delay throughout the task, whereas only 19% of low income children were able to do so.

Effortful control abilities are present as early as 6–7 months of age and increase modestly through toddlerhood (Sheese, Rothbart, Posner, White, & Faundorf, 2008). The most marked increase in the development of this self-regulatory capacity occurs in the period from 3 to 6 years of age (Carlson, 2005; Diamond & Taylor, 1996; Kochanska et al., 1996; Reed, Pien, & Rothbart, 1984). Income-related differences in the ability to regulate have been documented across the stages of development, including as early as the preschool and prekindergarten years (Hughes et al., 2010; Lengua et al., 2007; Mistry et al., 2010; Wanless et al., 2011), persisting into middle childhood (Evans & English, 2002; Evans & Rosenbaum, 2008) and early adolescence (Lengua, 2006).

Studies examining the relation of income and effortful control have not typically included longitudinal measure of effortful control, and as such, have not systematically examined income's effect on developmental changes in effortful control, particularly within the preschool period. The little research that has been conducted found low income related to smaller increases in effortful control (Lengua et al., 2007; Li-Grining, 2007). Other studies have found income-related risk to predict changes in regulation status (from well-regulated to undercontrolled) and smaller increases in effortful control during the preschool period (Hart, Atkins, & Fegley, 2003; Lengua et al., 2007). These studies provide preliminary support for the hypothesis that income disrupts the development of effortful control.

Although income-related differences in levels of effortful control persist into later developmental periods, there is some research to indicate that income no longer relates to differential rate of growth by middle childhood (Hughes et al., 2010; King et al., 2013). These findings suggest that the developmental timing of poverty and risk is critical to a child's ultimate level of effortful control, and that poverty or low income plays a role in the development of effortful control early in childhood, during or prior to the preschool period when it is demonstrating its greatest developmental growth. Therefore, the preschool period reflects a unique opportunity to explore meaningful differences in developmental trajectories over short periods of time.

Research has shown the brain's plastic response to experience (Garraghty, Churchill, & Banks, 1998). Given the research that early experiences of low income/poverty have long-lasting implications for adjustment (Brooks-Gunn & Duncan, 1997; Duncan et al., 2010), income is likely among the experiences that alters or interferes with brain development. Knowing that upper-level, attentional networks are a "vehicle" to the regulation of emotion and cognition (Posner & Rothbart, 2000), we believe that the disruption to preschooler's effortful control by low income may reflect a proximal link explaining the relation of low income to adjustment problems.

Providing initial support for the hypothesis that the mechanism for the effect of income on adjustment is the disruption of self-regulatory abilities, one study found that self-regulation at age 4 mediated the association between household chaos at age 3 and externalizing problems at age 5.5 in a low-income sample (Hardaway, Wilson, Shaw, & Dishion, 2012). However, no previous study has tested whether changes in effortful control related to income account for the effects of income on children's adjustment. If both level and rate of change of effortful control matter for children's adjustment, as hypothesized above, and if income is related to smaller increases in effortful control over time, then changes in effortful control related to income might partially account for the effects of low income on children's adjustment problems, a hypothesis that is tested in the present study. The goal of the present study is to articulate the pathway of income to adjustment problems through disruptions in the development of the self-regulatory system of effortful control. We examined whether income prospectively predicted change in effortful control, whether changes in effortful control predicted adjustment above the effects of income, and finally, whether effortful control mediated the relation of income to adjustment.

An important consideration in addressing this question is the sampling of participants. Studies have often divided their samples equally between low income and not low-income (Wanless et al., 2011), poverty and middle class, at risk and not at risk (Howse et al., 2003). Other researchers have chosen nationally representative samples (Evans & Rosenbaum, 2008), while others have focused exclusively on poverty or predominately disadvantaged samples (Hughes & Ensor, 2005; Mistry et al., 2002). Only one study investigating executive function was found that sampled equally across below poverty, near-poverty, and above-poverty groups (Hughes et al., 2010). This design strategy is crucial for producing robust estimates of the effects of income on the development of effortful control. The present study therefore samples equally across the range of income, to build an understanding of the role of income on the development of effortful control and delay.

1.3. Current study

This study sought to replicate existing studies linking low income to deficits in effortful control (Lengua, 2002; Mezzacappa, 2004; Mistry et al., 2010; Noble et al., 2005) in a sample including the full range of income, oversampling lower income categories to provide a robust test of the effect of income. Previous research on income and effortful control has disproportionately utilized low income/minority samples or represented a restricted range of the income spectrum. Although such studies are critical for understanding how other risk and protective factors operate in a high-risk sample, they do not allow a test of the effects of income itself.

Finally, this study tested the hypothesis that smaller increases in effortful control related to low income would account for the effects of income on preschool-age children's social competence and adjustment problems, based on limited existing research on low income's effect on the development of children's effortful control during the preschool period (Lengua et al., 2007; Li-Grining, 2007). In doing so, this study sought to identify one potential mechanism of the effect of income on children's adjustment, with the aim of informing preventive and promotive interventions. Using a longitudinal, prospective design, we tested the hypotheses that: (1) lower income relates to lower levels of effortful control and smaller relative increases in effortful control; (2) greater increases in effortful control predict higher levels of social competence and lower levels of adjustment problems among preschoolers; (3) effortful control mediates the effects of income on preschool adjustment;

and (4) there may be specificity to the effects of executive control and delay of gratification in the prediction of adjustment outcomes, with executive control predicting both higher social competence and lower problems, and delay ability relating only to lower problems and not social competence.

2. Method

2.1. Participants

Study participants were 306 mothers and their 36–39 month old children (*M* = 37, *SD* = 0.84 mos.) who were recruited from various public- and privately-funded sources, including daycares, preschools, libraries, health clinics, and charitable agencies and organizations serving low-income families (e.g., county-sponsored "play and learn" groups for mothers and children, food banks, Catholic Community Services). Families at these sites received information forms about the study and could indicate their interest in participating in the study on the information forms returned through their organization or mailed directly to the research project in postage-paid envelopes. Recruitment sites received an honorarium of $100 when 90% or more of their families returned the forms, regardless of the number of families indicating interest in participating. If a site returned 75% or 50% of the forms, the site received $75 or $50, respectively.

Families were recruited for participation so that there was equal representation across income levels to be able to rigorously test the effects of income. For recruitment, poverty status was determined using the 2009/2010 HHS Poverty Guidelines (Department of Health, n.d.) in place at the start of the study, which is an income-to-needs ratio based on the number of people in the home. The sample was evenly distributed across income levels, with 29% of the sample at or near poverty (*N* = 90 at or below 150% of the federal poverty threshold), 28% lower income (*N* = 84 above 150% of poverty threshold and below the local median income of $58 K), 25% middle- to upper-income (*N* = 77 above the median income to $100 K), and 18% affluent (*N* = 54 above $100 K). To participate, families required reasonable proficiency in English to comprehend the assessment procedures, and children diagnosed with a developmental disability were excluded. Participants included 50% girls. According to mothers reports, the racial and ethnic composition of the sample of children included 64% European American, 9% African American, 3% Asian American, 10% Latino or Hispanic, 2% Native or American Indian, and 12% multiple racial and ethnic backgrounds or other. Mothers' educational distribution included 3% mothers with some high school attainment, 6% completed high school, 34% with some college, technical school or professional school, 30% college graduates, and 27% with post-graduate education. Eighty-one percent of mothers were married or had long-time partners, 12% were never married, 7% were separated, divorced or widowed and were the single heads of household.

2.2. Procedures

Families were assessed in research offices on the university campus. They were assessed at two time points separated by nine months when children were 36–39 and 45–48 months, respectively. At the beginning of each assessment, following the guidelines stipulated by the Social and Behavioral Sciences Institutional Review Board, both active parental consent and child assent were secured prior to data collection. Assessments included neuropsychological, task performance, and questionnaire measures administered by a team of trained experimenters. Children completed neuropsychological and behavioral measures of effortful control, while mothers completed questionnaire measures in a separate room from which they were able to observe their children. Families were compensated $70 for their first visit to our research offices, and compensation increased by $20 for the subsequent visit. Once a family participated, parents provided written consent for the children's teachers to be contact to complete social competence and adjustment problem ratings on children. Teachers were compensated $10 for completing questionnaires on each child participant.

2.3. Measures

Descriptive statistics for the effortful control and adjustment measures are presented in Table 1.

2.3.1. Income

At time 1, mothers reported on household income from all sources on a 14-point Likert scale that provided a fine-grained breakdown of income at the lower levels facilitating identification of families at the federal poverty cutoff using an income to means ratio (e.g. 1 = $14,570 or less, 2 = $14,571-$18,310, 3 = $18,311–22,050, etc.). However, the 14-point variable representing the full range of income was used. The mean income was 8.75 (*SD* = 3.93, *Range* = 1.00–14.00).

2.3.2. Effortful control

Effortful control was assessed using measures of attention regulation, cognitive and behavioral inhibitory control, and delay of gratification. Identical measures were used at Time 1 (T1) and Time 2 (T2), and measures were selected to be of varying difficulty for children across the preschool period so that identical measures could be used over time. Measures included a combination of executive function subscales of the NEPSY, a developmental neuropsychological assessment battery (Korkman, Kirk, & Kemp, 1998), and tasks from Murray and Kochanska (2002). The effortful control measures used in the current study have been used extensively in prior research (Jones, Rothbart, & Posner, 2003; Kochanska et al., 2000; Li-Grining, 2007). Given emerging evidence that delay ability might operate differently than the executive attention and inhibitory control aspects of effortful control, two separate effortful

Table 1
Descriptive Statistics for Study Variables.

	M	*SD*	Range	Skew
Executive Control T1 (*n* = 306)	0.29	.00	0.00–0.77	0.66
Executive Control T2 (*n* = 290)	0.49	.20	0.00–0.91	−0.22
Delay Ability T1 (*n* = 268)	0.62	.25	0.09–1.00	−0.01
Delay Ability T2 (*n* = 274)	0.76	.23	0.08–1.00	−0.79
Adjustment Problems T1 (mother; *n* = 304)	10.52	5.76	0.00–30.00	0.71
Adjustment Problems T2 (teacher; *n* = 184)	10.13	6.37	0.00–31.00	0.89
Social Competence T1 (mother; *n* = 304)	45.53	8.42	17.00–66.00	−.03
Social Competence T2 (teacher; *n* = 176)	40.83	9.77	11.00–59.00	−.55

Note: Dimensions of effortful control were computed as proportion correct scores.

control variables were created: executive control and delay ability (Fisher, Tininenko, & Pears, 2007; Li-Grining, 2007).

2.3.3. Executive control

Executive control was assessed using six tasks. The Inhibition and Auditory Attention subscales of the NEPSY were designed for use with children age 5 and older. However, the scales were administered to the children in this study to allow use of identical measures of effortful control over time. Thus, these tasks were understandably difficult for children in this sample. The Inhibition subtest assesses a child's ability to inhibit a dominant response in order to enact a novel response. Specifically, children are shown an array of circles and squares and then asked to label each shape in an opposite manner (e.g. say circle when they see square) while being timed. The Auditory Attention subtest is a continuous performance test that assesses the ability to be vigilant and to maintain and shift selective auditory set. Children are required to listen to a series of words and respond only when they hear a specific target word, while refraining from response to all other words. Total scores for both scales were the proportion correct responses across the task. Average scores at T1 were 0.09 (*SD* = 0.24, *Range* = 0.00–0.89) and 0.14 (*SD* = 0.28, *Range* = 0.00–1.00) for Auditory Attention and Inhibition respectively. Average scores at T2 were 0.26 (*SD* = 0.34, *Range* = 0.00–0.98) and 0.49 (*SD* = 0.40, *Range* = 0.00–1.00) for Auditory Attention and Inhibition respectively. In combination, the means on these tasks, the wide ranges in the scores, and our analytic approach of combining the Inhibition and Auditory Attention scores with other executive attention scores mitigated concerns of floor effects.

Behavioral inhibitory control was assessed using the Bear-Dragon task (Kochanska et al., 1996; Li-Grining, 2007), which requires the child to perform actions when a directive is given by a bear puppet, but not when given by a dragon puppet. Children's actions were scored as performing no movement, a wrong movement, a partial movement, or a complete movement, with scores ranging from 0–3. Total scores were the proportion of the score across both bear and dragon items to the total possible score. The average scores at T1 and T2 were 0.62 (*SD* = 0.20, *Range* = 0.33–1.00) and 0.87 (*SD* = 0.20, *Range* = 0.33–1.00), respectively.

Cognitive inhibitory control was assessed using the Day-Night task (Gerstadt, Hong, & Diamond, 1994), which requires the child to say "day" when shown a picture of moon and stars and "night" when shown a picture of the sun. Children's actions were scored 1 for correctly providing the non-dominant response or 0 for providing the dominant response. Total scores were the proportion of correct responses. Average total scores at T1 and T2 were 0.44 (*SD* = 0.33, *Range* = 0.00–1.00) and 0.62 (*SD* = 0.30, *Range* = 0.00–1.00), respectively.

The Dimensional Change Card Sort (Zelazo, Muller, Frye, & Marcovitch, 2003) assesses cognitive inhibitory control, attention focusing and set shifting. In this task, children were introduced to two black recipe boxes with slots cut in the top. Target cards were attached to the front of each box. The target cards consisted of a silhouetted figure on a colored background (star on blue background and truck on red background). Children were instructed to sort cards according to either the shape or color properties on the target cards, first according to shape (six trials), then according to color (six trials). The experimenter stated the sorting rule before each trial, and presented a card and labeled it according to the current dimension (e.g., on a shape trial, "Here's a truck. Where does it go?"). If children correctly sorted ≥50% of cards, they advanced to the next level in which the target cards integrated the sorting properties. Target cards consisted of a colored figure on a white background (blue star and red truck), and children were again instructed to sort according to shape (six trials) and then color (six trials). If they correctly sorted ≥50% of the cards, children advanced to the next level in which they were instructed to sort by one dimension (color) if the card had a border on it and by the other dimension (shape) if the card lacked the border (12 trials). The score was the proportion of correct trials out of the total possible of 36 trials. The average total scores at T1 and T2 were 0.42 (*SD* = 0.20, *Range* = 0.00–0.89) and 0.61 (*SD* = 0.26, *Range* = 0.00–1.00), respectively.

The Head, Toes, Knees, Shoulders (HTKS) task also integrates attention and inhibitory control (Ponitz et al., 2008). Children are asked to follow the instructions of the experimenter, but to enact the opposite of what the experimenter directs (e.g. touch toes when asked to touch head). Behaviors were coded as 0 points if the child touched the directed body part, 1 point if the child self-corrected his/her behavior, and 2 points if the child only touched the opposite body part. Total scores were the proportion of the score across items to the total possible score. The average scores for T1 and T2 were 0.03 (*SD* = 0.09, *Range* = 0.00–0.65) and 0.19 (*SD* = 0.27, *Range* = 0.00–0.85), respectively. Twenty percent of all executive control tasks were independently re-scored to assess inter-rater reliability. ICC's on all tasks ranged from 0.72 to 0.98.

2.3.4. Delay ability

Children's ability to delay gratification was assessed using a gift-delay task (Kochanska et al., 1996). In this task, the child was told that s/he would receive a present, but that the experimenter wanted to wrap it. The child was instructed to sit facing the opposite direction and to not peek while the experimenter noisily wrapped the gift. Children's peeking behavior (frequency, degree, latency to peek, latency to turn around) and difficulty with the delay (fidgeting, tensing, getting out of seat, grimacing, talking) were rated. Latencies and behavior scores were converted to proportions of total possible times/scores and averaged, with higher delay scores reflecting greater ability to delay gratification. The average total scores at T1 and T2 were 0.62 (*SD* = 0.25, *Range* = 0.09–1.00) and 0.76 (*SD* = 0.23, *Range* = 0.08–1.00), respectively.

Confirmatory factor analyses were used to test the acceptability of a 2-factor model of effortful control that specified executive control and delay factors. The executive control factor loaded on inhibition, auditory attention, bear-dragon, day-night, DCCS, HTKS observed scores, and delay ability loaded on peeking frequency, latency to peak, latency to turn around, and difficulty with delay observed scores. Separate models were tested at each time point. At both T1 and T2, the models demonstrated acceptable fit to the data (T1 RMSEA = .04, CFI = .97, $\chi^2(42) = 64.95$, $p = .01$; T2 RMSEA = .03, CFI = .99, $\chi^2(42) = 50.27$, n.s.). All standardized loadings were significant and ≥ .36, and the correlations of the latent factors were .37 and .48 at T1 and T2, respectively, supporting the examination of a 2-factor model of effortful control. Further, the 2-factor model was compared to a 1-factor model in which a single factor loaded on all of the executive control and delay ability indicators. The 2-factor model demonstrated a significantly better fit compared to the 1-factor model at both time points (T1 χ^2 difference (1) = 133.30, $p < .001$; T2 χ^2 difference (1) = 176.80, $p < .001$). Consistent with previous research, an overall executive control score was computed as the mean of the proportion scores of the individual tasks. Executive control scores were considered missing if ≥50% of the component scores were missing, which was 11 cases at T1 (3.6%) and six cases at T2 (2%). Internal consistency of the composite executive control measure was 0.67, and the inter-rater reliability was 0.83. An overall delay ability score was computed as the mean of the proportion scores for the individual delay indicators and was considered missing of ≥50% of the component scores were missing. Internal consistency of the composite delay ability measure was .77 ($\alpha = .91$).

2.3.5. Mother reports of child adjustment

At T1, mothers reported on children's adjustment problems using the Child Behavior Checklist (Achenbach, 1991). The adjustment problems score, which combined internalizing and externalizing problems, was used, and raw scores were analyzed. The Cronbach's alpha for the present sample on adjustment problems was .82.

Also at T1, mothers reported on children's social competence using the Social Skills Rating Scale (SSRS: Gresham & Elliot, 1990). Mothers rated their child's cooperation (nine items), assertiveness (nine items), responsibility (10 items), and self-control (10 items) for a social competence score. The Cronbach's alpha for the composite social competence scale was .83.

2.3.6. Teacher reports of child adjustment

At T2, teachers rated children's social competence and adjustment problems using the preschool teacher form of the SSRS. Teachers rated children's cooperation (e.g. puts away toys, helps with tasks; 12 items), assertiveness (e.g. self-confident, introduces self; 8 items) and self-control (e.g. controls temper, attends to instructions; 10 items) for a social competence score (30 items). Given the potential for overlap of the self-control items on the social competence scale and the predictors, analyses were also conducted with a social competence composite that did not include the self-control scale. Results did not vary across social competence composites. Results are reported using the full social competence composite, including the self-control items. Teachers rated children's externalizing problems (seven items), internalizing problems (six items) and hyperactivity (six items) for an adjustment problems score (19 items). The SSRS was standardized on a large national sample. Validity of the teacher SSRS was established based on significant correlations with the Harter Teacher Rating Scale (TRS; Harter, 1985), the Social Behavior Assessment (SBA; Stephens, 1981), and the Child Behavior Checklist-Teacher report form (CBCL-TRF; Achenbach & Edelbrock, 1986). The social skills scale of the SSRS showed negative correlations with problem behaviors as measured by the SBA and CBCL-TRF and positive correlations with self-perception on the TRS. The adjustment problems scale showed positive correlations with problem behaviors as measured by the SBA and CBCL-TRF and negative correlations with self-perception on the TRS (Gresham & Elliot, 1990). In this study, alpha for the composite SSRS scales were .91 for social competence and .87 for adjustment problems.

3. Results

3.1. Analytic plan

Analyses were conducted to examine the prospective effects of low income on children's social competence and adjustment problems, and to test whether these effects were accounted for by relative changes in the effortful control dimensions of executive control and delay ability. First, correlations among the study variables were examined to determine the plausibility of the proposed hypotheses. Next, path analyses were conducted to examine whether rank-order changes in effortful control explained adjustment above the effects of income and accounted for the relation between low income and adjustment outcomes (see Fig. 1). Path models were tested in Mplus 6.0 (Muthén & Muthén, 2010) using Full Information Maximum Likelihood Estimation (FIML). FIML requires estimation of means and intercepts, as well as covariances and beta coefficients, and uses all the data available simultaneously to calculate parameter estimates. FIML has been found to be less biased and more efficient than other techniques for handling missing data (Arbuckle, 1996). Our examination of bias in missing data (see below) suggested that the pattern of missing data introduced minimal bias and aligned with the assumptions of FIML. Therefore, families with any data were included in the analyses for a sample size of 306. Finally, indirect effects of income on adjustment were tested to assess whether effortful control mediated the effects of income (Fig. 2).

3.2. Missing data

Analyses were conducted to assess the degree of bias introduced by missing data and sample attrition. All participants had complete data on income. Complete data were available for 95% on T2 executive control, 91% on T2 delay, 94% on mother reports of child adjustment, and 61% on teacher reports of adjustment problems and 57% on teacher reports of social competence. The high rate of missing teacher data can be partially understood by the fact that only 67% of children were enrolled in preschool at the second assessment point of the study. Given that sample size would be severely impacted by attempting to control for T1 reports of teacher adjustment when only 166 of children were enrolled in school (many of our subjects entered preschool between the first and second time point), we utilize T1 mother reports of social competence and adjustment problems as a covariate when predicting the T2 teacher-reported social competence and adjustment outcomes. While this approach does not allow us to account for changes in the adjustment outcomes, we utilized the covariate in an effort to rule out the possibility that children's prior adjustment problems accounted for the relation between effortful control and adjustment. Results did not vary as a function of including or removing mother report of child adjustment at T1. Analyses were conducted with the full sample ($N = 306$) using FIML estimation in Mplus (described below). Identical analyses were conducted using listwise deletion in the path analyses, excluding participants missing teacher-report data. The pattern and magnitude of significant associations did not differ across the two approaches. Therefore, we utilized missing data estimation to make use of the whole sample in all analyses. Levels of family income, T2 effortful control, mother report of adjustment, and teacher report of adjustment were compared across participants missing no data and those missing any data. Participants missing any data ($N = 141$) on study variables were compared with those missing no data ($N = 165$) to assess the

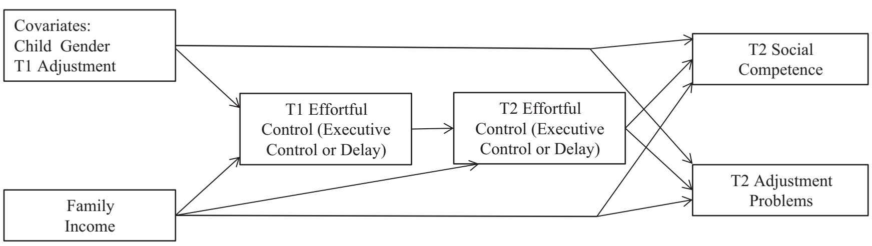

Fig. 1. The conceptual model testing if changes in effortful control account for the relation of income to preschool adjustment.

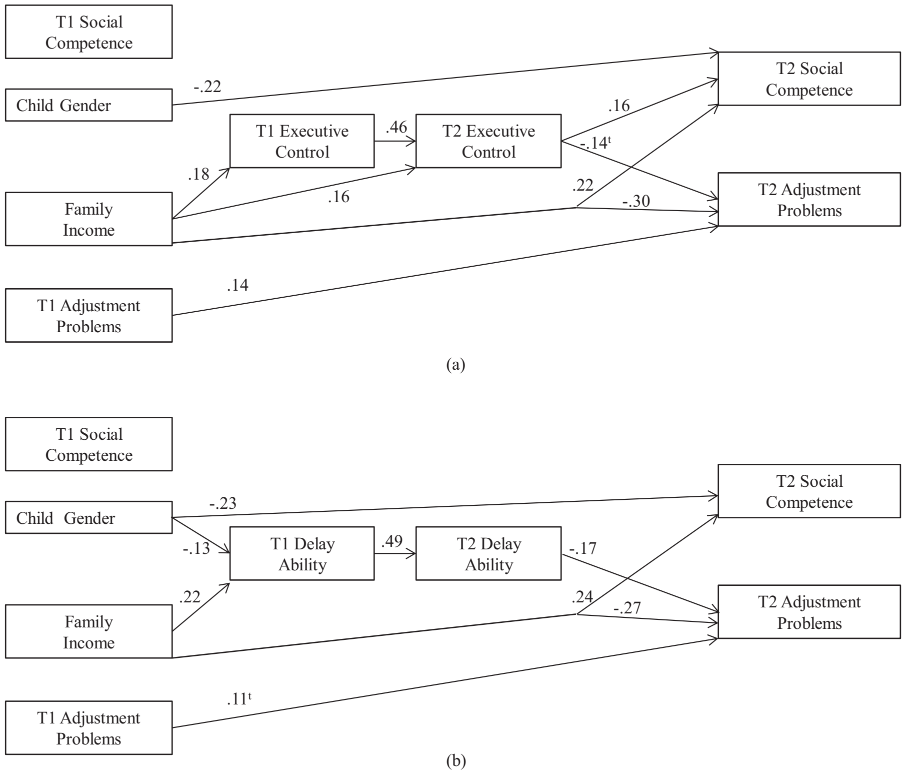

Fig. 2. Standardized beta coefficients from path analyses testing the effects of income on rank order changes in (a) executive control and (b) delay ability in predicting teacher-report social competence and adjustment problems in preschool-age children. *Note*: Only significant coefficients are depicted for simplicity of presentation.

extent of bias introduced by missing data. Participants missing data differed from those not missing data in that they had lower income (M missing = 8.16, M no missing = 9.24, $t[304] = 2.42$, $p = .02$) and lower T2 executive control (M missing = 0.44, M no missing = 0.53, $t[288] = 3.50$, $p > .01$). However, the effect sizes of the associations of missingness to income ($r = -.14$), and executive control ($r = -.20$) were modest and did not reach previously cited thresholds for introducing substantial bias (i.e., $r > .40$, see Collins et al., 2001). Thus, it appears that little bias was introduced due to missing data.

3.3. Correlations

Correlations among the study variables were examined to evaluate the plausibility of the study hypotheses (see Table 2). Child gender (0 = female, 1 = male) was related to both executive control at time 2 and delay ability at time 1, with boys lower in each, and included as a covariate in all subsequent analyses. Income was related to higher teacher reported social competence and lower adjustment problems. Lower income was also associated with lower levels of executive control and delay ability at both time points. T1 and T2 executive control were related positively to teacher reports of social competence. T1 delay ability was related positively to teacher reports of social competence and negatively to adjustment problems. T2 delay ability was related negatively to teacher reports of adjustment problems. Taken together, the correlations suggested the plausibility of the hypotheses surrounding income's effect on changes in effortful control, which might account for the effect of income on adjustment.

3.4. Income, effortful control, and adjustment

Path analyses were conducted to test the role of income, executive control, delay ability, and rank order changes in these dimensions of effortful control on preschool adjustment. Rank-order changes in the dimensions of effortful control were modeled by including both the T1 and T2 measure of effortful control into the same model, that is, residualizing T2 effortful control on T1. Two models were specified, one for executive control and one for delay ability, predicting both adjustment outcomes in each model. Child

Table 2
Correlations among Study Variables.

	2	3	4	5	6	7	8	9	10
1. Child Gender	–.05	–.09	–.12*	–.15*	–.11	–.07	.09	–.24*	.07
2. Income	–	.19*	.25*	.23*	.14*	.04	.03	.26*	–.29*
3. Exec. Control T1		–	.50*	.26*	.27*	.13*	–.05	.13*	–.07
4. Exec. Control T2			–	.31*	.35*	.15*	–.04	.24*	–.19*
5. Delay Ability T1				–	.50*	.07	–.11	.13*	–.22*
6. Delay Ability T2					–	.13*	–.15*	.10	–.25*
7. Social Comp. T1						–	–.21*	.11	–.03
8. Adj. Problems T1							–	–.15*	21*
9. Social Comp. T2								–	–.64*
10. Adj. Problems T2									–

* $p < .05$.

gender and T1 mother-reported adjustment were covaried in each model.

In the model testing the effects of executive control, lower income directly predicted more adjustment problems ($\beta = -0.30$, $p < .001$) and less social competence ($\beta = 0.22$, $p < .01$). In addition, low income predicted smaller rank-order increases in executive control ($\beta = 0.16$, $p < .01$). Above the effects of income and after controlling for T1 executive control, T2 executive control was related to more social competence ($\beta = 0.16$, $p = .05$), and there was a trend for lower T2 executive control to account for more adjustment problems ($\beta = -0.14$, $p = .08$). To test whether the effect of income on adjustment was accounted for through executive control, an indirect path was specified, from income, through T1 and T2 executive control, to the adjustment outcomes. The test of the indirect effect of income on adjustment problems through T1 and T2 executive control was not significant ($\beta = -0.01$, $p = .13$). There was a trend toward an indirect effect of income on social competence through T1 and T2 executive control ($\beta = 0.01$, $p = .10$).

In the model testing the effects of delay ability, lower income directly predicted more adjustment problems ($\beta = -0.27$, $p < .001$) and less social competence ($\beta = 0.24$, $p = .001$). Income did not predict rank-order changes in delay ability ($\beta = 0.04$, $p = .53$). After controlling for income and T1 delay, lower T2 delay ability predicted more teacher reported adjustment problems ($\beta = -0.17$, $p < .05$) but not social competence ($\beta = 0.04$, $p = .62$). To test whether the effect of income on adjustment was accounted for by delay ability, the indirect effect from income, through T1 and T2 delay ability, to adjustment was tested. There was a trend toward an indirect effect of income on adjustment problems through T1 and T2 delay ($\beta = -0.02$, $p = .07$). The indirect effect of income on social competence through delay was not significant ($\beta = 0.01$, $p = .62$).

4. Discussion

This study examined the relations of income and effortful control to preschool-age children's social competence and adjustment problems. These relations were examined in a sample that represented the full range of income, over-sampling families in lower-income groups, providing a robust test of the effects of income. Previous findings that lower income was related to lower effortful control and that effortful control was related to higher social competence and lower adjustment problems were replicated. Few previous studies have examined the relation of income to changes in effortful control. Importantly, this study tested the hypothesis that income-related changes in effortful control would account for the effects of income on children's adjustment, examining a potential proximal mechanism of the effects of income on children's adjustment. The results offer some support for income shaping children's effortful control and for changes in effortful control predicting child adjustment. The hypothesis that the effects of income on children's adjustment would be explained by the role that income plays in diverting the development of effortful control was partially supported.

Consistent with findings from previous studies and our study hypothesis of the relation of income and effortful control, low income was related to lower levels of effortful control (Hughes et al., 2010; Lengua et al., 2007; Li-Grining, 2007; Mistry et al., 2010), relating to lower levels of both executive control and delay ability. Further, in support of the hypotheses that low income might divert the development of effortful control, income predicted smaller relative increases in executive control. We did not find support for the relation of income to change in delay ability. Thus, there was partial support for the study hypothesis that relative changes in executive control could account for the effects of income on children's adjustment in the preschool context.

Relative changes in effortful control, indicated by the T2 measures of effortful control residualized on T1 levels, predicted teacher-reports of children's adjustment in their preschool classrooms. There was evidence of specificity in these associations, with components of effortful control relating differentially to domains of adjustment. Rank-order changes in executive control were associated with both adjustment problems and social competence, whereas rank-order changes in delay ability predicted adjustment problems only. These findings highlight that children's relative increases in executive control and delay abilities are directly, though differentially predictive of children's adjustment in the classroom.

The distinct patterns of findings support the practice of delineating rather than aggregating components of effortful control (Li-Grining, 2007). It also suggests that these aspects of effortful control might relate differentially to classroom behaviors. Social competence includes responsibility, organization, and cooperating with peers and adults; these components of social competence may be most facilitated by the self-control, persistence to rules and social norms, management of attention to the requests of adults and the desires of peers, and general decision making afforded by good executive control (Kochanska, 1997; Kochanska et al., 2000). Executive control may also promote the regulation of internal emotional states, planful direction and re-direction of attention, modulation of anger, and inhibition of antisocial behavior associated with fewer adjustment problems (Eisenberg, Cumberland, et al., 2001; Eisenberg, Gershoff, et al., 2001; Lengua, 2003). These capacities to regulate and inhibit may point to activity in the prefrontal cortex, which is thought to be the biological underpinning of executive control capacities. On the other hand, children with poorer delay of gratification skills may be less able to sit still and wait for rewards or the teachers' attention in a way that makes them more disruptive and difficult to manage within the classroom setting. Likewise, children with poorer delay of gratification capacity might be more likely to have run-ins with peers when they struggle to wait their turn in the classroom and on the playground (Krueger, Caspi, Moffitt, White, & Stouthamer-Loeber, 1996). These aspects of preschool life may carry more motivational charge, and rely more heavily on the mesolimbic dopaminergic pathways thought to be associated with the ability to delay gratification (Dixon, 2010). This study is among the first to consider specificity across the executive control and delay dimensions of effortful to the emergence of both social competence and behavior problems.

Finally, we examined the indirect effects of income on adjustment through executive control and delay ability to examine if disruption to the development of self-regulatory capacity accounted for the relation between income and child adjustment. In both cases, there were trends toward indirect effects of income on adjustment through effortful control. However, the indirect effects were less prominent than the direct effects of both income and effortful control. This suggests that the association of income with levels and changes in effortful control might be relevant to accounting for the effects of income on children's preschool adjustment, although perhaps less robustly than the direct effects.

Our hypothesis that low income might divert the development of effortful control, which in turn would account for children's poor adjustment outcome, was grounded in the theory that higher-order attention networks in the brain are both plastic and underlie adjustment (Posner & Rothbart, 2000), and therefore be more proximal to income and confer its risk. The modest effects observed in this study suggest that there are likely many complicated causal mechanisms at play in the relation between income and children's adjustment, and effortful control is perhaps a downstream mechanism influenced by other potential mediators. For example, the Family Stress Model (Conger & Elder, 1994) holds that income-related stress is, in part, accounted for by the impact of low income on parental psychopathology, family stress, and parenting. Other risk factors associated with low income include the increased exposure to negative life events and increased residential instability (Evans, 2003). These income-related stressors and risk factors may play a more proximal role to income in predicting child adjustment. While the tests of indirect effects of effortful control did not achieve significance, it is important to consider that income predicted relative changes in effortful control and relative changes in effortful control predicted adjustment. That is, effortful control predicted adjustment above the effects of income and prior adjustment. This suggests that effortful control uniquely contributes to children's adjustment and is an important factor in understanding preschool-age children's adjustment, with an effect that is not attributable to spurious associations from shared relations with income, child gender, and prior adjustment. Though effect sizes were relatively small, the findings also underscore that income is an important factor in understanding the development of self-regulatory abilities integral to young children's adjustment. Raver and colleagues (2011) have demonstrated the potential for intervention to promote the development of attention based self-regulation among low-income preschoolers, which in turn mediated pre-academic outcomes and highlights the importance and potential fruitfulness of targeting self-regulatory capacities at this age.

Strengths of this study include the use of a relatively large sample that is over-represented by lower-income families, but that also includes the full range of income, allowing us to better understand the relation between income and the development of effortful control across the income spectrum. The longitudinal design of the study was a further strength, as this allowed us to examine whether the effect of income on adjustment could be understood, in part, by the influence of income on the emergence of effortful control abilities in young children. Finally, the use of multiple methods of assessment, including neuropsychological and questionnaire measures, in conjunction with multiple informants (mothers and teachers) was a further strength. One limitation of the study is the assessment of delay ability. Although the executive control component of effortful control was assessed using indicators from multiple tasks, the delay ability indicators were all drawn from one task. However, previous research has shown the longitudinal predictive value of children's delay of gratification even when assessed with just one delay task (Shoda, Mischel, & Peake, 1990). In addition, the low-income participants who volunteer for research may not be entirely representative of low-income populations in ways that may systematically relate to children's effortful control abilities. Although the study utilized a longitudinal design, only two time points of data were available, limiting our ability to assess developmental growth in effortful control and limiting temporal resolution for a rigorous test of mediation. Future studies should employ growth modeling techniques with multiple time points of data to examine these relations in an effort to elucidate how income relates to the developmental trajectory of effortful control, and how this in turn relates to child adjustment. Further exploration of the specificity of the effects of components of effortful control across its developmental course is needed.

In conclusion, low income and the effortful control dimensions of executive control and delay ability have implications for children's social, emotional, and behavioral adjustment. A potential mechanism to understanding the effect of income on children's social competence and adjustment problems may be disruptions in the development of effortful control due to low income. At the preschool age, there may be specificity of the effects of components of effortful control to adjustment, with executive control predicting social competence and behavior problems, whereas delay of gratification predicts behavior problems only. These findings highlight the need for the promotion of effortful control in children growing up in high risk contexts (Raver et al., 2011), as effortful control may not only account for early adjustment as reported by teachers, but may have long-term and widespread effects on children's social-emotional well-being and mental health.

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