Published in final edited form as:

Early Child Res Q. 2018 ; 42: 247–255. doi:10.1016/j.ecresq.2017.10.010.

Growth in inhibitory control among low-income, ethnic-minority preschoolers: A group-based modeling approach

Daniel Pacheco^a, Margaret Owen^a, and Margaret Caughy^b

^aThe University of Texas at Dallas, Psychological Sciences Program, 800 W. Campbell Road, GR41, Richardson, TX, 75080, United States

^bThe University of Georgia, Department of Human Development and Family Science, 202 Family Science Center II (House D), 405 Sanford Drive, Athens, GA, 30602, United States

Abstract

The emergence of self-regulation skills such as inhibitory control in children is an important developmental process associated with adjustment across multiple domains. Individual differences in inhibitory control are associated with family socioeconomic status but have not been studied in relation to variations in risk found within a low-income (i.e., high risk) sample ($N = 407$). Using a group-based modeling approach, change in inhibitory control was examined from 30 to 42 months of age in a sample of low-income Hispanic and African-American children. Patterns of change in inhibitory control were examined in relation to cumulative risk and child externalizing behavior using the Child Behavior Checklist measured at 42 months. A three-group solution was identified as optimally fitting the data, representing patterns of change in inhibitory control: a normative group, exhibiting increasing inhibitory control (48%); a low-stable group (40%); and a high-stable group (12%). Group membership did not differ by child ethnicity or gender. Higher cumulative risk was found among the children in the low-stable group than in the other groups. Mothers reported more externalizing problems at 42 months for children in the low-stable group than in the other groups, even controlling for the effect of cumulative risk. Intervention and policy implications are discussed.

Keywords

Group-based modeling; Preschoolers; Self-regulation; Ecological risk

1. Introduction

Executive functions related to self-regulation develop rapidly during the preschool years with increasing abilities to control impulses and follow directions (Bronson, 2000; Calkins & Howse, 2004; Cicchetti, Ganiban, & Barnett, 1991; Kopp, 1989). Normative development of self-regulation skills is evidenced by discernible improvement in children's abilities to plan and focus attention (Garon, Bryson, & Smith, 2008; Kopp, 1991; Tronick, 1989). One of the hallmark self-regulatory skills that emerges early is inhibitory control, which is the

ability to inhibit or suppress a dominant behavior in deference to a more subdominant behavior (Rothbart, Ahadi, Hershey, & Fisher, 2001). Most children improve in their inhibitory control skills across early childhood; however, there are individual differences in the rates and patterns of change in those skills during this period of development (Vaughn, Kopp, & Krakow, 1984).

Although most children show normative increases in inhibitory control during early childhood, some may not. The absence of improvement in inhibitory control in early childhood may be accompanied by difficulties in other developmental domains (Posner & Rothbart, 2000). The current study examines the relation of developmental change in inhibitory control in early childhood with problem behaviors. Given associations found between low self-regulation skills and externalizing behaviors in preschool children (Eisenberg et al., 2001), it is expected that lack of improvement or negative change in inhibitory control will be associated with greater behavior problems. Although, on average, self-regulatory skills such as inhibitory control improve fairly rapidly during the preschool years, children who are initially low in such skills and do not improve are at greater risk for externalizing problems when compared to their counterparts who develop more normatively in this area (Vaughn, DeLisi, Beaver, & Wright, 2009).

Household risk factors, so defined on the basis of their demonstrated negative association with developmental outcomes, have been shown to have a negative influence on behavioral regulation (Doan, Fuller-Rowell, & Evans, 2012; Sektnan, McClelland, Acock, & Morrison, 2010). The more risks a child has, the more vulnerable a child is to suboptimal development. Such risk indices have better predictive power for child outcomes relative to any single risk factor considered alone (Doan et al., 2012; Rutter, 1979; Sameroff, Seifer, Barocas, Zax, & Greenspan, 1987).

The current study examined how cumulative household risk, inhibitory control, and externalizing behavior relate in a sample of low-income, African-American and Hispanic preschool children followed longitudinally. When compared to their non-Hispanic white, typically more economically advantaged peers, African-American and Hispanic children have been shown to be at greater risk of having less well-developed self-regulation skills (Caughy, Owen, & Hurst, 2015; Parker, Greer, & Zuckerman, 1988; Raver et al., 2011). For the current study, variation in risk was examined within an “at-risk” sample: all participants were from low-income households with parents identifying as either African-American or Hispanic. Because of evidence of substantial variability within low-income and minority groups (see Herrnstein & Murray, 1996), it is important to examine variations in household risk, profiles of change in inhibitory control, and externalizing behavior within these at-risk populations.

1.1. The development of inhibitory control

Self-regulation skills in children, including inhibitory control, develop quickly between the ages of two and five years (Carlson, 2011). During this period, children begin to rely less on external controls to manage their behavior and begin to rely more on their own internal cues to regulate their behavior (Kochanska & Aksan, 1995; Kochanska, Coy, & Murray, 2001; Kopp, 1982; see also Maccoby, 1984). Research on individual differences in children’s self-

regulation has found that inhibitory control is a relatively stable developmental characteristic: children who demonstrate higher levels of inhibitory control when they are young tend to continue to do so as they develop (Lengua, Honorado, & Bush, 2007; Putnam, Gartstein, & Rothbart, 2006). Additionally, on average, inhibitory control increases with age (Li-Grining, 2007; McClelland et al., 2007; Moilanen, Shaw, Dishion, Gardner, & Wilson, 2010). As children grow older, they become increasingly better at managing their behavior.

Inhibitory control has been associated with several child behavioral characteristics and developmental outcomes. For example, four-year-old children who were better able to delay their consumption of a desired treat displayed better academic outcomes and were better able to manage stress and aggravation ten years later (Mischel, Shoda, & Rodriguez, 1989). Children lacking in inhibitory control are more likely to develop maladaptive behavioral responses such as aggression (Raaijmakers et al., 2008), problems with peer networks (Hughes, White, Sharpen, & Dunn, 2000), and poor emotional competence (Rhoades, Greenberg, & Domitrovich, 2009).

Most of the evidence on inhibitory control, however, has come from middle-income, mostly non-Hispanic white samples of children. On average, evidence from these samples indicates that older (compared with younger) children have better inhibitory control skills (Jones, Rothbart, & Posner, 2003); the inhibitory control skills of male children tend to be delayed and poorer compared to inhibitory control among female children (Carlson & Moses, 2001; Olson, Sameroff, Kerr, Lopez, & Wellman, 2005); and children with deficient emotional regulation (i.e., anger control) have poorer inhibitory control skills (Buss & Plomin, 1984; Kochanska & Knaack, 2003). Additionally, children who reside in low-income contexts do not evidence the executive function competence of their more privileged peers (Li-Grining, 2007), and African-American and Hispanic children do not show self-regulatory skills equivalent to those of non-Hispanic White counterparts (Caughy, Mills, Owen, & Hurst, 2013; Raver et al., 2011). Because African-American and Hispanic children disproportionately come from low-income contexts, they may be at particular disadvantage for suboptimal executive function development. The current study will thus contribute to understanding of variations in inhibitory control in a high risk sample of African-American and Hispanic preschoolers.

1.2. Inhibitory control, cumulative household risk, and externalizing behavior

When children are lacking in inhibitory control, they tend to have other behavioral difficulties. One way in which inhibitory control can be compromised is through exposure to various risk factors (Doan et al., 2012). Ecological risks are certain conditions and contexts, including living in poverty, having a depressed caregiver, and a single-parent household, among others, that are so called because of their known negative associations with a child's well-being, developmental trajectory, and outcome sequelae (Doan et al., 2012; Shonkoff et al., 2012). Cumulative risk is the compounded effect of two or more risks and has been associated with a greater propensity for both self-regulatory and behavioral problems than any single risk factor (Doan et al., 2012; Evans & English, 2002; Lengua, 2002; Sameroff, 2000). Ecological risk may be particularly problematic for young children during the period of development when self-regulation skills are becoming established and crystallized (Cole,

Martin, & Dennis, 2004; Raver, 2004). Ethnic minority children tend to be exposed to more ecological risks, many of them related to poverty to which they are disproportionately exposed, when compared to their more advantaged peers and possibly because of this also have more self-regulatory and behavioral deficiencies (Raver, 2004). Such risks may include having a caregiver with elevated depressive symptoms, living in a neighborhood characterized by physical and social disorder, and/or living in a household characterized by general chaos. When a caregiver has depressive symptomology, their general caregiving for a child is compromised through deficient or absent monitoring and prosocial behavioral reinforcement (Hughes, Roman, Hart, & Ensor, 2013). Children growing up in a neighborhood characterized by violence may be more hypervigilant and reactive when compared to children from neighborhoods not characterized by violence (Evans & English, 2002). Furthermore, children who live in a household characterized by chaos such as having clutter, a dirty environment, or dysregulated schedule not only have difficulty regulating their behavior, but they also are more likely to develop conduct problems (Deater-Deckard et al., 2009)

Children's externalizing behavior problems have also been associated with diminished inhibitory control capacity (Rhoades et al., 2009; Spinrad et al., 2007). Externalizing problems have been described as behaviors that do not conform to social standards and can include aggression and other kinds of non-compliant behaviors (Campbell, 2006; Deater-Deckard, Dodge, Bates, & Pettit, 1998). Additionally, children who have difficulty controlling their impulses find it difficult to control their emotions and can be reactive and challenging for caregivers (Hughes et al., 2000). Because children who are low in inhibitory control are more likely to have externalizing problems, and externalizing problems are predictive of multiple poor outcomes, including delinquency in adolescence, it is important to gain a better understanding of the way inhibitory control and externalizing problems are linked (Carlson & Sroufe, 1995; Patterson, DeBaryshe, & Ramsey, 1989; Sroufe, 1979).

1.3. An ecological perspective on self-regulation development in low-income minority children

Bronfenbrenner's ecological systems perspective emphasizes that child development is a function of child characteristics as well as interrelated characteristics of the child's environment (Bronfenbrenner, 2005). This is particularly salient for children living in the context of poverty because evidence has shown that poverty has a negative influence on the development of self-regulatory abilities (Evans & English, 2002). Moreover, African American and Hispanic children are disproportionately represented among children living in poverty, with the implication that they are at greater risk for suboptimal self-regulation development due to exposure to poverty-related risks when compared to their middle-class, Caucasian counterparts (Cole et al., 2004; Raver, 2004). In fact, the relationship between poverty and minority status has been often cited as being confounded to the extent that the effect of one cannot be disentangled from effects of the other (Duncan, Brooks-Gunn, & Klebanov, 1994; Huston, McLoyd, & Coll, 1994).

One mechanism implicated in the facilitation of ethnic and socioeconomic differences is caregiver stress (McLoyd, 1998). Caregivers living in a context of poverty are

disproportionately exposed to a variety of stressors that can include a high density household, unstable and inconsistent employment, and being the lone caregiver (Evans, 2004). These stressors can take an emotional toll on the caregiver and potentially lead to feelings of hopelessness and the experience of depressive symptoms. In turn, stress and depression in caregivers has been associated with lower parental sensitivity, inconsistent parenting behaviors (i.e., monitoring), and even harsh (i.e., hostile) parenting behaviors (Conger & Donnellan, 2007; Gallo & Matthews, 1999; Grant et al., 2003). Low-income, minority children may be particularly vulnerable to suboptimal self-regulatory skill development (i.e., inhibitory control) because they are growing up in a context of multiple environmental risks. These multiple risks can work synergistically against optimal development, including externalizing and other maladaptive behaviors (Raver, 2004).

1.4. The current study

The current study will examine patterns of change in inhibitory control in a sample of low-income African-American and Hispanic children from age 2½ years (Wave 1) to 3½ years (Wave 2). Differences will be examined in relation to household cumulative risk at Wave 1 and child externalizing behavior at Wave 2. It is expected that children who display patterns of greater growth in inhibitory control will have been exposed to fewer household risks. In addition, children with greater growth in inhibitory control will subsequently display lower externalizing behavior problems. Although cumulative household risk has been positively related to suboptimal outcomes (Deater-Deckard et al., 1998; Doan et al., 2012; Rutter, 1979; Sameroff, 2000), it is not known how variations in risk within a relatively higher-risk sample of low-income, ethnic minority preschool children may relate to individual differences in children's developing inhibitory control across the time period studied and the children's externalizing behaviors.

2. Method

2.1. Participants

Study participants were from a longitudinal study of 407 African-American and Hispanic children from low-income backgrounds. Participating families were recruited from a large, southwestern metropolitan area when the target children were approximately 30 months old (Wave 1, $M = 30.23$ months, $SD = 0.51$). The second wave was collected one year later when target children were approximately 42 months of age (Wave 2, $M = 41.58$ months, $SD = 1.33$).

Descriptive statistics for the study sample are presented in Table 1. Child gender did not differ by ethnicity. Economic status was measured using an income-to-needs ratio in which reported family income was divided by the federal poverty threshold for the family's household size. The overall average income-to-needs ratio for the initial wave of data collection was below the poverty line ($M = .78$, $SD = 0.60$). At Wave 1, the average income-to-needs ratio for African-Americans was 0.59 ($SD = 0.63$), and 0.92 ($SD = 0.53$) for Hispanics. Average income-to-needs differed by ethnicity, $t(367) = 5.54$, $p < 0.001$. As shown in Table 1, more than 30% of study participants came from households that were at or less than 50% of the federal poverty level (FPL), with a greater percentage of African-American

than Hispanic families falling into this extreme poverty group. In contrast, 86 African-American families (47%) and 184 Hispanic families (82%) reported being at more than 50% of FPL.

Retention was high from Wave 1 to Wave 2 with 366 (90%) of participants completing assessments at Wave 2. More Hispanic families participated at Wave 2 (93%) than African-American families (86%), $\chi^2(1) = 6.27, p < 0.05$. Retained participants' income-to-needs ratio did not differ from those participants who were lost to follow-up, $t(405) = 0.78, p = 0.44$. There were no differences between retained participants and those lost to follow-up in regard to caregiver depressive symptoms, $t(405) = -1.38, p = 0.16$; single parent status, $\chi^2(1) = 1.74, p = 0.18$; caregiver education, $\chi^2(1) = 2.41, p = 0.12$; maternal negative regard, $\chi^2(1) = 1.04, p = 0.31$; number of residential moves, $\chi^2(1) = 0.17, p = 0.68$; and household density (i.e., child-to-adult ratio $\chi^2(1) = 0.29, p = 0.59$).

2.2. Measures

2.2.1. Inhibitory control—At Wave 1, inhibitory control was a composite measure using the snack delay (Kochanska et al., 2001); wrapped gift/wait for bow (Kochanska, Murray, & Harlan, 2000); and forbidden toy tasks (Lewis, Stanger, & Sullivan, 1989). At Wave 2, the snack delay and wrapped gift/wait for bow tasks were used. In the snack delay task, children were instructed to abstain from eating a chocolate candy until a bell rang. The task consisted of four trials of four waiting times: 10s, 20s, 30s, and 15s. Trials were coded based on the latency to touch the candy. Inter-rater reliability based on an intra-class correlation coefficient (ICC) was 0.99 based on 15% of cases.

The wrapped gift/wait for bow task required the child to abstain from “peeking” while an examiner wrapped a gift out of view of the child for a period of 60 s. Subsequently, the child was told to not touch the gift while the examiner left the area to retrieve a bow for a period of 90 s. Scoring was based on latencies to peek, touch, lift, and open the gift. Inter-rater reliability (ICC) ranged from 0.90 to 0.99 based on 21% of cases.

In the forbidden toy task, both the examiner and child played with a toy car that would wiggle and roll forward after being shaken. The examiner and child played with the toy for 60 s at which point the child was instructed to not touch the toy until the examiner returned (150s). Scoring was based on latency to touch the toy. Inter-rater reliability (ICC) averaged 0.95 based on 16% of cases.

In general, at both waves of task administrations, children either waited for the entire time as instructed or failed to wait at all resulting in a bimodal distribution. In order to preserve the intent of measuring the trial-level variables, values for the three tasks were dichotomized, then summed, resulting in a single index measure of inhibitory control at each age (Caughy et al., 2013). If the child waited the entire time in a certain trial and task, s/he was recoded a 1. If s/he did not wait, s/he was recoded a 0. There were 4 trials for the snack delay task, 4 latencies coded for wrapped gift/wait-for-bow, and a single latency coded for forbidden toy at Time 1. In the analysis for a prior published report of the factor structure of the inhibitory control variables from the same sample, one of the Time 1 wrapped gift/wait-for-bow trials (latency to move) was problematic due to inflated standard errors and multi-collinearity

(Caughy et al., 2013). Therefore, the Wave 1 inhibitory control composite had 8 components (4 trials from snack delay, 3 latencies from wrapped gift, and 1 latency from forbidden toy). Wave 2 also had 8 components (4 trials from snack delay and 4 latencies from wrapped gift).

The range of values was 0–8 for Wave 1 ($M = 2.11$, $SD = 2.03$), and 0–8 for Wave 2 ($M = 5.20$, $SD = 2.26$). Skew values were 1.12 and -0.42 , respectively. Larger inhibitory control values represent a more developed inhibitory control ability. On average, children's inhibitory control improved between Wave 1 and Wave 2, $t(348) = 22.35$, $p < 0.001$. Both Hispanic children, $t(198) = 17.16$, $p < 0.001$, and African-American children $t(149) = 14.31$, $p < 0.001$ had higher inhibitory control scores at Wave 2 than at Wave 1. There was no difference between Hispanics and African-Americans in inhibitory control at Wave 1, $t(395) = 1.06$, $p = 0.29$, but Hispanic children had higher inhibitory control scores than African-American children at Wave 2, $t(352) = 2.04$, $p = 0.04$.

2.2.2. Ecological/household risk—A variety of indicators were used to construct an index of household risk. These data included items regarding the stability of the household such as whether the family had relocated within the past year (Ackerman, Brown, & Izard, 2004; Ackerman, Kogos, Youngstrom, Schoff, & Izard, 1999), maternal depressive symptoms (Hughes et al., 2013), and an income-to-needs ratio constructed from reported household income and a roster of household members (Evans, 2003; Evans & English, 2002), resulting in a proportional metric and adjusted for family size.

In order to create a summated scale of cumulative risk, seven items measured at the first wave of data collection were dichotomized where a value of 1 reflected the presence of the risk factor. The seven items included were caregiver depressive symptoms above a cutoff of 16 or higher on the Center for Epidemiologic Studies Depression Scale –Revised (CESD-R) (Eaton, Smith, Ybarra, Muntaner, & Tien, 2004); single-parent household; residential relocations in the 12 month period immediately preceding the Wave 1 data collection; less than high school education of the primary caregiver; maternal negative regard score of 4 or 5 on the 5-point scale rated from the videotaped 15-min mother-child interaction; high child-to-adult ratio in the household of 3 or more to 1; family income-to-needs ratio indicative of extreme poverty (less than or equal to 50 percent of the federal poverty level for household size). The cumulative risk variable had values that ranged from 0 to 6, with larger values indicating more risks, and the variable was positively skewed ($M = 1.37$, $SD = 1.21$, skew value = 0.82). Approximately 28% of the sample ($n = 113$) did not have any of these risk factors, approximately 31% ($n = 125$) had one risk factor and 26% ($n = 105$) had two risk factors present. More than 15% of the sample ($n = 64$) had three or more risk factors.

2.2.3. Externalizing behavior—The outcome measure for this study was primary caregiver-reported externalizing behavior at the Wave 2. Externalizing behavior was measured using the Child Behavioral Checklist (Achenbach & Rescorla, 2001). The CBCL is a 112-item instrument with internalizing and externalizing subscales as well as a composite or total problems scale. The CBCL has been validated on a number of samples and is a standard measure of externalizing behavior in children (Gross et al., 2006; Qi & Kaiser, 2003; Votruba-Drzal, Coley, Maldonado-Carreño, Li-Grining, & Chase-Lansdale, 2010). The CBCL has also been validated with under-represented populations including

minority populations such as African-Americans and Hispanics (Gross et al., 2006). T-scores on the externalizing subscale ranged from 28 to 82 with a mean of 48.15 ($SD = 10.15$). A total of 88 (22%) children had scores above 59, the threshold for concern for the CBCL externalizing measure (Achenbach & Rescorla, 2001). For the current sample, the CBCL externalizing subscale did not differ by ethnicity, $t(364) = 0.63$, $p = 0.53$.

2.3. Group-based trajectory analysis approach

On average, inhibitory control in typically developing children increases with age, but there is substantial variability in the celerity and magnitude for the way this executive function ability unfolds over time (Mischel & Mischel, 1983). Any improvements in inhibitory control that are made may vary considerably between children. Children who fail to improve or improve only marginally are at the greatest risk for having externalizing behavior problems and are the most vulnerable to the negative effects of living within a multiple risk context. One approach to differentially examine children's development across time is group-based trajectory modeling (GBTM, Nagin, 2005).

The basic assumption for using GBTM is that in a longitudinal context, unobserved heterogeneity (i.e., individual differences) within a population can be statistically identified, forming qualitatively different groups of individuals that together share a unique developmental course (Nagin, 1999, 2005, 2016). Therefore, change between time periods can be modeled in a person-centered approach based on the measured characteristic. In a GBTM analysis, all individuals have a nonzero probability of being classified into any one of the estimated number of groups; however, individuals will have higher probabilities of being classified into one group over the others based on their developmental course (Nagin, 2005).

GBTM has been used in prior research on the emergence of self-regulatory skills (Côté, Tremblay, Nagin, Zoccolillo, & Vitaro, 2002). These researchers examined fearfulness, helplessness, and impulsivity and found a three-group solution for fearfulness and for helpfulness, and a less stable four-group solution for impulsivity. The groups differed by gender and males were more impulsive and less helpful than were females. To date, however, GBTM has not been applied to emerging executive function skills of inhibitory control in early childhood.

The analytic strategy proceeded in two stages. In the first stage, latent profiles or groups of children's inhibitory control measured at Waves 1 and 2 were estimated using Stata statistical software, version 14.1 (StataCorp, 2015) and the *traj* routine as recommended by Jones and Nagin (Jones & Nagin, 2013). The resulting latent profiles were analyzed for differences between them using the cumulative risk measure and externalizing behavior at Wave 2. Additional analyses were conducted using child gender, ethnicity, and income-to-needs to uncover individual differences in the way children were classified. Inasmuch as the group estimation was exploratory, all analyses with the resulting groups were executed as a means of validating the profiles of change in inhibitory control in that they were expected to be related to cumulative risk and externalizing behavior in systematic ways.

3. Results

3.1. Group-based modeling of inhibitory control at Waves 1 and 2

Latent profile groups were estimated using Waves 1 and 2 measures of inhibitory control. One, two, three, and four group solutions were estimated, and their associated fit indices are reported in Table 2. The fit indices used for model selection were the Bayesian Information Criterion (BIC), Adjusted Bayesian Information Criterion (Adj BIC), and Akaike Information Criterion (AIC). Specifically, the model with the largest BIC and AIC values (in the current case, the values that are the least negative) indicate better fit (Nagin, 2005; Singer & Willett, 2003). As indicated in Table 2, the 4-group solution had the largest AIC value, and the 2- and 4-group solutions had the largest BIC, albeit by a very small margin over the 3-group solution. The 3-group solution had the largest adjusted BIC values. Because the 4-group solution would result in one group having only two members, this solution was discarded as untenable. Comparing the 2-group and 3-group solutions, the 3-group solution had better fit according to the AIC and adjusted BIC statistics, whereas the 2-group solution had better fit according to the unadjusted AIC.

The two groups from the 2-group solution were labeled “increasing” (moderately low inhibitory control at T1 and rising at T2) and “low-stable” (low inhibitory control at both time points). The three groups from the 3-group solution were labeled “normative (low inhibitory control at T1 and high inhibitory control at T2), ‘low-stable’ (low inhibitory control at both time points), and “high-stable” (high inhibitory control at both time points). Average posterior probabilities were also compared between the 2-group and 3-group solutions. These values correspond with not only how well the model classified individual children into groups (i.e., classification error) but also with how well individual children fit into the predicted number of groups across the sample (Nagin, 1999). The posterior probabilities for the 3-group solution were 0.84, 0.88, and 0.81 for the normative group, low-stable, and high-stable groups, respectively. Because the 3-group solution had better fit than the 2-group solution on two out of three of the fit indices and had better posterior probabilities, the 3-group solution was selected.

The first group ($n = 168$, 48%), the *normative* group, was the largest group and included children who demonstrated low inhibitory control at 30 months (Wave 1) and improved considerably by the second wave (see Fig. 1). The second group ($n = 140$, 40%), the *low-stable* group, represents children who initially scored lower than the first group and improved little by the second wave. The third and relatively small group of children ($n = 41$, 12%), the *high-stable* group, demonstrated high inhibitory control at Wave 1 and maintained this level to Wave 2. There was no difference between the groups by gender, $\chi^2(2) = 3.46$, $p = 0.18$, or ethnicity, $\chi^2(2) = 4.76$, $p = 0.09$, but the groups did differ by income-to-needs, $\chi^2(4) = 13.15$, $p = 0.01$ (see Table 3).

Children living in households below 50% of the poverty level were more likely to be classified in the low-stable group, i.e. the group whose inhibitory control did not improve from age 2½ to 3½ years.

The main predictor variable was a composite of household risk. The distribution of risk factors for each inhibitory control group is shown in Table 4. The normative group had an average of 1.21 risks ($SD = 1.20$, skew value = 0.93), the low-stable group averaged 1.59 risks ($SD = 1.26$, skew value = 0.88), and the high-stable group averaged 1.24 risks ($SD = 1.02$, skew value = 0.50). There was an overall difference between groups in total risk, $F(2, 346) = 3.98$, $p = 0.02$. Applying the Scheffe' post hoc criterion, the normative group had significantly fewer risks than the low-stable groups, but no other comparisons differed significantly.

Differences in CBCL externalizing t -scores by inhibitory control group are displayed in Fig. 2. The normative group had an average externalizing score of 46.76 ($SD = 9.64$), the low-stable group had an average externalizing score of 50.06 ($SD = 10.02$), and the high-stable group had an average externalizing score of 46.63 ($SD = 11.08$). Overall differences between groups in Wave 2 externalizing behavior were statistically significant, $F(2, 346) = 4.65$, $p = 0.01$. Applying the Scheffe' post hoc criterion indicated significantly higher externalizing problems in the low-stable group than the normative group, but there were no other significant differences between groups in externalizing behavior.

Two regression models were estimated using externalizing behavior at Wave 2 as the outcome (Table 5) adjusting for effects of household risk, child gender and ethnicity. In the base model, household risk was a significant predictor of externalizing behavior accounting for both gender and ethnicity. The second model estimated added inhibitory control group identification as predictors with the normative group as the reference group. When compared to the normative group, the low-stable group was approximately three points higher in externalizing behavior, representing an effect size of 0.34. The high-stable group, did not display significantly lower externalizing behavior compared with the normative group. Household risk remained a significant predictor of more externalizing problems.

4. Discussion

One of the main objectives of this study was to empirically estimate distinct unobserved groups of children using GBTM from inhibitory control composite scores formed from multiple measures collected at 30 and 42 months of age to examine different patterns of change in this sample of children from low-income families. A three-group solution was determined to fit the data best compared to two- and four-group solutions. The three-group solution was comprised of a normative group that showed a steep increase in inhibitory control from 30 to 42 months; a low-stable group with lower inhibitory control scores than the normative group even at the earlier age and increasing only slightly in inhibitory control skill measured at Wave 2, and a relatively small high-stable group with higher inhibitory control scores at both time periods.

A key independent variable in the current analysis was cumulative risk, an index of seven items all measured at the initial wave of data. Differences in cumulative risk between the normative and low-stable groups emerged, consistent with prior work indicating that more risks are associated with suboptimal self-regulation development (Doan et al., 2012). In the current study, the high-stable group—those children with more optimal inhibitory control

scores at both ages—had the fewest risks but not significantly different from the risks present for children in the normative group. Other factors, unexamined in the present study, may be found to distinguish these two groups.

Differences between the normative and low-stable groups were found on measures of risk and externalizing behavior, indicating partial support for the prediction that patterns of change in inhibitory control between 30 and 42 months of age would be meaningfully associated with risk and caregiver-reported externalizing behavior. Indeed, children in the normative group with higher inhibitory control competence than those in the low-stable group had fewer risks and less externalizing behavior. However, neither cumulative risk nor child externalizing behaviors differed between the high-stable and the normative groups, or between the high-stable and low-stable groups in these bivariate analyses. Inasmuch as the high-stable group was the smallest group of the 3-group solution from the group-based analyses, comprising only 12 percent of the sample ($n = 41$), significant differences in risk and externalizing behavior may not have been detectable. Alternatively, the high-stable group may represent that small group of children who demonstrate temperamental inhibition from an early age (Kagan, Reznick, & Snidman, 1987).

Based on the multivariate analyses examining relations of externalizing behavior to the inhibitory control groups, controlling for cumulative risk, child gender and ethnicity, externalizing scores of the low-stable group were significantly higher than the normative group. The pattern of results in the current sample is congruent with previous findings that link multiple household risk factors to lower levels of inhibitory control (Doan et al., 2012; Evans & English, 2002; Lengua, 2002; Raver, 2004). Moreover, the finding that risk contributed significant variance in externalizing behavior beyond ethnicity and poverty status shows the cumulative nature of the way such factors can adversely influence the development of self-regulation skills such as inhibitory control.

One of the hallmark premises for applying a group-based modeling strategy to longitudinal data is that it does not require *a priori* distributional assumptions to be made about the data (Nagin, 2005; Nagin & Odgers, 2012). The idea behind a group-based modeling approach is to uncover the unobserved heterogeneity within the sample. However, as the groups emerge, their characteristics should be congruent to the group to which they had the highest probability of membership (Nagin & Land, 1993; Zhou et al., 2007). For the current study, those children classified into the low-stable group who scored lower in inhibitory control skill across both waves than children in the other two groups were expected to have the greatest risks given previous findings linking risk with lower inhibitory control, and they were also expected to exhibit more externalizing behaviors. Children in the normative group were expected to fall in between the low-stable and high-stable groups in terms of risk and externalizing behavior because of the group's increases in inhibitory control from Wave 1 to Wave 2 compared to the lower scores and change in inhibitory control that characterized the low-stable group, and the higher scores characterized by the high-stable group. Prior research suggests that, on average, lower levels of inhibitory control is associated with more reported externalizing behaviors (Hughes et al., 2000; Rhoades et al., 2009) which was the basic pattern found in the current study: the low-stable group had high externalizing behavior scores when compared to the normative group.

Typically, inhibitory control improves with a child's age, increasing dramatically between the age of two and five years (Campbell, 2006; Carlson, Davis, & Leach, 2005). Inhibitory control as well as other markers of self-regulation will improve along a normative trajectory for many if not most children, but some may show delays in such improvement, such as the group of children identified as low-stable in the current study. It is notable that children in the low-stable group had more risk factors than those in the normative group. This association suggests that the development of inhibitory control may be undermined when living in environmental contexts characterized by the types of risk factors found within the sample of low-income children of this study. Such skills may not be modeled or their development supported by caregivers with stressors in their lives such as extreme poverty, depression, and household instability and crowding found in this sample. For example, in a household where angry outbursts are frequent, and the anger results in a desired outcome for the angry individual, a child may emulate that behavior, consider it normal, and not be provided with supports to develop skills needed to modulate his or her behavior (Buss & Plomin, 1984; Kochanska & Knaack, 2003). The effects of living in poverty have also been linked to suboptimal brain development in infants (Hanson et al., 2013) and suboptimal development of regulatory control (Buckner, Mezzacappa, & Beardslee, 2009; Evans & English, 2002; Evans & Rosenbaum, 2008). The various risk indicators in the present study are ones likely associated with different degrees of stress in the lives of these families, and the degree of stress in the household is likely greater the higher the number of concurrent risk factors (Trentacosta et al., 2008). The result can be that stress is working against optimal self-regulatory development (Evans & Kim, 2013).

The inhibitory control groups did not differ by gender or ethnicity. A prior report on the same sample found ethnic but no gender differences in the children's inhibitory control (Caughy et al., 2013), making the current lack of differences by ethnicity in distributions of the three groups somewhat surprising. Although all participants were similar with respect to the recruitment requirement of low family income, cultural differences in socialization between the Hispanic and African-American children (Caughy et al., 2013) suggest that ethnic differences in inhibitory control would be found at these ages. However, in another study comprised mostly of Hispanic and African-American children, no ethnic differences in self-regulation skills were also not found in early childhood (Li-Grining, 2007). One possible explanation for the difference in findings between the prior analyses of these data and the current study regarding ethnic differences in self-regulation is that the prior analysis was variable-centered whereas the current analysis was person-centered. In the prior analysis, comparisons of average scores on inhibitory control at Time 1 (age 2½ years) and at Time 2 (age 3½ years) found no ethnic differences at age 2½, but Hispanic children had higher inhibitory control scores at age 3½ (Caughy et al., 2013). In contrast, in the current person-centered analysis, children were grouped according to their *pattern* of change in inhibitory control between age 2½ and 3½. The lack of ethnic differences suggests that the patterns of change in inhibitory control do not differ by ethnicity, with roughly equivalent proportions of children falling into the three patterns of inhibitory control of high-stable, normative, and low-stable. This is an example of how person-oriented analyses can yield different information from variable-centered analyses.

The current study has several limitations that should be noted. The first limitation regards the number of time points used to estimate the latent groups from the sample. Although, in theory, any study is longitudinal if data are collected beyond a single time point and is therefore appropriate for group-based modeling, such modeling is more appropriate and better suited for data with more than two time points (Nagin, 2005; Nagin & Odgers, 2012). Inasmuch as the data for the current study come from an ongoing study, future reports will include subsequent time points to estimate trajectories of inhibitory control through the transition to school to examine how the emergent groups from this “at risk” sample relate to risk and externalizing behavior.

A second limitation is the way groups were estimated. No covariates were used to determine group membership, and this is a salient point for a sample comprised of low-income minority children. Group classifications could easily be affected by extreme poverty status as it relates to a specific ethnicity. African-American children may perceive and experience living in extreme poverty differently than Hispanic children which may be expressed through suboptimal inhibitory control (Dearing, 2004; Hill, Bush, & Roosa, 2003). Prior research has pointedly asserted that the effects of poverty and minority status are extremely difficult to disaggregate (Abidin, Jenkins, & McGaughey, 1992; Atzaba-Poria, Pike, & Deater-Deckard, 2004); hence, using those variables to estimate the unobserved heterogeneity within a sample may be a worthy first-step. Future research should consider both the economic status and ethnicity of participants as predictors to estimate profiles of change. Although participants in the sample were both ethnic minorities and low-income, there was broad variability in family income and associated income-to-needs ratios. Group-based modeling that accounts for both ethnic and economic variability may result in a different distribution of unobserved heterogeneity in terms of inhibitory control. Additionally, participants in the current study were already considered “at-risk” because of inclusion criteria for the principal study meaning that any risk measure accounts for risk above economic and minority status (Parker et al., 1988). Using these material variables in future analyses will provide a clearer representation of the dynamics underlying emerging self-regulation and its relevant relations to risk and externalizing behavior.

The large number of studies that have examined self-regulatory skills, inhibitory control in particular, reported findings based on samples of Caucasian, middle income samples of children where race and ethnicity were largely relegated to the status of a control variable (e.g., Rhoades et al., 2009). Many of these studies have reported that ethnic minority and low-income children do not demonstrate the self-regulatory competence typically found in non-Hispanic White more advantaged children. The current study demonstrated that broad, within-group variability can not only exist within a high-risk sample of ethnic minority children, but that it can be detected, representing a significant, first step response to calls for research that specifically examines Hispanic and African-American, low income children (Flores, Cicchetti, & Rogosch, 2005; Flores et al., 2002; Garcia-Coll et al., 1996; Li-Grining, 2007).

4.1. Implications for educators

Gaining a better understanding for the way self-regulatory competency develops in early childhood, especially in low-income African American and Hispanic children, is important for a number of reasons. First, as children transition to school, they are expected to regulate their emotions and behaviors in order to sit patiently, attend to a teacher, and integrate new information into their repertoires of knowledge. Low-income, minority children may demonstrate greater difficulty with this because of various environmental factors where they reside. Second, one of the greatest benefits of this study was showing the within-group variation in the development of inhibitory control over the period of one year. Whereas many studies have resorted to explaining differences between Caucasian and non-Caucasian children, this study was innovative in showing the high degree of variability within a high-risk, all minority sample of children. Finally, this study was also able to demonstrate through group-based trajectory modeling that the arc of growth in inhibitory control is steep between the ages of 2½ and 3½ years. What this means particularly for preschool educators is that although some children may be somewhat delayed in their inhibitory control competency, there remains time for this important skill to improve and crystallize before children begin formal schooling. For children identified as having significant problems, interventions such as the Chicago School Readiness Project have shown much promise (Raver et al., 2011).

Acknowledgments

This work was supported by the *Eunice Kennedy Shriver* National Institute of Child Health and Development (1R01HD058643-01A1). The authors thank everyone on the research team and a very special thanks to the families who participated in the research.

References

- Abidin RR, Jenkins CL, McGaughey MC. The relationship of early family variables to children's subsequent behavioral adjustment. *Journal of Clinical Child and Adolescent Psychology*. 1992; 21:60. http://dx.doi.org/10.1207/s15374424jccp2101_9.
- Achenbach, TM., Rescorla, L. Manual for the ASEBA school-age forms & profiles. Burlington, VT: University of Vermont, Research Center for Children, Youth, and Families; 2001.
- Ackerman BP, Kogos J, Youngstrom E, Schoff K, Izard C. Family instability and the problem behaviors of children from economically disadvantaged families. *Developmental Psychology*. 1999; 35:258. <http://dx.doi.org/10.1037/0012-1649.35.1.258>. [PubMed: 9923480]
- Ackerman BP, Brown ED, Izard CE. The relations between contextual risk, earned income, and the school adjustment of children from economically disadvantaged families. *Developmental Psychology*. 2004; 40:204. <http://dx.doi.org/10.1037/0012-1649.40.2.204>. [PubMed: 14979761]
- Atzaba-Poria N, Pike A, Deater-Deckard K. Do risk factors for problem behaviour act in a cumulative manner? An examination of ethnic minority and majority children through an ecological perspective. *Journal of Child Psychology and Psychiatry*. 2004; 45:707. <http://dx.doi.org/10.1111/j.1469-7610.2004.00265.x>. [PubMed: 15056303]
- Bronfenbrenner, U. Making human beings human: Bioecological perspectives on human development. Sage; 2005.
- Bronson, MB. Self-regulation in early childhood: Nature and nurture. New York, NY: Guilford Press; 2000.
- Buckner JC, Mezzacappa E, Beardslee WR. Self-regulation and its relations to adaptive functioning in low income youths. *American Journal of Orthopsychiatry*. 2009; 79:19. <http://dx.doi.org/10.1037/a0014796>. [PubMed: 19290722]

- Buss, AH., Plomin, R. Temperament: Early developing personality traits. Buss, AH., Plomin, R., editors. Hillsdale, NJ: NJL Erlbaum Associates; 1984.
- Côté SM, Tremblay RE, Nagin DS, Zoccolillo M, Vitaro F. Childhood behavioral profiles leading to adolescent conduct disorder: Risk trajectories for boys and girls. *Journal of the American Academy of Child and Adolescent Psychiatry*. 2002; 41:1086–1094. <http://dx.doi.org/10.1097/00004583-200209000-00009>. [PubMed: 12218430]
- Calkins, SD., Howse, RB. Individual differences in self-regulation: Implications for childhood adjustment. In: Philippot, P., Feldman, RS., editors. *The regulation of emotion*. Mahwah, NJ, US: Lawrence Erlbaum Associates Publishers; 2004. p. 307-332.
- Campbell, SB. Behavior problems in preschool children: Clinical and developmental issues. New York, NY: Guilford Press; 2006.
- Carlson SM, Moses LJ. Individual differences in inhibitory control and children's theory of mind. *Child Development*. 2001; 72:1032–1053. <http://dx.doi.org/10.1111/1467-8624.00333>. [PubMed: 11480933]
- Carlson, EA., Sroufe, LA. Contribution of attachment theory to developmental psychopathology. In: Cicchetti, D., Cohen, DJ., editors. *Developmental psychopathology: Theory and methods*. Vol. 3. New York: Wiley; 1995. p. 581-617.
- Carlson SM, Davis AC, Leach JG. Less is more executive function and symbolic representation in preschool children. *Psychological Science*. 2005; 16:609–616. <http://dx.doi.org/10.1111/j.1467-9280.2005.01583.x>. [PubMed: 16102063]
- Carlson SM. Introduction to the special issue: Executive function. *Journal of Experimental Child Psychology*. 2011; 108:411–413. <http://dx.doi.org/10.1016/j.jecp.2011.01.004>. [PubMed: 21334489]
- Caughy MO, Mills B, Owen MT, Hurst JR. Emergent self-regulation skills among very young ethnic minority children: A confirmatory factor model. *Journal of Experimental Child Psychology*. 2013; 116:839–855. <http://dx.doi.org/10.1016/j.jecp.2013.07.17>. [PubMed: 24076382]
- Caughy, MO., Owen, MT., Hurst, JR. Assessing developmental trajectories of executive functions in low income ethnic minority preschoolers: Challenges and opportunities. In: Griffin, JA, McCardle, P., Freund, LS., editors. *Executive Function in Preschool-Age Children: Integrating Measurement, Neurodevelopment, and Translational Research*. American Psychological Association; 2015. <http://dx.doi.org/10.1037/14797-013>
- Cicchetti, D., Ganiban, J., Barnett, D. Contributions from the study of high-risk populations to understanding the development of emotion regulation. In: Garber, J., Dodge, KA., editors. *The development of emotion regulation and dysregulation*. New York, NY: Cambridge University Press; 1991.
- Cole PM, Martin SE, Dennis TA. Emotion regulation as a scientific construct: Methodological challenges and directions for child development research. *Child Development*. 2004; 75:317–333. <http://dx.doi.org/10.1111/j.1467-8624.2004.00673.x>. [PubMed: 15056186]
- Conger RD, Donnellan MB. An interactionist perspective on the socioeconomic context of human development. *Annual Review of Psychology*. 2007; 58:175–199.
- Dearing E. The developmental implications of restrictive and supportive parenting across neighborhoods and ethnicities: Exceptions are the rule. *Journal of Applied Developmental Psychology*. 2004; 25:555–575. <http://dx.doi.org/10.1016/j.appdev.2004.08.007>.
- Deater-Deckard K, Dodge KA, Bates JE, Pettit GS. Multiple risk factors in the development of externalizing behavior problems: group and individual differences. *Development and Psychopathology*. 1998; 10:469–493. <http://dx.doi.org/10.1017/s0954579498001709>. [PubMed: 9741678]
- Deater-Deckard K, Mullineaux PY, Beekman C, Petrill SA, Schatschneider C, Thompson LA. Conduct problems, IQ, and household chaos: A longitudinal multi-informant study. *Journal of Child Psychology and Psychiatry*. 2009; 50:1301–1308. <http://dx.doi.org/10.1111/j.1469-7610.2009.02108.x>. [PubMed: 19527431]
- Doan SN, Fuller-Rowell TE, Evans GW. Cumulative risk and adolescent's internalizing and externalizing problems: the mediating roles of maternal responsiveness and self-regulation.

- Developmental Psychology. 2012; 48:1529–1539. <http://dx.doi.org/10.1037/a0027815>. [PubMed: 22486443]
- Duncan GJ, Brooks-Gunn J, Klebanov PK. Economic deprivation and early childhood development. *Child Development*. 1994; 65(2):296–318. DOI: 10.2307/1131385 [PubMed: 7516849]
- Eaton, WW., Smith, C., Ybarra, M., Muntaner, C., Tien, A. Center for epidemiologic studies depression scale: Review and revision (CESD and CESD-R). In: Maruish, ME., editor. *The use of psychological testing for treatment planning and outcomes assessment: Instruments for adults*. 3. Vol. 3. Mahwah, NJ: Lawrence Erlbaum Associates; 2004. p. 363-377.
- Eisenberg N, Cumberland A, Spinrad TL, Fabes RA, Shepard SA, Reiser M, et al. The relations of regulation and emotionality to children's externalizing and internalizing problem behavior. *Child Development*. 2001; 72:1112–1134. <http://dx.doi.org/10.1111/1467-8624.00337>. [PubMed: 11480937]
- Evans GW, English K. The environment of poverty: Multiple stressor exposure, psychophysiological stress, and socioemotional adjustment. *Child Development*. 2002; 73:1238–1248. <http://dx.doi.org/10.1111/1467-8624.00469>. [PubMed: 12146745]
- Evans GW, Kim P. Childhood poverty, chronic stress, self-regulation, and coping. *Child Development Perspectives*. 2013; 7:43–48. <http://dx.doi.org/10.1111/cdep.12013>.
- Evans GW, Rosenbaum J. Self-regulation and the income-achievement gap. *Early Childhood Research Quarterly*. 2008; 23:504–514. <http://dx.doi.org/10.1016/j.ecresq.2008.07.002>.
- Evans GW. A multimethodological analysis of cumulative risk and allostatic load among rural children. *Developmental Psychology*. 2003; 39(5):924. [PubMed: 12952404]
- Evans GW. The environment of childhood poverty. *American Psychologist*. 2004; 59(2):77–92. <http://dx.doi.org/10.1037/0003-066X.59.2.77>. [PubMed: 14992634]
- Flores G, Fuentes-Afflick E, Barbot O, Carter-Pokras O, Claudio L, Lara M, et al. The health of Latino children: urgent priorities, unanswered questions, and a research agenda. *JAMA*. 2002; 288:82–90. <http://dx.doi.org/10.1001/jama.288.1.82>. [PubMed: 12090866]
- Flores E, Cicchetti D, Rogosch FA. Predictors of resilience in maltreated and nonmaltreated Latino children. *Developmental Psychology*. 2005; 41:338. <http://dx.doi.org/10.1037/0012-1649.41.2.338>. [PubMed: 15769190]
- Gallo LC, Matthews KA. Do negative emotions mediate the association between socioeconomic status and health? *Annals of the New York Academy of Sciences*. 1999; 896(1):226–245. [PubMed: 10681900]
- Garcia-Coll C, Crnic K, Lamberty G, Wasik BH, Jenkins R, Garcia HV, et al. An integrative model for the study of developmental competencies in minority children. *Child Development*. 1996; 67:1891–1914. <http://dx.doi.org/10.2307/1131600>. [PubMed: 9022222]
- Garon N, Bryson SE, Smith IM. Executive function in preschoolers: A review using an integrative framework. *Psychological Bulletin*. 2008; 134:31–60. <http://dx.doi.org/10.1037/0033-2909.134.1.31>. [PubMed: 18193994]
- Grant KE, Compas BE, Stuhlmacher AF, Thurm AE, McMahon SD, Halpert JA. Stressors and child and adolescent psychopathology: moving from markers to mechanisms of risk. *Psychological Bulletin*. 2003; 129(3):447. [PubMed: 12784938]
- Gross D, Fogg L, Young M, Ridge A, Cowell JM, Richardson R, et al. The equivalence of the child behavior checklist/1 1/2–5 across parent race/ethnicity, income level, and language. *Psychological Assessment*. 2006; 18:313. <http://dx.doi.org/10.1037/1040-3590.18.3.313>. [PubMed: 16953734]
- Hanson JL, Hair N, Shen DG, Shi F, Gilmore JH, Wolfe BL, et al. Family poverty affects the rate of human infant brain growth. *Public Library of Science*. 2013; 8(12):e80954.doi: 10.1371/journal.pone.0080954
- Herrnstein, RJ., Murray, C. *The bell curve: Intelligence and class structure in american life*. New York: Simon & Schuster; 1996.
- Hill NE, Bush KR, Roosa MW. Parenting and family socialization strategies and children's mental health: Low-income Mexican-American and Euro-American mothers and children. *Child Development*. 2003; 74:189–204. <http://dx.doi.org/10.1111/1467-8624.t01-1-00530>. [PubMed: 12625445]

- Hughes C, White A, Sharpen J, Dunn J. Antisocial, angry, and unsympathetic: Hard-to-manage preschoolers' peer problems and possible cognitive influences. *Journal of Child Psychology and Psychiatry*. 2000; 41:169–179. <http://dx.doi.org/10.1111/1469-7610.00558>. [PubMed: 10750543]
- Hughes C, Roman G, Hart MJ, Ensor R. Does maternal depression predict young children's executive function? A 4-year longitudinal study. *Journal of Child Psychology and Psychiatry*. 2013; 54(2): 169–177. <http://dx.doi.org/10.1111/jcpp.12014>. [PubMed: 23171379]
- Huston AC, McLoyd VC, Coll CG. Children and poverty: Issues in contemporary research. *Child Development*. 1994; 65(2):275–282. DOI: 10.1111/j.1467-8624.1994.tb00750.x
- Jones BL, Nagin DS. A note on a Stata plugin for estimating group-based trajectory models. *Sociological Methods & Research*. 2013; 42:608–613. <http://dx.doi.org/10.1177/0049124113503141>.
- Jones LB, Rothbart MK, Posner MI. Development of executive attention in preschool children. *Developmental Science*. 2003; 6:498–504. <http://dx.doi.org/10.1111/1467-7687.00307>.
- Kagan, J., Reznick, JS., Snidman, N. The physiology and psychology of behavioral inhibition in children; *Child Development*. 1987. p. 1459-1473. <http://dx.doi.org/10.2307/1130685>
- Kochanska G, Aksan N. Mother-child mutually positive affect, the quality of child compliance to requests and prohibitions, and maternal control as correlates of early internalization. *Child Development*. 1995; 66:236–254. <http://dx.doi.org/10.1111/j.1467-8624.1995.tb00868.x>.
- Kochanska G, Knaack A. Effortful control as a personality characteristic of young children: Antecedents, correlates, and consequences. *Journal of Personality*. 2003; 71:1087–1112. <http://dx.doi.org/10.1111/1467-6494.7106008>. [PubMed: 14633059]
- Kochanska G, Murray KT, Harlan ET. Effortful control in early childhood: Continuity and change, antecedents, and implications for social development. *Developmental Psychology*. 2000; 36:220–232. <http://dx.doi.org/10.1037/0012-1649.36.2.220>. [PubMed: 10749079]
- Kochanska G, Coy KC, Murray KT. The Development of self-regulation in the first four years of life. *Child Development*. 2001; 72:1091–1111. <http://dx.doi.org/10.1111/1467-8624.00336>. [PubMed: 11480936]
- Kopp CB. Antecedents of self-regulation: A developmental perspective. *Developmental Psychology*. 1982; 18:199–214. <http://dx.doi.org/10.1037/0012-1649.18.2.199>.
- Kopp CB. Regulation of distress and negative emotions: A developmental view. *Developmental Psychology*. 1989; 25:343. <http://dx.doi.org/10.1037/0012-1649.25.3.343>.
- Kopp, CB. Young children's progression to self-regulation. In: Bullock, M., editor. *The development of intentional action: Cognitive, motivational, and interactive processes*. Vol. 22. Basel, Switzerland: Karger; 1991. p. 38-54.
- Lengua LJ, Honorado E, Bush NR. Contextual risk and parenting as predictors of effortful control and social competence in preschool children. *Journal of Applied Developmental Psychology*. 2007; 28:40–55. <http://dx.doi.org/10.1016/j.appdev.2006.10.001>. [PubMed: 21687825]
- Lengua LJ. The contribution of emotionality and self-Regulation to the understanding of children's response to multiple risk. *Child Development*. 2002; 73:144–161. <http://dx.doi.org/10.1111/1467-8624.00397>. [PubMed: 14717249]
- Lewis M, Stanger C, Sullivan MW. Deception in 3-year-olds. *Developmental Psychology*. 1989; 25:439. <http://dx.doi.org/10.1037/0012-1649.25.3.439>.
- Li-Grining, CP. Effortful control among low-income preschoolers in three cities: Stability, change, and individual differences; *Developmental Psychology*. 2007. p. 43. <http://dx.doi.org/10.1037/0012-1649.43.1.208>
- Maccoby, EE. Middle childhood in the context of the family. In: Collins, WA., editor. *Development during middle childhood: The years from six to twelve*. Washington, D.C: National Academy Press; 1984. p. 184-239.
- McClelland MM, Cameron CE, Connor CM, Farris CL, Jewkes AM, Morrison FJ. Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology*. 2007; 43:947–959. <http://dx.doi.org/10.1037/0012-1649.43.4.947>. [PubMed: 17605527]
- McLoyd VC. Socioeconomic disadvantage and child development. *American Psychologist*. 1998; 53(2):185. <http://dx.doi.org/10.1037/0003-066x.53.2.185>. [PubMed: 9491747]

- Mischel, HN., Mischel, W. The development of children's knowledge of self-control strategies; *Child Development*. 1983. p. 603-619. <http://dx.doi.org/10.2307/1130047>
- Mischel W, Shoda Y, Rodriguez MI. Delay of gratification in children. *Science*. 1989; 244:933–938. <http://dx.doi.org/10.1126/science.2658056>. [PubMed: 2658056]
- Moilanen KL, Shaw DS, Dishion TJ, Gardner F, Wilson M. Predictors of longitudinal growth in inhibitory control in early childhood. *Social Development*. 2010; 19:326–347. <http://dx.doi.org/10.1111/j.1467-9507.2009.00536.x>.
- Nagin DS, Land KC. Age, criminal careers, and population heterogeneity: Specification and estimation of a non-parametric, mixed Poisson model. *Criminology*. 1993; 31(3):327–362. DOI: 10.1111/j.1745-9125.1993.tb01133.x
- Nagin, DS., Odgers, CL. Group-based trajectory modeling in developmental science. In: Laursen, B.Little, TD., Card, NA., editors. *Handbook of developmental research methods*. New York, NY: Guilford; 2012. p. 464-480.
- Nagin DS. Analyzing developmental trajectories: A semiparametric, group-based approach. *Psychological Methods*. 1999; 4:139. <http://dx.doi.org/10.1037/1082-989X.4.2.139>.
- Nagin, DS. Group-based modeling of development. Harvard University Press; 2005.
- Nagin DS. Group-based trajectory modeling and criminal career research. *Journal of Research in Crime and Delinquency*. 2016; 53:356–371. <http://dx.doi.org/10.1177/0022427815611710>.
- Olson SL, Sameroff AJ, Kerr DCR, Lopez NL, Wellman HM. Developmental foundations of externalizing problems in young children: The role of effortful control. *Development and Psychopathology*. 2005; 17:25–45. <http://dx.doi.org/10.1017/S0954579405050029>. [PubMed: 15971758]
- Parker S, Greer S, Zuckerman B. Double jeopardy: The impact of poverty on early child development. *Pediatric Clinics of North America*. 1988; 35:1227–1240. [http://dx.doi.org/10.1016/S0031-3955\(16\)36580-4](http://dx.doi.org/10.1016/S0031-3955(16)36580-4). [PubMed: 3059296]
- Patterson, GR., DeBaryshe, BD., Ramsey, E. A developmental perspective on antisocial behavior. Vol. 44. American Psychological Association; 1989.
- Posner MI, Rothbart MK. Developing mechanisms of self-regulation. *Development and Psychopathology*. 2000; 12:427–441. <http://dx.doi.org/10.1017/S0954579400003096>. [PubMed: 11014746]
- Putnam SP, Gartstein MA, Rothbart MK. Measurement of fine-grained aspects of toddler temperament: The early childhood behavior questionnaire. *Infant Behavior and Development*. 2006; 29:386–401. <http://dx.doi.org/10.1016/j.infbeh.2006.01.004>. [PubMed: 17138293]
- Qi CH, Kaiser AP. Behavior problems of preschool children from low-income families review of the literature. *Topics in Early Childhood Special Education*. 2003; 23(4):188–216. DOI: 10.1177/02711214030230040201
- Raaijmakers MA, Smidts DP, Sergeant JA, Maassen GH, Posthumus JA, Van Engeland H, et al. Executive functions in preschool children with aggressive behavior: Impairments in inhibitory control. *Journal of Abnormal Child Psychology*. 2008; 36:1097–1107. <http://dx.doi.org/10.1007/s10802-008-9235-7>. [PubMed: 18437548]
- Raver CC, Jones SM, Li-Grining C, Zhai F, Bub K, Pressler E. CSRP's impact on low-income preschoolers' preacademic skills: Self-regulation as a mediating mechanism. *Child Development*. 2011; 82:362–378. <http://dx.doi.org/10.1111/j.1467-8624.2010.01561.x>. [PubMed: 21291447]
- Raver CC. Placing emotional self-regulation in sociocultural and socioeconomic contexts. *Child Development*. 2004; 75:346–353. <http://dx.doi.org/10.1111/j.1467-8624.2004.00676.x>. [PubMed: 15056189]
- Rhoades BL, Greenberg MT, Domitrovich CE. The contribution of inhibitory control to preschoolers' social-emotional competence. *Journal of Applied Developmental Psychology*. 2009; 30:310–320. <http://dx.doi.org/10.1016/j.appdev.2008.12.012>.
- Rothbart MK, Ahadi SA, Hershey KL, Fisher P. Investigations of temperament at three to seven years: The Children's Behavior Questionnaire. *Child Development*. 2001; 72:1394–1408. <http://dx.doi.org/10.1111/1467-8624.00355>. [PubMed: 11699677]
- Rutter M. Protective factors in children's responses to stress and disadvantage. *Annals of the Academy of Medicine, Singapore*. 1979; 8:324–338.

- Sameroff AJ, Seifer R, Barocas R, Zax M, Greenspan S. Intelligence quotient scores of 4-year-old children: Social-environmental risk factors. *Pediatrics*. 1987; 79:343–350. [PubMed: 3822634]
- Sameroff AJ. Ecological perspectives on developmental risk. *WAIMH handbook of infant mental health*. 2000; 4:4–33.
- Sektman M, McClelland MM, Acock A, Morrison FJ. Relations between early family risk, children's behavioral regulation, and academic achievement. *Early Childhood Research Quarterly*. 2010; 25:464–479. <http://dx.doi.org/10.1016/j.ecresq.2010.02.005>. [PubMed: 20953343]
- Shonkoff JP, Garner AS, Siegel BS, Dobbins MI, Earls MF, McGuinn L, et al. The lifelong effects of early childhood adversity and toxic stress. *Pediatrics*. 2012; 129:e232–e246. <http://dx.doi.org/10.1542/peds.2011-2663>. [PubMed: 22201156]
- Singer, JD., Willett, JB. *Applied longitudinal data analysis: Modeling change and event occurrence*. Oxford University Press; 2003.
- Spinrad TL, Eisenberg N, Gaertner B, Popp T, Smith CL, Kupfer A, et al. Relations of maternal socialization and toddlers' effortful control to children's adjustment and social competence. *Developmental Psychology*. 2007; 43(5):1170–1186. <http://dx.doi.org/10.1037/0012-1649.43.5.1170>. [PubMed: 17723043]
- Sroufe LA. The coherence of individual development: Early care, attachment, and subsequent developmental issues. *American Psychologist*. 1979; 34:834. <http://dx.doi.org/10.1037/0003-066X.34.10.834>.
- StataCorp. *Stata statistical software release 14.1: Programming*. Stata Corporation; 2015.
- Trentacosta CJ, Hyde LW, Shaw DS, Dishion TJ, Gardner F, Wilson M. The relations among cumulative risk, parenting, and behavior problems during early childhood. *Journal of Child Psychology and Psychiatry*. 2008; 49:1211–1219. <http://dx.doi.org/10.1111/j.1469-7610.2008.01941.x>. [PubMed: 18665880]
- Tronick EZ. Emotions and emotional communication in infants. *American Psychologist*. 1989; 44:112. <http://dx.doi.org/10.1037/0003-066X.44.2.112>. [PubMed: 2653124]
- Vaughn, BE., Kopp, CB., Krakow, JB. The emergence and consolidation of self-control from eighteen to thirty months of age: Normative trends and individual differences; *Child Development*. 1984. p. 990-1004. <http://dx.doi.org/10.2307/1130151>
- Vaughn MG, DeLisi M, Beaver KM, Wright JP. Identifying latent classes of behavioral risk based on early childhood manifestations of self-control. *Youth Violence and Juvenile Justice*. 2009; 7(1): 16–31. <http://dx.doi.org/10.1177/1541204008324911>.
- Votruba-Drzal E, Coley RL, Maldonado-Carreño C, Li-Grining CP, Chase-Lansdale PL. Child care and the development of behavior problems among economically disadvantaged children in middle childhood. *Child Development*. 2010; 81:1460–1474. <http://dx.doi.org/10.1111/j.1467-8624.2010.01485.x>. [PubMed: 20840234]
- Zhou Q, Hofer C, Eisenberg N, Reiser M, Spinrad TL, Fabes RA. The developmental trajectories of attention focusing, attentional and behavioral persistence, and externalizing problems during school-age years. *Developmental Psychology*. 2007; 43:369–385. <http://dx.doi.org/10.1037/0012-1649.43.2.369>. [PubMed: 17352545]

Fig. 1.
Developmental Profiles of Change in Inhibitory Control.

Fig. 2.
Developmental Profiles of Change and Externalizing Behavior.

Table 1

Sample characteristics (N = 407).

	Child Ethnicity		χ^2
	African-American (n = 183) N (%)	Hispanic (n = 224) N (%)	
Child Gender			
Male	101 (55.2)	118 (52.7)	0.26
Female	82 (44.8)	106 (47.3)	
Income-to-Needs			
50% FPL	97 (53.0)	40 (17.9)	61.86 **
51–100% FPL	26 (14.2)	87 (38.8)	
> 100% FPL	60 (32.8)	97 (43.3)	
Caregiver Education			
< High school	26 (14.3)	96 (42.9)	39.00 **
High school	156 (85.7)	128 (57.1)	
Caregiver Language			
English-dominant		15 (7.1)	
Spanish-dominant		129 (61.4)	
Bilingual		66 (31.4)	

**
p < 0.01.

Table 2

GBTM Comparative Fit Indices for 1, 2, 3, and 4 Group Solutions for Children's Inhibitory Control.

	AIC	BIC	Adj BIC (n = 349)
1 Group	-1459.39	-1466.21	-1465.18
2 Group	-1444.92	-1458.57	-1456.49
3 Group	-1438.20	-1458.67	-1455.55
4 Group	-1435.43	-1462.72	-1458.56

Table 3

Distribution of Child Characteristics by Profile of Change Group.

	Profile of Change Group			χ^2
	Low Stable (<i>n</i> = 140)	Normative (<i>n</i> = 168)	High Stable (<i>n</i> = 41)	
	N (%)	N (%)	N (%)	
Gender				
Male	85 (44.5)	86 (45.0)	20 (10.5)	3.46
Female	55 (34.8)	82 (52)	21 (13.3)	
Ethnicity				
Hispanic	70 (35.2)	103 (51.9)	26 (13.1)	4.76
African-American	70 (46.7)	65 (43.3)	15 (10.0)	
Income-to-Needs				
0.5 & Below	59 (52.7)	43 (38.4)	10 (8.9)	13.15 **
> 0.5–1.00	40 (39.6)	48 (47.5)	13 (12.9)	
> 1.00	41 (30.1)	77 (56.6)	18 (13.2)	
Maternal Education				
< High School	46 (42.6)	51 (47.2)	11 (10.2)	0.65
High School	93 (38.8)	117 (48.8)	30 (12.5)	

*
 $p < 0.05$.***
 $p < 0.001$.**
 $p < 0.01$.

Table 4

Inhibitory Control Change Profiles and Number of Risks.

Number of Risks	Change Profiles		
	Normative	Low-Stable	High-Stable
0	59	27	11
1	48	47	14
2	39	40	12
3	14	14	3
4	5	8	1
5	3	3	0
6	0	1	0

Table 5

OLS Regression Models Predicting Wave 2 Externalizing Behavior.

Variable	Base Model		Full model	
	b (se)	t	b (se)	t
Gender (Female = 1)	-1.76 (1.08)	-1.63	-1.45 (1.08)	-1.35
Ethnicity (Hispanic = 1)	1.22 (1.12)	1.08	1.45 (1.12)	1.30
Household Risk	1.08 (0.46) **	2.35 *	0.91 (0.46) **	1.99
Low-Stable Group			2.98 (1.16) ***	2.57
High-Stable Group			-0.16 (1.73)	-0.09
Constant	46.70 (1.21)	38.51 ***	45.48 (1.33) ***	34.29
R ²	0.02		0.04	

*
 $p < 0.05$.**
 $p < 0.01$.***
 $p < 0.001$.