August, 2013

The Longitudinal Relation Between Academic/ Cognitive Skills and Externalizing Behavior Problems in Preschool Children

Lindsay A Metcalfe
Elizabeth Harvey, *University of Massachusetts - Amherst*
Holly B Laws

Published in final edited form as:
J Educ Psychol. 2013 August ; 105(3): 881–894. doi:10.1037/a0032624.

The Longitudinal Relation Between Academic/Cognitive Skills and Externalizing Behavior Problems in Preschool Children

Lindsay A. Metcalfe,
Department of Psychology, University of Massachusetts Amherst

Elizabeth A. Harvey, and
Department of Psychology, University of Massachusetts Amherst

Holly B. Laws
Department of Psychology, University of Massachusetts Amherst

Abstract

Objective—Existing research suggests that there is a relation between academic/cognitive deficits and externalizing behavior in young children, but the direction of this relation is unclear. The present study tested competing models of the relation between academic/cognitive functioning and behavior problems during early childhood

Method—Participants were 221 children (120 boys, 101 girls) who participated in a longitudinal study from age 3 to 6

Results—A reciprocal relation (Model 3) was observed only between inattention and academic achievement; this relation remained controlling for SES and family stress. The relation between inattention and cognitive ability was consistent with Model 1 (cognitive skills predicting later inattention) with controls. For hyperactivity and aggression, there was some support for Model 2 (early behavior predicting later academic/cognitive ability), but this model was no longer supported when controlling for family functioning.

Conclusion—These results suggest that the relation between academic achievement/cognitive ability and externalizing problems may be driven primarily by inattention. These results also suggest that this relation is evident early in development, highlighting the need for early assessment and intervention.

Keywords

externalizing problems; ADHD; academic/cognitive skills; preschool-age children

Externalizing behavior problems and academic/cognitive difficulties are among the most common problems in children (American Psychiatric Association, 2000). Externalizing behavior problems are characterized by a constellation of disruptive behaviors, including symptoms associated with attention-deficit hyperactivity disorder (ADHD) and oppositional defiant disorder (ODD), such as hyperactivity, impulsivity, attention problems, aggression, and noncompliance. Academic and cognitive skills are distinct though highly related constructs. Academic skills are the skills necessary to succeed in school and often correspond to educational curriculum (Stetson, Stetson, & Sattler, 2001), whereas cognitive

Correspondence concerning this article should be addressed to Elizabeth Harvey, Dept. of Psychology, Tobin Hall, 135 Hicks Way, University of Massachusetts, Amherst, Massachusetts 01003; phone: 1 (413) 349-9199; fax: 1 (413) 545-0996; eharvey@psych.umass.edu.

skills reflect one's ability to think and apply experiences, and include abilities such as abstract thinking, working memory, processing speed, and visual processing (Sattler, 2001).

It has been widely established that there is a link between externalizing problems and academic/cognitive deficits, but there is a lack of consensus regarding the cause of this relation. Some research supports the notion that academic and cognitive deficits lead children to display externalizing behavior (e.g., Halonen, Aunola, Ahonen, & Nurmi, 2006; Miles & Stipek, 2006), whereas other studies support the theory that externalizing behavior problems lead children to experience academic and cognitive difficulties (e.g., Jorm, Share, Matthews, & Maclean, 1986; McMichael, 1979; Palfrey, Levine, Walker, & Sullivan, 1985). In addition, there is empirical support for a reciprocal model whereby early academic/cognitive problems and externalizing behavior affect one another over time (e.g., Chen, Rubin, & Li, 1997; Morgan, Farkas, Tufis, & Sperling, 2008; Richman, Stevenson, & Graham, 1982; Trzesniewski, Moffitt, Caspi, Taylor, & Maughan, 2006). There is also other empirical evidence suggesting that third variables may account for the relation between academic/cognitive problems and externalizing problems (Fergusson & Lynskey, 1997). Much of the literature on the relation between academic/cognitive and behavior problems has historically focused on elementary school children and adolescents; however, it is now understood that difficulties in these domains can be identified at early ages (Grimm, Steele, Mashburn, Burchinal, & Pianta, 2010).

Evidence for a Link Between Academic/Cognitive Deficits and Externalizing Problems

The link between academic/cognitive deficits and externalizing behavior has been established for various forms of academic and cognitive skills, including reading (Maughan, Gray, & Rutter, 1985; Wilcutt & Pennington, 2000) and preliteracy skills (Doctoroff, Greer, & Arnold, 2006), general achievement (Loeber, Farrington, Stouthamer-Loeber, & van Kammen, 1998), intelligence/cognitive abilities (Patterson, 1990; Schonfeld, 1990), and learning disabilities (Yu, Buka, McCormick, Fitzmaurice, & Indurkhya, 2006). Although most studies have used broad measures of externalizing problems, studies that have examined different types of externalizing problems have yielded mixed findings, which appear to vary as a function of age (Hinshaw, 1992). Among older children, there is evidence that academic underachievement is linked with both ADHD (e.g., August & Stewart, 1982; Barkley, 2003; McClelland et al., 2007) and conduct disorder (CD; Farrington, 2005). However, in preschoolers, hyperactivity/inattention has been linked to general cognitive abilities, but conduct problems have not (Friedman-Weieneth, Harvey, Youngwirth, & Goldstein, 2007; Sonuga-Barke, Lamparelli, Stevenson, Thompson, & Henry, 1994). This supports the developing notion that the relation between academic and cognitive problems and symptoms of ADHD works in a manner distinct from the relation between other externalizing behaviors and academic and cognitive problems (Massetti et al., 2008). The importance of inattention, in particular, has been highlighted. For example, inattention, specifically, has been shown to be related to emergent academic development when controlling for aggression and prosocial behavior (Arnold, Kupersmidt, Voegler-Lee, & Marshall, 2012). Moreover, there is evidence that inattention in preschoolers mediates the relation between behavior problems and emergent academic skills (Arnold, 1997). Thus, research points to the importance of teasing apart different types of externalizing problems in examining their relation to academic/cognitive deficits.

Proposed Mechanisms Underlying the Relation Between Academic/Cognitive Deficits and Externalizing Problems

Although the link between externalizing problems and academic/cognitive deficits has been well documented, more research is needed to better understand the mechanisms underlying this relationship. In his landmark review, Hinshaw (1992) proposed four possible causal pathways that could explain the association between academic/cognitive deficits and externalizing behavior:

Model 1: Academic and cognitive deficits lead to externalizing behavior

The basis for this model stems from a learned helplessness model. It has been suggested that repeated academic failure leads children to feel helpless, which decreases motivation and increases various maladaptive behaviors, including behavior problems (Thomas, 1979).

Model 2: Externalizing behavior leads to academic and cognitive deficits

Because behavior problems during the preschool years can hinder children's abilities to benefit from valuable lessons in preschool, it has been suggested that early behavior problems might play a causal role in contributing to future reading problems (Spira & Fischel, 2005).

Model 3: Academic/cognitive deficits and externalizing behavior have a reciprocal relationship

Given the rationales for Models 1 and 2, it follows that a reciprocal model in which the two constructs predict one another would be a plausible model.

Model 4: Antecedent variables, such as socioeconomic status (SES) and family adversity, contribute to both problem domains

The established relation between academic problems and externalizing behavior may, in fact, be explained by other variables (referred to here as antecedent variables). The most common antecedent variables that have been controlled for in studies of the relation between academic/cognitive skills and externalizing behavior include SES, maternal depression, and other measures of family adversity. SES may contribute to both externalizing problems and to academic and cognitive deficits through its impact on the home environment and thus account for the relation between these two domains. Links between SES and externalizing problems (Offord, Alder, & Boyle, 1986) and between SES and academic/cognitive skills (Hinshaw, 1992) have in fact been well documented. Maternal depression may also contribute both to externalizing problems (Trapolini, McMahon, & Ungerer, 2007) and to academic and cognitive deficits (Sohr-Preston & Scaramella, 2006), by interfering with a mother's ability to respond to her child in a consistent, sensitive, and warm manner (Wright, George, Burke, Gelfand, & Teti, 2000). With respect to other measures of family adversity (which have included recent family stressors, single parenthood, large family size, etc.), it has been suggested that such environmental factors inhibit children's abilities to learn both academic skills (Sameroff, Seifer, Barocos, Zax, & Greenspan, 1987) and behavior regulation (McGee, Williams, Share, Anderson, & Silva, 1986).

Empirical support for causal models

Different methods have been used to test these models, but the most rigorous studies have utilized longitudinal designs and controlled for antecedent variables. Longitudinal studies that assess externalizing problems and/or academic and cognitive skills at more than one time point allow for some insight into the direction of causality. In addition, studies that control for the effects of correlated predictors allow for the evaluation of whether antecedent

variables may account for the relation between behavior problems and academic/cognitive functioning. Because the present study focuses on understanding the mechanisms involved in the early development of academic/cognitive deficits and externalizing behavior, this review will focus on studies of children prior to secondary school.

Only one study has tested Models 1 through 3 and only found support for Model 1. Poor literacy achievement in the first and third grades was shown to predict relatively high aggressive behavior in the third and fifth grades, respectively, but early aggression did not predict later literacy (Miles & Stipek, 2006). A handful of studies have tested Models 1 through 3 and only found support for Model 2. For example, antisocial behavior in kindergarten predicted poor reading in first and second grades but not vice versa (McMichael, 1979). A number of other studies have tested and found support for Model 1 or Model 2, but did not test the reverse model and therefore could be consistent with either Model 3 or one of the unidirectional models (Bennett, Brown, Boyle, Racine, & Offord, 2003; Bub, McCartney, & Willett, 2007; Giannopulu, Escolano, Cusin, Citeau, & Dellatolas, 2008; Jorm et al., 1986; Kellam, Branch, Agrawal, & Ensminger, 1975; McGee et al., 1986; Palfrey et al., 1985; Stanton, Feehan, McGee, & Silva, 1990; Stott, 1981).

A number of studies have found specific support for a reciprocal causal relationship between academic problems and externalizing behavior. In children as young as 3 years, externalizing behavior has been show to predict reading problems in early elementary school and poor reading and low general cognitive ability in preschool has been shown to be predictive of externalizing behavior in early elementary school (Richman et al., 1982; Trzesniewski, et al., 2006). Two studies of children in early elementary school found partial support for the reciprocal model. Morgan et al. (2008) found that poor reading in first grade significantly predicted problem behavior (poor task engagement, poor self-control, externalizing behavior problems, and internalizing behavior problems) in third grade. However, only one type of behavior problem (poor task engagement) in first grade was significantly predictive of reading problems in third grade. Similarly, Halonen et al. (2006) found that lower reading scores consistently predicted later externalizing behavior problems across several time points in the early primary grades, and that externalizing problems predicted reading scores, but only between the beginning and end of first grade. Further support for the reciprocal model comes from research on children in later elementary school. Chen et al. (1997) showed that children in fourth grade who were aggressive and disruptive displayed lower academic achievement in sixth grade than did children who did not display these behaviors. In addition, fourth-grade academic underachievement predicted sixth-grade aggression.

Only three studies tested the hypothesized models and failed to support any of the models; two studies tested Model 2 and failed to support it (Adams, Snowling, Hennessy & Kind, 1999; Lambert & Nicoll, 1977) and Velting and Whitehurst (1997) did not find that preschool inattention/hyperactivity predicted later reading skills or vice versa. Many of the studies reviewed controlled for one or more antecedent variables (e.g., maternal education, SES, ethnicity, family living standards, and maternal responsiveness) in their analyses, but Fergusson and Lynskey (1997) was the only study that concluded that antecedent variables accounted for the relation between academic/cognitive problems and externalizing behavior.

Taken together, the majority of studies are consistent with a reciprocal causal model, but several studies provide contradictory evidence, supporting just one of the unidirectional causal models or the theory that antecedent variables are at the root of the relation between academic/cognitive deficits and externalizing behavior. Only three studies (Halonen et al., 2006; Morgan et al., 2008; Trzesniewski et al., 2006) utilized a design sufficient to accurately test all four possible causal models proposed, and they all found at least some

support for Model 3. However, these studies measured externalizing problems or antisocial behavior, but did not specifically examine hyperactivity or inattention, and these studies focused almost exclusively on reading achievement. The relation between academic/cognitive deficits and externalizing behavior may vary as a function of the type of externalizing behavior (hyperactivity, inattention, or aggression) and type of cognitive/academic functioning. In addition, no studies have tested all four models beginning in the early preschool years. Thus, there is a need for longitudinal research designed to evaluate all four causal models, by controlling for confounding variables, and measuring multiple dimensions of academic and behavior problems at both initial assessment and follow-up.

The Present Study

The present study sought to examine the longitudinal relation between academic/cognitive functioning and attention and disruptive behavior problems during early childhood when the relation between these two variables is likely first emerging. The four models described above were compared and it was predicted that the reciprocal model (Model 3) would fit the data significantly better than the other three models. In particular, it was predicted that early externalizing behavior would significantly predict later academic and cognitive deficits and that early academic and cognitive deficits would significantly predict later externalizing behavior, controlling for mothers' education, family stressors, and maternal depression.

Method

Participants

Participants were 221 children (120 boys, 101 girls) who participated in a longitudinal study of the early development of ADHD and ODD. Participants were drawn from 259 children (199 children with externalizing problems and 60 without problems) who completed four annual assessments beginning at age 3. Children were selected for the present study if they completed measures both at age 3 and approximately 3 years later. These 221 children were all 3 years old at the time of initial screening and were 36 to 50 months ($M = 44.27$, $SD = 3.35$) at the time of the first assessment, and were 69 to 92 months ($M = 80.08$, $SD = 4.24$) at the time of the second assessment. The sample consisted of 58.8% European-American children, 18.6% Latino children (predominantly Puerto Rican), 9.5% African-American children, and 13.1% multiethnic children. Mothers' average age was 32.6 years ($SD = 6.62$), their mean number of years of education was 13.53 ($SD = 2.77$), and 26% of mothers were single. The median family income was $50,000, and 45% of children lived in an urban area, 37% lived in a suburb/small town (between 10K and 50K), and 18% lived in a rural town (< 10K). Participants included 165 children who had significant externalizing problems (hyperactivity and/or aggression) at the time of screening and 56 children who did not have behavior problems. Children with behavior problems had been oversampled because the primary focus of the larger study was on examining factors that determined whether young children with behavior problems would outgrow their early difficulties.

Procedure

Children were recruited over a 3-year period (2000 to 2003) from 3-year-old children ($N = 1752$) whose parents completed a screening packet which they received through mail (via state birth records), pediatrician offices, child care centers, and community centers throughout western Massachusetts. The questionnaire packet contained an informed consent form; a Behavior Assessment System for Children-Parent Report Scale (BASC-PRS, described in more detail below); and a questionnaire assessing for exclusion criteria, parental concern about externalizing symptoms, and demographic information. Criteria for all participants included no evidence of intellectual disabilities, deafness, blindness,

language delay, cerebral palsy, epilepsy, autism, or psychosis. Criteria for the externalizing group were: (a) parent responded “yes” or “possibly” to the question, “Are you concerned about your child's activity level, defiance, aggression, or impulse control?” and (b) BASC-PRS hyperactivity and/or aggression subscale T scores fell at or above 65 (approximately 92nd percentile). Criteria for the non-problem comparison children were: (a) parent responded “no” to the question, “Are you concerned about your child's activity level, defiance, aggression, or impulse control?” and (b) T scores on the BASC-PRS hyperactivity, aggression, attention problems, anxiety, and depression subscales fell at or below a T score of 60. Parents and their children who met criteria listed above for either the externalizing group or non-problem group were invited to participate. Fifty-nine percent of externalizing problem children and 72% of non-problem children whom we sought to recruit participated. For matching, 60 children in the externalizing group were identified by selecting every third or fourth child in the externalizing group separately by gender and ethnicity. For each of these children, a child was identified from the pool of non-problem children who was of the same gender and ethnicity[1], and most similar to the target child on parent education and child age.

The present study focused on data collected during two 3-hr home visits scheduled 1 week apart at Time 1 (age 3) and one 3-hr home visit at Time 2 (approximately 3 years later). Time 2 assessments were conducted an average of 36 months after Time 1 assessments (*SD* = 2.21; range from 30 to 46). Assessments were completed in families' homes by trained graduate students (in clinical or school psychology) or post-baccalaureate project managers. Graduate students had taken a graduate level course in child assessment, and project managers received individual training in child assessment by the principal investigator who is a licensed psychologist. Assessments were videotaped and the principal investigator reviewed each examiner's initial assessments to ensure quality. Parents were paid $200 for their participation at Time 1 and $100 at Time 2. Written informed consent was obtained from all parents who participated. The study was conducted in compliance with the authors' Institutional Review Board.

Control Variables

SES—Mothers' years of education and family income at Time 1 were used as indicators of SES. Mothers were asked to circle their highest level of education on a demographic form and family income was assessed via an income interview designed for this study.

Family stress—The Life Experiences Survey (LES; Sarason, Johnson, & Siegel, 1978) is a 57-item measure of family stress. At Time 1, parents rated the valence and severity of positive and negative events (e.g., “moved to a new place,” “trouble with the law”) that occurred within the last calendar year (on a scale from -3 to 3, with -3 indicating very negative events and 3 indicating very positive events). The severity of negative events on the LES was calculated by summing across the absolute value of the negative valence ratings. This variable was skewed, so a square root transformation was conducted. The LES negative events scale has been reported to have moderate test-retest reliability (average $r = .72$) and has been found to correlate with anxiety, depression, and locus of control (Sarason et al., 1978).

Maternal depression—The Center for Epidemiological Studies Depression scale (CES-D; Radloff, 1977) is a 20-item, widely-used measure of depression. Mothers rated themselves on a scale from 1 (rarely or none of the time) to 4 (most or all of the time) at

[1]Because we had difficulty recruiting enough Latino children who were eligible for the non-problem group to fully match on ethnicity, European American children were selected to match some of the Latino externalizing children.

Time 1, and responses were averaged across the 20 items (e.g., “I had crying spells,” “I felt that people dislike me”). The scale has demonstrated excellent internal consistency in previous studies and has been reported to have moderate test-retest reliability (average $r = .53$; Radloff, 1977).

Time 1 Child Measures

Time 1 child behavior—The BASC-PRS Preschool Version is a comprehensive rating scale that assesses a broad range of psychopathology in children ages 2 years 6 months and older and has demonstrated good reliability and validity (Reynolds & Kamphaus, 1992). Mother-completed BASC-PRS T scores for the aggression, hyperactivity, and attention problems subscales were used in this study, and have demonstrated good reliability for 3-year-old children (.79, .83, and .73, respectively; Reynolds & Kamphaus, 1992).

The NIMH-Diagnostic Interview Schedule for Children-IV (NIMH-DISC-IV; Shaffer, Fisher, Lucas, Dulcan, & Schwab-Stone, 2000) was also used as a measure of child behavior. The ADHD and ODD sections were administered to parents, with minor modification to school-related questions. The NIMH-DISC-IV has demonstrated adequate test-retest reliability with older children for ADHD (.79) and ODD (.54; Shaffer et al., 2000). Symptom counts for hyperactivity, inattention, and ODD were used.

Time 1 preacademic achievement—The Kaufman Survey of Early Academic and Language Skills (KSEALS; Kaufman & Kaufman, 1993) is a measure of preacademic, language, and articulation skills, and was administered during the first half of the second home visit at Time 1. The Early Academic and Language Skills Composite (KSEALS Composite) is a summary score for the Vocabulary and Numbers, Letters, and Words subtests and was used to measure preacademic skills for this study. The KSEALS subscale scores have demonstrated adequate reliability, with split-half correlations ranging between .88 and .91 for 3-year-old children and good predictive validity for children ages 3 to 6 years (Kaufman & Kaufman, 1993). The KSEALS composite score correlates highly with other measures of achievement and language skills and has been found to be predictive of teachers' grades and teachers' ratings on measures of children's academic performance, social skills, and early intervention services (Kaufman & Kaufman, 1993).

Time 1 cognitive ability—Cognitive ability at age 3 was measured using the McCarthy Scales of Children's Abilities (McCarthy, 1972), which was administered at the beginning of the first home visit at Time 1. The McCarthy measures cognitive ability in children age 2 and up. The General Cognitive Index (GCI), which was used in this study as the measure of cognitive ability, is an aggregate standard score composed of the three core scales: Verbal, Perceptual-Performance, and Quantitative. The McCarthy composite and core scale scores have been found to have adequate reliability, with split-half estimates ranging from .79 to .88, and they correlate well with other cognitive measures (McCarthy, 1972).

Time 2 Child Measures

Time 2 child behavior—Mothers completed the BASC-PRS Child Version at Time 2. T scores (based on general, not gender-specific, norms) for the hyperactivity, attention problems, and aggression subscales were used in this study and have demonstrated good reliability for 6-year-old children (Reynolds & Kamphaus, 1992). Symptom counts for inattention, hyperactivity, and ODD assessed via the NIMH-DISC-IV were also used as a measure of child behavior at Time 2.

Time 2 academic achievement—Academic skills were measured with the overall composite score of the Wechsler Individual Achievement Test-Second Edition-Abbreviated

(WIAT-II-A), which is a brief, individually administered test for assessing achievement in the areas of word reading, math calculation, and spelling (Wechsler, 2001). The WIAT-II-A has high to moderately high inter-item reliability, with average reliability coefficients ranging from .71 to .99. The WIAT-II-A was administered in the second half of the home visit at Time 2.

Time 2 cognitive ability—The Wechsler Intelligence Scale for Children-Fourth Edition (WISC-IV) is a widely used measure of intellectual ability in children ages 6 to 16 (Wechsler, 2003), and was administered at the beginning of the home visit at Time 2. There are ten core subtests that yield a Full Scale IQ (FSIQ) score and four composite scores that include Verbal Comprehension, Perceptual Reasoning, Working Memory, and Processing Speed. The composites have been found to have adequate reliability, with split-half estimates ranging from .88 to .97. The average reliability coefficients of the subtests range from .79 to .90 (Wechsler, 2003). The FSIQ was used in this study as a measure of overall cognitive ability.

Results

Analytic Approach

Path modeling with Mplus (Muthén & Muthén, 1998-2010) was used to test all models. Full information maximum likelihood was used to address missing data. In this method, all observed information (including from cases with some missing data) is used to estimate parameters. Model fit was evaluated by using four indicators: χ^2/df (< 2 indicates good model fit), Root Mean Square Error of Approximation (RMSEA; values of .08 and lower represent acceptable model fit and values between .08 and .1 indicate mediocre model fit), Bentler's Comparative Fit Index (CFI; values higher than .90 indicate acceptable model fit), and Standardized Root Mean Square Residual (SRMR; values lower than .08 indicate adequate model fit). Two-tailed tests were used for model comparisons and one-tailed tests were used to evaluate path coefficients that were based on a priori predictions.

Analyses were conducted in several steps separately for each type of externalizing problem (hyperactivity, inattention, and aggression scores) paired with each academic/cognitive variable (achievement and cognitive score). First, the measurement model for the variables for each baseline model was assessed. The errors of each externalizing measure were allowed to correlate between each Time 1 variable and its Time 2 counterpart to account for measure-specific shared error. Correlated error terms that were significant were retained in all subsequent models. Error terms for academic/cognitive indicators were not allowed to correlate, because, unlike measures of externalizing problems, different instruments were used to measure academic/cognitive skills at Time 1 and Time 2.

Second, control variables were examined. Control variables (SES, maternal depression, and family stressors) were added to the baseline model (in which early academic/cognitive functioning predicted later academic/cognitive functioning and early externalizing behavior predicted later externalizing behavior [see Figure 1a]) and each academic/cognitive/externalizing variable was regressed on each control variable. SES and family stressors significantly predicted at least one variable, and thus, were kept in tests of Model 4. Exploratory analyses indicated that although maternal depression was associated with some variables when entered alone, the relations were no longer significant when SES and family stressors were entered, suggesting that SES and family stressors accounted for potential effects of maternal depression. Maternal depression was therefore not included in the models.

In addition, because there was some variability in children's age at Time 1, age at Time 2, and the time lag between Time 1 and Time 2, these three age variables were entered as predictors of each variable in each baseline model (each age variable predicting its concurrent academic/cognitive/externalizing variables in one set of models, and the age difference variable predicting all academic/cognitive/externalizing variables in another set of models) to determine whether children's age was related to their externalizing and academic/cognitive scores. None of the age variables were significant predictors of any of the academic/cognitive/externalizing variables so they were not included in any of the models. We also examined whether child sex was a predictor of each variable in the baseline models and it was not, so it was also not included as a control variable in any of the models.

Next, the following structural regression models were estimated and compared to test the reciprocal relationship between academic/cognitive functioning and externalizing behavior: A baseline model; each unidirectional model (Model 1 [see Figure 1b] and Model 2 [see Figure 1c]); and a reciprocal model (Model 3 [see Figure 1d]). These models were then compared to one another, with control variables added to each model to examine whether antecedent variables account for observed relations (Model 4; see Figure 1e). We also explored whether there were gender differences in the models, using multigroup modeling. Models were similar for boys and girls so boys and girls were analyzed together.

Descriptive Statistics

Table 1 contains means, standard deviations, and intercorrelations among all variables. As one would expect, Time 1 and Time 2 hyperactivity, inattention, and aggression variables assessed with the BASC-PRS and NIMH-DISC-IV were all highly correlated with each other. Similarly, the Time 1 and Time 2 measures of academic achievement and cognitive ability were all highly correlated with each other. The stability of externalizing and cognitive/academic measures observed in this study across time is remarkably similar to stability coefficients reported in previous studies of the stability of preschool externalizing problems and cognitive development (e.g., Bub et al., 2007; Heller, Baker, Henker, & Hinshaw, 1996; Stanton et al., 1990; Velting & Whitehurst, 1997). Moderate negative correlations were also found between all three Time 1 externalizing variables and Time 1 academic achievement and cognitive ability. At Time 2, however, only hyperactivity and inattention were significantly negatively correlated with academic achievement and cognitive ability. Similarly, the Time 1 externalizing variables were significantly negatively correlated with Time 2 academic achievement and cognitive ability, but Time 1 academic achievement and cognitive ability were only significantly negatively correlated with Time 2 hyperactivity and inattention. SES and family stress were significantly correlated with nearly all externalizing variables (negatively and positively, respectively) and SES was also significantly positively correlated with the academic and cognitive variables.

The 221 children who were included in this study were compared on demographic and Time 1 measures of behavior and academic/cognitive skills to the 38 children who were not included because they did not complete measures for the present study at 3-year follow-up. There were no significant differences in gender, child age, or maternal education, all ps > .10. There was a significant relation between ethnicity and dropout status, X^2 (3) = 16.48, p = .001, with higher rates of dropout among African American (34%), and multiethnic (24%) children than among Latino (11%) and European American (9%) children. There were significant differences on three of the eight behavior and academic/cognitive measures. Children who were included in this study were rated as less hyperactive on the BASC-PRS, less inattentive on the NIMH-DISC-IV, and scored higher on the KSEALS, all ps < .05.

Measurement Models

Measurement models indicated that for hyperactivity, the two behavior measures (BASC-PRS and DISC-IV measures) at each time point significantly predicted the latent hyperactivity factor (with standardized coefficients of .90 and .79 at Time 1 and .90 and .84 at Time 2). Model fit was good, $\chi^2/df = 1.05$, RMSEA = .02, CFI = 1.00, and SRMR = .02. Similarly, for aggression, the two behavior measures at each time point significantly predicted the latent aggression factor (with standardized coefficients of .82 and .70 at Time 1 and .71 and .76 at Time 2). Model fit was good, $\chi^2/df = .83$, RMSEA = .00, CFI = 1.00, and SRMR = .02. Finally, for inattention, the two behavior measures at each time point significantly predicted the latent inattention factor (with standardized coefficients of .71 and .89 at Time 1 and .84 and .77 at Time 2). Model fit was good, $\chi^2/df = 1.62$, RMSEA = .05, CFI = .99, and SRMR = .03.

Results of the Structural Models

Without controls—Structural models were estimated separately for each externalizing variable and both academic achievement and cognitive ability. For hyperactivity and academic achievement, Model 1, $\Delta\chi^2$ (1, $N = 221$) = .35, $p = .56$, did not fit the data significantly better than the more parsimonious baseline model. Model 2, however, was a better fit than the baseline model at a level approaching significance, $\Delta\chi^2$ (1, $N = 221$) = 3.04, $p = .08$. Model 3 did not fit the data better than Model 2, $\Delta\chi^2$ (1, $N = 221$) = .50, $p = .48$. In Model 2, the path coefficient between Time 1 hyperactivity and Time 2 academic achievement was significant (β = -.13, $SE = .07$, $p = .04$). In addition, there was stability in the constructs for Model 2; Time 1 hyperactivity significantly predicted Time 2 hyperactivity (β = .81, $SE = .04$, $p < .001$) and Time 1 academic achievement significantly predicted Time 2 academic achievement (β = .57, $SE = .05$, $p < .001$). Model fit indices suggested that Model 2 was a good fit to the data, $\chi^2/df = 1.58$, RMSEA = .05, CFI = .99, and SRMR = .02.

Similarly, for hyperactivity and cognitive ability, Model 1, $\Delta\chi^2$ (1, $N = 221$) = .07, $p = .80$, did not fit the data significantly better than the more parsimonious model (the baseline model). Model 2, however, was a better fit than the baseline model, $\Delta\chi^2$ (1, $N = 221$) = 6.00, $p = .01$. Model 3 did not fit the data better than Model 2, $\Delta\chi^2$ (1, $N = 221$) = .19, $p = .67$. In Model 2, the path coefficient between Time 1 hyperactivity and Time 2 cognitive ability was significant (β = -.17, $SE = .07$, $p = .007$). In addition, there was stability in the constructs for Model 2; Time 1 hyperactivity significantly predicted Time 2 hyperactivity (β = .81, $SE = .04$, $p < .001$) and Time 1 cognitive ability significantly predicted Time 2 cognitive ability (β = .58, $SE = .06$, $p < .001$). Model fit indices suggested that Model 2 was a good fit to the data, $\chi^2/df = 2.06$, RMSEA = .07, CFI = .99, and SRMR = .02.

For inattention and academic achievement, Models 1 and 2 were better fitting than the baseline model, $\Delta\chi^2$ (1, $N = 221$) = 4.99, $p = .03$, and $\Delta\chi^2$ (1, $N = 221$) = 7.90, $p = .005$, respectively. Model 3, however, was a significantly better fit than Model 1, $\Delta\chi^2$ (1, $N = 221$) = 8.17, $p = .004$, and Model 2, $\Delta\chi^2$ (1, $N = 221$) = 5.27, $p = .02$. In Model 3 there were significant paths between Time 1 inattention and Time 2 academic achievement (β = -.21, $SE = .07$, $p = .002$) and between Time 1 academic achievement and Time 2 inattention (β = -.18, $SE = .08$, $p = .01$). In addition, there was stability in the constructs for Model 3; Time 1 inattention significantly predicted Time 2 inattention (β = .61, $SE = .07$, $p < .001$) and Time 1 academic achievement significantly predicted Time 2 academic achievement (β = .54, $SE = .05$, $p < .001$). Model fit indices for the inattention Model 3, $\chi^2/df = 1.42$, RMSEA = .04, CFI = 1.00, and SRMR = .02, suggested a good fit.

For inattention and cognitive ability, Model 1, $\Delta\chi^2$ (1, N = 221) = .73, p = .39, did not fit the data significantly better than the more parsimonious model (the baseline model). Model 2, however, was a better fit than the baseline model, $\Delta\chi^2$ (1, N = 221) = 7.38, p = .007. Model 3 did not fit the data better than Model 2, $\Delta\chi^2$ (1, N = 221) = .87, p = .352. In Model 2, the path coefficient between Time 1 inattention and Time 2 cognitive ability was significant (β = -.20, SE = .07, p = .003). In addition, there was stability in the constructs for Model 2; Time 1 inattention significantly predicted Time 2 inattention (β = .68, SE = .06, p < .001) and Time 1 cognitive ability significantly predicted Time 2 cognitive ability (β = .55, SE = .06, p < .001). Model fit indices suggested that Model 2 was a good fit to the data, χ^2/df = 1.39, RMSEA = .05, CFI = 1.00, and SRMR = .02.

For aggression and academic achievement, Model 1, $\Delta\chi^2$ (1, N = 221) = .08, p = .78, Model 2, $\Delta\chi^2$ (1, N = 221) = 1.43, p = .23, and Model 3, $\Delta\chi^2$ (2, N = 221) = 1.54, p = .46, did not fit the data significantly better than the more parsimonious model (the baseline model). There were no significant paths between academic achievement and aggression (or the reverse direction) in any of the models. There was stability in the constructs; Time 1 aggression significantly predicted Time 2 aggression (β = .70, SE = .06, p < .001) and Time 1 academic achievement significantly predicted Time 2 academic achievement (β = .61, SE = .05, p < .001). Model fit indices suggest that the baseline model was a good fit to the data, χ^2/df = .47, RMSEA = .00, CFI = 1.00, and SRMR = .01.

Finally, for aggression and cognitive ability, Model 1, $\Delta\chi^2$ (1, N = 221) = .04, p = .84, did not fit the data significantly better than the more parsimonious model (the baseline model). Model 2, however, was a better fit than the baseline model, $\Delta\chi^2$ (1, N = 221) = 8.31, p = .004. Model 3 did not fit the data better than Model 2, $\Delta\chi^2$ (1, N = 221) = .14, p = .71. In Model 2, the path coefficient between Time 1 aggression and Time 2 cognitive ability was significant (β = -.30, SE = .11, p = .003). In addition, there was stability in the constructs for Model 2; Time 1 aggression significantly predicted Time 2 aggression (β = .69, SE = .07, p < .001) and Time 1 cognitive ability significantly predicted Time 2 cognitive ability (β = .58, SE = .05, p < .001). Model fit indices suggested that Model 2 was a good fit to the data, χ^2/df = .28, RMSEA = .00, CFI = 1.00, and SRMR = .01.

In sum, without controls, Model 2 was the best fitting model for hyperactivity and academic achievement, hyperactivity and cognitive ability, inattention and cognitive ability, and aggression and cognitive ability. Model 3 was the best fitting model for inattention and academic achievement. The baseline model was the best fitting model for aggression and academic achievement.

Control variables—To assess the effect of antecedent variables (as suggested by Model 4 outlined earlier), control variables (SES and family stressors) were added to each model and each externalizing and academic/cognitive variable was regressed on each control variable.

For hyperactivity and academic achievement, Model 1, $\Delta\chi^2$ (1, N = 221) = 1.11, p = .29, Model 2, $\Delta\chi^2$ (1, N = 221) = 1.56, p = .21, and Model 3, $\Delta\chi^2$ (2, N = 221) = 2.87, p = .24, did not fit the data significantly better than the more parsimonious model (the baseline model). There were no significant cross paths in Models 1, 2, or 3. There was stability in the constructs for the baseline model; Time 1 hyperactivity significantly predicted Time 2 hyperactivity (β = .76, SE = .06, p < .001) and Time 1 academic achievement significantly predicted Time 2 academic achievement (β = .54, SE = .08, p < .001). Model fit indices for the baseline model, χ^2/df = 1.77, RMSEA = .06, CFI = .98, and SRMR = .04, suggested a good fit.

Similarly, for hyperactivity and cognitive ability, Model 1, $\Delta\chi^2$ (1, N = 221) = .32, p = .57, Model 2, $\Delta\chi^2$ (1, N = 221) = 1.19, p = .28, and Model 3, $\Delta\chi^2$ (2, N = 221) = 1.62, p = .44, did not fit the data significantly better than the more parsimonious baseline model. There were no significant cross paths in Models 1, 2, or 3. There was stability in the constructs for the baseline model; Time 1 hyperactivity significantly predicted Time 2 hyperactivity (β = .77, SE = .06, p < .001) and Time 1 cognitive ability significantly predicted Time 2 cognitive ability (β = .49, SE = .08, p < .001). Model fit indices for the baseline model (χ^2/df = 1.56, RMSEA = .05, CFI = .99, and SRMR = .04) suggested a good fit.

For inattention and academic achievement, Models 1 and 2 were better fitting than the baseline model, $\Delta\chi^2$ (1, N = 221) = 8.42, p = .004, and $\Delta\chi^2$ (1, N = 221) = 4.95, p = .03, respectively. Model 3, however, was a significantly better fit than Model 1, $\Delta\chi^2$ (1, N = 221) = 6.42, p = .01, and Model 2, $\Delta\chi^2$ (1, N = 221) = 9.89, p = .002. In Model 3 there were significant paths between Time 1 inattention and Time 2 academic achievement (β = -.32, SE = .12, p = .005) and between Time 1 academic achievement and Time 2 inattention (β = -.14, SE = .04, p < .001). In addition, there was stability in the constructs for Model 3; Time 1 inattention significantly predicted Time 2 inattention (β = .51, SE = .08, p < .001) and Time 1 academic achievement significantly predicted Time 2 academic achievement (β = .49, SE = .07, p < .001). Model fit indices for Model 3, χ^2/df = 1.67, RMSEA = .06, CFI = .98, and SRMR = .04, suggested a good fit.

For inattention and cognitive ability, Model 1 was better fitting than the baseline model at a level approaching significance, $\Delta\chi^2$ (1, N = 221) = 3.65, p = .06. Model 2 was not better fitting than the baseline model, $\Delta\chi^2$ (1, N = 221) = 1.26, p = .26. Model 3 did not fit the data better than Model 1, $\Delta\chi^2$ (1, N = 221) = 1.69, p = .19. In Model 1, the path between Time 1 cognitive ability and Time 2 inattention was significant (β = -.12, SE = .06, p = .03). In addition, there was stability in the constructs for Model 1; Time 1 inattention significantly predicted Time 2 inattention (β = .51, SE = .09, p < .001) and Time 1 cognitive ability significantly predicted Time 2 cognitive ability (β = .45, SE = .09, p < .001). Model fit indices for Model 1, χ^2/df = 1.77, RMSEA = .05, CFI = .98, and SRMR = .04, suggested a good fit.

For aggression and academic achievement, Model 1, $\Delta\chi^2$ (1, N = 221) = .98, p = .32, Model 2, $\Delta\chi^2$ (1, N = 221) = .63, p = .43, and Model 3, $\Delta\chi^2$ (2, N = 221) = 1.64, p = .44, did not fit the data significantly better than the more parsimonious baseline model. There were no significant cross paths in Models 1, 2, or 3. There was stability in the constructs for the baseline model; Time 1 aggression significantly predicted Time 2 aggression (β = .68, SE = .08, p < .001) and Time 1 academic achievement significantly predicted Time 2 academic achievement (β = .56, SE = .07, p < .001). Model fit indices for the baseline model (χ^2/df = 1.17, RMSEA = .03, CFI = .99, and SRMR = .04) suggested a good fit.

Similarly, for aggression and cognitive ability, Model 1, $\Delta\chi^2$ (1, N = 221) = 1.12, p = .29, Model 2, $\Delta\chi^2$ (1, N = 221) = 2.72, p = .10, and Model 3, $\Delta\chi^2$ (2, N = 221) = 3.93, p = .14, did not fit the data significantly better than the more parsimonious baseline model. There were no significant cross paths in Models 1, 2, or 3. There was stability in the constructs for the baseline model; Time 1 aggression significantly predicted Time 2 aggression (β = .68, SE = .08, p < .001) and Time 1 cognitive ability significantly predicted Time 2 cognitive ability (β = .52, SE = .08, p < .001). Model fit indices for the baseline model (χ^2/df = .95, RMSEA = .00, CFI = 1.00, and SRMR = .04) suggested a good fit.

In sum, with controls, the baseline model was the best fitting model for hyperactivity and academic achievement, hyperactivity and cognitive ability, aggression and academic achievement, and aggression and cognitive ability. Model 3 (the reciprocal model) was the

best fitting model for inattention and academic achievement (Figure 2). Model 1 (in which early cognitive ability significantly predicted later inattention) was the best fitting model for inattention and cognitive ability (Figure 3). Table 2 summarizes the best-fitting models and Table 3 summarizes the fit indices of the six best-fitting models with controls.

Discussion

The present study prospectively examined the relation between academic/cognitive problems and externalizing behavior problems. Results suggest that the relation between these constructs varies considerably across dimensions. In particular, a reciprocal relation was observed only between inattention and academic achievement and this relation remained when controlling for SES and family stress. In contrast, for hyperactivity and aggression, there was some support for Model 2 (behavior problems predicting later cognitive/academic skills), but this model was no longer supported when controlling for SES and family stress. The relation between inattention and cognitive ability was also consistent with Model 2 without controls; however, Model 1 (cognitive ability predicted later inattention) was supported when SES and family stress were controlled. It is important to bear in mind that these findings may be specific to younger children; previous research suggests that the link between aggression/antisocial behavior and academic/cognitive deficits may emerge during adolescence (Hinshaw, 1992). Nonetheless, these findings highlight the importance of distinguishing between symptoms of ADHD and ODD (Waschbusch, 2002).

These findings are consistent with the notion that the relation between academic/cognitive problems and inattention operates in a distinct manner from the relation between academic/cognitive problems and hyperactivity or aggression (Massetti et al., 2008), and corroborates previous evidence that inattention, but not conduct problems are associated with lower general intellectual abilities in preschoolers (Sonuga-Barke et al., 1994). There are a number of possible processes underlying a reciprocal relation between inattention and academic problems. For example, early inattention may lead to academic difficulties because children who display early symptoms of inattention may struggle to acquire fundamental academic skills that are the basis for later academic success. It may be difficult for these children to focus in school, which can hinder their ability to benefit from lessons in preschool. It may also be the case that parents and teachers attend to children with inattention differently, either dismissing them or lowering academic expectations. On the other side of the reciprocal process, children with early academic problems may exhibit later inattention because academic tasks require greater effort for them than for children who do not have these academic struggles. For example, these children may be inattentive when reading stories or doing puzzles because they are more challenging for them than they are for children with strong academic skills. Finally, it could be that poor performance on early academic tests is a marker for ADHD and may be one of the first signs of difficulties with inattention. These mechanisms might also account for the unidirectional relation observed between early cognitive ability and later inattention. Further research is needed to study these possible mechanisms.

Before taking into account controls, both early hyperactivity and aggression predicted later cognitive ability and early hyperactivity predicted later academic skills. However, these relations appeared to be accounted for by family adversity. Family adversity has been widely linked to both externalizing problems and academic/cognitive skills (e.g., Hinshaw, 1992; Offord et al., 1986). It may be that family adversity contributes to early externalizing problems in children as well is to later academic/cognitive deficits, and thus accounts for the link between externalizing problems and academic/cognitive difficulties. It may also be that family adversity sets into motion both early externalizing problems and academic/cognitive

difficulties during the preschool years, but that as these unfold over time, a direct causal link between these variables evolves. Further research is needed to explore this possibility.

The present study extends previous research by assessing the relation between academic/cognitive problems and externalizing behavior problems as early as age 3. Very few studies have assessed these constructs at such an early age, despite growing evidence that these constructs can be identified and measured in young preschoolers (e.g., Adams et al., 1999; Bub et al., 2007; Richman et al., 1982; Stanton et al., 1990). Of the handful of longitudinal studies that have focused on young preschoolers, only one (Richman et al., 1982) tested both unidirectional paths (and found support for both), but did not include any control variables that may contribute to the established relation. The present study suggests that controlling for family functioning may be key for understanding the relation between externalizing problems and academic/cognitive functioning in preschoolers.

Findings from this study have a number of important clinical implications. First, the reciprocal relation between academic difficulty and inattention is evident early in development, highlighting the need for early assessment and intervention. With early recognition and intervention, children may be more likely to enter a positive behavior and academic cycle. For example, Masten and colleagues (2005) hypothesized that there may be developmental cascades by which functioning in one domain of adaptive behavior spills over to influence functioning in other domains in a lasting way. Thus, identifying both academic struggles and attention problems as early as possible provides teacher and parents the best opportunity to intervene and interrupt negative cycles before they develop into larger problems. A second major implication of the present study is the need to focus on the unique role of inattention in preschool development. The present findings are consistent with a growing body of research that highlights the significance of attention problems in understanding difficulties in the classroom (e.g., Rabiner & Coie, 2000).

The results of the present study should be interpreted in the context of several limitations. First, externalizing behavior was measured by mothers' reports. Although mothers have been shown to be reliable reporters of child behavior (Loeber, Green, Lahey, & Stouthamer-Loeber, 1991), future research should include other measures of child behavior, including observational data and teachers' reports. Second, although cross-lagged longitudinal analyses were used, caution should be taken in making causal conclusions. Another variable that was not measured in these models may account for the established reciprocal relationships. Third, the present sample consisted of a large number of children displaying externalizing behavior and these results may differ in a typical community sample. In addition, attrition from Time 1 to Time 2 may have influenced these results. Fourth, although this study considered a wide range of antecedent control variables, there may be other control variables that could change results; further research is needed to explore additional potential controls. Finally, although this was a diverse sample, there were not sufficient numbers of each ethnic group to examine models separately for each ethnic group, so is unclear whether findings generalize to all ethnic groups.

Despite these limitations, the present study adds to our understanding of the relation between different types of behavior problems and academic/cognitive functioning during the preschool years. Further research is needed to continue to better understand the mechanisms underlying these relations. For example, it may be useful to examine whether specific types of parent-child or teacher-child interactions may mediate the relation between attention problems and academic/cognitive abilities. Research should also more directly examine developmental changes in the relation between externalizing problems and academic functioning. Measuring trajectories of change in these domains across multiple time points would allow for more nuanced understanding of this relation. Additional research is also

needed to better understand the interplay between antecedent variables, externalizing behavior, and academic functioning. It seems as though family adversity, in particular, may contribute to or set into motion the development of externalizing behavior and academic struggles; a better understanding is needed of how this process unfolds over time. Similarly, it would be useful to better understand how other contextual factors (e.g., ethnicity) may influence the relation between externalizing behavior and cognitive functioning. In conclusion, the present findings indicate that the relation between externalizing behavior and cognitive functioning varies considerably across dimensions, begins at a young age, and is influenced by antecedent variables, but a better understanding of the mechanisms underlying these relations is needed.

Acknowledgments

This research was supported by a grant from the National Institutes of Health (MH60132) awarded to the second author.

References

Adams JW, Snowling MJ, Hennessy SM, Kind P. Problems of behaviour, reading and arithmetic: Assessments of comorbidity using the Strengths and Difficulties Questionnaire. British Journal of Educational Psychology. 1999; 69:571–585.10.1348/000709999157905 [PubMed: 10665170]

American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th, revised. Washington DC: Author; 2000.

Arnold DH. Co-occurrence of externalizing behavior problems and emergent academic difficulties in young high-risk boys: A preliminary evaluation of patterns and mechanisms. Journal of Applied Developmental Psychology. 1997; 18:317–330.10.1016/S0193-3973

Arnold DH, Kupersmidt DH, Voegler-Lee ME, Marshall NA. The association between preschool children's social functioning and their emergent academic skills. Early Childhood Research Quarterly. 2012; 27:376–386.10.1016/j.ecresq.2011.12.009 [PubMed: 23002324]

August GJ, Stewart MA. Familial subtypes of childhood hyperactivity. Journal of Nervous and Mental Disease. 1983; 171:362–368.10.1097/00005053-198306000-00006 [PubMed: 6854302]

Barkley, RA. Attention-deficit/hyperactivity disorder. In: Mash, EJ.; Barkley, RA., editors. Child Psychopathology. New York: Guilford Press; 2003. p. 144-198.

Bennett KJ, Brown KS, Boyle M, Racine Y, Offord D. Does low reading achievement at school entry cause conduct problems? Social Science & Medicine. 2003; 56:2443–2448.10.1016/S0277-9536 [PubMed: 12742607]

Bub KL, McCartney K, Willett JB. Behavior problem trajectories and first-grade cognitive ability and achievement skills: A latent growth curve analysis. Journal of Educational Psychology. 2007; 99:653–670.10.1037/0022-0663.99.3.653

Chen X, Rubin KH, Li D. Relation between academic achievement and social adjustment: Evidence from Chinese children. Developmental Psychology. 1997; 33:518–525.10.1037//0012-1649.33.3.518 [PubMed: 9149930]

Doctoroff GL, Greer JA, Arnold D. The relationship between social behavior and emergent literacy among preschool boys and girls. Journal of Applied Developmental Psychology. 2006; 27:1–13.10.1016/j.appdev.2005.12.003

Farrington DP. Childhood origins of antisocial behavior. Clinical Psychology and Psychotherapy. 2005; 12:177–190.10.1002/cpp.448

Fergusson DM, Lynskey MT. Early reading difficulties and later conduct problems. Journal of Child Psychology and Psychiatry. 1997; 38:899–907.10.1111/j.1469-7610.1997.tb01609.x [PubMed: 9413790]

Friedman-Weieneth JL, Harvey EA, Youngwirth SD, Goldstein LH. The relation between 3-year-old children's skills and their hyperactivity, inattention, and aggression. Journal of Educational Psychology. 2007; 99:671–681.10.1037/0022-0663.99.3.671

Giannopulu I, Escolano S, Cusin F, Citeau H, Dellatolas G. Teachers' reporting of behavioural problems and cognitive-academic performances in children aged 5-7 years. British Journal of Educational Psychology. 2008; 78:127–147.10.1080/09297040701314881 [PubMed: 17535517]

Grimm KJ, Steele JS, Mashburn AJ, Burchinal M, Pianta RC. Early behavioral associations of achievement trajectories. Developmental Psychology. 2010; 46:976–983.10.1037/a0018878 [PubMed: 20822216]

Halonen A, Aunola K, Ahonen T, Nurmi J. The role of learning to read in the development of problem behaviour: A cross-lagged longitudinal study. British Journal of Educational Psychology. 2006; 76:517–534.10.1348/000709905X51590 [PubMed: 16953960]

Heller TL, Baker BL, Henker B, Hinshaw SP. Externalizing behavior and cognitive functioning from preschool to first grade: Stability and predictors. Journal of Clinical Child Psychology. 1996; 25:376–387.10.1207/s15374424jccp2504_3.

Hinshaw SP. Externalizing behavior problems and academic underachievement in childhood and adolescence: Causal relationships and underlying mechanisms. Psychological Bulletin. 1992; 111:127–155.10.1037/0033-2909.111.1.127 [PubMed: 1539086]

Jorm AF, Share DL, Matthews R, Maclean R. Behaviour problems in specific reading retarded and general reading backward children: A longitudinal study. Journal of Child Psychology and Psychiatry. 1986; 27:33–43.10.1111/j.1469-7610.1986.tb00619.x [PubMed: 3949905]

Kaufman, AS.; Kaufman, NL. The Kaufman Assessment Battery for Children (K-ABC). Circle Pines, MN: American Guidance Services; 1983.

Kellam, SG.; Branch, JD.; Agrawal, DC.; Ensminger, EE. Mental health and going to school. Chicago: University of Chicago Press; 1975.

Lambert NM, Nicoll RC. Conceptual model for nonintellectual behavior and its relationship to early reading achievement. Journal of Educational Psychology. 1977; 69:481–490.10.1037/0022-0663.69.5.481

Loeber, R.; Farrington, DP.; Stouthamer-Loeber, M.; van Kammen, WB. Antisocial behavior and mental health problems: Explanatory factors in childhood and adolescence. Mahwah, NJ: Erlbaum; 1998.

Loeber R, Green SM, Lahey BB, Stouthamer-Loeber M. Differences and similarities between children, mothers, and teachers as informants on disruptive child behavior. Journal of Abnormal Child Psychology. 1991; 19:75–95.10.1007/BF00910566 [PubMed: 2030249]

Massetti GM, Lahey BB, Pelham WE, Loney J, Ehrnhardt A, Lee SS, Kipp H. Academic achievement over 8 years among children who met modified criteria for Attention-Deficit/Hyperactivity Disorder at 4-6 years of age. Journal of Abnormal Child Psychology. 2008; 36:399–410.10.1007/s10802-007-9186-4 [PubMed: 17940863]

Masten AS, Roisman GI, Long JD, Burth KB, Obradovic J, Riley JR…, Tellegen A. Developmental cascades: Linking academic achievement and externalizing and internalizing symptoms over 20 years. Developmental Psychology. 2005; 41:733–746.10.1037/0012-1649.41.5.733 [PubMed: 16173871]

Maughan B, Gray G, Rutter M. Reading retardation and antisocial behavior: A follow-up into employment. Journal of Child Psychology and Psychiatry. 1985; 26:741–758.10.1111/j.1469-7610.1985.tb00588.x [PubMed: 4044719]

McCarthy, D. McCarthy scales of children's abilities. New York: Psychological Corp; 1972.

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; 43:947–959.10.1037/0012-1649.43.4.947 [PubMed: 17605527]

McGee R, Williams S, Share DL, Anderson J, Silva PA. The relationship between specific reading retardation, general reading backwardness, and behavioural problems in a large sample of Dunedin boys: A longitudinal study from five to eleven years. Journal of Child Psychology and Psychiatry. 1986; 27:597–610.10.1111/j.1469-7610.1986.tb00185.x [PubMed: 3771677]

McMichael P. The hen or the egg? Which comes first -- antisocial emotional disorders or reading disability? British Journal of Educational Psychology. 1979; 49:226–238.10.1111/j.2044-8279.1979.tb02421.x [PubMed: 526439]

Miles SB, Stipek D. Contemporaneous and longitudinal associations between social behavior and literacy achievement in a sample of low-income elementary school children. Child Development. 2006; 77:103–117.10.1111/j.1467-8624.2006.00859.x [PubMed: 16460528]

Morgan PL, Farkas G, Tugis PA, Sperling RA. Are reading and behavior problems risk factors for each other? Journal of Learning Disabilities. 2008; 41:417–436.10.1177/0022219408321123 [PubMed: 18768774]

Muthén, LK.; Muthén, BO. Mplus User's Guide, Sixth Edition. Los Angeles, CA: Muthén & Muthén; 1998-2010.

Offord DR, Alder RJ, Boyle MH. Prevalence and sociodemographic correlates of conduct disorder. American Journal of Social Psychiatry. 1986; 6:272–278.

Palfrey JS, Levine MD, Walker DK, Sullivan M. The emergence of attention deficits in early childhood: A prospective study. Developmental and Behavioral Pediatrics. 1985; 6:339–348.10.1097/00004703-198512000-00004

Patterson GR. Some comments about cognitions as causal variables. American Psychologist. 1990; 45:984.10.1037//0003-066X.45.8.984

Rabiner D, Coie JD. Early attention problems and children's reading achievement: A longitudinal investigation. Journal of the American Academy of Child and Adolescent Psychiatry. 2000; 39:859–867.10.1097/00004583-200007000-00014 [PubMed: 10892227]

Radloff LS. The CES-D scale: A self-report depression scale for research in the general population. Applied Psychological Measurement. 1977; 1:385–401.10.1177/014662167700100306

Reynolds, CR.; Kamphaus, RW. Behavior Assessment System for Children. Circle Pines, MNL American Guidance Service; 1992.

Richman, N.; Stevenson, J.; Graham, P. Preschool to school: A behavioural study. San Diego, CA: Academic Press; 1982.

Sameroff AJ, Seifer R, Barocos R, Zax M, Greenspan S. Intelligence quotient scores of 4-year-old children: Social-environmental risk factors. Pediatrics. 1987; 79:343–350. [PubMed: 3822634]

Sarason IG, Johnson JH, Siegel JM. Assessing the impact of life changes: Development of the life experiences survey. Journal of Consulting and Clinical Psychology. 1978; 46:932–946.10.1037//0022-006X.46.5.932 [PubMed: 701572]

Sattler, JM. Assessment of children: Cognitive applications. 4th. San Diego, CA: Sattler; 2001. p. 128-159.

Schonfeld IS. A developmental perspective and antisocial behavior: Cognitive functioning. American Psychologist. 1990; 45:983.10.1037/0003-066X.45.8.983.b

Shaffer D, Fisher P, Lucas CP, Dulcan MK, Schwab-Stone ME. NIMH Diagnostic Interview Schedule for Children (NIMH DISC-IV): Description, differences from previous versions, and reliability of some common diagnoses. Journal of the American Academy of Child and Adolescent Psychiatry. 2000; 39:28–38.10.1097/00004583-200001000-00014 [PubMed: 10638065]

Sohr-Preston SL, Scaramella LV. Implications of timing of maternal depressive symptoms for early cognitive and language development. Clinical Child and Family Psychology Review. 2006; 9:65–83.10.1007/s10567-006-0004-2 [PubMed: 16817009]

Sonuga-Barke EJ, Lamparelli M, Stevenson J, Thompson M, Henry A. Behaviour problems and pre-school intellectual attainment: The associations of hyperactivity and conduct problems. Journal of Child Psychology and Psychiatry. 1994; 35:949–960.10.1111/j.1469-7610.1994.tb02304.x [PubMed: 7962250]

Spira EG, Fischel JE. The impact of preschool inattention, hyperactivity, and impulsivity on social and academic development: A review. Journal of Child Psychology and Psychiatry. 2005; 46:755–773.10.1111/j.1469-7610.2005.01466.x [PubMed: 15972069]

Stanton WR, Feehan M, McGee R, Silva PA. The relative value of reading ability and IQ as predictors of teacher-reported behavior problems. Journal of Learning Disabilities. 1990; 23:514–517.10.1177/002221949002300810 [PubMed: 2246604]

Stetson, R.; Stetson, EG.; Sattler, JM. Assessment of academic achievement. In: Sattler, JM., editor. Assessment of children: Cognitive applications. San Diego, CA: Sattler; 2001. p. 576-609.

Stott DH. Behaviour disturbance and failure to learn: A study of cause and effect. Educational Research. 1981; 23:163–172.10.1080/0013188810230301

Thomas A. Learned helplessness and expectancy factors: Implications for research in learning disabilities. Reviews in Education Research. 1979; 49:208–221.10.2307/1169959

Trapolini T, McMahon CA, Ungerer JA. The effect of maternal depression and marital adjustment on young children's internalizing and externalizing behavior problems. Child: Care, Health and Development. 2007; 33:794–803.10.1111/j.1365-2214.2007.00739.x

Trzesniewski KH, Moffitt TE, Caspi A, Taylor A, Maughan B. Revisiting the association between reading achievement and antisocial behavior: New evidence of an environmental explanation from a twin study. Child Development. 2006; 77:72–88.10.1111/j.1467-8624.2006.00857.x [PubMed: 16460526]

Velting ON, Whitehurst GJ. Inattention-hyperactivity and reading achievement in children from low-income families: A longitudinal model. Journal of Abnormal Child Psychology. 1997; 25:321–-331.10.1023/A:1025716520345 [PubMed: 9304448]

Waschbusch D. A meta-analytic examination of comorbid hyperactive-impulsive-attention problems and conduct problems. Psychological Bulletin. 2002; 128:118–150.10.1037//0033-2909.128.1.118 [PubMed: 11843545]

Wechsler, D. Wechsler Individual Achievement Tests. Second. San Antonio, TX: Psychological Corporation; 2001.

Wechsler, D. WISC-IV technical and interpretive manual. San Antonio, TX: Psychological Corporation; 2003.

Wilcutt EG, Pennington BF. Psychiatric comorbidity in children and adolescents with reading disability. Journal of Child Psychology and Psychiatry. 2000:41, 1039–1048.

Wright CA, George TP, Burke R, Gelfand DM, Teti DM. Early maternal depression and children's adjustment to school. Child Study Journal. 2000; 30:153–168.

Yu JW, Buka SL, McCormick MS, Fitzmaurice GM, Indurkhya A. Behavioral problems and the effects of early intervention on eight-year-old children with learning disabilities. Maternal and Child Health Journal. 2006; 10:329–338.10.1007/s10995-005-0066-7 [PubMed: 16474990]

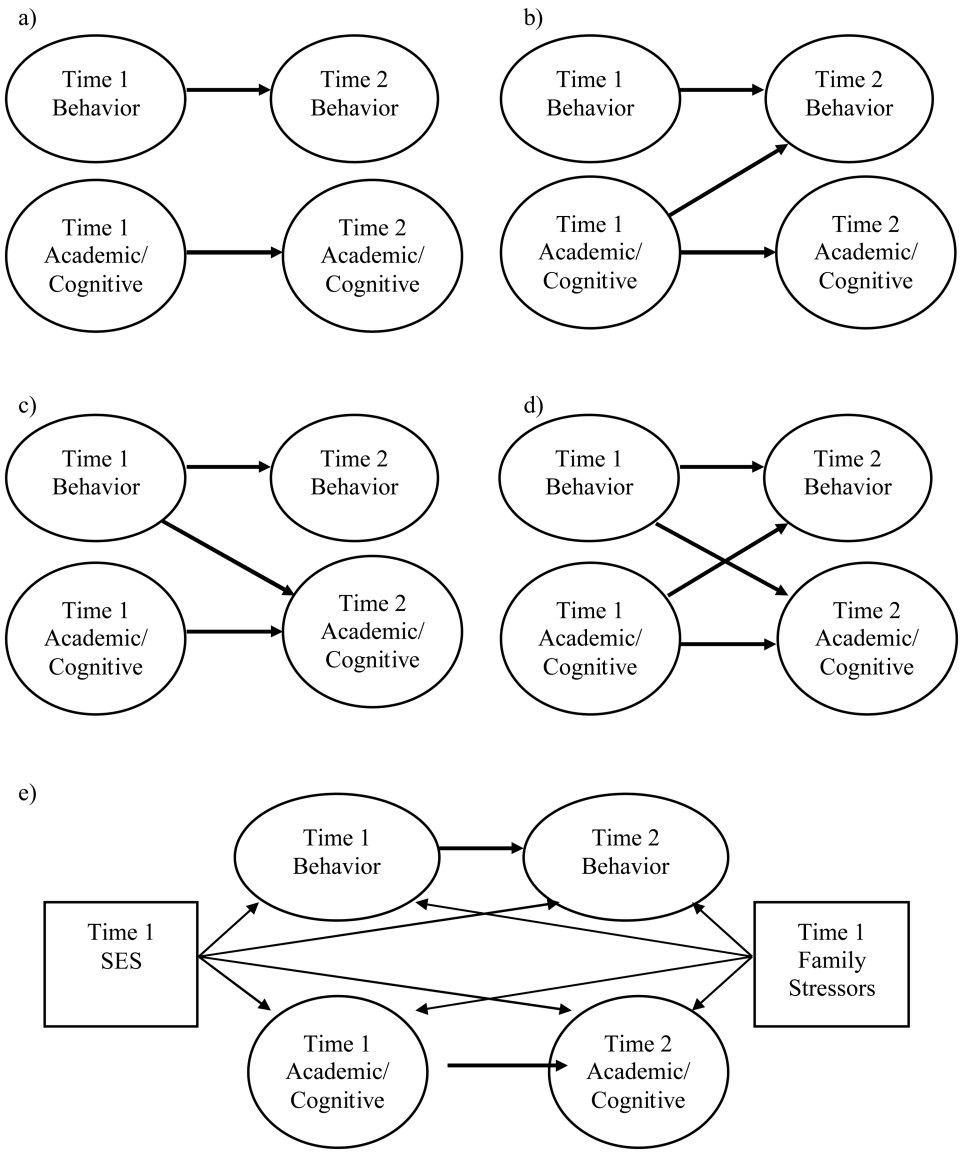

Figure 1.
Visual representation of a) baseline model, b) Model 1, c) Model 2, d) Model 3, and Model 4.

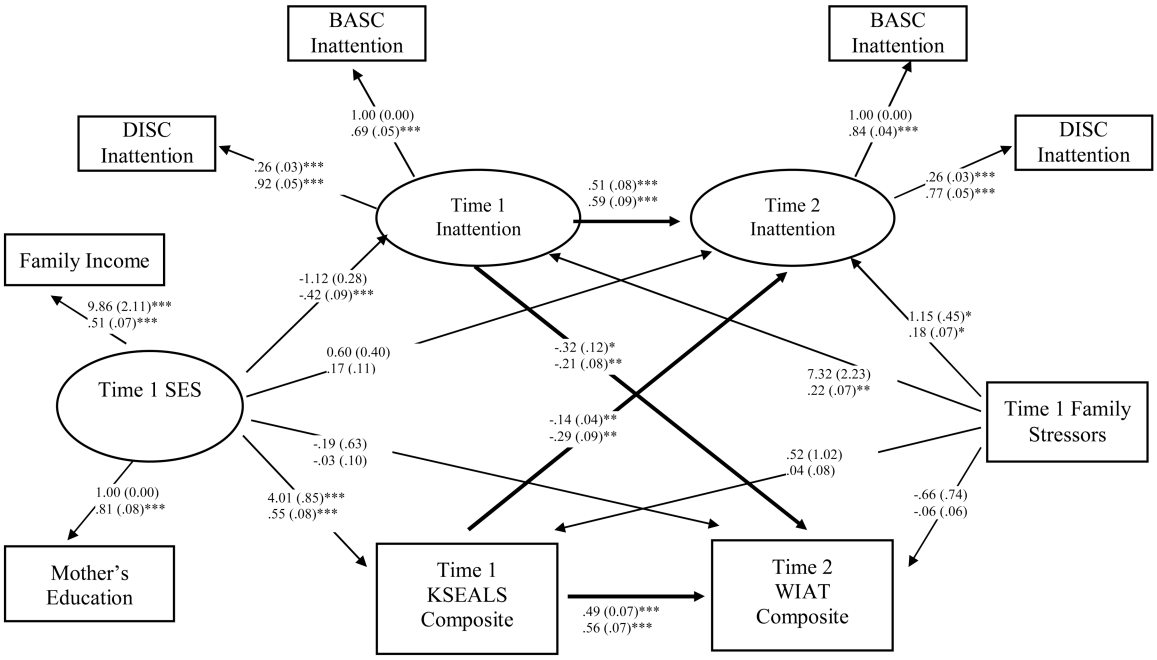

Figure 2.

Reciprocal model (Model 3) for inattention and academic achievement. Unstandardized coefficients and standard errors are on top and standardized coefficients and standard errors are on the bottom. *$p < .05$; **$p < .01$, ***$p < .001$

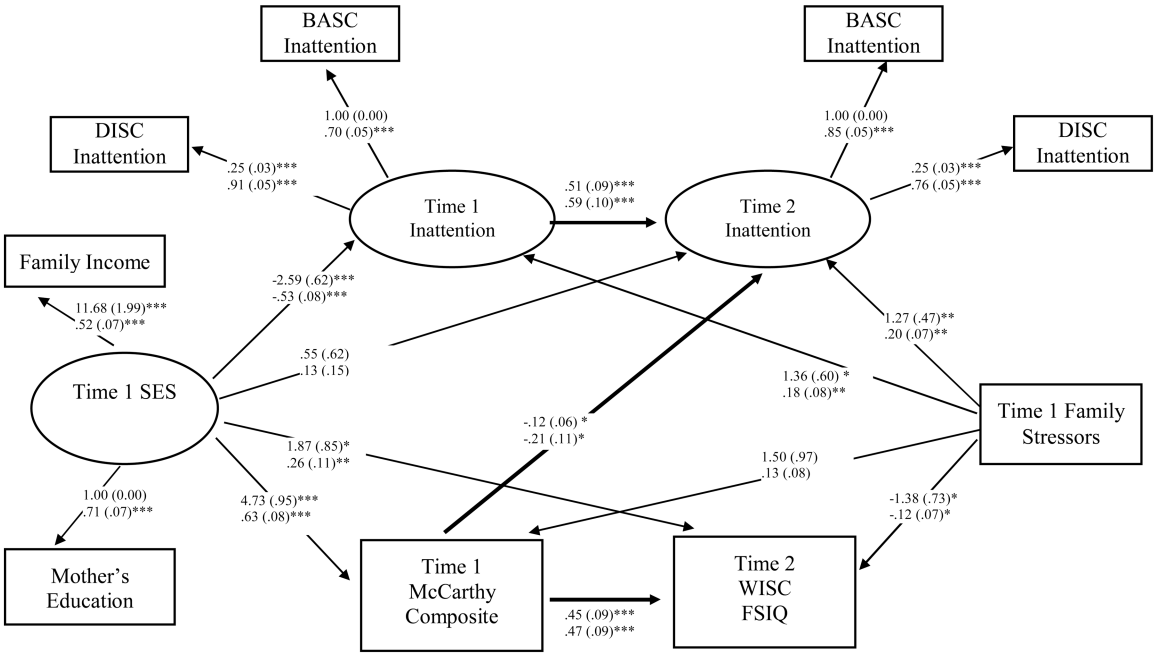

Figure 3.

Model 1 for inattention and cognitive ability. Unstandardized coefficients and standard errors are on top and standardized coefficients and standard errors are on the bottom. *$p < .05$; **$p < .01$, ***$p < .001$

Table 1

Intercorrelations Among Observed Variables and Controls

Variable	*M (SD)*	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. T1 BASC hyperactivity[a]	58.45 (13.44)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. T1 BASC aggression[a]	56.38 (13.43)	.69***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3. T1 BASC inattention[a]	54.98 (13.63)	.69***	.51***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4. T1 DISC hyperactivity	4.61 (2.42)	.70***	.47***	.51***	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5. T1 DISC ODD	3.80 (2.35)	.53***	.58***	.45***	.52***	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6. T1 DISC inattention	3.32 (2.66)	.62***	.43***	.63***	.67***	.52***	-	-	-	-	-	-	-	-	-	-	-	-	-
7. McCarthy	106.16 (14.27)	-.13	-.07	-.14	-.21***	-.09	-.30***	-	-	-	-	-	-	-	-	-	-	-	-
8. KSEALS	107.07 (16.99)	-.19*	-.14	-.12	-.24***	-.17*	-.27**	.71***	-	-	-	-	-	-	-	-	-	-	-
9. T2 BASC hyperactivity[a]	54.93 (12.62)	.66***	.46***	.51***	.54***	.37***	.48***	-.17*	-.23**	-	-	-	-	-	-	-	-	-	-
10. T2 BASC aggression[a]	54.72 (11.16)	.52***	.59***	.42***	.35***	.43***	.39***	-.06	-.16	.61***	-	-	-	-	-	-	-	-	-
11. T2 BASC inattention[a]	52.67 (9.77)	.53***	.40***	.52***	.43***	.40***	.48***	-.26**	-.28***	.68***	.57***	-	-	-	-	-	-	-	-
12. T2 DISC hyperactivity	3.13 (2.65)	.59***	.38***	.48***	.57***	.33***	.49***	-.15	-.22**	.75***	.48***	.60***	-	-	-	-	-	-	-
13. T2 DISC ODD	2.14 (2.16)	.33***	.36***	.25***	.29***	.40***	.31***	-.06	-.12	.47***	.55***	.45***	.47***	-	-	-	-	-	-
14. T2 DISC inattention	2.37 (2.74)	.44***	.27***	.42***	.37***	.28***	.46***	-.18*	-.28***	.55***	.39***	.66***	.67***	.40***	-	-	-	-	-
15. WISC-IV	100.57 (14.07)	-.27***	-.18*	-.27***	-.27***	-.27***	-.37***	.59***	.62***	-.26***	-.09	-.31***	-.22	-.12	-.21**	-	-	-	-
16. WIAT-IIA	98.21 (14.53)	-.24**	-.15*	-.18*	-.23**	-.20**	-.34***	.59***	.62***	-.28***	-.14	-.34***	-.25***	-.18*	-.29***	.70***	-	-	-
17. T1 mothers' education	13.53 (2.77)	-.23**	-.15*	-.15*	-.23***	-.16*	-.33***	.42***	.46***	-.18*	-.08	-.15*	-.17*	-.07	-.15*	.38***	.27***	-	-
18. T1 family stress	2.15 (1.26)	.31***	.26***	.24***	.19**	.18**	.26***	.10	-.00	.30***	.31***	.30***	.23**	.18**	.22**	-.14	-.13	-.12	-
19. T1 income	60,070 (43,698)	-.23**	-.15*	-.23**	-.23**	-.16*	-.28***	.19*	.21**	-.25***	-.10	-.20**	-.25***	-.10	-.21**	.23**	.22**	.42***	-.18*

Note: BASC= Behavior Assessment System for Children-Parent Report Scale; DISC =NIMH-Diagnostic Interview Schedule for Children-IV; KSEALS = Kaufman Survey of Early Academic and Language Skills; WISC-IV = Wechsler Intelligence Scale for Children Fourth Edition; WIAT-IIA = Wechsler Individual Achievement Test Second Edition Abbreviated

[a]T scores were used

*p <.05

**p <.01

$^{***}p < .001$

Table 2

Summary of Best-Fitting Models

Variables	No Controls	With Controls
Hyperactivity and Academic Achievement	Model 2	Baseline
Hyperactivity and Cognitive Ability	Model 2	Baseline
Inattention and Academic Achievement	Model 3	Model 3
Inattention and Cognitive Ability	Model 2	Model 1
Aggression and Academic Achievement	Baseline	Baseline
Aggression and Cognitive Ability	Model 2	Baseline

Table 3

Fit Indices for All Models (With Controls)

	Model Fit for Academic Achievement/Cognitive Ability				
Model	χ^2	*df*	**CFI**	**RMSEA**	**SRMR**
Hyperactivity Baseline Model	31.84/28.06	18/18	.98/.99	.06/.05	.04/.04
Hyperactivity Model 1	30.73/27.74	17/17	.98/.98	.06/.05	.04/.04
Hyperactivity Model 2	30.28/26.88	17/17	.98/.99	.06/.05	.04/.04
Hyperactivity Model 3	28.85/26.44	16/16	.98/.98	.06/.05	.04/.04
Inattention Baseline Model	39.83/30.01	17/17	.96/.98	.08/.06	.05/.04
Inattention Model 1	31.41/26.36	16/16	.97/.98	.07/.05	.04/.04
Inattention Model 2	34.88/28.75	16/16	.97/.98	.07/.06	.05/.04
Inattention Model 3	24.9/24.67	15/15	.98/.98	.06/.05	.04/.04
Aggression Baseline Model	19.84/16.13	17/17	.99/1.00	.03/.00	.04/.04
Aggression Model 1	18.86/15.01	16/16	.99/1.00	.03/.00	.04/.03
Aggression Model 2	19.21/13.42	16/16	.99/1.00	.03/.00	.04/.03
Aggression Model 3	18.20/12.20	15/15	.99/1.00	.03/.00	.03/.03

Note: CFI = Comparative Fit Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Square Residual. Fit indices are presented for academic achievement before the "/" and cognitive ability after the "/."