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Longitudinal Predictors of School-Age Academic Achievement: Unique Contributions of Toddler-Age Aggression, Oppositionality, Inattention, and Hyperactivity

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Abstract This project examined the unique predictive validity of parent ratings of toddler-age aggression, oppositionality, inattention, and hyperactivity-impulsivity to academic achievement at school-age in a sample of 566 high-risk children and families. The study also investigated potential indirect effects of the Family Check-Up on school-age academic achievement through changes in child behavior problems. The results demonstrated that toddler-age aggression was most consistently associated with school-age academic achievement, albeit modestly. Moreover, findings showed that the intervention predicted greater decreases in aggression from ages 2–3 to 4–5 compared to controls. The results suggest that in high-risk toddler-aged children, aggression may be a more consistent predictor of school-age academic achievement than other externalizing dimensions, which has implications for early identification and efforts to promote children's adaptation.

Keywords Disruptive behavior · Developmental psychopathology · Intervention · Parenting · Risk factors

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Introduction

A body of research has demonstrated a link between school-age externalizing behaviors and academic achievement. It is estimated that between 10 % and 50 % of school-age children who exhibit externalizing behaviors also demonstrate low academic achievement (Hinshaw 1992). The achievement-externalizing behavior relationship has received attention from researchers, in part, because of the severity of its predicted consequences, which include: continued underachievement, receipt of special services, deviant peer affiliation, delinquency, and school dropout (e.g., Moilanen and Shaw 2010). However, the behaviors referred to as "externalizing" are quite heterogeneous, spanning from core symptoms of ADHD such as inattention, impulsivity, and hyperactivity, to symptoms associated with ODD and CD, such as oppositional and aggressive behavior. Moreover, these behaviors are known to be normative at moderate levels during toddlerhood (Campbell 2002), to progressively decrease with development (Shaw et al. 2005), and to frequently co-occur (Waschbusch 2002). As a result, the extent to which or whether *specific* externalizing dimensions, particularly those measured during early childhood, independently predict later academic achievement remains unclear.

Thus, the current study sought to examine the independent contributions of multiple components of externalizing behavior at age 2–3 to academic achievement at age 7.5 in an ethnically diverse sample of 566 low-income children. In addition, the study investigated the potential indirect effect of the Family Check-Up, which has previously been shown to reduce preschool-age externalizing behavior, on school-age academic achievement. Research that elucidates the independent contribution of different components of early externalizing behavior on achievement and the potential effect of a parenting

intervention on problem behavior and subsequent achievement would have important implications for basic and intervention research.

Externalizing Behaviors and Academic Achievement

Externalizing behaviors have been the focus of much research in recent decades. Data suggest that such behaviors account for over 50 % of childhood clinic referrals (Waschbusch 2002). Although it is normative for problem behaviors to emerge in children between 2 and 3 years of age, high levels of such behavior are worrisome because they are known to be moderately stable throughout childhood and to predict more severe forms of antisocial behavior into adolescence and adulthood (Broidy et al. 2003; Campbell et al. 2000).

The presence of externalizing behaviors in early childhood represents additional concern because they are associated with an array of negative outcomes from childhood through adulthood, including poor social skills (Campbell et al. 2006), more serious antisocial behavior (Broidy et al. 2003), substance abuse (Wilson and Marcotte 1996), and academic underachievement (Hinshaw 1992). Following up on research demonstrating predictive validity between early forms of behavior problems and later problematic outcomes, many researchers have focused on the specific relationship between early disruptive behavior and academic achievement, as this association is present at school-entry (Duncan et al. 2007), remains evident into high school (Massetti et al. 2008; Wilson and Marcotte 1996), demonstrates reciprocity over time (Moilanen and Shaw 2010), and puts children at risk for grade retention and special services (Vitaro et al. 2005).

A plethora of research has been conducted on childhood behavior problems and both concurrent and future academic achievement. This literature has consistently found that children with higher levels of externalizing behavior between toddlerhood and school-age are at increased risk of academic difficulties throughout later childhood and adolescence (Campbell et al. 2006; Fergusson and Horwood 1995). While the relationship between externalizing and academic achievement seems well-established, less is known about the ways in which specific disruptive behaviors, particularly in young children, are independently predictive of later achievement.

Components of Externalizing Behavior and Academic Achievement

Aggression, oppositionality, inattention, hyperactivity and impulsivity, assessed during the preschool and school-age periods, have each been demonstrated to be both concurrently and longitudinally associated with academic performance at preschool-age (Friedman-Weieneth et al. 2007), school-age (Campbell et al. 2006), and adolescence (Fergusson and Horwood 1995), although their rate of co-occurrence makes it possible that the predictive nature of one disruptive behavior for later achievement is accounted for by another covarying disruptive behavior. High levels of inattention, hyperactivity, and impulsivity in school-age children are well-known concurrent and longitudinal predictors of achievement (Fergusson and Horwood 1995; Merrell and Tymms 2001). In fact, a large literature has implicated early symptoms and/or diagnoses of ADHD to be one of the most salient correlates of academic achievement (Duncan et al. 2007; Hinshaw 1992).

Studies that have examined different components of ADHD, specifically inattention and hyperactivity-impulsivity, have demonstrated a link between both behaviors in school-age children and later academic achievement. Theoretically, young children who have difficulty sustaining attention may also be challenged at self-regulating and focusing on academic tasks once they reach school (Barkley 2003), and consequently be less likely to develop core academic skills in the early school years. Consistent with this theory, in a recent meta-analysis, inattentive behavior at school entry was found to be a robust predictor of elementary school academic functioning even after accounting for early academic abilities and socio-demographic characteristics (Duncan et al. 2007). Similarly, longitudinal work has shown that decreases in ratings of inattention from early to late elementary school predict improvements in academic achievement from elementary to late high school (Breslau et al. 2010).

Children who exhibit hyperactive-impulsive behaviors are also known to struggle in the areas of behavioral inhibition and planning (Barkley 2003). Consequently, it is theorized that hyperactive-impulsive children will be less likely to formulate well-planned responses and remain on task when they are in the classroom, which could result in lowered academic performance. In fact, research has shown that hyperactive-impulsive behaviors in 5- to 7-year olds have also been found to be associated with academic achievement both concurrently and longitudinally during school-age (Merrell and Tymms 2001; Saudino and Plomin 2007). In sum, research demonstrates that each of the core dimensions of ADHD measured in school-aged children is related to academic achievement; however, many studies have failed to account for the high rate of comorbidity between ADHD behaviors, making it difficult to determine the degree to which specific ADHD symptoms are uniquely associated with academic achievement.

It is also known that aggression, even when measured prior to school entry, is correlated with a host of subsequent negative school outcomes (Campbell et al. 2006). There is also evidence that school-age children who act aggressively may fail to engage in academic learning tasks. In fact, a concurrent observation of "time engaged in academic learning" reveals dramatically lower rates for aggressive school-age children compared to typically developing students (Shinn et al. 1987). Thus, the emergence of aggression in early childhood can be

viewed as a behavioral style that will have cascading effects and disrupt a child's ability to remain engaged academically (Stipek and Miles 2008). As might be expected, aggressive behavior in toddlerhood, preschool, and kindergarten has been shown to be associated with academic achievement in elementary school and middle school (Campbell et al. 2006; Stipek and Miles 2008), as well as high school completion (Vitaro et al. 2005). However, a consistent element shared by the studies linking aggression to academic outcomes is their failure to account for comorbid externalizing behaviors such as inattention and hyperactivity-impulsivity. Thus, it remains an empirical question as to whether aggressive behavior in early childhood is uniquely associated with risk for low academic achievement during school-age.

Although not much work has been conducted to investigate the independent association between early oppositional behavior and later achievement, it is possible that oppositional children would perform more poorly in the classroom as a consequence of refusing to comply with instruction. In fact, the link between aggressive behavior and poor academic performance may be best explained by the underlying functional dynamics of children's noncompliance (Patterson et al. 1992). Therefore, one might expect that oppositional behavior in early childhood would be uniquely prognostic of academic achievement at school-age. In addition, oppositionality is known to be particularly prevalent in early childhood and may be accounting for a large proportion of variance in early measures of broad-band externalizing constructs that have been associated with subsequent academic functioning (Bub et al. 2007; Moilanen and Shaw 2010). In sum, the pattern of findings suggests that aggressive and oppositional behaviors, beginning in early childhood, would be associated with later impairments in academic achievement, but the extent to which each association is independent of other correlated disruptive behaviors remains unclear.

Independent Contributions of Externalizing Dimensions to Academic Achievement

Research has established that behavior problems at preschool- and school-age are associated with concurrent and future underachievement, but their high rate of comorbidity makes it plausible that only a subset of these behaviors contribute directly to variation in academic performance. As an example, estimates in clinical settings suggest that children with ADHD or ODD/CD average a 50 % overlap in symptoms (Waschbusch 2002). Moreover, research comparing the predictive validity of specific dimensions of disruptive behavior, such as aggression and oppositionality, suggest variation in the magnitude of association with specific outcomes. For example, Gross et al. (2009) found that 18-month olds' noncompliance, more so than aggression, was related to persistently high trajectories of maternal depressive symptoms between ages 2 and 10. In addition, although hyperactivity-impulsivity and inattention are often combined into one factor, differences in associations with the development of various child outcomes (e.g., anxiety and learning problems) have been found in studies in which they were examined separately (Barkley 2003).

To date, only a small number of studies have examined the *independent* contributions of disruptive behavior symptoms in relation to academic achievement either concurrently or longitudinally. The few cross-sectional studies that have explored these associations found mixed results, with one study with preschoolers finding that parent-reported hyperactivity is associated with concurrent preacademic skills (Friedman-Weieneth et al. 2007), and another with adolescents finding that inattention is uniquely associated with achievement (Barriga et al. 2002). In addition, only one longitudinal study examining the *independent* contributions of school-age aggressive-oppositional behaviors and ADHD symptoms to later academic achievement could be identified (Fergusson and Horwood 1995). Their findings indicated that ADHD behaviors at school-age account for the association between "conduct problems" and underachievement in high school (Fergusson and Horwood 1995). Although examining the association between conduct problems and broad-band ADHD in school-aged children and later achievement is an important first step, because of the heterogeneous components of these constructs that combine aggression and oppositionality, as well as inattention and hyperactivity-impulsivity, it is unclear whether different associations between behavior problems and academic achievement would emerge when externalizing dimensions are more purely defined. Thus, there is a dearth of research examining whether disruptive behaviors parsed into dimensions of aggression, oppositionality, inattention, and hyperactivity-impulsivity are associated with later academic achievement. Furthermore, the majority of existing studies have measured externalizing behaviors in school-aged children or later, but the relationship between independent dimensions of externalizing behavior measured in toddlerhood, a developmental period during which some level of these behaviors are known to be normative (Campbell 2002), and longitudinal academic outcomes has yet to be investigated. Based on previous findings demonstrating consistent associations between ADHD behaviors and later academic achievement in preschool and school-age children (Duncan et al. 2007; Hinshaw 1992; Rapport et al. 1999), it would be expected that measurements of ADHD dimensions in early childhood would also show more robust associations with later achievement than oppositional and aggressive behavior. However, it would be particularly important to clarify whether there are unique associations between behavior problems and later academic achievement from toddlerhood, a time that is crucial for the initiation of prevention and early intervention.

In conclusion, research suggests that when independent contributions of externalizing behaviors are taken into account, an inconsistent picture with primarily concurrent academic achievement emerges. However, no study could be identified that considered dimensions of aggression, oppositionality, inattention, and hyperactivity-impulsivity *simultaneously* in relation to later achievement, particularly from toddlerhood. Moreover, few studies have included diverse high-risk populations, who are important to consider when examining behavior and achievement difficulties because of their elevated risk of developing both (Brooks-Gunn and Duncan 1997).

Parenting Intervention, Externalizing Behaviors, and Academic Achievement

In addition to child behaviors linked with later achievement, proximal characteristics, such as parenting, have been shown to play an important role in the development of both child behavior problems and academic achievement. Empirical evidence suggests there are numerous pathways through which early parenting has the potential to influence achievement, including cognitive stimulation during early childhood (Brooks-Gunn and Duncan 1997), transmission of beliefs and attitudes toward school (Taylor et al. 2004), and the modeling and scaffolding of effective regulatory and problem-solving approaches (Englund et al. 2004). The coercion model in particular would hypothesize that young families characterized by conflict and negative exchanges would be poor for supporting the skill set needed for self-regulated learning. In contrast, families with high levels of supportive interactions and encouragement of expressivity are known to support growth in effortful attention control (Eisenberg et al. 2003). Based on this literature and theory, it would be expected that changes in parenting interactions in early childhood would be prognostic of reduced externalizing behaviors and higher levels of future academic achievement. Thus, in this project, we also examined potential intervention effects on school-age achievement through changes in dimensions of externalizing behavior between ages 2–3 and 4–5. Previously, random assignment to the Family Check-Up (FCU) in the current sample was associated with reduced growth in broad-band factors of externalizing behavior (i.e., CBCL Externalizing) from ages 2 to 4 compared to the control group (Dishion et al. 2008). In addition, the FCU was indirectly associated with improved language development from ages 3 to 4 through changes in parenting behaviors from ages 2 to 3 (Lunkenheimer et al. 2008). Thus, based on the study's experimental design, the final goal of the project was to test whether random assignment to the FCU was associated with decreases in dimensions of externalizing behavior from ages 2–3 and 4–5, and consequently, higher levels of academic achievement at school-age.

The Current Study

The aim of this project was to examine whether research linking multiple components of preschool- and school-age externalizing behavior and academic achievement could be extended to toddlerhood. Furthermore, the paper aimed to determine which toddler-age externalizing dimensions might be independently predictive of academic achievement at early school-age. Specifically, as studies with preschool- and primarily school-age children have demonstrated, it was expected that there would be significant univariate associations between age 2–3 inattention, hyperactivity-impulsivity, aggression, and oppositional behavior and school-age academic achievement. Furthermore, in line with evidence showing links between early signs of ADHD and academic achievement, it was hypothesized that in multivariate analyses, only early inattention and hyperactivity-impulsivity would contribute unique variance to later academics.

Finally, following up on findings that random assignment to the FCU was related to greater decreases in externalizing behavior compared to controls (Dishion et al. 2008), the study also sought to examine whether the FCU would affect school-age academic achievement through changes in dimensions of externalizing behavior from ages 2–3 to 4–5. Based on the FCU's emphasis on addressing coercive parent–child interactions (Patterson et al. 1992), intervention would be expected to lead to decreases in aggressive and oppositional behaviors over time. It is less clear how the FCU would affect ADHD dimensions; however, similar parenting-focused interventions have been shown to improve ADHD behaviors in preschool-age children (Young and Amarasinghe 2010). Moreover, previous findings from this project have shown collateral benefits of the FCU on elements of child and parent functioning that were less directly targeted (e.g., maternal depression and inhibitory control; Lunkenheimer et al. 2008; Shaw et al. 2009). Therefore, it was anticipated that the intervention would be associated with higher levels of academic achievement through decreases primarily in aggressive and oppositional behavior, and to a more modest extent inattention and hyperactive-impulsive child behavior.

Methods

Participants

Participants included approximately 566 children and families recruited between 2002 and 2003 from Women, Infants, and Children Nutrition Programs (WIC) in the metropolitan areas of Pittsburgh, PA, and Eugene, OR, and in and outside the town of Charlottesville, VA. Families were contacted at WIC sites and invited to participate if they had a son or daughter between age 2 years 0 month and 2 years 11 months, following

a screen to ensure that they met the study criteria by having socioeconomic, family, and/or child risk factors for future behavior problems (Dishion et al. 2008). Risk criteria for recruitment were defined at or above 1 SD above normative averages on several screening measures in the following three domains: (a) child behavior (conduct problems, high-conflict relationships with adults), (b) family problems (maternal depression, daily parenting challenges, substance-use problems (yes/no self-report question), teen parent status (i.e., first child born when parent was 19 years old or younger)), and (c) sociodemographic risk (low education achievement and low family income, relevant to WIC criterion). To qualify for a given domain, families had to meet criteria for at least one scale within that domain. Two or more of the three risk domains were required for inclusion in the sample. In the case of children not qualifying on the criterion of child conduct problems, all participants were required to have at least above-average scores to increase parent motivation to reduce child problem behavior.

Of the 1,666 families who had children in the appropriate age range and who were contacted at WIC sites across the three study sites, 879 met the eligibility requirements (52 % in Pittsburgh, 57 % in Eugene, and 49 % in Charlottesville) and 731 (83.2 %) agreed to participate (88 % in Pittsburgh, 84 % in Eugene, and 76 % in Charlottesville). The children in the sample had a mean age of 29.9 months (SD=3.2) at the time of the age 2 assessment. Of the 731 families (49 % female), 272 (37 %) were recruited in Pittsburgh, 271 (37 %) in Eugene, and 188 (26 %) in Charlottesville. Across sites, primary caregivers self-identified as belonging to the following ethnic groups: 28 % African American, 50 % European American, 13 % biracial, and 9 % other groups (e.g., American Indian, Native Hawaiian). Thirteen percent of the sample reported being Hispanic American. During the 2002–2003 screening period, more than two thirds of those families enrolled in the project had an annual income of less than $20,000, and the average number of family members per household was 4.5 (*SD*=1.63). Forty-one percent of the population had a high school diploma or general education diploma (GED), and an additional 32 % had 1–2 years of post-high school training.

Of the 731 families who initially participated, 659 (90 %) were available at the age-3 follow-up, 619 (85 %) participated at the age-4 follow-up, 621 (85 %) participated at the age-5 follow-up, and 566 (77 %) participated in the age 7.5 follow-up. Selective attrition analyses comparing age-2 study variables for participants retained versus attrited at ages 3, 4, 5, and 7.5 have revealed no significant differences with respect to project site, children's race, ethnicity, or gender, maternal depression, children's externalizing behavior, or intervention status.

Procedure

At the ages of 2, 3, 4, 5, and 7.5, the target child (TC), primary caregiver (PC) and when available, alternate caregiver (AC), participated in 2–3 hour assessments at the family's home. These assessments consisted of a battery of self-report measures, observational interaction tasks and a child testing session (for a detailed description of the protocol, see Dishion et al. 2008). This study used a subset of the collected data, the parent-report measures from ages 2–5 and the child testing results from ages 3 and 7.5. Families who participated in the age 2, 3, 4, 5, and 7.5 assessments were reimbursed $100, $120, $140, $160, and $180, respectively.

Intervention protocol: The Family Check-Up (FCU) The FCU is a brief, typically three-session, intervention based on motivational interviewing techniques (for a complete description see Dishion et al. 2008). Families who were randomly assigned to the intervention condition were scheduled to meet with a parent consultant for two or more sessions, depending on the family's preference. The three meetings in which families are typically involved include an initial contact meeting, an assessment meeting, and a feedback session. For research purposes, the sequence of contacts was assessment, randomization, initial interview, and feedback session with the option for follow-up sessions. Families in the feedback session received a $25 gift certificate for completing the FCU and feedback session.

After the first meeting, (the assessment described above), the second visit called the "get to know you" (GTKY) meeting consisted of the parent consultant meeting with the parent or parents and discussing their concerns with a focus on current family issues that were most critical to their child's and family's functioning. For the third meeting, the feedback session, parent consultants utilized motivational interviewing to summarize the results of the assessment and highlight areas of strength and areas in need of attention. The parent was given the choice to participate in additional follow-up sessions that were focused on parenting practices as well as other family management and contextual issues (e.g., co-parenting, child care resources, or housing). Parent consultants were also able to recommend community service organizations that may be of assistance to the family. Parents in the intervention group received the FCU after each year's assessment at child ages 2, 3, 4, and 5, with *n*=276 (75 %) participating at age 2, *n*=242 (66 %) at age 3, *n*=231 (63 %) at age 4, and *n*=202 (55 %) at age 5, respectively.

Measures

Demographics Questionnaire A demographics questionnaire was administered to the mothers during the age 2, 3, 4, 5 and 7.5 visits. This measure included questions about family structure, parental education and income, parental criminal history, and areas of familial stress.

Child Language Ability The Fluharty-2 (Fluharty 2001) is a brief examiner-administered screening tool used to assess children between the ages of 2 and 6 who may be at risk for language difficulties. The measure produces three composite scores: Receptive Language, Expressive Language, and a General Language Quotient. This study will use the General Language Quotient from age 3 as a measure of toddler-age language ability.

Child Behavior Checklist 1 1/2–5 & 6–18 (CBCL) The CBCL (Achenbach and Rescorla 2001; Achenbach and Rescorla 2000) for ages 1 1/2–5 and for ages 6–18 are 99-item and 118-item questionnaires, respectively, that assess behavioral problems in children falling within the respective age groups. Mothers completed the CBCL 1 1/2–5 at the ages 2, 3, and 4 visits and the CBCL 6–18 at the age 5 assessment. The CBCL has two broad-band factors, internalizing and externalizing. Individual items from the externalizing factor were combined with items from the Eyberg Child Behavior Inventory to create individual scales of inattention, hyperactivity-impulsivity, aggression, and oppositionality (see description below).

Eyberg Child Behavior Inventory (ECBI) The ECBI is a 36-item parent-report behavior checklist also administered at the ages 2, 3, 4, and 5 assessments (Robinson et al. 1980). The ECBI assesses conduct problems in children between 2 and 16 years of age via two factors, one that focuses on the perceived intensity of behavior and another on the degree the behavior is a problem for caregivers. As the intensity factor is similar in structure, and complementary in content, to the CBCL externalizing factor, items from this were used to supplement items from the CBCL in creating DSM-based scales of inattention, hyperactivity-impulsivity, aggression, and oppositionality (see the following description).

Externalizing Behavior Scales To create externalizing behavior composites, ECBI items were initially rescaled from a 7-point Likert scale to match the 3-point scale of the CBCL. Scores were recoded so that values reflecting conceptually similar behavior frequencies were equated (i.e., 1, or "Never," on the ECBI was equal to 0, or "Not True," on the CBCL; 2–4, or "Sometimes," on the ECBI was equal to 1, or "Somewhat or Sometimes True," on the CBCL; and 5–7, or "Always," on the ECBI was equal to 2, or "Very True or Often True," on the CBCL). Individual items from the externalizing factor of the CBCL were then averaged with rescaled items from the ECBI and matched with DSM-IV criteria for ADHD-Inattentive, ADHD-Hyperactive-Impulsive, Oppositional Defiant Disorder, and the aggressive items from the CD diagnosis to create four scales (i.e., items that assessed a specific DSM symptom for a disorder were included on that disorder's scale) of inattention (INATT; 3 CBCL, 4 ECBI items), hyperactivity-impulsivity (H-I; 3 CBCL, 2 ECBI items), oppositionality (OPP; 5 CBCL, 6 ECBI items), and aggression (AGG; 6 CBCL, 4 ECBI items), respectively. These scales were then averaged across the age 2–3 and the age 4–5 assessments to obtain a more stable indicator of child problem behaviors. Internal consistencies for the composites of INATT, H-I, AGG, and OPP scales were 0.79, 0.69, 0.82, and 0.85 at ages 2–3, respectively, and 0.87, 0.71, 0.84, and 0.90 at ages 4–5, respectively.

Academic Achievement Academic abilities were assessed at the age 7.5 home visit by administering the Academic Skills Cluster of the Woodcock-Johnson Tests of Achievement III (W-J), which consists of an aggregate, age-standardized composite of the subtests Letter-Word Identification, Math Calculation, and Spelling (Woodcock et al. 2001). It uses a standard score scale based on a mean of 100 and standard deviation of 15 and has a median reliability of 0.95.

Data Analysis

To carry out the study's objectives, correlations and path analysis were utilized. Analyses were conducted in MPlus 4.0 using full information maximum likelihood estimation (Muthén and Muthén 2007). Indirect intervention effects were analyzed using Prodclin (MacKinnon et al. 2007), which is preferable to other strategies (e.g., Sobel's product of coefficients test), because this method takes into account the potential non-normality of the distribution of the indirect effect. In multivariate analyses, child gender, child race and ethnicity, child language ability at age 3, and primary caregiver education level at age 2, were included as covariates because of gender, ethnic, socioeconomic, and language differences associated with externalizing behavior (Brooks-Gunn and Duncan 1997; Campbell et al. 2000; Hinshaw 1992), although no differences based on these factors were expected in the magnitude of associations between early externalizing and later academic achievement.

Results are initially presented examining age 7.5W-J Academic Skills as the outcome, followed by a summary of results of analyses using raw scores from the three W-J subtests: Letter-Word Identification, Calculation, and Spelling. For those with data at only one of two composited assessment points, scores consisted of the available data point (e.g., if data were missing at age 3, only age 2 scores were used). In addition, to ensure that multicollinearity was not problematic in analyses, tolerance statistics were examined. Below are described the findings for the study's primary hypotheses.

Results

Descriptive Statistics

Although this sample was screened for child disruptive behavior at age 2, *T scores* from the original CBCL factors indicated that participants showed similarly elevated scores on both the broad-band externalizing factor and the narrow-band aggressive behavior factor (mean *T score*s (standard deviation; *SD*) of 59.49 (8.21) and 60.17 (8.02), respectively). In addition, average *T score*s (*SD*) on narrow-band DSM-based factors for attention problems and oppositional defiant behaviors were 57.82 (6.55) and 59.15 (7.41), respectively, demonstrating that at age 2 these children were struggling in multiple externalizing domains. Comparisons between this sample's standard deviations and those identified in the CBCL standardization sample (i.e., 10) revealed that the variability in this sample is less than in lower risk samples.

Table 1 contains descriptive statistics for the study's primary independent and dependent variables. The externalizing behavior composites were created specifically for this study and, therefore, are difficult to compare to other samples. Paired samples *t*-tests between externalizing composites at age 2–3 and 4–5 demonstrate that caregiver ratings of AGG, OPP, and H-I all significantly decreased over time, while INATT did not change significantly across time points. The remaining variables represent W-J performance; the raw W-J scores indicate number of items correct while the overall Academic Skills score has been age-standardized. This sample's Academic Skills mean of 100.66 is consistent with the mean of the W-J standardization sample.

Direct Associations Between Early Externalizing Behaviors and Later Academic Achievement

As shown in Table 1, the study's first hypothesis was partially supported as age 2–3 AGG was significantly negatively correlated with the age 7.5 W-J Academic Skills composite, albeit modestly ($r=-0.094$, $p<0.05$). There was also a significant, yet modest, relationship between age 2–3 H-I and overall Academic Skills ($r=-0.090$, $p<0.05$). However, in contrast to expectations, age 2–3 INATT and OPP were not significantly related to the Academic Skills composite at school-age. Correlations between age 2–3 externalizing behaviors and individual W-J subtests at age 7.5 demonstrated similar results, with only age 2–3 AGG being significantly correlated with Letter-Word Identification ($r=-0.125$, $p<0.01$) and Spelling ($r=-0.089$, $p<0.05$). There were no other significant associations between early externalizing behaviors and the W-J subtests.

Independent Associations Between Early Externalizing and School-Age Academic Achievement

Results from multivariate path analysis with child gender, child race/ethnicity, child language, and parental education as covariates demonstrated that there were no significant associations between age 2–3 externalizing variables and school-age overall Academic Skills. However, as Fig. 1 shows, including significant associations for primary caregiver educational attainment ($\beta=0.108$, $p<0.05$) and child age 3 language ability ($\beta=0.311$, $p<0.001$), age 2–3 AGG was significantly associated with the age 7.5 Letter-Word Identification subtest ($\beta=-0.136$, $p<0.05$). A similar pattern of results was found for Spelling, with primary caregiver education ($\beta=0.096$, $p<0.05$), child language ability ($\beta=0.242$, $p<0.001$), and child AGG ($\beta=-0.123$, $p<0.05$) all emerging as significant predictors of age 7.5 Spelling. For Calculation, although no externalizing behaviors were significant, higher age 3 language ability was significantly related to higher Calculation scores at age 7.5. The associations between externalizing dimensions and achievement were similar when covariates were not included in the model. In summary, contrary to what was expected, no age 2–3 externalizing behaviors were significantly related to the overall Academic Skills outcome. Furthermore, only early AGG, rather than INATT, H-I, or OPP, was significantly associated with lower Letter-Word Identification and Spelling at school-age.

Parenting Intervention, Externalizing Behaviors, and Academic Achievement

To test the hypothesis that intervention group status would be indirectly associated with higher levels of academic achievement at school-age through greater decreases in dimensions of externalizing behaviors from toddlerhood to preschool-age, a path analysis was computed in which the dummy coded intervention variable was used to predict age 4–5 externalizing dimensions, controlling for age 2–3 levels and covariates. Age 4–5 behaviors were, in turn, used to predict academic achievement at age 7.5. Contrary to hypotheses, the majority of results demonstrated that intervention status did not have a significant indirect effect on school-age academic achievement. However, there were significant indirect effects of intervention status on age 7.5 overall Academic Skills and Letter-Word Identification through changes in aggression from ages 2–3 to 4–5. As demonstrated in Fig. 2, compared to children in the control group, children in the intervention group showed greater decreases in levels of aggression from toddlerhood to preschool-age ($\beta=-0.056$, $p<0.05$) and, subsequently, achieved higher scores on the W-J Academic Skills composite at school-age (indirect 95 % CI=0.002–0.437), driven by increases in the Letter-Word Identification subtest (95 % CI=0.002–0.293).

Table 1 Descriptives and Pearson correlations between externalizing variables and W-J academic achievement

	N	Mean (SD)	1	2	3	4	5	6	7	8	9	10	11
1. AGG composite ages 2–3	730	0.582 (0.31)											
2. OPP composite ages 2–3	731	1.09 (0.32)	0.564**										
3. H-I composite ages 2–3	731	1.23 (0.37)	0.511**	0.607**									
4. INATT composite ages 2–3	731	1.01 (0.34)	0.356**	0.479**	0.620**								
5. AGG composite ages 4–5	656	0.454 (0.31)	0.678**	0.442**	0.446**	0.317**							
6. OPP composite ages 4–5	656	1.04 (0.41)	0.494**	0.661***	0.467**	0.355**	0.639**						
7. H-I composite ages 4–5	656	1.14 (0.46)	0.344**	0.412**	0.614**	0.499**	0.509**	573**					
8. INATT composite ages 4–5	656	1.02 (0.42)	0.323**	0.366**	0.497**	0.575**	0.493**	0.530**	0.744**				
9. W-JIII: Letter Word Identification—raw score	516	36.36 (9.30)	−0.125**	−0.033	−0.070	−0.050	−0.112*	−0.084	−0.050	−0.091*			
10. W-JIII: Calculation—raw score	522	8.31 (3.03)	−0.067	−0.027	−0.064	−0.019	−0.073	−0.050	−0.084	−0.108*	0.597**		
11. W-JIII: Spelling—raw score	509	22.69 (5.14)	−0.089*	−0.013	−0.039	−0.043	−0.113*	−0.078	−0.059	−0.087	0.832**	0.563**	
12. W-JIII: Academic Skills—standard score	504	100.66 (14.31)	−0.094*	−0.018	−0.090*	−0.042	−0.116*	−0.069	−0.069	−0.092*	0.921**	0.708**	0.878**

Age 7.5 achievement N varies due to incomplete academic data for some participants

*$p<0.05$, **$p<0.01$

Discussion

Based upon the extant literature and theory it was expected that ADHD behaviors, namely inattention and, to a lesser extent, hyperactivity-impulsivity at age 2–3 would be significantly negatively associated with school-age academic achievement. However, the findings demonstrated that age 2–3 aggression was more consistently associated with age 7.5 academic performance than inattention or hyperactivity-impulsivity, albeit modestly. It was also expected that intervention group status would be indirectly related to higher levels of academic achievement at school-age, through improvements in externalizing dimensions between toddlerhood and preschool-age. Results showed that there was a significant indirect effect of the intervention on age 7.5 Academic Skills and Letter-Word Identification through changes in aggression from ages 2–3 to 4–5. Indirect effects on the other W-J subtests were not significant.

Direct Pathways Between Early Externalizing Behaviors and School-Age Academic Achievement

In both univariate and multivariate analyses, age 2–3 aggression emerged as a significant predictor of age 7.5 academic performance. Specifically, levels of aggression at age 2–3 were negatively, albeit modestly, correlated with scores in Spelling, Letter-Word Identification, and overall Academic Skills at school-age. Moreover, age 2–3 aggression continued to be a significant predictor of age 7.5 Letter-Word Identification and Spelling after accounting for other early problem behaviors, language ability, and demographic characteristics. The findings suggest that during the toddler period, aggressive behavior might be a more meaningful predictor of later academic achievement than other forms of early disruptive behavior, including inattention and hyperactivity-impulsivity. One potential explanation for this finding is that, although all externalizing dimensions from toddlerhood would be expected to show a decrease throughout development (Barkley 2003; Shaw et al. 2005), early aggression might more indicative of an emerging behavioral style that will have more disruptive cascading effects on multiple domains of later functioning than early inattention or hyperactivity-impulsivity.

Despite similar levels of oppositional behavior and aggression on the CBCL at age 2, age 2–3 oppositionality was not significantly related to age 7.5 W-J scores. In addition, contrary to a large literature connecting ADHD behaviors and academic performance, hyperactivity-impulsivity at age 2–3 was only modestly related to age 7.5 overall Academic Skills. Moreover, and contrary to expectations, once analyzed in a multivariate framework, neither hyperactivity-impulsivity nor inattention was related to age 7.5 W-J performance. The findings suggest that hyperactivity-impulsivity and inattention, assessed at age 2–3, may not be useful indicators of future

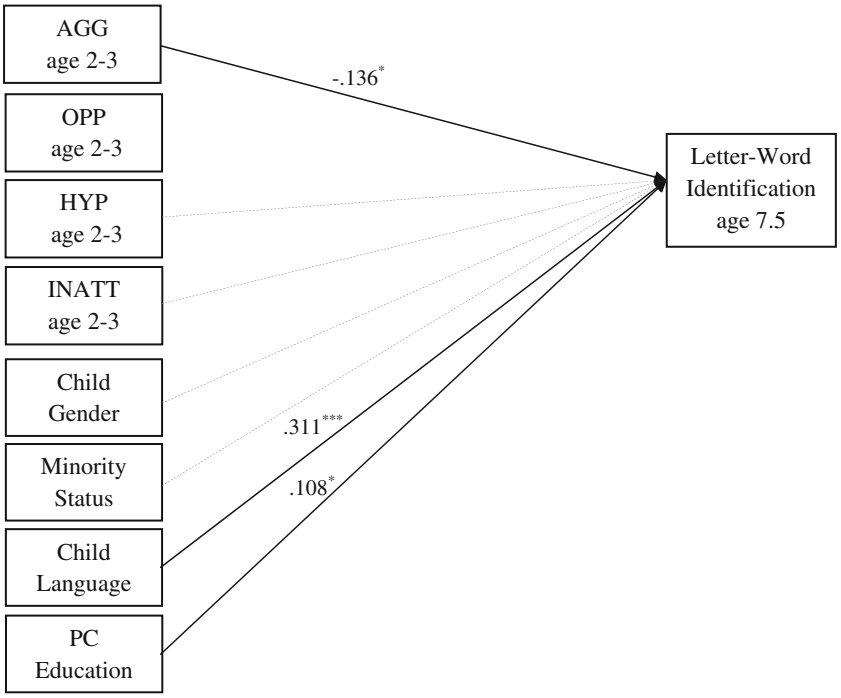

Fig. 1 Path model of age 2–3 externalizing dimensions and letter-word identification at age 7.5 with covariates. *Note.* Coefficients presented as standardized estimates; Model just-identified; *$p<0.05$, **$p<0.01$, ***$p<0.001$

academic achievement, at least in community samples of low-income children selected on the basis of risk factors in multiple domains, including early externalizing behavior. It is possible that consistent associations with ADHD and later functioning demonstrated in the extant literature do not emerge until preschool (e.g., Sanson et al. 1993). However, it is also plausible that relationships between dimensions of early problem behaviors and later academic achievement play out differently in the context of high levels of multiple types of psychosocial risk *and* multiple types of elevated externalizing behavior.

One way to test whether our findings were simply due to the relative instability of ADHD-like behaviors in toddlerhood was to examine whether associations changed when externalizing dimensions were measured at age 4–5. Consequently, all path models were re-analyzed replacing age 2–3 externalizing behaviors with the same variables measured at age 4–5. These results demonstrated that only age 4–5 aggression was

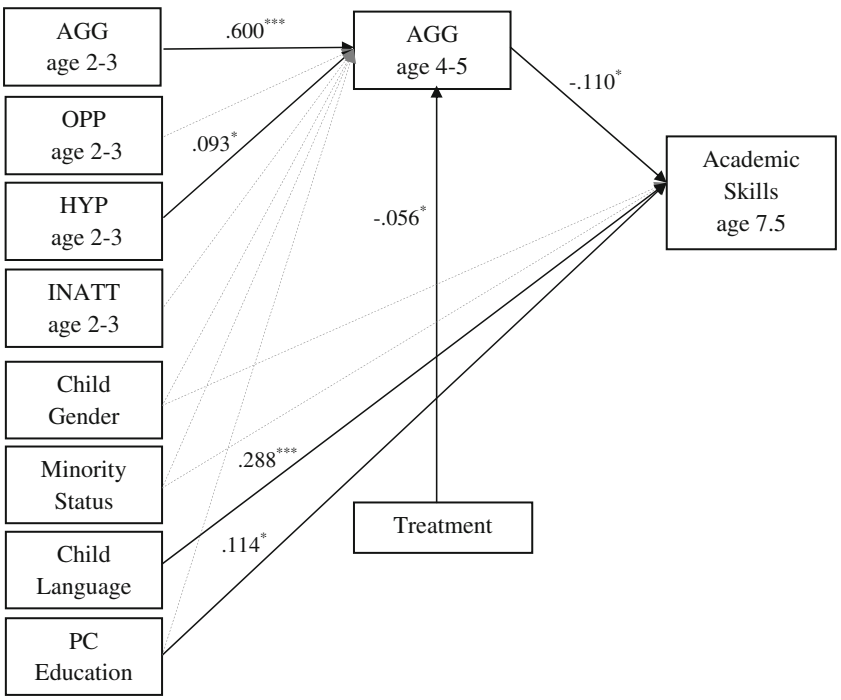

Fig. 2 Path model of indirect effect of intervention on overall academic skills at age 7.5. Note. Coefficients presented as standardized estimates; Model fit statistics: Chi-sq (20)= 44.94, $p=0.001$, CFI=0.947, TLI=0.950, RMSEA=0.04, SRMR=0.03; Treatment indirect effect 95 % CI=(0.002–0.437). *$p<0.05$, **$p<0.01$, ***$p<0.001$

associated with Letter-Word Identification (β=−0.144, p< 0.05), Spelling (β=−0.135, p<0.05), and overall Academic Skills (β=−0.159, p<0.05) at age 7.5. Thus, the consistency of our findings suggests early aggression can interfere with the acquisition of later academic skills, at least when demonstrated within the context of other socioeconomic and family risk factors and likely in the presence of elevated levels of other externalizing behaviors. Notably, the sample used in this study was recruited for being at an elevated risk of developing externalizing behavior problems when the children were 2 years old. In contrast, many of the previous studies have focused on community samples (Bub et al. 2007; Fergusson and Horwood 1995; Rapport et al. 1999) or samples recruited based on a diagnosis of ADHD (Massetti et al. 2008; Wilson and Marcotte 1996). Therefore, it is plausible that there may be a threshold above which aggression overpowers other externalizing dimensions, at least with respect to associations with later achievement. Moreover, a comparison of our sample's age 2 original CBCL *T* score standard deviations (which were not used in this study) with those from the standardization sample revealed that our sample demonstrated less variability, particularly on age 2 attention problems (e.g., sample standard deviation of 6.55 vs. 10 in the standardization sample). However, the age 2–3 measures of externalizing behavior used in this study demonstrated comparable variability (standard deviations; see Table 1). Thus, it is not likely that this study's failure to find associations between early childhood inattention and hyperactivity-impulsivity and academic achievement is due to variance differences between externalizing dimensions in our sample.

Conversely, although more research is needed on this topic, it is possible that subsequent studies examining externalizing behavior dimensions in toddlerhood will find that aggression, because of the severity of aggressive behaviors relative to symptoms of inattention, hyperactivity, and oppositionality, might be a better marker of difficulties in regulating emotions and behavior, and subsequently more likely to have deleterious cascading effects on multiple domains of functioning when children reach school-age. Specifically, the extreme nature of many aggressive behaviors (e.g., hitting others) may have broader implications than items included on the other disruptive dimensions (e.g., difficulty sustaining attention) for academic and socioemotional domains at school-age (e.g., social skills). This explanation would be consistent with the findings of Campbell et al. (2006), which demonstrated that persistently high trajectories of aggression are associated with aspects of social and emotional functioning in middle school, as well as academic outcomes at the same age. Thus, it is possible that when aggression, oppositionality, inattention, and hyperactivity-impulsivity are measured at age 2–3, aggression might be the more meaningful predictor of several dimensions of academic and socioemotional functioning at school-age. Clearly there is a need for more research examining *toddler-age* externalizing dimensions and later academic achievement in both community and high-risk samples to resolve this issue.

Parenting Intervention, Externalizing Behaviors, and Academic Achievement

Finally, intervention was found to indirectly affect overall Academic Skills and Letter-Word Identification at age 7.5 through greater decreases in levels of aggression from ages 2–3 to 4–5 for children in the intervention group than for controls. However, the magnitude of the effects was modest. One potential explanation for this could be the intent to treat nature of the analyses and the preventative design of the study. This design increases the likelihood that not all families who are offered the intervention are in need. In fact, only 47.4 % of families in the intervention group participated in all 3 annual feedbacks for which they were eligible. However, given that aggression was the externalizing dimension most consistently linked with school-age achievement, the findings relating the intervention to both changes in childhood aggression and school-age academic achievement are promising.

Limitations

In addition to this project's numerous methodological strengths, which included a longitudinal prospective design following a high-risk, low-SES sample from early childhood, this study also had several noteworthy limitations. First, child intelligence was not assessed in early childhood. This is an issue because previous work has established a link between both verbal and performance dimensions of IQ in early childhood and later externalizing problems (Hinshaw 1992), and between early intellectual abilities and later academic achievement (Duncan et al. 2007). It has been postulated that depressed IQ underlies the externalizing-achievement relationship (Hinshaw 1992). However, prior research has demonstrated that associations between school-age problem behaviors and subsequent academic achievement remain evident after accounting for child IQ (Rapport et al. 1999; Tremblay et al. 1992). Moreover, toddler-age language ability was used as a proxy of IQ in this study and our findings linking aggression in toddlerhood and preschool to later academic achievement are significant after controlling for early language.

Second, at the age 5 assessment the 1 1/2–5-year-old CBCL measure was replaced with the 6–18-year-old version, which resulted in a loss of items from all externalizing behavior composites. As a result, it was not possible to utilize identical composites at ages 2–3 and 4–5. Instead, the age 4–5 externalizing composites consisted of only those items that appeared on both the preschool-age and school-age versions of the CBCL (i.e., items that were not included on the 6–18-year-old form were not included in the age 4–5 composites).

However, the decrease in item numbers did not appear to adversely affect the internal consistencies of externalizing behavior composites at age 4–5 (e.g., Cronbach's alpha values between 0.71 and 0.90).

Third, measures of child externalizing dimensions were only available by primary caregiver report. Unfortunately, the study did not collect data from other informants such as teachers or daycare providers, who might have added a different perspective of child behavior specific to a school setting, which could be particularly relevant for later academic functioning. Future work that examines associations between teacher report of early childhood behavior and school-age academic functioning could provide important insight into whether ratings of early childhood aggression are associated with later academic achievement across settings.

Fourth, academic achievement was measured through a standardized achievement test administered by project examiners. However, it is possible that a child's performance on this measure would not translate to the classroom. To corroborate the relationship between W-J performance and actual school performance, it would be important for future work to also examine school grades, absences, and standardized test scores administered at school. Such information might elucidate additional mechanisms that could be interfering with child functioning, particularly for children who apparently possess adequate academic skills but do not carry them over to the school setting.

Finally, although it is crucial to study the relationship between child externalizing behaviors and school-age academic achievement in a population at high-risk of experiencing difficulties in both domains, in part because it is a population likely to benefit greatly from intervention (Brooks-Gunn and Duncan 1997) these findings may not generalize to other lower-risk samples. However, longitudinal research with community samples from predominantly middle-class families has revealed similar associations between early externalizing behaviors and school-age academic achievement (Bub et al. 2007; Campbell et al. 2006), suggesting that these results could be applicable to broader populations.

Clinical and Social Policy Implications and Future Directions

This study builds upon what is known of the relationship between preschool-age externalizing behavior problems and school-age academic achievement by extending this link to toddlerhood. The findings have potential clinical implications for which children could be targeted for intervention programs as early as age 2. Specifically, our results suggest that when aggression, oppositionality, inattention, and hyperactivity-impulsivity are assessed at ages 2 and 3 in a sample with multiple psychosocial risk factors, aggression might be the more meaningful indicator (albeit modest) of future school-age academic achievement. Such findings could have significant implications for prevention and intervention programs designed to target young children at risk for later academic, and potentially socioemotional, difficulties. Namely, it may be ideal for policymakers and early academic intervention programs to take into account child characteristics, such as language ability and aggression level, and family demographic variables, such as primary caregiver educational attainment, in combination when considering factors that may place a child at risk for lower academic achievement at school-age.

Future studies should examine whether the predictive utility of age 2–3 aggression is limited to academic achievement or if it is a better predictor of overall socioemotional functioning at school-age than other externalizing dimensions in toddlerhood. In addition, examining specific combinations of externalizing behaviors (e.g., aggression and hyperactivity) in toddlers in conjunction with demographic factors (e.g., educational attainment) could lead to increased predictive utility of toddler-age disruptive behaviors for school-age functioning.

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