Prevention Science (2020) 21:211–221
https://doi.org/10.1007/s11121-019-01055-9

The Cascading Effects of Externalizing Behaviors and Academic Achievement Across Developmental Transitions: Implications for Prevention and Intervention

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Published online: 17 December 2019

Abstract
Children's behavior and achievement problems are interrelated causes of distress for individuals, schools, and families, and generate long-term individual and societal costs. Yet, little is known about how the timing and direction of relationships involving achievement and problem behaviors (1) varies by standardized versus teacher ratings of achievement and (2) changes as students enter adolescence and begin secondary school. Using data from the Study of Early Child Care and Youth Development ($N = 1048$, 50.05% female), we employed longitudinal structural equation modeling to examine the relationship between externalizing behaviors and two forms of achievement from third through ninth grade. Results revealed that externalizing behaviors in grades three, five, and six directly and indirectly influenced teacher ratings of school achievement in grades 5, 6, and 9, and indirectly influenced standardized assessments of achievement over time. The reciprocal relationships involving externalizing behaviors and school achievement were especially strong from grade 6 to grade 9with their contemporaneous association peaking in grade 9. Demographic and maturational factors influenced the average levels of externalizing behaviors and achievement scores over development, but none altered the timing and direction of these relationships. Our findings highlight early adolescence as an important period for implementing evidence-based interventions related to the reduction of externalizing behaviors and improvements in achievement. Implications for prevention research, practice, and policy are discussed.

Keywords Developmental cascades · Externalizing behaviors · Achievement · Adolescent · Autoregressive cross-lagged panel model

Children's academic achievement and behavior influence key public health outcomes and later health disparities (Conti et al. 2010; Moffitt et al. 2011). Behavioral problems are precursors or manifestations of several prevalent mental health disorders that often emerge during adolescence, including conduct disorders, mood disorders, and substance use disorders (Merikangas et al. 2009). Similarly, academic achievement, uniquely predicts mental health outcomes (Suldo et al. 2011), and declines in achievement become increasingly common as children enter secondary school (Blackwell et al. 2007). This heightened vulnerability to mental health conditions and reduced school achievement during adolescence may arise from the accumulation of interrelated academic and behavioral problems. Because behavioral and academic problems are so interrelated (Burt and Roisman 2010), identifying emerging deficits in one area can prevent future problems in multiple areas, thereby reducing their cumulative costs to individuals, families, schools, and society. However, to date, few studies have disentangled the timing and direction of relationships involving children's achievement and behavior problems across key developmental transitions.

Electronic supplementary material The online version of this article (https://doi.org/10.1007/s11121-019-01055-9) contains supplementary material, which is available to authorized users.

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Externalizing Behaviors and Achievement

Youth's behavioral functioning is important to their overall socio-emotional development and achievement in school. The current study focuses on aggressive and delinquent externalizing behaviors that impair healthy developmental and academic progress from elementary through high school. These problem behaviors distract students and interfere with their ability to engage in classroom learning. They may also affect a teacher's judgment of a student's achievement (Zimmermann et al. 2013). Moreover, aggressive and delinquent behaviors are amenable to prevention and intervention across the school years.

Academic achievement is also a critical competency for youth that depends on their cognitive abilities, behavioral functioning, and opportunities and expectations for learning and achievement. Achievement is primarily characterized throughout research and practice in two ways: (1) Teacher assigned grades and ratings of academic performance in school, and (2) standardized assessments of subject knowledge, often referred to as cognitive achievement. Teacher assigned grades that reflect the degree to which students meet context-specific expectations for academic performance and their success in navigating the social processes of school (Bowers 2009). In addition, grades provide regular feedback on students' academic performance, are easily understood and compared between peers, and proximally shape students' perceptions of their academic abilities (Pinxten et al. 2010). In contrast, standardized assessments of achievement provide more objective evaluations of academic abilities and aptitudes at a point in time, are more stable over time, and allow interpretation against age-adjusted normative performance (Pinxten et al. 2010). This study examines the combined average of students' reading and mathematics achievement in school and on standardized assessments, as these are the primary indicators of achievement used for decision-making by school administrators and policy makers. We conceptualize reading and mathematics achievement as a combined construct with collective implications to health and development, in order to facilitate comparison and interpretation of this study within research specific to the interrelationships of children's overall behavior and achievement.

Teacher ratings and standardized assessments are likely to differentially affect and be affected by externalizing behaviors, thereby yielding distinct implications for both research and practice. Carifio and Carey suggest that grades have a greater effect on student confidence, behavior, motivation, and future performance compared to standardized test scores (2009). Students' perceptions of their academic abilities and the value they attribute to learning are positively influenced by academic success and negatively influenced by academic failure (Durlak et al. 2011). Repeated failure in school is likely to elicit further negative responses to classroom practices and disrupt students' learning behaviors and interpersonal interactions (Bowers 2009). Indeed, the value that students attribute to learning is influenced by their grades (Durlak et al. 2011), with low academic performance in school leading to student disengagement with learning and peers (Bowers 2009). In contrast, standardized assessments of achievement are less affected by rater and context (Durlak et al. 2011), and are therefore less likely to influence students' self-perceptions and behavior within learning contexts. Because of this and the fact that teacher ratings of student achievement are provided more frequently, the interrelationships of externalizing behaviors with school achievement are likely greater than those with cognitive achievement. Whether low grades earned by misbehaving students reflect poor performance on classwork, are used as a means of penalizing students for disruptive or oppositional behaviors, or incorporate teachers' selective perceptions and expectations—examining the relationship between externalizing behaviors and different assessments of achievement in a US sample, where grading practices widely vary across schools and classrooms—may elucidate differential implications of various assessment practices to children's externalizing problems across development.

Externalizing Behaviors and Achievement: Developmental Cascades

Previous research identifies concurrent and longitudinal associations between externalizing behaviors and low achievement (Zimmermann et al. 2013; Moilanen et al. 2010). Disentangling the directionality of these relationships is complex. Problems in either externalizing behaviors or achievement "spread" directly to the other domain and "accumulate" as a sequence of direct and indirect effects that culminate over time. This accumulation of direct and indirect effects is known as a "developmental cascade" (Masten et al. 2005). Empirical studies of developmental cascades account for the cross-sectional associations between functional domains and the longitudinal stabilities within each domain of functioning, in order to determine the timing and directionality of the cross-domain relationships over development. Masten and Ciccchetti (2010) suggest three substantive explanations for why two functional domains become linked over time:

1. Problems in one functional domain undermine adaptive functioning in another.
2. Failures in adaptive functioning contribute to problems in another functional domain.
3. An unmeasured factor contributes to both adaptive functioning and problems.

Prior studies of developmental cascades involving externalizing and achievement problems provide some support

for these first two substantive explanations, a few of which control for potential third-variable explanations such as socioeconomic status (SES) and gender (Masten et al. 2005; Burt and Roisman 2010). Indeed, negative cascades from externalizing problems in early childhood to low achievement in childhood (Burt and Roisman 2010) and late adolescence (Masten et al. 2005) hold across gender and SES, despite differences in rates and types of academic and externalizing problems in girls and boys. To date, however, no studies of developmental cascades involving externalizing and academic problems have accounted for a comprehensive range of non-demographic factors that contribute to children's adaptive functioning and problems.

The Influence of Developmental Processes

Social and maturational factors likely influence developmental cascades involving externalizing behaviors and achievement. Even normative biological and social transitions create novel and additional demands, and success or failure to adapt to such changes creates opportunities or problems that contribute to later successes or failures (Eccles et al. 1993). The transition to secondary school, increased parental autonomy, or a natural change in a biological system such as the onset of puberty create novel demands that may strain adaptive functioning (Eccles et al. 1993). Failure to adapt to the additional and novel demands associated with these transitions may be demonstrated in terms of oppositional behavior and/or academic disengagement. Despite their importance to both adaptive functioning and academic and behavioral problems, no prior study of developmental cascades has accounted for social and maturational factors as a possible explanation for why externalizing and achievement problems become linked over time.

Moreover, the many changes that occur at the onset of adolescence and beginning of secondary school make the late elementary and middle school years ideal times to prevent and intervene upon negative progressions of problems. Indeed, the middle elementary grades have been identified as pivotal contexts to recapture the portion of youth who are likely to struggle academically, demonstrate conduct problems and affiliations with negative peers, and experience mental health problems during this time (Eccles et al. 1993).

Current Study

Identifying optimal periods for prevention and intervention of negative cascades may improve efforts to support struggling students and ensure that they receive the comprehensive support they need to thrive in school. In addition, accounting for multiple measures of achievement will inform best practices for identifying children at risk for academic or behavior. To date, however, no study of developmental cascades has simultaneously examined the unique interrelationships of children's behavior problems with their achievement in school and on standardized assessments, ruling out adolescent social and maturational factors as potential confounders. This study aims to identify the timing and direction by which developmental cascades involving children's externalizing behaviors, achievement in school, and achievement on standardized assessments unfold as they transition to adolescence. We had three hypotheses: (1) Developmental cascades involving externalizing behaviors, achievement in school, and achievement on standardized assessments will be significant from third through fifth grades, and these effects persist through sixth and ninth grades; (2) the timing of transition to secondary school, parenting, and pubertal timing are important to average levels of externalizing behaviors and achievement, but do not confound the timing and direction of their interrelationships; and (3) the magnitudes of developmental cascades involving children's externalizing behaviors and their achievement in school will be greater than those involving externalizing behaviors and their achievement on standardized assessments.

Method

Participants and Data Collection Procedures

Using a prospective longitudinal study, we analyzed data from a subset (n = 1048) of participants enrolled in the National Institute of Child Health and Development Study of Early Child Care and Youth Development (NICHD SECCYD) from 1991 to 2007. Healthy newborns and families were recruited within 24 h of birth in 1991 from 31 US hospitals in ten locations that each made up approximately 10% of the entire sample. The study represented a predominantly Caucasian (80%), geographically diverse sample identified approximately as 50% urban, 30% suburban, and 20% rural. Although the NICHD SECCYD is a large national study, the sample is not nationally representative. Data was collected in accordance with a random sampling plan conditioned on several inclusion criteria: (a) Mothers were healthy, older than 18, spoke conversant English; (b) infants were healthy and delivered as a single birth; and (c) families did not plan to give the infant up for adoption and resided in a neighborhood within a 1-h drive of the research site that police deemed safe to visit. Data collection procedures involved trained observers, interviewers, questionnaires, and direct testing (NICHD Early Child Care Research Network (ECCRN) 2005). Measures were collected across several settings (home, school, lab) and involved multiple

reporters (study participants, teachers, mothers) from birth through ninth grade (NICHD ECCRN 2005).

As illustrated in the flow chart (supplemental Fig. 1), our analytic sample includes 1048 of the 1364 children and families obtained at baseline. The current sample included children who did not have a severe developmental disability and had valid data for at least one of the main outcomes of interest (externalizing behavior, school achievement, and cognitive achievement) from at least one time point between fifth and ninth grades. Descriptive characteristics are provided in Supplemental Table 1.

Measures of Functioning

Externalizing Behaviors

Mothers reported children's externalizing behaviors in first, third, fifth, sixth, and ninth grades on the Child Behavior Checklist (Achenbach and Ruffle 2000). The externalizing behaviors subscales included 20 items that assessed aggressive behaviors ($\alpha = 0.88$–0.90) and 13 items that assessed delinquent behaviors ($\alpha = 0.56$–0.73), with response categories that range from 0 (not at all true) to 3 (very true). We used *t*-scores truncated at the population mean of $t = 50$ for comparison with prior research and clinical relevance.

School Achievement

Teachers completed the Current School Performance subscale of the Mock Report Card (Pierce et al. 1999), to assess school achievement using a five-point scale (1 = Below Grade Level to 5 = Excellent) for various subjects in first, third, fifth, and sixth grades. Reading and mathematics scores were averaged in this study. Children's high school transcripts provided ninth grade English and Mathematics grade point averages (0.0–4.0).

Standardized Assessment Achievement

Children were administered the Woodcock-Johnson Test of Academic Achievement – Revised (WJ-R) Test 23 for Passage Comprehension and Test 25 for Applied Mathematics Problems (Woodcock et al. 1990). The WJ-R provides age and grade normed scores. W scores were calculated using item response theory methods to provide comparable scores across grade levels. Alpha reliabilities of the literacy and mathematics composite scores were the following: grade 1, $\alpha = 0.83$; grade 3, $\alpha = 0.91$; grade 5, $\alpha = 0.88$; and grade 9, $\alpha = 0.89$.

Model Covariates

Parenting

Parenting quality was assessed through videotaped structured mother-child interactions at first, third, fifth, and ninth grades that were coded by trained NICHD personnel to rate mothers' supportive presence, respect for the child's autonomy, and reflected hostility. Per NICHD ECCRN recommendations, a composite score was constructed at each wave (1 = low; 7 = high) and averaged across all waves ($\alpha = 0.80$ to 0.85).

Timing of Pubertal Onset

Tanner's stages of pubertal development (Tanner and Whitehouse 1976) were assessed by a nurse practitioner or pediatric endocrinologist when children were 9 ½ years and repeated annually. Stages range from 1 (pre-puberty) to 5 (full maturation). The criterion used for age of pubertal onset was Tanner stage 2 for pubic hair. The age of pubertal onset was race and gender normed.

Secondary School Transition

Principals reported the grade configurations for each child's school. The transition to secondary school was operationalized as a binary indicator of whether (or not) the child experienced a typical transition from an elementary to a secondary educational setting between fifth and sixth grades.

Demographic Characteristics

Mothers reported their education level and the child's race and gender when the child was 1 month old. An income ratio was calculated by dividing the total family income by the US Census-based poverty-level income for the family size and averaged over assessments obtained at 6 months through first grade.

Early Functioning

First-grade externalizing behaviors, school achievement, and cognitive achievement were controlled for in all analyses.

Statistical Analyses

After examining descriptive statistics and bivariate correlations, we conducted confirmatory factor analyses (CFA) to estimate a measurement model for parenting quality and externalizing behaviors from their observed indicators All other variables, including the average of children's reading and

mathematics achievement in school and on standardized assessments, were treated as manifest variables.

Next, we fit the full baseline autoregressive cross-lagged (ARCL) panel model presented in supplemental Fig. 2, which estimated all cross-sectional associations between functions, stability paths within each function across the first and second lags and cross-lagged paths between functions; we also estimated all possible indirect effects from each function in third grade to those in ninth using bias-corrected products of the coefficients as recommended by Hayes (2009) and MacKinnon (2008). We assessed gender invariance of the baseline model (supplemental Fig. 2) before regressing pubertal onset, parenting quality, secondary transition indicator, and other demographic covariates on each of the functions presented in the analytic model (Fig. 1); note that all cross-sectional associations, stability paths, and cross-lagged paths estimated in the baseline model (supplemental Fig. 2) were retained in the analytic model with covariates (Fig. 1), regardless of significance but are not pictured for clarity. Early parenting quality, demographic characteristics, and early functioning were treated as time invariant and controlled for prior to third grade. We added the other covariates by regressing all functions in fifth through ninth grades on pubertal timing, all functions from third through ninth grades on parenting, and all functions in sixth and ninth grades on the sixth grade school transition indicator.

We estimated the CFA and SEM models using Mplus version 7 (Muthén and Muthén 2012). The assessment of model fit was guided by two fit indices: Smaller values of the root mean square of approximation (RMSEA) suggest better model fit, with adequate values ≤ 0.05, whereas values above 0.90 on comparative fit index (CFI) indicate good model fit (Little 2013).

Theoretical and conceptual interpretability, parsimony, and overall fit to the data informed all model comparisons. Measures that exceeded the average of 11% missingness include school achievement data in grades 5 (15%), 6 (18%), and 9 (32%), and parenting quality in grade 9 (18%). Data were considered missing at random based on the large number of unique missing data patterns, documented changes to data collection protocols for school achievement data in grade 9 in which principals replaced teachers as sole providers of school achievement data, and the ability to account for variables such as income and race related to the propensity of missing data. In addition, sensitivity analyses comparing model fit and results between those with and without ninth grade achievement data suggested the model fit and results did not significantly differ. We used full information maximum likelihood estimation techniques in order to include all available data for participants (Muthén and Muthén 2012).

Results Measurement Model

Confirmatory factor analysis results indicated that the observed parenting data fit the latent variable model well (CFI = 0.978, RMSEA = 0.04, 90% confidence interval (CI) [0.036, 0.043]. Factor loadings ranged from 0.52 to 0.94 across all parenting items. The confirmatory factor analysis for externalizing behaviors was not identified since the assessment of externalizing behaviors using the Child Behavior Checklist was comprised of only two subscales. However, in the larger structural model, it was identifiable and thus a latent variable for externalizing behaviors was included.

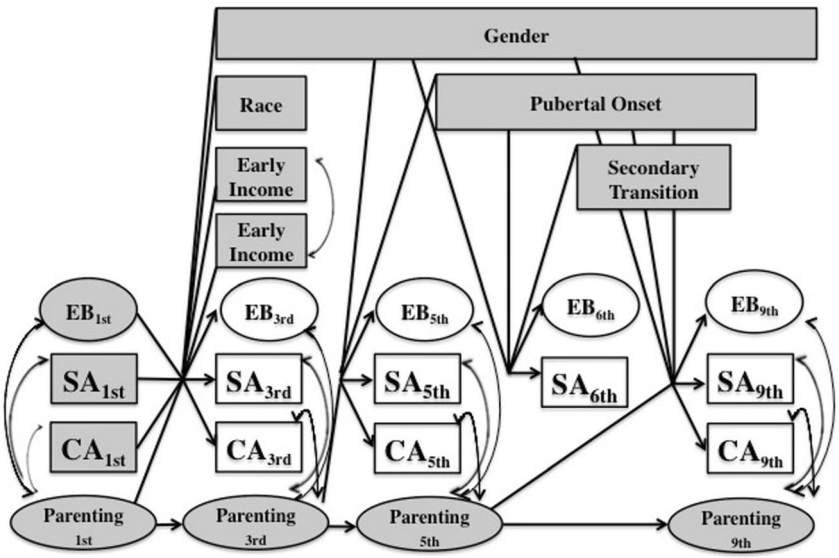

Fig. 1 Analytic model with covariates. All stability paths, contemporaneous associations, and cascade paths retained but omitted from the figure for clarity. EB externalizing behaviors, SA school achievement, CA standardized achievement

Hypothesis 1. Developmental Cascades Involving Externalizing Behaviors and Achievement

The hypothesized, unadjusted model of developmental cascades fit the observed data well (CFI = 0.989, RMSEA = 0.032) and was gender invariant $\Delta\chi^2$ (21) = 0.26.9, p = 0.17. We identified several significant direct cross-domain paths across lags, accounting for the cross-sectional associations between functions (Table 1) and longitudinal stability within functions (Table 2), indicating the presence of cascades between some, but not all, functions. We present the adjusted cascade estimates, as they remained comparable in magnitude and significance to the unadjusted estimates (Fig. 2).

There were significant negative effects of externalizing behaviors on school achievement from grade 3 to grade 5 ($\beta = -0.082$, $p < 0.05$) and from grade 5 to grade 6 ($\beta = -0.063$, $p < 0.05$), and the magnitude more than doubled from grade 6 to grade 9 ($\beta = -0.160$, $p < 0.05$) (Fig. 2). The reciprocal effect of school achievement on later externalizing behaviors was only significant from grade 6 to grade 9 ($\beta = -0.131$, $p < 0.05$). Significant cascades were observed between children's standardized assessment scores and their achievement in school in both directions, with the largest path occurring from third grade standardized achievement to fifth grade school achievement ($\beta = 0.316$, $p < 0.01$). No significant cascades involving externalizing behaviors and standardized achievement were observed in either direction at any point.

While not directly related to the primary study hypotheses, it is worth noting the relative magnitudes and significance of cross-sectional associations between functions (Table 1) and stabilities within functions (Table 2). Significant cross-sectional associations were identified between school and standardized achievement in each grade ($\beta = 0.22$–0.37, $p < 0.001$), externalizing behaviors and school achievement in grades 3, 5, and 9 ($\beta = 0.03$–0.20, $p < .001$–$.05$), and only one cross-sectional association was significant between externalizing behaviors and standardized achievement in grade three ($\beta = 0.15$, $p < 0.01$). Standardized achievement and externalizing behaviors were more stable over time ($\beta = 0.22$–0.69, $p < 0.001$; $\beta = 0.31$–0.71, $p < 0.001$, respectively) relative to school achievement ($\beta = 0.22$–0.48, $p < 0.001$).

Hypothesis 2. Developmental Cascades Persist after Accounting for Social and Maturational Factors

When the model was adjusted to account for family and maturational factors good model fit was maintained (CFI = 0.976, RMSEA = 0.037), all direct and indirect cascade paths identified in the baseline model remained significant when adjusting for pubertal onset, parenting quality, the sixth grade transition to secondary school, gender, and demographic characteristics. Figure 2 presents significant cascade and covariate paths obtained from the final structural model with covariates. All paths fit in the baseline (supplemental Fig. 2) and analytic models (Fig. 1) were retained regardless of significance, but only the significant cascade and covariate paths are pictured in Fig. 2. All cross-sectional associations and stability paths were also retained regardless of significance and reported separately in Tables 1 and 2. Early family income, maternal education, and race significantly affected school and standardized achievement in third grade, but did not significantly affect

Table 1 Cross-sectional associations of behavior and achievement outcomes (n = 1048)

Path	Unadjusted effects		Adjusted effects	
	ψ	SE	ψ	SE
Externalizing behaviors with school achievement				
EB3 and SA3	−.11*	.05	−.10*	.05
EB5 and SA5	−.03*	.04	−.02	.04
EB6 and SA6	−.07	.05	−.07	.05
EB9 and SA9	−.20***	.05	−.22***	.05
Externalizing behaviors with standardized achievement				
EB3 and CA3	−.15**	.05	−.14**	.05
EB5 and CA5	−.01	.05	−.01	.05
EB9 and CA9	−.04	.04	−.04	.04
School achievement with standardized achievement				
SA3 and CA3	.37***	.03	.34***	.03
SA5 and CA5	.22***	.04	.21***	.04
SA9 and CA9	.26***	.04	.28***	.04

EB externalizing behaviors, *SA* school achievement, *CA* standardized achievement

*$p < .05$; **$p < .01$; ***$p < .001$

Table 2 Stability paths of behavior and achievement outcomes across lags ($n = 1048$)

Path	Unadjusted effects		Adjusted effects	
	ψ	SE	ψ	SE
Externalizing behaviors (EB)				
EB3 to EB5	.38***	.09	.37***	.09
EB5 to EB6	.71***	.06	.72***	.07
EB6 to EB9	.36***	.11	.36**	.11
EB3 to EB5	.38***	.09	.37***	.09
EB5 to EB9	.31**	.11	.29**	.11
School achievement (SA)				
SA3 to SA5	.36***	.04	.35***	.04
SA5 to SA6	.48***	.03	.47***	.03
SA6 to SA9	.23***	.05	.20***	.05
SA3 to SA6	.32***	.03	.32***	.03
SA5 to SA9	.22***	.05	.19***	.05
Standardized achievement (CA)				
CA3 to CA5	.69***	.04	.69***	.04
CA5 to CA6	.49***	.04	.47***	.04
CA5 to CA9	.22***	.04	.22***	.04

EB externalizing behaviors, *SA* school achievement, *CA* standardized achievement

*$p < .05$; **$p < .01$; ***$p < .001$

externalizing behaviors (Fig. 2). Gender significantly affected externalizing behaviors in grade 3, school achievement in grades 5–9, and standardized achievement in grade 9 (Fig. 2). Otherwise, the zero-order relationships between demographic factors and achievement and behavior were consistent with previous literature (Hinshaw 1992).

Effects of adolescent social and maturational processes on functional domains varied. Students who transitioned to secondary school between fifth and sixth grades showed greater levels of externalizing behaviors in grade 6 ($\beta = 0.056$, $p < 0.05$) and lower school achievement in grade 9 ($\beta = -0.07$, $p < 0.05$) compared to those who transitioned at another time, usually later. The age of pubertal onset did not significantly affect any functions at any time point.

Higher parenting quality in third grade significantly predicted lower externalizing behaviors in fifth grade; parenting quality in third and fifth grades significantly predicted higher school achievement in fifth and ninth grades, respectively; and parenting quality in first, third, and fifth grades significantly predicted standardized achievement in third, fifth, and ninth grades, respectively. Lastly, the within-time associations involving each function and parenting were significant and negative for externalizing behaviors at all time points, school achievement in third grade, and standardized achievement in fifth and ninth grades ($p < 0.01$).

Hypothesis 3. Magnitudes of Developmental Cascades Are Strongest for Externalizing Behaviors and School Achievement

Four direct (Fig. 2) and four indirect cascade paths (Supplemental Table 1) involving externalizing behaviors with school achievement were significant. Only one indirect pathway involving externalizing behaviors with cognitive achievement was significant (Supplemental Table 1).

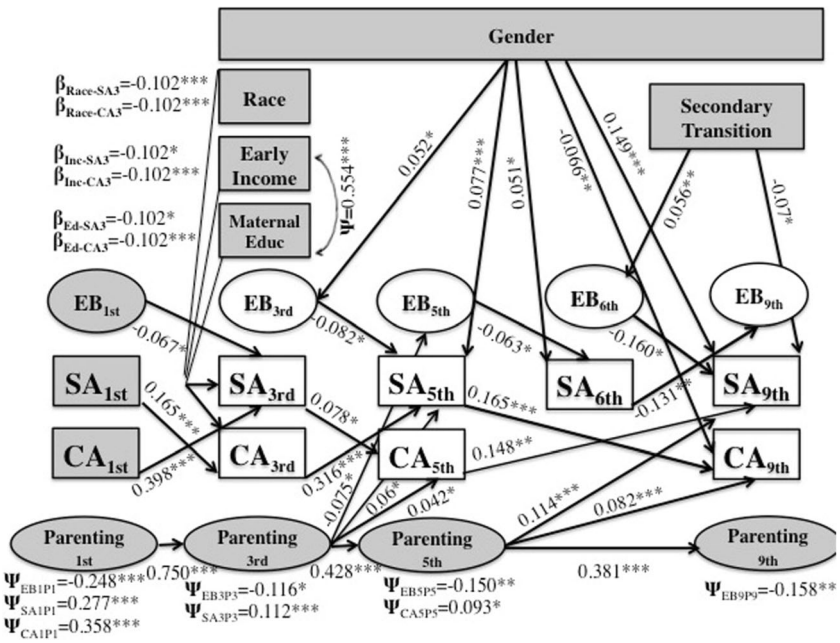

Fig. 2 Statistically significant cascade and covariate effects estimated in the final model. All stability paths and contemporaneous associations of functions presented in Tables 1 and 2 and omitted from the figure for clarity. EB externalizing behaviors, SA school achievement, CA standardized achievement, P parenting. ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

Sensitivity Analyses

Examination of the extent to which the 32% of adolescents for whom school achievement data was missing in ninth grade may have biased findings suggests that this proportion of missing data did not bias inferences. Multiple group analyses of the final adjusted model with all paths through sixth grade, and through ninth grade (excluding paths involving school achievement in ninth grade) demonstrate that both models fit the data equally well across samples with and without ninth grade school achievement data ($\Delta\chi^2$ (15) = 13.99, p = 0.53 and $\Delta\chi^2$ (20) = 20.40, p = 0.43, respectively), indicating that the missing data did not bias the findings.

Given prior findings of the importance of internalizing problems (Vaillancourt et al. 2013) and inattention (Herman et al. 2007) to externalizing behaviors and achievement, a set of sensitivity analyses were conducted to control for these factors. When each function was regressed on maternal reported internalizing problems on the Child Behavior Checklist (CBCL) (Achenbach and Ruffle 2000), model fit declined to below acceptable (CFI = 0.88, RMSEA = .05) and yielded estimates that were comparable in magnitude and significance to those obtained from the original model. Two additional sensitivity analyses accounted for attention problems reported by mothers on the CBCL across all grades, and lab-based assessments of inattention using the Continuous Performance Task (Klee and Garfinkel 1983) measured in grades 1 and 4. Each model fit the data less well (CFI = 0.90, RMSEA = 0.05 and CFI = 0.949, RMSEA = 0.036, respectively) than our original hypothesized model (CFI = 0.976, RMSEA = 0.037); however, our primary findings remained the same.

Discussion

This longitudinal study of U.S. children helps to disentangle the timing and mechanisms of developmental cascades involving children's externalizing behaviors and two aspects of achievement from elementary through early high school, accounting for key family factors and adolescent social and maturational processes. It is the first US study to follow children across this period to understand the dynamic interrelationships of children's externalizing behaviors with their achievement in school and on standardized assessments.

Significant cascades between externalizing behaviors and school achievement, and between school and standardized achievement from elementary through secondary school, provide support for our first hypothesis. Results are largely consistent with the notion that children's externalizing behaviors and school achievement are both independent of and interdependent with each other, as explained by Masten and Cicchetti (2010). Further, these results provide evidence that the importance of behavior and achievement problems and the processes by which they influence each other do not significantly differ between boys and girls. Of note, the reciprocal cascades involving externalizing problems and school achievement were especially strong from grade 6 to grade 9, with their contemporaneous association peaking in grade 9. Importantly, the mean level of externalizing behaviors remained remarkably consistent over the course of the study. Taken together, these findings suggest that the negative *effects* of externalizing behaviors worsen as children enter adolescence, even when changes in the level of these behaviors are minimal.

Developmental cascades persisted after accounting for unmeasured factors linked to children's behavioral and academic adaptive functioning and problems, therefore providing support for our second hypothesis. Primary findings and sensitivity analyses confirm that social and maturational factors, demographic characteristics, inattention, and internalizing problems are important to children's average levels of achievement and behavior problems. However, these factors do not confound the processes by which externalizing and achievement problems become linked over time, making the third possible mechanism for developmental cascades proposed by Masten and Cicchetti less likely (2010). In other words, the degree to which a child experiences success or difficulty in their functioning is influenced by such factors, but the factors themselves do not account for the actual impact that problems in one domain of functioning have on another.

Despite observed declines in parenting quality through adolescence, the relative magnitude of the relationship between parenting and functioning increased as children progressed through adolescence. This finding further enriches a large body of research that identifies parenting as a critical developmental context for problem behaviors and the transmission of values for education, persisting through adolescence (Pinquart 2016).

The negative impact on sixth grade externalizing behaviors and ninth grade school achievement among those who did not transition to middle school at grade 6 is congruent with previous studies that identify increased behavior problems and achievement loss associated with school transitions earlier than sixth grade (Ray and Elliott 2006). The decline suggests that for some students, school transitions may exceed their ability to adapt to new instructional formats, decreased perceived support, disrupted social networks, and heightened expectations for personal responsibility (Steinberg 2005).

Our last hypothesis was fully supported. In accordance with prior comparisons of teacher ratings and standardized assessments of achievement (Bowers 2009), the magnitudes of total developmental cascade paths involving externalizing behaviors and school achievement far exceeded that of the sole indirect pathway linking third grade externalizing behaviors to ninth grade cognitive achievement through fifth grade school achievement. Results are consistent with

findings by Zimmermann et al. (2013) who found no direct relationships between standardized achievement and externalizing behaviors when accounting for school achievement among German youth, and with Burt and Roisman (2010) who identified no direct cascades involving standardized assessments of achievement and externalizing behaviors. Results further confirm that the way in which achievement is assessed differentially affects and is affected by children's behavior problems. The effects of externalizing behaviors on achievement not captured by standardized assessments may relate to the challenges they present to teacher's instructional delivery and classroom management techniques. Student's delinquent or aggressive behavior strains teacher's abilities to judiciously respond to misbehavior, may elicit additional misbehavior by other students, and interrupts teaching and learning (Randall and Engelhard 2010). In addition, a student's misbehavior in the classroom distracts them from instructional learning and threatens the performances on formal and informal assessments of classroom learning outcomes (Randall and Engelhard 2010). Disruptive and non-compliant children also become increasingly more likely to be removed from classroom learning opportunities as they enter secondary school (Eccles et al. 1993).

Taken together, these results confirm the meaningful role of behavior problems in elementary school to later academic success in school, and they highlight the importance of understanding early adolescents' academic difficulties as *both a consequence and risk factor* for delinquent and aggressive behaviors. Moreover, the significance of developmental cascades from elementary through high school, holding early functioning constant, suggests that middle childhood and early adolescence may be unique periods during which achievement and behavioral problems interact powerfully to influence one another. Our findings highlight the importance of efforts to promote parenting quality among parents of older children and early adolescents, especially those challenged by children with behavioral or academic problems.

Strengths and Limitations

The multiple, repeated assessments of externalizing behaviors, achievement, and key social and biological factors are major strengths of this study. Triangulating from the breadth and depth of the multi-method data collection involving observation, direct measurement, clinical assessments, and questionnaires of multiple informants further strengthens the validity and reliability of study inferences.

The results of this study should be interpreted with consideration of its limitations. As with all studies, generalizability should be considered in terms of the sample, which is relatively advantaged and predominantly White. Consequently, findings are likely to be conservative estimates of relationships, given the modest level of externalizing problems and high mean school achievement scores, and subgroup analyses by racial/ethnic group were not possible. The level of missing data on ninth grade achievement is not ideal, but the data were missing at random and our sensitivity analysis demonstrated that the results were not biased by the missing data. Additionally, the percentage of missing ninth grade achievement data is similar to other secondary data analyses of educational and developmental outcomes in longitudinal studies (e.g., Chatterji 2005; Balistreri and Van Hook 2009; Carlson et al. 2008).

Implications

Elementary and middle schools are logical settings to promote children's positive behavioral functioning given the persistent cascading effects of behavior problems on achievement and nearly universal system for promoting children's health and development. Identification and intervention for externalizing behaviors in elementary school may serve to attenuate the risk posed to achievement across the school years, and it may also prevent behavior problems in high school brought on by low achievement in middle school. Universal interventions such as PATHS to PAX delivered in middle and late elementary hold promise for promoting children's positive behavior and later high school achievement. Selective and indicated interventions in elementary and middle school (e.g., Positive Behavior Intervention and Support (PBIS) tiers II and III systems) are important for attenuating the risk posed for achievement and may also prevent subsequent behavior problems brought on by low achievement as students transition to high school (Diamond 2012).

The shifting relative contributions of school and cognitive achievement in elementary school to later achievement in high school, and the significance of the parenting and middle school transition status, highlight the importance of targeting promotion efforts to the unique developmental needs of adolescents. These results further support the value of formal interventions such as the Coping with Middle School Transitions program (Lochman and Wells 2002) and school-based practices that are effective in targeting parent involvement, improving teachers' identification of children with problem behaviors, advancing teachers' use of positive classroom management strategies, and incorporating instructional activities to directly facilitate children's social and study skills (Cohen and Smerdon 2009). It is also imperative to *support* teachers and parents facing the challenges of misbehavior by providing them with a range of techniques to establish clear expectations for behavior and social interaction, deliver positive feedback, and enforce rules with consistency and effective discipline.

Lastly, findings highlight the importance of considering the differential implications of assessments of school and cognitive achievement for research and in practice. Teacher assessments of children's school achievement add information that can be particularly important for effectively targeting prevention and intervention. When grades and standardized test scores are both low, remedial instruction is warranted. However, low grades alone necessitate a closer examination of school culture around grading practices (Carifio and Carey 2009; Randall and Engelhard 2010), teacher beliefs and expectations for student achievement (Cox 2011), and the student's work ethic, conduct, and interpersonal interactions (Carifio and Carey 2009). Indeed, results suggest that valid grade assignment can help prevent further maladaptive responses to classroom practices among students with emerging behavior problems. Additional strategies may involve assigning separate behavior grades and establishing systematic methods for the assessment of school performance within and across schools.

Conclusion

Positive behavioral and academic functioning in school is important for healthy development through adolescence and adulthood and is protective against later poor health, substance abuse, criminality, school dropout, and serious behavior problems (Henry et al. 2012). Our study powerfully demonstrates elementary school as a critical and foundational period to address externalizing behaviors and promote school achievement in secondary school. In addition, addressing low achievement in middle school may be critical for the prevention of subsequent behavior problems in high school. Future studies should more closely examine how school environments and available supports may be able to modify the processes by which cascade effects involving externalizing behaviors and academic functioning unfold especially prior to and during school transitions.

Acknowledgments We gratefully acknowledge the NICHD Early Child Care Network who facilitated in the recruitment and follow-up of the Study of Early Child Care and Youth Development, as well as the participants of this study. Through their contributions, this work has been possible.

Funding Source This Study of Early Child Care and Youth Development (the parent study) was supported by the National Institute of Child Health and Development. Lauren Okano was supported by the NIMH (5 T32 MH 19545-24) in her training.

Compliance with Ethical Standards

The research reported in this manuscript has been funded through the National Institutes of Health, and, therefore, its publication must comply with the NIH Public Access Policy (http://grants.nih.gov/grants/guide/notice-files/NOT-OD-08-033.html).

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All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of Interest The authors declare that they have no conflicts of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with animals performed by any of the authors. Informed consent was obtained from all individual participants included in the parent study.

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