



Demographic and Socioeconomic Predictors of Behavioral Trajectories from Age 3 to 15: A Longitudinal Mixed Effects Approach

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Abstract

Socioeconomically disadvantaged children face elevated risk for behavior problems. Greater understanding of the relationships between a range of socioeconomic factors and behavioral trajectories across childhood is needed to improve prevention efforts. The present study leveraged a large longitudinal survey to examine how gender, race, household socioeconomic status, and home environment influence behavior from early childhood to adolescence. Multivariate imputation by chained equations maximized available data across 12 years. Linear mixed effects models compared behavioral trajectories by gender, as well as the longitudinal effects of socioeconomic status on internalizing and externalizing behavior problems accounting for within- and between-child differences from age 3 to 15. Results indicated declines in both internalizing and externalizing scores over time. On average, boys displayed higher initial scores, but more rapid declines; by age 15, boys scored substantially lower than girls on internalizing problems, while externalizing scores were similar for both genders. Household income ($\beta_{Internalizing} = -0.02$; $\beta_{Externalizing} = -0.01$) and higher quality interior home environment ($\beta_{Internalizing} = -0.43$; $\beta_{Externalizing} = -0.60$) both protected against behavioral problems while perceived material hardship and exterior home environment had no effects. Gender moderated the effects of race and the interior environment on externalizing problems. Findings suggest unique developmental trajectories by gender whereby girls display more persistent internalizing problems and African American boys face highest risk for externalizing problems. Children in socioeconomically disadvantaged families face elevated risk for behavior problems, but the home environment remains an opportunity for prevention.

Keywords Child behavior · Gender · Home environment · Families · Mixed effects models · Longitudinal models

Highlights

- Both boys and girls display declines in behavior problems from age 3 to 15 years.
- Internalizing problems decline more rapidly for boys than for girls.
- Household income and higher quality home environment are protective.
- Gender moderates the effects of race and home environment on externalizing problems.

Child behavior problems impact well-being, family functioning, and academic performance. Furthermore, problem behavior in childhood can indicate risk for future mental and emotional disorder. Both child- and household-level

characteristics influence behavior, and socioeconomically disadvantaged children face elevated risk for problems. Although several studies have focused on either early childhood or adolescence as crucial periods for preventing disorder (Carneiro et al. 2016; Cicognani et al. 2008; de Haan and MacDermid 1999), fewer in recent years examine longer-term trajectories of behavior problems by gender with a thorough consideration of socioeconomic risk (Leve et al. 2005). Boys and girls display different levels of behavioral problems at various points throughout childhood and adolescence, and prior studies suggest unique

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developmental trajectories (Leve et al. 2005). However the impacts of various socioeconomic indicators on boys versus girls are not well understood. More detailed understanding of gender-specific behavioral trajectories among at-risk children is needed in order to improve assessment and intervention.

Child Behavioral Trajectories by Gender

Behavioral problems in childhood indicate risk for ongoing mental and emotional disorder (Coe and Dodge 1998; Kovacs and Devlin 1998). Child behavior problems have been linked to later risk for mood disorders such as depression and bipolar disorder (Carlson and Weinrub 1993; Kjeldsen et al. 2016). Externalizing problems in childhood can manifest as adult personality disorder, increasing likelihood of substance use and legal involvement (Border et al. 2018; Farmer et al. 2016). Analyses of a population-based sample in Norway found that high levels of externalizing behavior problems beginning in early childhood predicted lower life satisfaction and less flourishing in adulthood (Kjeldsen et al. 2016). A recent examination of population-based, prospective data in Sweden found that childhood behavior problems threatened productivity in young adulthood; both internalizing and externalizing problems at age 8–9 years predicted greater absences from work due to illness as well as disability receipt a decade later (Narusyte et al. 2017). Early behavior problems can portend future psychopathology as well significant ongoing challenges in functioning and well-being.

Prior research has suggested differences in the prevalence of childhood behavior problems between boys and girls. Externalizing behaviors, or “acting out” (e.g. frequent temper tantrums, defiance, hyperactivity, destructiveness) have typically been more common among boys (Bongers et al. 2004; Gleason et al. 2011; Miner and Clarke-Stewart 2008), whereas girls have more frequently shown elevated levels of internalizing behaviors (e.g. withdrawal, low self-esteem, depressive symptoms, etc.; Rocchino et al. 2013). This trend has been observed across age groups; a sample of 682 young children (age 2–4 years) recruited from the Chicago area was found to have higher externalizing behaviors among boys compared to girls (Gross et al. 2006). Similarly, males displayed elevated levels of delinquency and females displayed elevated levels of depressive symptoms and poor self-esteem in a nationally representative sample of adolescents (Mack et al. 2015). In a sample of low-income, primarily African American high school students, girls reported significantly higher levels of internalizing behaviors than boys; however, gender was not related to externalizing (Rocchino et al. 2013). In sum, findings suggest differential developmental trends by

gender, although the nature of these trajectories as yet remains poorly understood.

Much remains to be understood about the long-term trajectories of children’s behavioral development—particularly among racially and ethnically diverse samples. Trends suggests normative declines in externalizing behaviors as children age, while internalizing problems may remain more stable or emerge later (Fanti and Heinrich 2010; Keiley et al. 2000; Perry et al. 2018). Two studies using data from the National Institute of Child Health and Human Development (NICHD) Study of Early Child Care found a pattern of declining externalizing problems across early- to middle-childhood (Fanti and Heinrich 2010; Miner and Clarke-Stewart 2008); internalizing behaviors typically remained low across childhood, while a small subset of children displayed increases into pre-adolescence. Similarly, Bongers et al. (2004) investigated trajectories of various externalizing behaviors and found distinct developmental subgroups that emerged in a sample of primarily Caucasian children living in the Netherlands. Most children displayed very low levels of externalizing problems, with a minority of children engaging in problematic behaviors more frequently. Gender differences emerged across externalizing subtypes; physical aggression was highest among boys in childhood, and declined over time for both genders. Oppositional behaviors were also higher among boys starting in early childhood, but declined over time such that gender differences disappeared by adolescence. The overall shapes of trajectories across behavior types did not differ substantially between boys and girls.

Examining trajectories of behavior problems in adolescence yields another story. Behavioral trajectories were found to differ between the genders in a study conducted with a community-based sample in the Pacific Northwest (Leve et al. 2005); findings indicated that while externalizing behaviors decreased for both boys and girls from age 5 to 17, internalizing behaviors increased for girls while remaining stable for boys. These trajectories suggested unique developmental processes unfolding as children transitioned from childhood to adolescence, offering important insights into normative changes as well as early indicators of mental disorder. Understanding the trajectories of behavioral problems, even those below a clinical threshold, provides insight into designing efficient and effective interventions (Keiley et al. 2000).

Socioeconomic Drivers of Behavioral Trajectories

In addition to gender and age, socioeconomic factors can also contribute risk for behavioral problems among children and adolescents. A substantial body of theoretical and

empirical work emphasizes the significance of socioeconomic status (SES) to child development and well-being. The Family Stress Theory posits that economic stress disrupts healthy family processes; the increased likelihood of dysfunction or conflict can impede healthy child development (Conger et al. 1992, 1994). Applications of the Family Stress Theory have linked indicators of SES with child well-being in a variety of contexts (e.g. Mistry et al. 2002; Warren and Font 2015). Low income has been associated with both internalizing (Ciciolla et al. 2014) and externalizing (Paterson et al. 2013) problems across genders. In a sample of 682 children aged 2 to 4 years from the Chicago metropolitan area, both internalizing and externalizing scores were higher for low-income children than middle- and upper-income children (Gross et al. 2006). A cumulative effect has also emerged, whereby more time spent in poverty during childhood increased externalizing symptoms in emerging adulthood (Evans and Cassells 2014). Keiley et al. (2000) defined socioeconomic status as parent years of education and current occupation. Individual growth models found this indicator of SES was negatively associated with initial externalizing behaviors among a multisite sample of 405 kindergartners, but growth curve analyses found parent education and occupation did not predict changes in child behaviors over time (Keiley et al. 2000).

Interesting differences emerge when definitions of socioeconomic status are expanded to include *perceptions* of economic well-being. A recent systematic review targeted the relationship between SES and adolescent well-being, with indicators of SES focused on poverty status, low income, and subjective status terms such as “underprivileged” and “marginalized” (Devenish et al. 2017). A longitudinal study of families in Germany ($N = 358$) found that *perceived* economic hardship—based on maternal and adolescent report—predicted depressiveness among adolescents and young adults (Walper 2009). When the sample was sub-grouped by gender, the effect of perceived hardship disappeared among boys but persisted among girls. Similarly, Budescu and Taylor (2013) found that perceived adequacy of household resources—but not income—reduced problem behaviors in a sample of inner-city African American adolescents ($N = 115$). Likewise, a study of 297 Italian adolescents distinguished between *subjective* and *objective* socioeconomic status (Cicognani et al. 2008). The former was assessed using a single item in which participants were asked to rate the economic situation of their families, from ‘not good’ to ‘very good’. Objective SES was assessed based on parent education and occupation; income was not considered. Hierarchical regression models showed that higher *subjective* SES increased adolescent psychological well-being, but *objective* SES had no effect.

Home Environment and Child Behavior

Socioeconomic status frequently goes hand-in-hand with housing conditions. Household environment can expose children to additional significant threats to behavioral health. Poor housing quality in particular has been shown to contribute to child behavioral problems independent of household income (Coley et al. 2014; Coley et al. 2015; Evans et al. 2001). In a longitudinal study of rural American children, Rollings et al. (2017) found that physical housing quality (e.g. structural problems, clutter, hazards, indoor climate, and crowding), but not neighborhood quality, was linked with both internalizing and externalizing problems as well as learned helplessness. A detailed assessment of housing quality including the presence of leaking roofs, broken windows, exposed wiring, rodents, and peeling paint was found to predict both internalizing and externalizing scores among a sample of low-income children from Boston, Chicago, and San Antonio (Coley et al. 2013). Children living in low-income households were more likely to experience chaotic, unstable, poor quality environments on a consistent basis—thus facing ongoing threats to behavioral well-being as they undertake normative developmental processes (Crespo et al. 2019; Evans et al. 2001). While neighborhood violence and disorder have been linked to mental health and behavioral problems (Cecil et al. 2014; Lambert et al. 2012; Thompson et al. 2019), less is understood about the impact of the immediate exterior home environment. As a primary domain for child development, the home environment unsurprisingly has important implications for behavioral problems. Nonetheless, additional research on the impact of gender and household environment is needed to better understand how to intervene with at-risk children.

Race, Ethnicity, and Child Behavior

Finally, race and ethnicity have been associated with child behavioral outcomes and may be confounded with socioeconomic indicators. Significant disparities exist across racial and ethnic groups in regards to reported problem behavior (Dodge et al. 1994; Keiley et al. 2000; Lopez et al. 2017) and mental health services receipt (Alegria et al. 2010; Gudino et al. 2009; van Oort et al. 2007), compounding risk for ongoing behavioral disorder. However, the role of race in context of other socioeconomic indicators predicting behavior problems remains murky. While Dodge et al. (1994) found higher rates of externalizing problems among African American children compared to white children, differences were accounted for by differences in parents’ education levels and occupations. Elevated internalizing and externalizing behavior problems among ethnic

minority youth may also be driven by disparities in trauma exposure (Lopez et al. 2017). Another study found trajectories of problem behaviors among African American children differed depending on the report; mother-reported externalizing behaviors declined over time, whereas teacher-reported externalizing increased over the same period (Keiley et al. 2000). Historical oppression and ongoing discrimination may contribute to socioeconomic disadvantage among racial and ethnic minority families that drive behavioral health risk (Williams et al. 2016).

Theoretical Framework

The present study was further informed by a transactional approach to developmental psychopathology (Cicchetti and Toth 1998). According to this framework, development occurs across multiple contexts and levels of influence that interact with and adapt to one another (Beauchaine and McNulty 2012). Building on prior theoretical work in child development such as Bronfenbrenner's ecological perspective (1979) and Shonkoff's ecobiodevelopmental framework (Shonkoff et al. 2012), the transactional approach advocates for interdisciplinary study of development that embraces complexity (Beauchaine and Gatzke-Kopp 2012). According to Bronfenbrenner (1979), the home environment is a proximal context for child development that should exert a stronger influence than more distal contexts such as neighborhoods or schools. A transactional perspective incorporates this insight with the dynamic influences of family structure, economic well-being, and time. The present study applied the transactional approach in considering the complexity of defining and assessing socioeconomic status across domains, as well as individual-, household-, and societal-level impacts on development through adolescence.

Present Study

The present study leveraged a large, multi-wave sample to investigate the longitudinal relationship of a range of demographic and socioeconomic indicators to behavior problems from early childhood to adolescence. Mixed effects longitudinal models accounted for both within- and between-child differences on both internalizing and externalizing behavior problems from age 3 to age 15. Specifically, the following hypotheses were tested:

- (1) Behavior problems will decline over time for all children on average, but the rate of change will differ by gender.
- (2) Higher household income, less material hardship, and higher quality home environment will relate with

fewer behavior problems over time; minority race/ethnicity status will relate with more behavior problems over time.

- (3) Race/ethnicity, household income, material hardship, and home environment will have differential effects on children's behavior by gender.

While elements of socioeconomic status have been linked to behavioral outcomes in children, neither SES nor behavior is a static construct. Greater knowledge of these relationships over time is needed in order to accurately identify children at risk and develop sustainable means of reducing behavioral problems from early childhood to adolescence and beyond. Findings from the present study will increase understanding of the differing developmental trajectories of boys and girls, as well as the unique impacts of socioeconomic status and the household environment.

Methods

Participants

Data for the present study came from the Fragile Families and Child Well-Being Study (hereafter "Fragile Families"). Fragile Families followed 4,898 children born 1998–2000 in 20 large American cities, with an intentional oversample of those born to unmarried parents (considered "fragile families"; Reichman et al. 2001). The present study utilized data from children who lived with either or both parents, and whose families participated in the In-Home subsample, which included in-depth interviews with parents as well as interviewer observations in Years 3–15 ($N = 1090$). The sample represented a relatively young, racially and ethnically diverse urban population (Table 1). Mothers were on average 25 years old at the time of the focal child's birth. The sample was approximately half (47.5%) African American, one-quarter (27.1%) Hispanic, and one-fifth (21.5%) white, with the remaining small portion (3.9%) identifying as another race. Approximately half (48.7%) of parents were married or cohabitating at the Year 3 interview, and this rate declined to one in three (32%) by Year 15. This was well below the national average, which showed nearly 70% of children lived with two married or cohabitating parents in 2015 (which corresponded roughly with the time of the Year 15 interviews; Federal Interagency Forum on Child and Family Statistics 2019). Average household income showed relatively low- to middle-income families; incomes increased from an average of \$35,000 to \$60,000 per family over the 12-year study period (approximately 48,000 to \$65,000 in 2019 dollars). The proportion of children with a depressed caregiver ranged from approximately one in six to one in five at each wave.

Full demographic information about the sample was described in Table 1.

Procedure

American cities with populations over 200,000 people in 1998 ($N = 77$) were stratified by welfare policy climate and economic conditions (Reichman et al. 2001). Hospitals were randomly selected within cities, and births selected within hospitals with an oversample of births to unmarried parents. Mothers (and fathers, when possible) were interviewed in hospitals shortly after the focal child's birth, or as soon as possible thereafter (Reichman et al. 2001). Parents were re-interviewed at 1-, 3-, 5-, 9-, and 15-year follow-ups. Follow-up interviews were conducted over the phone, though a subgroup of participant families were included in the In-Home sub-study. This included in-person interviews and home observation in later waves.

Measures

The primary predictor *child gender* was a dichotomous indicator (female, male) collected at the time of the child's birth. The dependent variable *child behavior* captured the extent to which children displayed behavioral problems indicative of emotional disorder. Primary caregivers reported on internalizing and externalizing behavior problems using the Child Behavior Checklist (CBCL), a validated assessment tool for preschool, school-aged, and adolescent children (Achenbach 1992; Achenbach and Rescorla 2000, 2001). The Fragile Families survey contained several age-appropriate CBCL subscales at each wave such as "Anxious/Depressed", "Withdrawn", "Aggressive", "Rule-Breaking", and "Somatic Complaints" Internalizing, externalizing, and total problems scores were calculated for each child at each wave starting in Year 3, when children were approximately three years old. Scores were standardized such that they ranged from zero to 100, with higher scores indicating more behavior problems. Child race/ethnicity was collected at baseline and coded as white (reference group), black, Hispanic, or Other. *Household income* was calculated as the total income in dollars for the child's primary residence at each wave. For mixed effects models, household income was rescaled to thousands of dollars to improve interpretability of models. *Home environment* assessed the quality of the child's living circumstances. This construct was measured through interviewer observation using the Home Observation for Measurement of the Environment scale (HOME; Caldwell and Bradley 1984). HOME included two subscales—one each to assess the interior and exterior home environments. The interior subscale included items about adequate lighting, exposed wiring or other hazards, excessive noise, and crowding. The

exterior subscale included items about the condition of the home's exterior and surrounding block, such as broken windows or the presence of garbage or drug paraphernalia. Items were coded and summed such that higher scores indicated better quality environments. The subscales have been validated in a variety of settings across age groups (Bradley 1993; Bradley et al. 1988; 1996; 2000).

Covariates

Mother's age at the child's birth in years was collected as baseline. All additional covariates were measured at each wave. Parents were asked whether or not they were *married or cohabitating* at each interview. Parents reported at each interview the extent to which their families were experiencing *material hardship*; a set of dichotomous items were drawn from the 1996 Survey on Income and Program Participation (SIPP), the 1997 and 1999 New York City Social Indicators Surveys (SIS), and the 1999 Study of Work, Welfare, and Family Well-Being (Sing et al. 2001). Sample items included "In the past 12 months, did you not pay the full amount of rent or mortgage because there wasn't enough money?" and "In the past 12 months, was there anyone in your household who needed to see a doctor or go to the hospital but couldn't go because of the cost?" and were coded 1 = yes, 0 = no; dichotomous responses were summed such that total scores ranged from 0 to 8, with higher values indicating greater difficulty meeting basic needs. Finally, *caregiver depression* assessed whether the child's primary caregiver (or at least one of the primary caregivers, if parents were cohabitating or married) met criteria for major depressive disorder in accordance with the Diagnostic and Statistical Manual IV as assessed by the Composite International Diagnostic Interview—Short Form (CIDI-SF; Kessler et al. 1998).

Missing Data

Missing data were handled using multivariate imputation by chained equations (MICE). MICE, a multiple imputation technique, generates multiple predictions ("imputations") for missing variables based on other variables in the dataset using regression models that treat each missing value as a dependent variable (Azur et al. 2011). The present study applied MICE with predictive mean matching, a robust method that maximized available information to generate imputed values (Morris et al. 2014).

Data Analyses

Univariate and bivariate statistics described the full sample and compared boys and girls on key demographics at each wave using *t* tests and chi-squared tests. For longitudinal

Table 1 Sample description on key variables and comparisons by child gender

	Total (<i>N</i> = 1090) M(SD) or N(%)	Male (<i>N</i> = 546) M(SD) or N(%)	Female (<i>N</i> = 544) M(SD) or N(%)	χ^2 or <i>t</i>
Mother's Age at Child's Birth (<i>years</i>)	25.24 (6.01)	25.23 (6.13)	25.24 (5.86)	0.06
Race/Ethnicity				1.33
White	234 (21.47)	124 (22.71)	110 (20.22)	
Black	518 (47.52)	255 (46.70)	263 (48.35)	
Hispanic	295 (27.06)	144 (26.37)	151 (27.76)	
Other	43 (3.94)	23 (4.21)	20 (3.68)	
Parents Married or Cohabiting				
Year 3	568 (48.72)	282 (51.65)	286 (52.57)	0.06
Year 5	513 (47.06)	253 (46.34)	260 (47.79)	0.18
Year 9	446 (40.92)	222 (40.81)	224 (41.18)	0.01
Year 15	349 (32.02)	184 (33.70)	165 (30.33)	1.27
Material Hardship				
Year 3	0.91 (1.28)	0.84 (1.28)	0.98 (1.28)	1.82
Year 5	0.98 (1.40)	0.92 (1.37)	1.03 (1.42)	1.28
Year 9	1.15 (1.51)	1.15 (1.54)	1.15 (1.48)	0.03
Year 15	0.97 (1.40)	0.93 (1.37)	1.02 (1.44)	1.08
Household Income (<i>dollars</i>)				
Year 3	35,388.51 (36,631.05)	35,825.66 (39,040.38)	34,849.58 (34,071.07)	−0.44
Year 5	39,665.22 (46,484.51)	40,415.80 (44,814.11)	38,911.88 (48,132.33)	−0.53
Year 9	46,866.92 (51,036.93)	51,250.22 (58,601.19)	42,467.50 (41,694.96)	−2.85**
Year 15	60,738.83 (60,423.68)	64,474.89 (63,055.03)	56,989.04 (57,476.18)	−2.05*
Caregiver Depression				
Year 3	239 (21.93)	111 (20.33)	128 (23.53)	1.45
Year 5	178 (16.33)	87 (15.93)	91 (16.73)	0.07
Year 9	176 (16.15)	90 (16.48)	86 (15.81)	0.05
Year 15	195 (17.89)	99 (18.13)	96 (17.65)	0.02
Interior Home Quality				
Year 3	9.10 (1.91)	9.15 (1.85)	9.06 (1.97)	−0.80
Year 5	8.89 (1.80)	8.96 (1.71)	8.82 (1.88)	−1.27
Year 9	9.58 (1.80)	9.55 (1.81)	9.62 (1.78)	0.64
Year 15	9.85 (1.53)	9.79 (1.58)	9.91 (1.48)	1.30
Exterior Home Quality				
Year 3	12.23 (2.64)	12.435 (2.58)	12.12 (2.71)	−1.46
Year 5	11.64 (2.82)	11.62 (2.91)	11.67 (2.73)	0.30
Year 9	12.43 (2.06)	12.37 (2.13)	12.48 (1.99)	0.89
Year 15	12.35 (2.27)	12.31 (2.24)	12.39 (2.30)	0.60
Internalizing Score				
Year 3	21.29 (12.74)	21.66 (12.87)	20.92 (12.60)	−0.97
Year 5	12.10 (9.77)	12.79 (10.46)	11.41 (8.98)	−2.33*
Year 9	7.74 (8.58)	7.71 (8.90)	7.77 (8.26)	0.11
Year 15	13.99 (17.24)	12.74 (16.64)	15.25 (17.74)	2.41*
Externalizing Score				
Year 3	30.61 (17.05)	32.07 (17.30)	29.15 (16.69)	−2.83***
Year 5	18.79 (11.18)	20.01 (11.71)	17.56 (10.48)	−3.64***
Year 9	8.86 (9.89)	9.76 (10.33)	7.95 (9.34)	−3.03**
Year 15	10.78 (12.37)	11.41 (12.80)	10.14 (11.90)	−1.69

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

analyses, the dataset was transformed from long to wide format, with rows representing each time a child or parent was interviewed. Linear mixed effects models tested within- and between-child differences in behavior scores over 12 years. The following model-building procedures were

followed to predict both internalizing and externalizing scores: first, a null model with no predictors assessed the appropriateness of including random effects to capture between-child differences (Luke 2004). Next, unconditional linear growth models included no covariates, allowed

intercepts to vary, and constrained slopes to be the same across all children. Covariates were added to adjust for confounding factors based on prior empirical literature and child development theory. *Time* was added as a random effect, allowing slopes to vary across children. This “slope-intercept” was compared to the “random-slope” model using AIC and -2LL values to determine the better-fitting model. Finally, interaction terms were included to test hypotheses. Nested models were compared using AIC, BIC, and -2LL values, and fit was assessed using R-squared values. The final set of models included: (1) Two models testing the main effects of time, gender, race/ethnicity, household income, and home environment on child internalizing and externalizing behaviors from age 3 to age 15; (2) Two models incorporating Gender*Time interaction terms to test the different rates of change for boys and girls; (3) Two models including the following interactions: Gender*Time, Gender*Race/Ethnicity, Gender*Income, Gender*Material Hardship, Gender*Interior Home Environment, and Gender*Exterior Home Environment. Sensitivity analyses compared findings conducted using the imputed sample with the original sample. All data management and analyses were conducted in R Version 3.6.1.

Results

Bivariate analyses compared male and female children on study variables. No differences existed on predictors except income in later waves, suggesting the sample was relatively balanced on key demographics. Significant differences by gender did occur on behavior problems. Boys had higher externalizing scores in Years 3–9. By Year 15, when children were adolescents, differences in externalizing scores had disappeared but girls had significantly higher internalizing scores than boys.

Results of Mixed Effects Models Testing Within- and Between-Child Behavior Change

A null model yielded an intraclass correlation of 0.148, indicating that approximately 15% of variation in behavior scores could be attributed to between-person differences, while the remainder was explaining by within-person change. The ICC suggested sufficient between-person variation to merit the use of a mixed effects model that accounted for clustering of scores within individual children (Luke 2004).

The final set of models tested the effect of gender on child behavior problems while including all covariates listed above as fixed effects, as well as time as a random effect; these “slope-intercept” models allowed the initial behavior scores as well as rates of change vary across children. Non-

linear (quadratic and cubic) models were tested and compared with nested linear models using AIC values; linear models were found to have the best fit to the data.

Two models tested the main effects of gender on behavior scores (Table 2). Average internalizing scores across all children declined by approximately one-third point per year controlling for all other factors, and gender had no impact on average internalizing scores. Externalizing scores declined much more quickly—by 1.4 points per year—and boys’ scores were on average more than two points higher than girls’. There was less variation in initial internalizing ($\sigma^2_{\text{Intercept}} = 23.42$; $SD = 4.84$) than externalizing ($\sigma^2_{\text{Intercept}} = 86.94$; $SD = 9.32$) scores, although greater variation in internalizing trajectories ($\sigma^2_{\text{Year}} = 0.89$; $SD = 0.95$) versus externalizing trajectories ($\sigma^2_{\text{Year}} = 0.25$; $SD = 0.50$) over time.

These main effects models also found that household income was negatively associated with behavior scores. Each one thousand-dollar increase in household income corresponded to small reductions in predicted internalizing and externalizing scores (0.02 and 0.01 points respectively). Thus, a child in a family earning \$125,000 per year would have a predicted internalizing score 2 points lower than a child in a family earning \$25,000 per year. Higher quality interior home environments reduced internalizing and externalizing scores by 0.32 and 0.29 points respectively. Other significant predictors of behavior scores included the mother’s age at the child’s birth; each one year older that a mother was when she gave birth to her child reduced behavior scores by 0.15 to 0.22 points; for example, a child born to a 30-year-old mother would have a predicted externalizing score 2.4 points lower than a child born to a 20-year-old mother—a difference comparable to that driven by a \$100,000 difference in household income. Caregiver depression significantly elevated internalizing and externalizing scores by over five points each.

Next, two models included the interaction term Gender*Year to test whether gender affected change in behavior problems over time (Table 3). Main effects were largely consistent with the previous models. The interaction term was statistically significant in predicting internalizing scores ($\beta_{\text{Gender*Year}} = -0.32$; $SE = 0.09$), indicating that internalizing scores declined more quickly for boys compared to girls (Fig. 1). The interaction term was insignificant in the model predicting externalizing, suggesting no difference in the rate of change in scores between boys and girls despite higher initial scores among boys (Fig. 2).

Finally, two models tested whether gender moderated the effect of time, race/ethnicity, income, material hardship, or home environment on internalizing or externalizing respectively (Table 3). Internalizing scores declined faster for boys than for girls ($\beta_{\text{Gender*Time}} = -0.31$; $SE = 0.09$), but gender did not moderate the other predictors. For

Table 2 Results of main effects mixed models testing the impacts of household income, material hardship, and home environment on child behavior problems

Fixed Effects	Internalizing			Externalizing		
	Estimate	SE	<i>t</i>	Estimate	SE	<i>t</i>
Intercept	18.34***	1.39	13.15	26.83***	1.54	17.41
Year	−0.35***	0.05	−7.43	−1.40***	0.04	−32.10
Child Gender (<i>ref</i> = female)	0.45	0.43	1.05	2.06***	0.50	4.15
Household Income (<i>per \$1000</i>)	−0.02**	0.00	−3.17	−0.01*	0.00	−2.17
Material Hardship	−0.05	0.15	−0.35	0.28	0.16	1.80
Quality of Home Environment						
Interior	−0.32**	0.11	−2.81	−0.29*	0.12	−2.33
Exterior	0.01	0.08	0.06	0.13	0.09	1.37
Mother's Age at Child's Birth (<i>years</i>)	−0.14***	0.04	−3.78	−0.24***	0.04	−5.59
Child Race/Ethnicity (<i>ref</i> = white)						
Black	−0.18	0.59	−0.30	−0.36	0.68	−0.53
Hispanic	1.31*	0.64	2.04	−1.23	0.73	−1.68
Other race	4.31***	1.18	3.65	2.25	1.35	1.66
Parents Married and/or Cohabiting	−0.90*	0.45	−2.02	−1.17*	0.50	−2.35
Caregiver Depression	6.19***	0.51	12.07	5.26***	0.55	9.54
Random Effects	Variance	95% CI	SD	Variance	95% CI	SD
Intercept	23.42	12.76–34.02	4.84	86.94	70.90–102.21	9.32
Year (<i>slope</i>)	0.89	0.70–1.10	0.95	0.25	0.15–0.42	0.50
Residual (<i>within-child</i>)	116.45	109.63–123.54	10.79	138.20	130.19–145.20	11.76
Model Fit	AIC	−2LL	R ²	AIC	−2LL	R ²
	34,293	34,260	0.08	34,769	34,724	0.24

Mother's age centered at mean value * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

externalizing, time, race, and interior home environment were moderated by gender. Externalizing scores declined faster for boys than girls ($\beta_{\text{Gender} \times \text{Time}} = -0.17$; SE = 0.08). Being black and male increased predicted externalizing scores by 2.8 points compared to non-black girls; males of “other race” had lower predicted scores by 5.32 points. Gender also moderated the effect of interior home environment such that a higher quality home environment related with slightly higher externalizing scores for boys compared to girls ($\beta_{\text{Gender} \times \text{Interior Home Environment}} = 0.61$; SE = 0.25).

Discussion

The present study expands our understanding of the unique developmental trajectories of boys and girls in at-risk families. Prevalence of internalizing and externalizing behavior problems differ between the genders from early childhood into mid-adolescence. On average, all children display reductions in behavior problems from age 3 to 15. While no difference in internalizing problems exists

between boys and girls at age 3, boys show a faster rate of decline such that they display fewer internalizing problems by age 15. Meanwhile, boys display more externalizing problems at age 3 compared to girls, but differences disappear by age 15. Higher household income and higher quality interior home environment relate with fewer internalizing and externalizing problems, while material hardship and exterior home environment have no effects. Gender moderates the effect of time on internalizing problems such that scores decline faster for boys than for girls. For externalizing behaviors, race and time interact such that African American boys display the highest risk for problems. Results indicate behavioral trajectories vary for children based on gender and multiple indicators of socioeconomic status (Table 4).

Findings support prior research suggesting greater externalizing behaviors among boys compared to girls in young childhood (Bongers et al. 2004), as well as the general trend of declining externalizing problems as children mature (Fanti and Heinrich 2010; Leve et al. 2005; Miner and Clarke-Stewart 2008). It is possible that normative declines in

Table 3 Results of main effects mixed models testing whether time moderates the impact of time on child behavior problems

Fixed Effects	Internalizing			Externalizing		
	Estimate	SE	<i>t</i>	Estimate	SE	<i>t</i>
Intercept	17.59***	1.41	12.48	26.32***	1.57	16.76
Year	-0.19**	0.06	-2.93	-1.33***	0.06	-22.32
Child Gender (<i>ref</i> =female)	2.13***	0.63	3.37	3.19***	0.83	3.82
Household Income (<i>per \$1,000</i>)	-0.01**	0.00	-3.06	-0.01*	0.00	-2.11
Material Hardship	-0.04	0.15	-0.32	0.29	0.16	1.82
Quality of Home Environment						
Interior	-0.32**	0.11	-2.85	-0.29*	0.12	-2.34
Exterior	-0.00	0.08	-0.04	0.12	0.09	1.31
Mother’s Age at Child’s Birth (<i>years</i>)	-0.14***	0.04	-3.81	-0.24***	0.04	-5.61
Child Race/Ethnicity (<i>ref</i> =white)						
Black	-0.17	0.59	-0.28	-0.35	0.68	-0.52
Hispanic	1.31*	0.64	2.04	-1.23	0.73	-1.68
Other race	4.30***	1.18	3.65	2.25	1.35	1.66
Parents Married and/or Cohabiting	-0.87	0.45	-1.95	-1.15*	0.50	-2.32
Caregiver Depression	6.21***	0.51	12.12	5.28***	0.55	9.57
Child Gender*Year	-0.32***	0.09	-3.61	-0.14	0.08	-1.69
Random Effects	Variance	95% CI	SD	Variance	95% CI	SD
Intercept	22.90	12.25–33.29	4.79	86.61	71.57–102.41	9.31
Year (<i>slope</i>)	0.87	0.67–1.08	0.93	0.25	0.15–0.42	0.50
Residual (<i>within-child</i>)	116.42	109.62–123.43	10.79	138.49	130.42–145.44	11.77
Model Fit	AIC	-2LL	R ²	AIC	-2LL	R ²
	34,282	34,246	0.08	34,769	34,734	0.24

Mother’s age centered at mean value **p* < 0.05, ***p* < 0.01, ****p* < 0.001

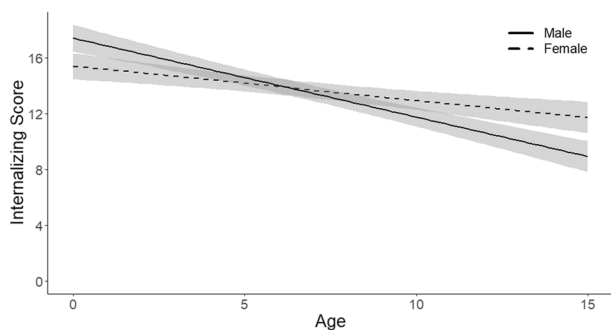


Fig. 1 Average CBCL Internalizing Problems scores over time by gender

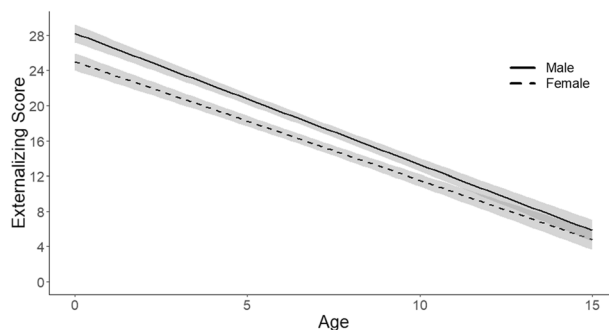


Fig. 2 Average CBCL Externalizing Problems scores over time by gender

externalizing problems are driven by increased self-regulation skills as children progress through formal schooling and approach adolescence (Kuhn et al. 2018; Perry et al. 2018). A large body of research links self-regulation with reduced externalizing behaviors over time, suggesting growth in

inhibitory skills promotes children’s abilities to control disruptive behaviors but not necessarily internal distress (Crespo et al. 2019; Perry et al. 2018; White et al. 2013). The present study also provides insights into the lesser-understood trajectories of internalizing behaviors. Boys display a faster

Table 4 Results of interaction models testing moderating effect of gender on household income, material hardship, and home environment

Fixed Effects	Internalizing			Externalizing		
	Estimate	SE	<i>t</i>	Estimate	SE	<i>t</i>
Intercept	17.73***	1.92	9.23	29.90***	2.12	14.09
Year	−0.20**	0.07	−2.98	−1.32***	0.06	−21.57
Child Gender (<i>ref</i> = female)	1.96	2.71	0.73	−3.99	2.98	−1.34
Household Income (<i>per</i> \$1,000)	−0.01	0.01	−1.15	−0.01	0.01	−0.75
Material Hardship	−0.01	0.20	−0.06	0.35	0.21	1.66
Quality of Home Environment						
Interior	−0.43**	0.16	−2.71	−0.60***	0.18	−3.42
Exterior	0.09	0.12	0.77	0.08	0.18	0.63
Child Race/Ethnicity (<i>ref</i> = white)						
Black	−0.79	0.83	−0.96	−1.69	0.05	−1.78
Hispanic	0.32	0.91	0.35	−1.44	1.04	−1.39
Other race	4.88**	1.72	2.83	5.05*	1.97	2.56
Mother's Age at Child's Birth (<i>years</i>)	−0.14***	0.04	−3.75	−0.23***	0.04	−5.46
Parents Married and/or Cohabiting	−0.87	0.45	−1.95	−1.16*	0.49	−2.35
Caregiver Depression	6.29***	0.51	12.26	5.36***	0.55	9.72
Child Gender*Year	−0.31***	0.09	−3.36	−0.17*	0.08	−1.98
Child Gender*Race/Ethnicity						
Gender*Black	1.13	1.17	0.97	2.80*	1.34	2.10
Gender*Hispanic	1.87	1.28	1.47	0.50	1.46	0.34
Gender*Other Race	−1.00	2.36	−0.42	−5.32*	2.70	−1.97
Child Gender*Household Income	−0.01	0.01	−1.25	−0.01	0.01	−0.75
Child Gender*Material Hardship	−0.11	0.28	−0.39	−0.17	0.31	−0.54
Child Gender*Interior	0.23	0.23	1.00	0.61*	0.25	2.45
Child Gender*Exterior	−0.2	0.17	−1.18	0.07	0.18	0.40
Random Effects	Variance	95% CI	SD	Variance	95% CI	SD
Intercept	23.17	12.28–33.41	4.81	87.09	71/06–102.82	9.33
Year (<i>slope</i>)	0.87	0.67–1.08	0.93	0.25	0.16–0.38	0.50
Residual (<i>within-child</i>)	116.50	109.62–123.43	10.79	138.16	129.96–144.96	11.75
Model Fit	AIC	−2LL	R ²	AIC	−2LL	R ²
	34,288	34,238	0.08	34,762	34,712	0.25

Mother's age centered at mean value * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

decline in internalizing behaviors from age 3 to 15 than girls. A similar pattern was observed for anxiety disorders in a sample of nearly 800 adolescents from upstate New York (Cohen et al. 1993); while boys demonstrated linearly declining prevalence of anxiety disorders from age 10 to 20, girls displayed much less change over the same period. Depressive symptoms also varied dramatically between boys and girls in late childhood and adolescence, with girls experiencing a dramatic spike around puberty. Effectively screening for and addressing internalizing problems among

adolescents depends upon the ability to detect behavioral risk factors that may emerge prior to full-blown disorder. The present study's findings of gender-specific trajectories combined with our knowledge of adolescent disorders suggest links that provide crucial information for improving prevention efforts.

The study suggests a complex relationship between socioeconomic status and child behavior problems over time. Higher household income protects against behavior problems, but material hardship—which indicates the

extent to which caregivers perceive difficulty meeting basic needs—has no effect. Other studies have similarly found discrepancies in the importance of “objective” measures of socioeconomic status (e.g. household income, caregiver education level and occupation) versus “subjective” or perceived hardship (Budescu and Taylor 2013; Devenish et al. 2017; Walper 2009). Whereas it might be assumed that *perceived* hardship drives the caregiver stress central to the Family Stress Theory (Conger 1992), it may alternately be that external, concrete consequences of low income such as residential instability or eviction are more impactful to child behavior. Another possible explanation for the comparative importance of household income versus perceived hardship is that visible status becomes more important as children enter school, particularly in adolescence. Thus, observable indicators of household income such as parental occupation may become more discernible and important to adolescents, despite any resilience to material hardship they may have developed in early childhood. Adverse peer relations such as bullying or social exclusion due to perceived differences in status could contribute to behavioral risk (Hjalmarsson 2018; Hjalmarsson and Mood 2015; McLoyd 2019; Sletten 2010).

The study also highlights differential impacts of children’s living environments. Higher quality interior home environment protects children against behavior problems, while the exterior environment has no effect. Living conditions have been linked to child mental health in the past, with indicators of chaos and instability in particular emerging as threats to healthy development (Coley et al. 2015; Evans et al. 2005). The present study contributes insights on the relative importance of the interior versus exterior home environment. While prior research has linked neighborhood violence and disorder with adolescent behavior problems (Cecil et al. 2014; Lambert et al. 2012; Thompson et al. 2019), less is understood about the immediate exterior quality of the home. Bronfenbrenner’s ecological framework (1979) posits that the immediate environment should have the strongest impact on well-being. We may then expect that the interior environment would be most important for young children while the exterior environment and neighborhood context have comparatively greater impacts on adolescents, who typically spend more time outside the home. Findings from the present study suggest that the interior environment remains more influential than the exterior even for adolescents. A question remains whether children living in the lowest quality buildings may be less likely to spend time outside due to safety concerns, thus moderating any negative effects of the exterior environment on behavior. Natural variation occurs as youth engage in normative experimentation and risk-taking (Arnett 2000), but

children living in unsafe or unstable environments display significantly greater risk over time.

When other indicators of socioeconomic status are accounted for, no direct effects exist between race and externalizing behavior. However, significant interactions emerge between race and gender. Predicted externalizing scores are elevated among African American boys, and reduced among boys of other races. This converges with prior research indicating higher rates of reported behavioral problems among African American children (e.g. Banta et al. 2013) and lends urgency to the issue of disparities in mental health services receipt (Alegría et al. 2010; Gudino et al. 2009). Furthermore, African American boys face disproportionate levels of school discipline, including suspension and expulsion, compared to children of other races (Loveless 2017), fueling the “school-to-prison pipeline” (Kim 2010). Future research must examine means of delivering culturally appropriate, non-stigmatizing mental health services to the highest need families that prevents behavioral issues from derailing children’s educations.

Children from minority, low-income, single-parent households display more behavior problems on average than their middle- or upper-income peers, yet face greater barriers to accessing supports. Few interventions specifically target the home environment in mental health promotion for at-risk children; prior research has emphasized parenting or school-based interpersonal interventions (Buchanan-Pascall et al. 2018; Kremer et al. 2015). Among struggling families for whom housing options may be limited, promoting self-regulation, father involvement, and family stability early on may help mitigate the effect of poor quality home environment on behavior problems (Crespo et al. 2019; Humphrey and Root 2017; Lee and Schoppe-Sullivan 2017). Providing supports to families for creating stable, healthy homes early on may pay dividends as youth develop.

Furthermore, a substantial amount of research has established effectiveness of interventions targeting externalizing behaviors (Kremer et al. 2015); however, limited evidence supports interventions targeting internalizing disorders—particularly among girls, who do not display the same normative decline as boys into adolescence. A systematic review and meta-analysis of parenting interventions to address both behavior problems found that only 35% of studies reviewed yielded improvements in internalizing compared to 80% for externalizing; furthermore, effect sizes were much smaller for interventions that improved internalizing behaviors compared to those that improved externalizing (Buchanan-Pascall et al. 2018). This discrepancy may be explained by the fact that internalizing behaviors are typically less disruptive than externalizing behaviors, making them more likely to remain unnoticed and unaddressed (Cohen et al. 1993). Given the importance of early intervention, failure to address internalizing problems by

early adolescence could increase risk for mood disorders in emerging adulthood (Kjeldsen et al. 2016).

Limitations

Study findings must be considered in context of limitations. First, Fragile Families only sampled births in cities, so rural families were not included. Rural children display comparable if not higher levels of behavior problems than the general population of children, and may face greater barriers to accessing services (Evans 2003; Poloha et al. 2011). Further, the present study limited the analytic sample to families who participated in the In-Home sub-survey in the Years 3–15 interviews; while this provided access to detailed information about the household's finances and home quality, sample size was reduced and findings may not generalize to the entire Fragile Families sample. Finally, multiple imputation by chained equations has several strengths that prevent loss of sample size, consensus over its theoretical justification and best practices for conducting MICE with clustered data have not been fully established (Azur et al. 2011). Sensitivity analyses suggest similar patterns of findings in the un-imputed data, but future research should examine behavioral trajectories in a variety of samples to test robustness of results. Finally, while a linear mixed effects model is able to handle complex within- and between-child variation across time including irregularly spaced measurements, the available time points (3, 5, 9, and 15 years) limit ability to examine smaller changes year-to-year (Luke 2004).

Aforementioned limitations notwithstanding, the present study clarifies important discrepancies in behavioral development that exist by gender and socioeconomic status. Boys and girls display substantially different behavioral trajectories from early childhood to adolescence; race has a differential effect by gender. Future research should examine mechanisms for these differences and develop approaches to minimize potential racial bias and stigmatization in the identification of behavioral problems. Finally, future studies should emphasize the relatively elevated risk for internalizing disorders that emerge among girls in early adolescence, and prioritize development and testing of interventions targeting prevention.

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Compliance with Ethical Standards

Conflict of Interest The author declares no conflict of interest.

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