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# Longitudinal Relations between Behavioral Engagement and Academic Achievement: The Moderating Roles of Socio-economic Status and Early Achievement

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## Abstract

This study investigated developmental trajectories of observationally coded engagement across the early elementary years and whether these trajectories were associated with children's academic achievement. Furthermore, we evaluated if these relations varied as a function of children's family socio-economic status and early reading and math skills. Data were collected from 301 children who were studied from kindergarten ($M_{age}$ = 65.74 months; 49% boys) to 2nd grade. Children's behavioral engagement was observed in kindergarten, 1st, and 2nd grade. Reading and math skills were assessed via standardized tests in kindergarten and 2nd grade. Growth mixture models identified two classes of behavioral engagement: most children (87.0%) displayed relatively high behavioral engagement in the fall of kindergarten and decreased significantly across time (referred to below as *high-decreasing class*), and other children (13.0%) exhibited moderate behavioral engagement in the fall of kindergarten that was stable across time (referred to below as *moderate-stable class*). After controlling for academic skills in kindergarten and demographic variables (i.e., child age, sex, ethnicity, and family socio-economic status), children in the high-decreasing class displayed higher reading skills, but not math skills, than children in the moderate-stable class. Additional analyses revealed that differences in reading skills between the two classes were present only for children from low socio-economic status families or for children low in kindergarten reading skills. The findings suggest that economically or academically at-risk students might benefit more than their peers from high behavioral engagement.

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**Keywords**

academic achievement; behavioral engagement; developmental trajectories; early elementary school

The importance of learning and achievement in the early elementary years for later academic success is well-documented within the educational, developmental, and clinical literatures (Duncan et al., 2007; Ferrer et al., 2015; Ladd & Dinella, 2009; Romano et al., 2010; Watts et al., 2014). Investigations designed to identify processes that facilitate academic success often support the importance of students' school engagement (Fredricks et al., 2004; Hughes et al., 2008; Reyes et al., 2012; Wang et al., 2019). However, there are key limitations in the school engagement literature, including the overreliance on cross-sectional data and the use of self- or teacher-reported engagement. The goals of this study were to address these limitations by identifying developmental trajectories of observationally coded engagement across the early elementary years and by examining if behavioral engagement trajectories were associated with academic achievement. Furthermore, we evaluated whether children's family socio-economic status (SES) and initial academic performance moderated the associations between behavioral engagement and academic achievement, given prior documented compensatory effects of behavioral engagement (Bodovski & Farkas, 2007).

National assessments of children's reading and mathematics in the United States indicate that a substantial percentage of children experience academic challenges (National Center for Education Statistics [NCES], 2018). According to the National Assessment of Educational Progress, only 40% of 4$^{th}$ graders reached proficiency in mathematics, and the percentage declined to 34% for 8$^{th}$ graders. Furthermore, only 36% of 4$^{th}$ graders and 36% of 8$^{th}$ graders obtained proficiency in reading (NCES, 2018). There is also good evidence that students' academic challenges begin early and are persistent as they move through elementary school (Fu et al., 2016; Garon-Carrier et al., 2018; Quirk et al., 2016). For example, emergent literacy skills in the early school years were predictive of state test achievement up to 7 years later (Utchell et al., 2016), and Ferrer et al. (2015) found that poor readers identified in 1$^{st}$ grade continued to have lower reading scores than typical readers through 9$^{th}$ grade. Likewise, investigators involved in a population-based study in Canada observed different levels of number knowledge, a form of early mathematics skill, among children at age 4 years, and the gaps between these levels persisted through age 7 years (Garon-Carrier et al., 2018).

School engagement has been viewed as a potential remedy to the academic challenges faced by many students because it is proximal to students' practices in learning environments. According to Fredricks et al. (2004), school engagement can be viewed as involving behavioral, emotional, and cognitive components. *Behavioral engagement* refers to participation in the learning environment (e.g., concentration, attention, persistence) and adherence to classroom rules (Finn, 1993; Skinner & Belmont, 1993). *Emotional engagement* refers to students' feelings and values such as the affective reactions toward teachers, classmates, and school (Ladd et al., 2000; Skinner & Belmont, 1993), whereas *cognitive engagement* refers to psychological investment in learning and mastering skills

(Newmann et al., 1992). In the present study, we focused on behavioral engagement in the classroom because it is more readily observable than emotional engagement and cognitive engagement, it is often emphasized in studies involving elementary students (e.g., Bryce et al., 2019; De Laet et al., 2015; Hughes et al., 2008; Wang et al., 2019), and it is viewed as a prerequisite for academic success (Hughes et al., 2008; Ladd et al., 2000; Wang et al., 2019).

There are strong theoretical reasons to expect behavioral engagement to predict academic achievement. Models of motivational development, such as the self-system model of motivational development (Skinner et al., 2008) and dynamic model of motivational development (Skinner & Pitzer, 2012), posit that school engagement is among the most proximal precursors of learning and achievement. Engagement, which has been described as the behavioral manifestation of motivation, is a direct and important pathway towards learning and academic success (Skinner & Pitzer, 2012). When children constructively engage in academic activities of the classroom, they are likely to learn, feel more academically competent, and build connections with teachers and peers. These experiences are likely to promote positive academic outcomes and school success.

Despite strong theoretical links between behavioral engagement and academic achievement, empirical evidence for this association is somewhat mixed. Dotterer and Lowe (2011) found that higher levels of observed behavioral engagement in 5$^{th}$ grade were concurrently associated with better performance on standardized tests. Using a nationally representative sample of students in the United States, Froiland and Oros (2014) reported that classroom engagement rated by teachers in 5$^{th}$ grade predicted reading achievement in 8$^{th}$ grade after accounting for prior reading. The predictive effect of behavioral engagement on later academic achievement also has been found among Chinese 3$^{rd}$ to 4$^{th}$ graders (Wang et al., 2019) and high school students (Chase et al., 2014). However, some studies failed to obtain significant relations, particularly for children in the early school years. Researchers who observed children's behavioral engagement in 1$^{st}$, 3$^{rd}$, and 5$^{th}$ grades found that, although behavioral engagement was concurrently related to academic achievement, it did not predict subsequent reading or math achievement (Bryce et al., 2019; Guo et al., 2015). Likewise, Goble et al. (2017) found that school engagement reported by teachers in preschool and kindergarten was concurrently, but not longitudinally, related to academic achievement. Finally, a study of students' behavioral engagement and academic achievement suggested that teacher-reported behavioral engagement in 4$^{th}$ grade predicted math but not reading achievement in 5$^{th}$ grade (Darensbourg & Blake, 2013).

The existence of subpopulations of students with different engagement experiences in elementary school offers a potential reason for the inconsistent longitudinal relations. Person-centered approaches represent a useful way to identify potential subpopulations of students who may have different developmental trajectories of behavioral engagement (Li & Lerner, 2011; Wylie & Hodgen, 2012). Presently, the understanding of behavioral engagement trajectories is limited because only a small number of longitudinal studies have used person-centered approaches, and most of these studies involved adolescents (e.g., Engels et al., 2017; Li & Lerner, 2011; Wang & Eccles, 2012). For example, one study examining teacher-reported trajectories of students' classroom engagement from 1$^{st}$ through 6$^{th}$ grades identified three distinct developmental trajectories: (a) approximately

43% of students persistently displayed high classroom engagement, (b) 34% displayed a medium level of classroom engagement, and (c) approximately 23% had a low level of classroom engagement (Pagani et al., 2012). Based on students' reports, Archambault and Dupéré (2017) found that most children in their sample displayed stable, high behavioral engagement from 3rd through 6th grades. Some researchers examining behavioral engagement trajectories in older children found high stable, moderate stable, and decreasing trajectories of self-reported engagement (Li & Lerner, 2011). Students in the group involving the highest level of behavioral engagement tended to have the highest academic achievement (Li & Lerner, 2011; Wylie & Hodgen, 2012). In summary, as far as we are aware, less than a handful of studies have investigated developmental trajectories of behavioral engagement during early elementary school and results are inconsistent. Furthermore, no study has examined whether these different trajectories, representing students' experiences over time, are associated with subsequent academic performance among young children.

According to the perspective that engagement provides students, particularly the most vulnerable students, with opportunities to learn, behavioral engagement may be especially important for students who are low on key predictors of academic success (Ng et al., 2018). To evaluate this hypothesis, we focused on two potentially relevant risk factors: low SES and low initial levels of achievement (Duncan et al., 2007; Garon-Carrier et al., 2018; Morgan et al., 2016). Students who are from higher SES families or are higher in initial levels of achievement are frequently observed to have higher academic achievement than their peers, which may be because they have more family resources that facilitate academic achievement. For students who do not have these advantages, engaging in school-based opportunities may be particularly beneficial. Results from a longitudinal study of children in the early elementary years indicated that school engagement was positively related to growth in math achievement; moreover, school engagement had the largest effect on achievement gains for students who began with the lowest math achievement (Bodovski & Farkas, 2007). However, a study involving 5th grade students suggested that behavioral engagement was positively associated with academic achievement among students who were not identified as struggling learners based on prior academic tests, and the link between behavioral engagement and academic achievement was absent for struggling learners (Dotterer & Lowe, 2011). Thus, findings involving moderation by prior achievement have been inconsistent, and we are unaware of relevant studies involving moderation by SES.

A significant limitation in the school engagement literature involves the overreliance on the self- and teacher-reports of behavioral engagement. This represents a limitation because such reports may be biased due to social desirability, inaccurate recall, and difficulty associated with teachers' ability to consistently observe how numerous students are behaving across the school year (Fredricks & McColskey, 2012). Direct observation of students' engagement represents an ideal methodological approach for assessing behavioral engagement that may overcome some of these challenges (Ostrov & Hart, 2013). Observing behavioral engagement in the classroom can be challenging, especially given the need to obtain multiple observations of engagement (from many students) across a long period of time (Booren et al., 2012; Fredricks & McColskey, 2012; Volpe et al., 2005). In the present study, in an effort to advance the behavioral engagement literature, we relied

on extensive observations of engagement. Specifically, we observed over 300 students' behavioral engagement in academic-related tasks across a wide range of settings (e.g., class, art, music, and library). Furthermore, using intensive observations of students' behavioral engagement across three years, we captured patterns of change in students' behavioral engagement in the early elementary years.

## The Present Study

The current literature is limited in at least two critical ways. First, little is known about behavioral engagement trajectories of students in the early elementary years, and even less is known regarding the association of these trajectories with students' academic skills. Second, most studies of behavioral engagement have relied on self- or teacher-reported data, which may lead to biased estimates of behavioral engagement and of the relations between engagement and other variables, such as achievement. To begin to overcome these limitations, we sought to (a) investigate the developmental trajectories of behavioral engagement across kindergarten, 1st grade, and 2nd grade; (b) predict academic achievement in 2nd grade from behavioral engagement trajectories (while controlling for kindergarten achievement); and (c) examine whether the prediction of achievement from behavioral engagement was moderated by family SES and students' initial academic skills. Because of the lack of research during the early elementary years and mixed findings in prior literature, it was difficult to develop a firm hypothesis describing types of developmental trajectories of behavioral engagement. We tentatively expected to find at least two, but perhaps three, distinct developmental trajectories of behavioral engagement (e.g., high-stable, medium-stable, and perhaps low-stable trends) based on prior research on teacher reports of student engagement across elementary school (Pagani et al., 2012). Based on the evidence that higher levels of behavioral engagement are often linked to higher academic achievement, we expected persistently high behavioral engagement to predict better academic skills, even when controlling for school-entry academic skills and demographic variables (i.e., child age, sex, ethnicity, and family SES). Guided by the notion that school engagement offers the most vulnerable students with opportunities to learn (Ng et al., 2018), we expected children in lower SES families or with lower initial academic skills to benefit more than their peers from higher behavioral engagement.

## Method

### Participants

Participants were 301 kindergarteners (49% boys, $M_{age}$ = 65.74 months, $SD$ = 4.18 months) initially sampled from 26 kindergarten classrooms in a large southwest city of the United States. At the beginning of the academic year (2012 for Cohort 1 and 2013 for Cohort 2), approximately 541 children were invited to participate in the study. Parents of 301 children (56%) provided consent. Participating children were from diverse ethnic backgrounds (53% Hispanic, 34% non-Hispanic White, 3% Asian, 2% non-Hispanic Black, 2% Native American backgrounds, 1% other, and 6% unknown; all percentages are rounded). Children's parents had varied education levels: 11% of mothers and 17% of fathers had less than a high school diploma, 18% of mothers and 21% of fathers attained

a high school diploma or equivalent, 30% of mothers and 24% of fathers attended some college, 39% of mothers and 36% of fathers attained a college degree or above, and 2% of mothers and 2% of fathers had missing education information. When children were in kindergarten, approximately 25% of families reported a household income of less than $40,000, 32% had a household income between $40,000 and $100,000, 19% were over $100,000, and 23% did not report income. Children in the two cohorts (178 children in Cohort 1 and 123 children in Cohort 2) were not significantly distinguishable regarding age ($t(296) = 0.92$, $p = .360$, Cohen's $d = 0.11$), sex ($\chi^2(1) = 0.01$, $p = .937$, Cramer's V = 0.01), Hispanic ethnicity (*Hispanic* and non-*Hispanic*; $\chi^2(1) = 0.21$, $p = .649$, Cramer's V = 0.03), and family SES (see the measure below; $t(299) = 1.66$, $p = .099$, Cohen's $d = 0.19$). Therefore, cohort was not considered further.

## Procedure

Research assistants attended kindergarten orientation nights in five public elementary schools to invite families to participate in a 3-year longitudinal study. Introductory letters were also mailed to parents of all incoming kindergartners. Parents' written consent and children's verbal assent were obtained prior to their participation. Research staff who received extensive training observed and coded children's behavioral engagement each semester from kindergarten through 2nd grade. During 3–4 weeks of training, observers rated children's engagement in pilot preschool settings and pre-coded videos (except during the first year of Cohort 1). All observers obtained acceptable reliability (i.e., intraclass correlation coefficients [ICC] > .70) with expert staff before data collection started. Additional live reliability checks between observers and expert staff were conducted throughout the study to ensure acceptable reliability was maintained (see below for ICC details). A separate group of research assistants conducted standardized assessments of children's reading and math skills in the spring of kindergarten and 2nd grade. These research assistants received two, 2.5 hr of training per week for 5 weeks to ensure that the assessments were administered according to the publisher's protocols. Each child was assessed individually in a quiet, private space separate from the classroom. Parents reported demographic information in the fall of kindergarten. Parents were paid $25 for completing a survey when children were in kindergarten, and children received small toys as gifts. The study protocol was approved by Arizona State University Institutional Review Board.

## Measures

**Observed Behavioral Engagement—**Engagement was coded using procedures that are similar to those implemented for the Classroom Observation Scale (La Paro et al., 2006). This observation method has been used in prior studies and demonstrated good validity (Hernández et al., 2018; Johns et al., 2019). In the fall and spring of kindergarten, 1st, and 2nd grade, trained research assistants observed children's behavioral engagement in academic-related activities in classrooms (e.g., class, art, music, library). Observers coded children's engagement in 30 s intervals on a 4-point scale: 0 = *no evidence of engagement* (e.g., not participating, not paying attention), 1 = *minimally or passively engaged* (e.g., paying attention but not participating for nearly all of the time or participating some of the time but is disruptive), 2 = *moderately engaged* (e.g., attending to the teacher and participating appropriately at least half of the time or attending and participating most of the

time but is disruptive), and 3 = *highly engaged* (e.g., actively participating a majority of the time and is not disruptive).

Observers were given a picture collage of all participating children in the classroom. At the start of each data collection session, observers randomly selected a child to start with on the collage. After observing the child's behavioral engagement for 30 s, the engagement code was assigned and the observer began observing the next participating child in the classroom. If a child was unavailable, the observer skipped that child and attempted to observe him or her prior to starting the list from the beginning again. Toward the end of each semester, if the number of observations for a particular child was low due to absences or an individualized academic schedule, observers were instructed to collect data on that child more often (e.g., every three scans rather than once per list cycle). Across kindergarten to 2nd grade, participating children's behavioral engagement in each classroom was observed by 2–3 observers who were in the classroom at separate times. There were 34 (24 females), 38 (25 females), 26 (20 females), 29 (25 females), 30 (24 females), and 27 (23 females) observers, respectively, per semester from the fall of kindergarten to the spring of 2nd grade. Observers conducted observations of children's engagement approximately 3 hr per day, 2–3 days per week, for 9–12 weeks each semester (see Hernández et al., 2018; Johns et al., 2019). Scores of behavioral engagement were computed by averaging across engagement codes within each semester and were coded as missing if there were less than 20 engagement codes in the semester. For children who had 20 or more engagement codes, the average number of engagement codes was 64.94 (range = 20–145), 69.09 (range = 36–175), 70.60 (range = 23–210), 76.99 (range = 21–168), 82.52 (range = 22–165), and 79.74 (range = 23–140), respectively, per semester from the fall of kindergarten to the spring of 2nd grade. Interrater reliability was calculated from live observations (approximately 10% of observations each semester) in which the observer and expert staff coded the same child at the same time. ICCs were .91 in kindergarten fall, .93 in kindergarten spring, .93 in 1st grade fall, .94 in 1st grade spring, .93 in 2nd grade fall, .93 in 2nd grade spring.

**Reading and Math Skills—**Standardized measures of achievement were used to assess reading and math skills in the late spring of kindergarten and 2nd grade. Reading and math skills were assessed with the passage comprehension and applied problems subtests, respectively, from the Woodcock-Johnson III Tests of Achievement (Woodcock et al., 2001). Only one child in kindergarten completed assessments in Spanish. In accordance with standard procedures, raw scores were converted to W-scores, which can be compared across time, and these scores were used in analyses (Woodcock et al., 2001). Passage comprehension and applied problems subtests are reliable and valid measures that are frequently utilized to assess reading and math skills among children in kindergarten, 1st, and 2nd grade (Cameron et al., 2012; Goble et al., 2017; Skibbe et al., 2012; Woodcock et al., 2001). Based on the normed samples, reliability estimates for the passage comprehension subtest, by age (in years), were as follows: age 4 (.94), age 5 (.96), age 6 (.96), age 7 (.96), age 8 (.92), age 9 (.91), and age 10 (.89; Woodcock et al., 2001). The applied problems subtest produced the following reliability coefficients: age 4 (.94), age 5 (.92), age 6 (.88), age 7 (.91), age 8 (.93), age 9 (.93), and age 10 (.91; Woodcock et al., 2001).

**Family SES—**Parents' education levels and family annual income were reported by parents when children were in the fall of kindergarten. Education levels were rated on a 4-point scale (1 = *less than high school diploma*, 2 = *high school degree or equivalent*, 3 = *some college, not graduated*, and 4 = *college graduate or higher*). Family annual income was rated with a 11-point scale (1 = *$0–$9,999*, 2 = *$10,000–$19,999*, 3 = *$20,000–$29,999*, 4 = *$30,000–$39,999*, 5 = *$40,000–$49,999*, 6 = *$50,000–$59,999*, 7 = *$60,000–$69,999*, 8 = *$70,000–$79,999*, 9 = *$80,000–$89,999*, 10 = *$90,000–$99,999*, and 11= $*100,000 or over*). Mothers' and fathers' education levels were positively related ($r(288) = .59$, $p < .001$) Therefore, these two variables were standardized using z-scores and then averaged to form a parents' education composite. The parents' education composite was positively related to income, $r(228) = .67$, $p < .001$. Thus, income was standardized via a z-score and then averaged with the parents' education composite to create a measure of family SES. The approach we used to calculate SES is consistent with a large body of empirical and theoretical work (e.g., Bradley, 2016; NCES, 2012; Valiente et al., 2014). We conducted sensitivity analyses with a family SES measure created from the average of the parents' education composite and standardized income-to-needs ratio. Results of sensitivity analyses were very similar to the present results (see Supplementary Table S1 for full results).

**Covariates—**Covariates included child age in the fall of kindergarten, sex (0 = *female*, 1 = *male*), and race/ethnicity. Child age at the beginning of kindergarten was calculated as the time elapsed from child's birthdate to the date (September 1, 2012, for Cohort 1, and September 1, 2013, for Cohort 2) that the child started kindergarten. The elapsed time was converted to months to represent child age in month at the beginning of kindergarten. Race/ethnicity was diverse and could be collapsed into three groups: Hispanic ($n = 159$, 53%), non-Hispanic White ($n = 103$, 34%), and non-Hispanic others ($n = 22$, 7%). We combined groups of non-Hispanic White and non-Hispanic others and recoded race/ethnicity as Hispanic (coded as 1) and non-Hispanic (coded as 0) because the percentage of non-Hispanic others was small. We also conducted sensitivity analyses with three racial/ethnic groups being dummy coded, the patterns of results for study variables were the same as compared to analyses with race/ethnicity being coded as Hispanic and non-Hispanic.

## Data Analytic Plan

Descriptive statistics and correlations among study and demographic variables were analyzed in M*plus* 7.0 using TYPE = Basic and ESTIMATOR = MLR commands. Next, a series of linear growth mixture modeling (GMM) analyses were conducted in M*plus* 7.0 to identify developmental trajectories of behavioral engagement across six semesters (Muthén & Muthén, 1998–2012). The TYPE = Mixture command was used in M*plus* for GMM analyses. To determine the optimal number of classes, multiple fit indices were utilized, including the Akaike information criteria (AIC), Bayesian Information Criterion (BIC), sample-size adjusted BIC (SSBIC), entropy, posterior probability of membership, Vuong–Lo–Mendell–Rubin likelihood ratio test (VLMR–LRT), and Lo–Mendell–Rubin Adjusted LRT test (LMR–LRT; Grimm et al., 2017; Nylund et al., 2007). Lower AIC, BIC, and SSBIC values indicate a better model. VLMR–LRT and LMR–LRT were used to compare $k$ with $k – 1$ class models. Significant VLMR–LRT and LMR–LRT indicate the $k$ classes model is better than the $k – 1$ classes model. Entropy, which ranges between 0

and 1, assesses the classification quality. Higher values suggest a better separation between latent classes. Similarly, higher posterior probabilities of membership indicate that latent classes are more easily distinguished. Importantly, theoretical criteria were also considered in determining the appropriate number of classes, including interpretability of classes and adequate class size. To ensure each class had an adequate class size, a criterion of at least 5% of the sample was utilized (Hipp & Bauer, 2006; Proctor et al., 2012).

After determining the number of behavioral engagement trajectory classes, we extracted engagement classes from the GMM (Jung & Wickrama, 2008) and conducted regression analyses to examine whether behavioral engagement trajectories predicted 2nd grade reading and math skills in M*plus*. Because children were initially from 26 classrooms in kindergarten, we calculated design effects to evaluate the extent to which non-independence might influence standard errors. A design effect of 2 or above indicates the need to account for non-independence of data (Muthén & Satorra, 1995). Design effects for 2nd grade reading and math skills were 2.43 and 2.98, respectively, based on fall kindergarten classroom (ICC was 0.18 for reading skills and 0.24 for math skills); scores were 1.74 and 2.02, respectively, based on 2nd grade classroom (ICC was 0.33 for reading skills and 0.45 for math skills). To account for the nested data structure (e.g., children clustered in classes) and the violation of the independence assumption, the TYPE = Complex command was used for regression analyses in M*plus*, with fall kindergarten classroom specified as the cluster variable. We also re-estimated regression analyses using 2nd grade classroom as the cluster variable and found that the pattern of findings did not change.

To provide a robust test of our predictions, academic skills during kindergarten (the specific measure depended on the outcome), child age, sex, Hispanic ethnicity, and family SES were included as covariates. To test if behavioral engagement was especially important for students at risk for low achievement, family SES and academic skills in kindergarten were tested as moderators of the relation between behavioral engagement and academic achievement. Interaction terms (i.e., behavioral engagement trajectory membership × family SES, or reading skills, or math skills in kindergarten) were created by calculating the products of dummy coded behavioral engagement trajectory membership and mean-centered family SES, kindergarten reading, or kindergarten math skills variables. Because M*plus* does not offer the $F$ test for $R^2$ change when including the interaction term in regression models, we used Satorra-Bentler (SB) scaled chi-square differences tests to evaluate whether fixing the interaction effect at zero in the interaction model generated a significant change in model fit compared to the model freely estimating the interaction effect. This test is analogous to the $F$ test for $R^2$ change in the traditional regression model. We tested the change in model fit for each interaction model and report these results after interactions effects.

The number of complete data for each study variable and covariate is presented in Table 1. The rate of missingness varied between 0%–27% for study variables and covariates, and the overall rate of missingness was 10.2%. Among 301 participants, 193 (64.1%) had complete data on study variables and covariates and 108 (35.9%) had missing data on 1–10 variables (see Supplementary Table S2 for the distribution of missing data). Missing data analyses (see Supplementary Table S3 for full results) indicated that children without missing data ($n$ = 205) on behavioral engagement and reading and math skills in 1st and 2nd grades did

not differ significantly from those who had some missing data ($n$ = 96) in terms of age, sex, Hispanic ethnicity, reading and math skills in kindergarten, and observed behavioral engagement in the fall and spring of kindergarten. However, family SES was higher for children who had no missing data compared to those with some missing data. A robust full information maximum likelihood estimator (MLR) in M*plus* 7.0 was employed to utilize all available data in estimating model parameters, with the assumption data are missing at random (Enders, 2010; Muthén & Muthén, 1998–2012). When fitting regression models, we estimated variances of exogenous variables, such that missing data on these variables were addressed.

## Results

### Preliminary Analyses

Descriptive statistics and correlations among study variables are presented in Table 1. Except for behavioral engagement in kindergarten fall (skewness = −2.31, kurtosis = 8.86), study variables did not show problematic departures from univariate normality: absolute values of skewness were lower than 2 (skewness ranged between −1.67–0.39) and kurtosis were lower than 7 (kurtosis ranged between −2.01–4.51; Bryne, 2010). A robust maximum likelihood estimator (MLR in M*plus* 7.0) was used to handle the slight deviation from normality (Lai, 2018). The measures of behavioral engagement were significantly correlated across semesters. Of particular interest, behavioral engagement scores during kindergarten and 1$^{st}$ grade were consistently related to all measures of academic skills. Behavioral engagement in the fall of 2$^{nd}$ grade did not correlate with measures of academic skills, whereas behavioral engagement in the spring of 2$^{nd}$ grade was related to reading skills in kindergarten and 2$^{nd}$ grade as well as math skills in 2$^{nd}$ grade. Sex and family SES were inconsistently related to behavioral engagement. Hispanic was negatively related to reading and math skills, whereas family SES and being male were positively related to reading and math skills. Correlations among predictors did not rise to a level that caused concern about multicollinearity for the regression analyses. We used correlation coefficients to evaluate multicollinearity because M*plus* does not provide statistics such as the variance inflation factor and tolerance.

### Growth Trajectories of Behavioral Engagement

Following the recommendation of Ram and Grimm (2009), we tested single-group latent growth curve models (LGCM) with no growth, linear growth, and nonlinear growth (i.e., quadratic growth and latent basis growth/free curve) prior to conducting GMM. Although the LGCM with linear growth had the lowest AIC, BIC, SSBIC, none of these LGCMs fit the data well, potentially indicating a single group does not represent the data (Ram & Grimm, 2009). Thus, we tested linear GMM with one to four classes.

Table 2 shows the model fit indices for the 1- through 4-class solutions for behavioral engagement. Based on the $p$ values of VLMR–LRT and LMR–LRT, the 2-class model was better than the 1-class solution and the 4-class solution was not better than the 3-class solution. The 2-class model was chosen over the 3-class solution because the entropy was relatively low in the 3-class solution as compared to the 2-class model and it has

been suggested that models with higher entropy are preferred when models have similar relative fit indices (Ram & Grimm, 2009). In addition, the average posterior probabilities for children in their most likely class were 0.86, 0.86, and 0.84 for classes 1 to 3, respectively, in the 3-class solution. These posterior probabilities were lower than those in the 2-class model (0.93 and 0.91), indicating that the 2-class model better distinguishes classes than the 3-class solution. Furthermore, although the AIC, BIC, and SSBIC values suggested the 3-class solution may provide a better solution than the 2-class model, the LMR–LRT $p$ value for the 3-class model was greater than .05 and the VLMR–LRT $p$ value of this same model was just barely significant, suggesting the 3-class solution may not be better than the 2-class model. Importantly, one class in the 3-class solution was very small ($n$ = 11, only 3.7% of the cases), which represents an additional reason for selecting the 2-class model over the 3-class solution (Hipp & Bauer, 2006; Proctor et al., 2012). Moreover, behavioral engagement in this small class was moderate in the fall of kindergarten and increased significantly over time. This trend is inconsistent with prior studies suggesting a decline of engagement across grades (e.g., Engels et al., 2017; Li & Lerner, 2011). We considered model assumptions of GMM (Bauer, 2007) with the 2-class solution and did not notice clear violations. Specifically, behavioral engagement measures from kindergarten to 2nd grades did not show problematic departures from univariate normality within each class (skewness values were −1.21 ~ −0.01 in one class and −1.31 ~ −0.49 in another class, and kurtosis values were −0.89 ~ 2.50 in one class and −0.36 ~ 3.01 in another class), indicating no violation of the within-class conditional normality assumption (Bauer, 2007). Additionally, we did not notice large values of residuals for means, variances, and covariances of behavioral engagement measures in each class, suggesting that the model was properly specified.

Figure 1 shows the estimated behavioral engagement trajectories for the 2-class model. Most children ($n$ = 262, 87.0%) were in the high-decreasing class. Students in this class had relatively high behavioral engagement in the fall of kindergarten ($M_{\text{intercept}}$ = 2.82, $p$ < .001; Variance = 0.005, $p$ = .012), and their behavioral engagement decreased significantly across time ($M_{\text{slope}}$ = −0.034, $p$ < .001; Variance < 0.001, $p$ = .227). The second class comprised students with moderate-stable behavioral engagement ($n$ = 39, 13.0%). Students in this class sustained a moderate level of behavioral engagement from the fall of kindergarten ($M_{\text{intercept}}$ = 2.53, $p$ < .001; Variance = 0.058, $p$ = .028) through 2nd grade ($M_{\text{slope}}$ = −0.012, $p$ = .614; Variance = 0.007, $p$ = .018).

## Prediction of Academic Achievement from Behavioral Engagement Trajectories

Next, we tested whether the behavioral engagement trajectory classes (0 = moderate-stable class, 1 = high-decreasing class) were predictive of rank-order change in academic skills in 2nd grade. As shown in the Model 1 column of Table 3, membership in the high-decreasing class was predictive of 2nd grade reading skills when controlling for reading skills in kindergarten: students in the high-decreasing class had higher reading skills than students in the moderate-stable class. The behavioral engagement trajectory classes, however, were not related to 2nd grade math skills after accounting for math skills in kindergarten.

Our third goal was to examine whether the relations between the behavioral engagement trajectory classes and academic skills were moderated by family SES or students' kindergarten academic skills. Family SES, kindergarten academic skills, and child age were grand mean centered. There was evidence that 2nd grade reading was predicted by the interaction between behavioral engagement trajectory membership and family SES. Specifically, the effect of the interaction term was significant (see Table 3) and this finding is consistent with the change in model fit when the interaction effect was fixed at zero compared to when it was freely estimated, ΔSB $\chi^2(1) = 3.83$, $p = .050$. As shown in Figure 2, Panel A, simple slope analyses indicated that behavioral engagement trajectory membership was predictive of 2nd grade reading skills among children from low (−1 *SD*) SES families ($b = 12.24$, $SE = 3.82$, $p = .002$), but not high (+1 *SD*) SES families ($b = 1.76$, $SE = 2.99$, $p = .556$). For children in low SES families, members in the high-decreasing class had higher 2nd grade reading skills than those in moderate-stable class. The interaction between behavioral engagement trajectory membership and kindergarten reading skills was also significant, given the significant effect of the interaction term (see Table 3) and the change in model fit that occurred when the interaction term was freely estimated versus fixed at zero, ΔSB $\chi^2(1) = 5.49$, $p = .019$. Likewise, as shown in Figure 2, Panel B, behavioral engagement trajectory membership was related to 2nd grade reading skills for students with low (−1 *SD*; $b = 11.54$, $SE = 4.45$, $p < .010$), but not high (+1 *SD*; $b = 0.69$, $SE = 1.99$, $p = .730$), kindergarten reading skills. No significant moderation effect of family SES or kindergarten math skills was found on the relation between behavioral engagement and 2nd grade math skills, given that the effects of the interaction terms were not significant (see Table 3) and the change in model fit was not significant when fixing the interaction effect between behavioral engagement trajectory membership and SES (ΔSB $\chi^2(1) = 0.26$, $p = .610$) or kindergarten math skills (ΔSB $\chi^2(1) = 0.12$, $p = .734$) at zero.

## Discussion

The goals of this study were to investigate developmental trajectories of observed behavioral engagement from kindergarten through 2nd grade and to test whether trajectory membership was associated with students' academic achievement in 2nd grade. Furthermore, we examined whether these associations were moderated by family SES and students' kindergarten academic skills. Most students in kindergarten displayed a high initial level of behavioral engagement, which declined moderately through 2nd grade, whereas a smaller group of students experienced moderate initial levels of behavioral engagement that were stable over time. Despite the declining trend, students in the high-decreasing group persistently exhibited higher behavioral engagement than those in the moderate-stable group. Moreover, our findings illustrate that students in the high-decreasing group had better reading skills in 2nd grade than those in the moderate-stable group. Interestingly, this group difference was only present for children from low SES families and for children low in kindergarten reading skills.

### Developmental Trajectories of Behavioral Engagement

As expected, our findings indicate that there are individual differences in the development of behavioral engagement over the early school years. Most children in our study exhibited a

decline in observed behavioral engagement from kindergarten through 2nd grade, whereas a smaller subgroup of students experienced no significant changes in behavioral engagement. This study extends prior work (De Laet et al., 2015; Engels et al., 2017; Fredricks et al., 2004; Wang & Eccles, 2012) by investigating different patterns of growth in behavioral engagement and is consistent with previous literature demonstrating that students generally show a downward trend in behavioral engagement from age 10 through 16 years while the initial levels and the rate of decline vary among children (Wylie & Hodgen, 2012). This finding adds to the current literature by extending these results to the early school years. The result that most students experienced a significant decline in behavioral engagement might stem from changes in the classroom learning activities and structure from kindergarten to 2nd grade (Sink et al., 2007). It is also possible that students become less interested in participating in classroom activities as the novelty of early elementary school wears off. Given the identification of different developmental trajectories in behavioral engagement, it will be important to identify constructs and processes that explain class membership and why the majority of students experienced a decline in behavioral engagement. This line of research is likely to be most fruitful when investigators consider a variety of possibilities, including student characteristics (e.g., temperament, problem behaviors, social skills), relationships with teachers and peers, and change in the school context (Fredricks et al., 2019).

We were somewhat surprised that we did not identify a low behavioral engagement trajectory class. This contrasts with findings involving students in Grades 1–6 (Pagani et al. (2012) and adolescents aged 12–16 years (Janosz et al., 2008). Several methodological differences may explain why our findings differ from those of Pagani et al. (2012) and Janosz et al. (2008). Specifically, they had much larger samples (*Ns* = 1,369 and 13,330, respectively) which may have allowed for the identification of more classes. In addition, they studied children from economically disadvantaged areas in Canada, which provides a different context than students in our sample, who had varied economic backgrounds and lived in the United States. Previous research has indicated that behavioral engagement might be lower in low SES samples (Li & Lerner, 2011). Last, engagement data were provided by teachers in the other studies. Teachers might be in a better position than research staff to identify students low in engagement. However, as mentioned earlier, teacher reports could be biased due to reasons such as inaccurate recall (Fredricks & McColskey, 2012). There remains a need for multi-method longitudinal studies to clarify patterns of behavioral engagement during the early elementary years.

## Behavioral Engagement Trajectories and Academic Achievement

The results of this investigation advance knowledge on the relations between behavioral engagement during early elementary school and students' reading and math achievement. Of particular interest, students in the high-decreasing group were higher in reading than students in the moderate-stable group. In subsequent analyses we also found evidence that this finding was moderated by SES and prior reading skills. Cumulatively, the findings are consistent with the perspective that behavioral engagement is most likely to help students who are at risk for low reading skills. Students high in SES likely have access to numerous assets (e.g., cognitively stimulating materials at home, parental support, health/nutrition,

school resources) that make high levels of behavioral engagement less critical for reading (Aikens & Barbarin, 2008; Bradley & Corwyn, 2002). Likewise, students high in initial reading achievement may have the same (or similar) assets noted above that facilitated continued reading regardless of their level of behavioral engagement. However, these assets may be absent (or lower) for students low in SES or initial reading skills, making high levels of behavioral engagement particularly important for reading. Overall, these findings provide support for the hypothesis that the most vulnerable students benefit from high behavioral engagement (Ng et al., 2018). Advancing behavioral engagement in children from low SES families or with low initial reading skills may have important implications for fostering their academic success.

It is interesting that there were many significant zero-order relations between behavioral engagement and math skills, but prediction of 2nd grade math skills from the behavioral engagement trajectories was non-significant after accounting for math skills in kindergarten. Findings from studies suggesting a relation between behavioral engagement and math skills should be interpreted with caution if prior math was not controlled for in the analyses. Although we coded hundreds of instances of behavioral engagement for each student, our approach did not allow us to explore the relations between behavioral engagement in, for example, math-specific activities and math skills because our coding scheme did not capture what subject was being taught. Future investigations may wish to adopt this approach as a way of further exploring the role of behavioral engagement for children's math.

## Strengths, Limitations, and Future Directions

The current study has three major strengths. First, the behavioral engagement data were extensively observed across kindergarten, 1st, and 2nd grade. Compared to self- and teacher-reports, observational assessments may be more objective and have greater ecological validity (Fredricks & McColskey, 2012; Ostrov & Hart, 2013). Second, based on previous studies that suggested multiple growth trajectories of behavioral engagement (e.g., Archambault & Dupéré, 2017; Li & Lerner, 2011; Pagani et al., 2012), we conducted GMM analyses following Ram and Grimm's (2009) recommendations to study the longitudinal trajectories of behavioral engagement in the early school years. The person-centered approach allowed us to identify interindividual differences in intraindividual change that advances the understanding of the individual differences in the development of behavioral engagement over time. We identified two distinct trajectories of behavioral engagement that showed implications for predicting subsequent academic achievement. Third, we assessed children's reading and math skills using standardized tests and controlled for kindergarten academic skills when predicting 2nd grade math and reading skills. Consequently, we provided a very rigorous test of our predictions.

Despite these strengths, the study is not without limitations. First, our study focused on behavioral engagement and we did not assess other types of engagement (e.g., emotional or cognitive engagement). The extent to which findings generalize to other forms of engagement is not known. Future studies should investigate the developmental trajectories of emotional and cognitive engagement and how these forms of engagement are associated with later academic achievement. Second, we did not investigate predictors of

the behavioral engagement trajectories. Additional research is needed to study how factors such as children's temperament, the student-teacher relationship, peer relations, and the classroom context are related to behavioral engagement trajectories. Moreover, theoretical frameworks suggest that academic achievement also could contribute to engagement, indicating reciprocal links between engagement and achievement (Skinner & Pitzer, 2012). Future studies should examine bidirectional relations between engagement and achievement. Third, although we included over 300 children in our intensive longitudinal study, additional trajectories may have been identified if we had a larger sample. Fourth, it is important to keep in mind that scores of behavioral engagement tended to be high from kindergarten across 2nd grade. It may be valuable to utilize or develop assessments of behavioral engagement that more fully assess the full potential range of engagement during this time frame. At the same time, given the structure of most early elementary classrooms, we believe it is unlikely that many children will be extremely low in this form of engagement. Fifth, considering the limited time schools allowed us to work with children, we employed one subtest each to assess reading and math skills. Given the concerns of using a single subtest from the Woodcock-Johnson III Tests of Achievement (Bradley-Johnson & Durmusoglu, 2005), future studies may benefit from using multiple tests for reading and math skills. We, along with many other investigators, often rely on reliability information from the publisher of the Woodcock-Johnson test (e.g., Duncan et al., 2017; Gonzales et al., 2021). Moving forward, it may be optimal for investigators to also report study specific reliability for this measure. Sixth, we included family income and parental education as indexes of SES, whereas some research also considers parental occupation as a third SES component (Bradley, 2016). In addition to assessing various components of SES, future studies should collect more detailed information about these indexes, such as family wealth (e.g., including family income, assets), to better capture family SES.

## Implications and Conclusions

Despite these limitations, this study provides evidence for heterogeneity of developmental trajectories of behavioral engagement and indicates that these trajectories are predictive of 2nd grade reading skills, especially for students who come from low SES families or have low school-entry reading achievement. Although these findings do not establish that behavioral engagement is causally related to reading skills, the fact that behavioral engagement predicted reading skills beyond several controls, including prior reading skills, suggests that it may be valuable to explore means of improving children's behavioral engagement as a way of supporting their reading. There is growing evidence that interventions can be an effective way to advance students' engagement (see Archambault et al., 2019). Given the evidence presented here that behavioral engagement is especially associated with reading skills for children low in initial reading skills and SES in kindergarten, there is reason to believe that identifying children at risk for low reading is especially important and interventions that promote behavioral engagement might be particularly helpful for these students. In addition to behavioral engagement, it is also important to identify and enhance other compensatory resources for children with low family SES and kindergarten academic skills.

## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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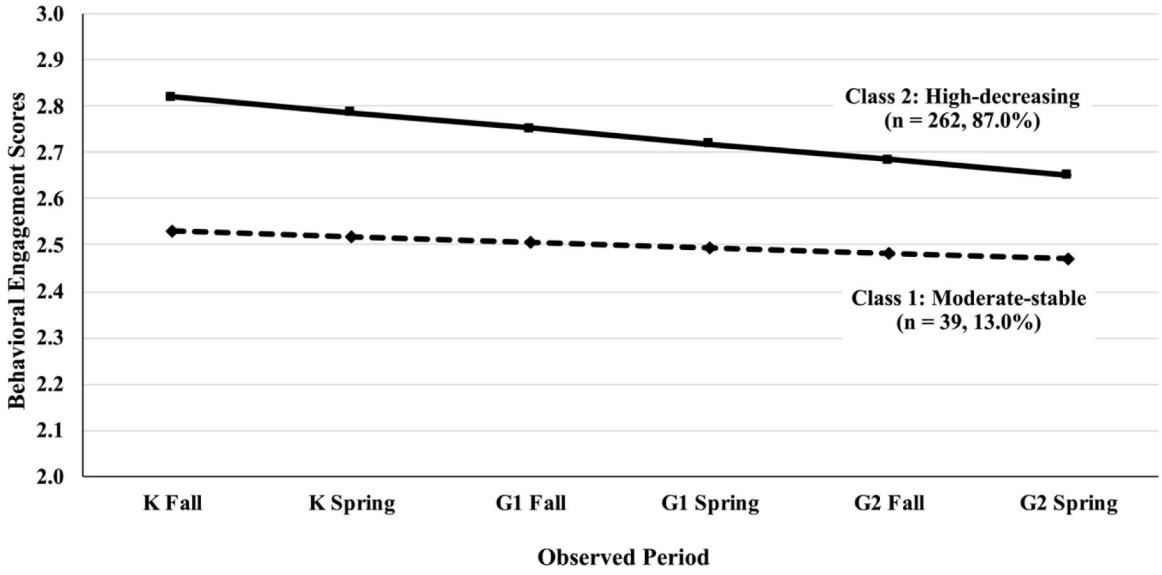


**Figure 1.**

Estimated Behavioral Engagement Trajectories from Kindergarten to 2nd Grade

*Note.* K = Kindergarten, G1 = 1st Grade; G2 = 2nd Grade.

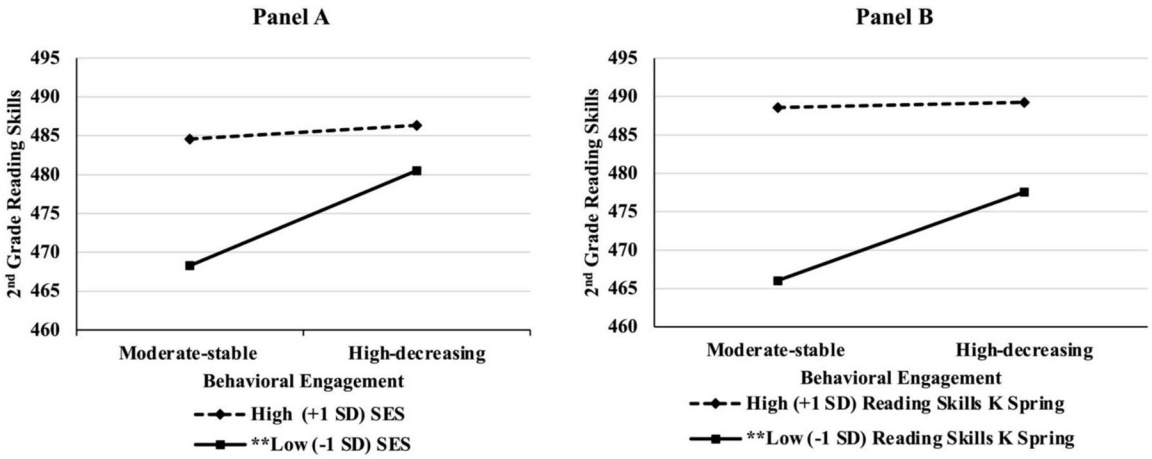


**Figure 2.**

Interaction Effects of Behavioral Engagement Trajectories with Family SES (Panel A) or Reading Skills in Kindergarten (Panel B) on Reading Skills in 2nd Grade

*Note.* SES = Socio-economic status, K = Kindergarten. $^{**}p < .01$.

**Table 1**

Descriptive Statistics and Correlations among Study Variables (N = 301)

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Behavioral Engagement K Fall | 1 | | | | | | | | | | | | | |
| 2. Behavioral Engagement K Spring | 0.64*** | 1 | | | | | | | | | | | | |
| 3. Behavioral Engagement G1 Fall | 0.39*** | 0.43*** | 1 | | | | | | | | | | | |
| 4. Behavioral Engagement G1 Spring | 0.38*** | 0.35*** | 0.60*** | 1 | | | | | | | | | | |
| 5. Behavioral Engagement G2 Fall | 0.29*** | 0.26*** | 0.35*** | 0.29*** | 1 | | | | | | | | | |
| 6. Behavioral Engagement G2 Spring | 0.28*** | 0.36*** | 0.29*** | 0.30*** | 0.47*** | 1 | | | | | | | | |
| 7. Reading Skills K Spring | 0.18** | 0.13* | 0.07 | 0.13* | 0.02 | 0.12* | 1 | | | | | | | |
| 8. Reading Skills G2 Spring | 0.24*** | 0.14* | 0.22*** | 0.22*** | 0.11 | 0.22*** | 0.57*** | 1 | | | | | | |
| 9. Math Skills K Spring | 0.24*** | 0.13* | 0.22*** | 0.25*** | 0.03 | 0.09 | 0.53*** | 0.63*** | 1 | | | | | |
| 10. Math Skills G2 Spring | 0.25*** | 0.13* | 0.19*** | 0.25*** | 0.05 | 0.16** | 0.59*** | 0.68*** | 0.73*** | 1 | | | | |
| 11. Child Age in Months K Fall | 0.08 | 0.06 | −0.07 | −0.03 | 0.09 | −0.09 | 0.002 | −0.11 | −0.001 | −0.05 | 1 | | | |
| 12. Male | −0.04 | −0.05 | −0.21*** | −0.16* | −0.10 | −0.01 | 0.03 | 0.09 | 0.16** | 0.25*** | 0.13* | 1 | | |
| 13. Hispanic | −0.07 | 0.02 | −0.09 | −0.09 | 0.001 | −0.08 | −0.21*** | −0.36*** | −0.29*** | −0.26*** | 0.13* | −0.09 | 1 | |
| 14. Family SES K Fall | 0.08 | −0.002 | 0.09 | 0.12* | −0.10 | 0.19*** | 0.38*** | 0.48*** | 0.46*** | 0.51*** | −0.10 | 0.10 | −0.37*** | 1 |
| *M* | 2.78 | 2.69 | 2.74 | 2.69 | 2.60 | 2.64 | 428.19 | 480.44 | 442.54 | 480.60 | 65.74 | 0.49 | 0.58 | −0.05 |
| *SD* | 0.18 | 0.22 | 0.19 | 0.23 | 0.24 | 0.23 | 21.05 | 14.96 | 15.97 | 20.60 | 4.18 | 0.50 | 0.50 | 0.91 |
| Valid *N* | 297 | 294 | 254 | 255 | 227 | 219 | 289 | 238 | 290 | 238 | 298 | 301 | 284 | 301 |

*Note*. K = Kindergarten, G1 = 1st Grade, G2 = 2nd Grade, SES = Socio-economic status; Means, standard deviations, and correlations were estimated in M*plus* 7.0 using TYPE = Basic and ESTIMATOR = MLR commands (*N* = 301);

* $p < .05$

** $p < .01$

*** $p < .001$.

**Table 2**

Fit Indices for 1- to 4-Class Growth Mixture Models for Behavioral Engagement (N = 301)

| | 1 class | 2 classes | 3 classes | 4 classes |
|---|---|---|---|---|
| *n* of class 1 | 301 | 39 | 11 | 7 |
| *n* of class 2 | - | 262 | 76 | 25 |
| *n* of class 3 | - | - | 214 | 58 |
| *n* of class 4 | - | - | - | 211 |
| AIC | −720.67 | −836.13 | −861.29 | −871.81 |
| BIC | −679.89 | −776.81 | −783.44 | −775.43 |
| SSBIC | −714.77 | −827.56 | −850.04 | −857.88 |
| Entropy | - | 0.71 | 0.67 | 0.69 |
| VLMR–LRT *p* value | - | 0.004 | 0.049 | 0.202 |
| LMR–LRT *p* value | - | 0.004 | 0.052 | 0.209 |

*Note.* AIC = Akaike information criterion; BIC = Bayesian information criterion; SSBIC = sample-size adjusted Bayesian information criterion; VLMR–LRT = Vuong–Lo–Mendell–Rubin likelihood ratio test; LMR–LRT = Lo–Mendell–Rubin Adjusted LRT test.

## Table 3

Behavioral Engagement Trajectories Predicting Academic Skills in 2nd Grade (N = 301)

| | Model 1 Main effect | | Model 2 Interaction of Behavioral Engagement Trajectories and SES | | Model 3 Interaction of Behavioral Engagement Trajectories and Academic Skills K Spring | |
|---|---|---|---|---|---|---|
| | ***b*** | ***SE*** | ***b*** | ***SE*** | ***b*** | ***SE*** |
| Reading Skills G2 Spring | | | | | | |
| Child Age | −0.30 | 0.18 | −0.29 | 0.17 | −0.28 | 0.18 |
| Male | 1.85 | 1.58 | 1.80 | 1.64 | 1.83 | 1.56 |
| Hispanic | −4.85* | 1.97 | −5.09* | 1.97 | −5.11** | 1.93 |
| SES | 3.75*** | 1.06 | 8.98*** | 2.49 | 3.76*** | 1.08 |
| Reading Skills K Spring | 0.31*** | 0.03 | 0.31*** | 0.03 | 0.54*** | 0.09 |
| High-decreasing Class | 6.68* | 2.77 | 7.00** | 2.61 | 6.11* | 2.56 |
| High-decreasing Class × SES | | | −5.77* | 2.46 | | |
| High-decreasing Class × Reading | | | | | −0.26* | 0.11 |
| $R^2$ | 0.46*** | | 0.48*** | | 0.48*** | |
| Math Skills G2 Spring | | | | | | |
| Child Age | −0.23 | 0.20 | −0.23 | 0.20 | −0.23 | 0.20 |
| Male | 5.33*** | 1.27 | 5.34*** | 1.26 | 5.35*** | 1.28 |
| Hispanic | 0.69 | 1.78 | 0.67 | 1.81 | 0.65 | 1.78 |
| SES | 4.59*** | 1.01 | 3.44* | 1.66 | 4.56*** | 1.01 |
| Math Skills K Spring | 0.78*** | 0.07 | 0.77*** | 0.07 | 0.72*** | 0.17 |
| High-decreasing Class | 2.41 | 2.51 | 2.34 | 2.55 | 2.68 | 3.01 |
| High-decreasing Class × SES | | | 1.26 | 2.39 | | |
| High-decreasing Class × Math | | | | | 0.06 | 0.19 |
| $R^2$ | 0.57*** | | 0.57*** | | 0.57*** | |

*Note.* K = Kindergarten; G2 = 2nd Grade; SES = Socio-economic status. The unstandardized coefficient (*b*) and its standard error (*SE*) are reported.

* $p < .05$

** $p < .01$

*** $p < .001$.