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How do behavior problems change over time in childhood? Evidence from the early childhood longitudinal study

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The trajectories and predictors of childhood behavior problems remain unclear, this study aims to examine this research topic using nine waves of data from the Early Childhood Longitudinal Study. A total of 1,1779 and 1,1785 children (ages 5 to 13 years) and their parents and teachers were recruited to examine the development of internalizing and externalizing problems, respectively. Results showed that internalizing problems had three developmental patterns, such as a low-increased pattern, a low-stable pattern, and a medium-decreased pattern, and externalizing problems had five developmental patterns, including a high-decreased pattern, a medium-decreased pattern, a low-high increased pattern, a low-increased pattern, and a low-stable pattern. The race, gender, family socioeconomic status, and self-control of the children predicted these trajectories. Findings suggest that changes in childhood behavior problems are heterogeneous and that individual differences should be considered when studying changes in behavior problems.

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Introduction

Behavior problems, including internalizing and externalizing problems, are an important maladaptive problem with high prevalence from early childhood to later childhood (McCrae, 2009), and they are also associated with mental health and violent behavior in adulthood (Kjeldsen et al., 2016; Reef et al., 2010), contributing to being an important developmental issue requiring prevention and intervention. However, the developmental patterns or trajectories of childhood behavior problems are unclear, for example, behavior problems may decrease throughout childhood (Marcal, 2020) and may be influenced by multiple factors (Lee and Holmes, 2021; Womack et al., 2022), while results of previous studies on the developmental trajectories and factors are inconsistent (Girard, 2021). Furthermore, the scarce research on the trajectories and predictors of behavior problems is mostly examined in low-income and clinical samples (Galán et al., 2020; Godinet et al., 2014) or is limited by small sample sizes (Olson et al., 2017).

Although research has examined the trajectories and predictors of behavior problems within large longitudinal samples (Farrell et al., 2017; Marcal, 2020), these may be based on the assumption that all individuals have the same change in behavior problems over time. It may not be valid to assume homogeneity within a sample with regard to the trajectories of behavior problems, as individual differences have been found to influence the development of behavior problems (Bevilacqua et al., 2018). This study aims to improve current knowledge of the trajectories and predictors of behavior problems within the assumption of within-sample heterogeneity using a large, ethnically diverse community sample, which will help to inform later prevention and intervention of behavior problems.

The development of internalizing and externalizing problems

Internalizing problems are characterized by emotional symptoms and are directed toward the individual (e.g., depression, sadness, and anxiety), whereas externalizing problems are defined as behavioral symptoms and are directed toward others (e.g., aggression and conduct problems), which may contribute to different trajectories of internalizing and externalizing problems in childhood. For example, several studies based on normal and clinical samples have reported that internalizing problems are stable and externalizing problems increase (Ahn et al., 2017; Bailey et al., 2019) or decrease (DaWalt et al., 2021; Yoon et al., 2017) throughout childhood, whereas other studies have shown that internalizing and externalizing problems decrease throughout childhood (Marcal, 2020). Furthermore, Zeng et al. (2012) have reported an increase in internalizing problems in the American kindergarteners, and Spieker et al. (1999) found a decrease in externalizing problems based on 183 young children aged 3.5–6 years.

Although the development of childhood behavior problems has been studied extensively, the developmental patterns or trajectories remain unclear. With the development of statistical techniques, person-centered approaches focusing on individual differences have been used to examine the trajectories of study variables. Several studies have reported that children are divided into three to five subgroups based on externalizing problems (Caleb et al., 2017; Figge et al., 2018; Kjeldsen et al., 2021; Thompson et al., 2011; Wildeboer et al., 2015), while few studies have examined the subgroups of internalizing problems (Chen, 2022). Not all children develop behavior problems in the same way, and individual differences may influence changes in behavior problems (Thelen and Smith, 1994), suggesting that individual differences should be considered in studies of behavior problems in order to better describe changes in behavior problems over time.

Guided by dynamic systems theory, which posits that the development of individuals is nonlinear and that development is embedded in time and context (Thelen and Smith, 1994), the current study aims to explore the developmental trajectories of internalizing and externalizing problems. Based on the above review, we hypothesize that childhood behavior problems are heterogeneous and that children can be divided into several subgroups based on their behavior problems.

Factors in the development of internalizing and externalizing problems

The development of behavior problems may be influenced by several factors. Some studies have reported that gender influences the development of behavior problems (e.g., Godinet et al., 2014; Marcal, 2020; Scott et al., 2017). Specifically, boys show a stable trend in the development of internalizing problems and an increasing trend in externalizing problems, whereas girls show a decreasing trend in both internalizing and externalizing problems during childhood (e.g., Wang and Yan, 2019). Moreover, race has been identified as a factor that influences the trajectory of behavior problems (Marcal, 2020). Meanwhile, several studies have reported that family socioeconomic status influences the trajectories of behavior problems (Gerstein et al., 2017; Zeng et al., 2012), while other studies have failed to confirm these findings (Scott et al., 2017). Furthermore, in addition to individual and family demographic factors, there are several psychological factors that may influence the development of behavior problems. For example, self-control is an important component of self-awareness, which may influence later emotions and behaviors (van Prooijena et al., 2018; Zhang and Wang, 2022). Rhee et al. (2018) have found that self-control predicted the development of behavior problems.

Although several studies have examined the predictors of behavior problems, the factors for the trajectories of behavior problems need to be further explored. According to ecological systems theory, the development of behavior problems may be influenced by various factors and interactions among factors (Bronfenbrenner, 1976), which may contribute to the rationale for examining the factors for behavior problems trajectories. Similarly, examining different levels of factors (e.g., individual, family, and psychological characteristics) for the development of behavior problems may provide clues for the prevention of maladaptive behaviors.

Guided by ecological systems theory, we attempt to examine the factors that influence the developmental trajectories of behavior problems. Based on the above review, we hypothesize that child characteristics (e.g., gender and race), family characteristics (e.g., socioeconomic status), and psychological characteristics (e.g., self-control) influence the trajectories of behavior problems.

Current study

Behavior problems are common developmental problems across nations and cultures and should be prevented and intervened in childhood. It is better to know the developmental law of behavior problems, which can help us to target prevention and intervention. However, previous studies have not produced consistent results on the developmental patterns or trajectories of behavior problems. Due to the inconsistent results on the development of behavior problems and the urgency of prevention and intervention of behavior problems in childhood, this study attempts to explore the trajectories of behavior problems in childhood and to examine the predictors of these trajectories based on a longitudinal study. The current study aims to answer two questions: (1) How do behavior problems change during childhood? (2) What factors influence the developmental patterns or trajectories of behavior problems?

To find answers to these two questions, the current study attempts to use growth mixture modelling (GMM) for data analysis. GMM is a model for identifying differences in longitudinal change between unobserved groups that emphasizes individual differences and makes appropriate distributional assumptions to incorporate categorical data into the model (Wickrama et al., 2016). Moreover, GMM provides a method by which we can develop a probabilistic representation of unobserved group classifications and group differences while preserving individual differences. Additionally, not all children have the same trajectory of behavior problems, and unconditional GMM may provide a method for identifying subgroups or developmental patterns of behavior problems while accounting for considering individual differences. Conditional GMM may provide a method for examining the factors that influence the trajectories or developmental patterns of behavior problems. Therefore, this study hypothesizes that (1) the development of childhood behavior problems is heterogeneous, that is, children are divided into several subgroups based on behavior problems; and (2) child characteristics (e.g., gender and race), family characteristics (e.g., socioeconomic status), and psychological characteristics (e.g., self-control) influence the trajectories of behavior problems based on a sample from the Early Childhood Longitudinal Study.

Methods

Participants. The Early Childhood Longitudinal Studies (ECLS) program, conducted by the America National Center for Education Statistics, examines child development, school readiness, and early school experiences using information from multiple sources (e.g., children, parents, teachers, and school administrators) in a longitudinal design. The Early Childhood Longitudinal Studies of 2010–2011 (ECLS-K: 2011) is the third study in the ECLS program, which followed a group of children from the kindergarten year (2010–2011 school year) through the fifth grade (2015–2016 school year). Parents provided data through interviews, and school administrators and teachers provided ratings for the children based on self-administered questionnaires. Data were collected twice (e.g., fall and spring) in the 2010–2011, 2011–2012, and 2012–2013 school years and once (e.g., spring) in the 2013–2014, 2014–2015, and 2015–2016 school years. Approximately 18,170 kindergartners recruited from about 1310 schools, and their parents, teachers, school administrators, and before- and after-school care providers also participated in the study during the 2010–2011 school year.

The current study aimed to examine the trajectories and predictors of internalizing and externalizing problems in childhood, so the longitudinal research design may be appropriate for these research questions. The current study used data from nine waves of teacher-reported internalizing and externalizing problems of children in the ECLS, including the fall and spring of the 2010–2011 school year (Waves 1 and 2), the fall and spring of the 2011–2012 school year (Waves 3 and 4), the fall and spring of the 2012–2013 school year (Waves 5 and 6), the spring of the 2013–2014, 2014–2015, and 2015–2016 school years (Waves 7, 8, and 9), and the parents provided the demographic information. Moreover, children with special needs and children with only one wave of data on behavior problems were excluded from the current study, and finally, 1,1779 and 1,1785 children were recruited from 18,170 children in the current study based on internalizing and externalizing behaviors, respectively. Children with special needs may have different trajectories of behavior problems than children without special needs. The present study was approved by the ethics committee of the America National Center for Education Statistics, and the procedures and measures were safe for the participants. Meanwhile, the current study did

not present any privacy information of the participants, and the data used in the current study were for research purposes only.

Measures

Social Rating Scale (SRS). The ECLS-K: 2011 used the SRS, revised from Gresham and Elliott's (1990) Social Skills Rating System, to measure behavior problems, self-control, and interpersonal skills via teacher report. The SRS has 19 items, such as a self-control subscale (4 items), an interpersonal skills subscale (5 items), an externalizing problem behaviors subscale (6 items), and an interpersonal problem behaviors subscale (4 items). Each item is rated on a four-option frequency scale ("never" to "very often"), and high scores indicate that the child exhibited the behaviors represented by the scale more often (e.g., higher scores on internalizing problem behaviors indicate that the child exhibited behaviors indicative of internalizing problem behaviors more often). The current study used data from nine waves of internalizing and externalizing problem behaviors, and the Cronbach α of the nine waves of internalizing problem behaviors were 0.79, 0.78, 0.77, 0.76, 0.78, 0.78, 0.78, 0.79, and 0.79, respectively, and the Cronbach α of the nine waves of externalizing problem behaviors were 0.88, 0.89, 0.88, 0.86, 0.88, 0.87, 0.87, 0.87, and 0.88, respectively. The self-control subscale was administered at Wave 1 in the current study, and its Cronbach α was 0.81.

Sociodemographic variables

Children's gender and race were collected at Wave 1, children's age was collected at each wave, and family socioeconomic status was collected at Waves 1, 4, and 9 (see <https://nces.ed.gov/ecls/index.asp> for detailed analysis process of family socioeconomic status).

Data analysis

Before the data analysis, chi-squared tests were used to examine the homogeneity of the data from these nine waves. Several steps were then used in the data analysis process. First, unconditional GMMs were conducted to describe changes in behavior problems over time. Second, conditional GMMs were conducted to examine predictors for trajectories of behavior problems.

Moreover, several indices were used to examine the optimal trajectories of behavior problems in the current study, such as Bayesian Information Criterion (BIC), Sample-Size Adjusted Bayesian Information Criterion (SSABIC), and Entropy. Lower values of BIC and SSABIC indicate that a good fit of the model (Feldman et al., 2009), and higher values of Entropy indicate better group classifications (Feldman et al., 2009; Nagin, 2005). Additionally, the Lo-Mendell-Rubin adjusted likelihood ratio test (aLRT) and the bootstrapped likelihood ratio test (BLRT) were also used to examine the optimal number of classifications in this study, and a significant aLRT and BLRT indicate that an n -profile solution was a significantly better fit than the $n-1$ model (Collins and Lanza, 2010). All analyses in the present study were conducted using Mplus version 7.4, and the full information maximum likelihood (FIML) estimator was used to deal with missing data.

Results

The descriptive analyses and summaries of demographic variables. The results of chi-squared tests showed that the differences in demographic information (e.g., gender, age, race, and family socioeconomic status) between the data from the nine waves were not significant ($p > 0.05$), indicating the homogeneity of the data from these nine waves. Detailed participant demographic information is provided in Table 1.

Table 1 Demographic Information of Participants.

	Wave 1	Wave 2	Wave 3	Wave 4	Wave 5	Wave 6	Wave 7	Wave 8	Wave 9
Age (M_months/SD)	67.28/4.60	73.21/5.02	78.80/4.21	85.18/4.64	90.68/4.17	97.26/4.79	108.77/4.78	120.75/4.96	151.69/4.59
Sex (n/%)	4970/41.9	5429/46.1	1783/15.1	4834/41.0	1573/13.3	4380/37.2	4063/34.5	3783/32.1	3575/30.3
	5534/47.0	6141/52.1	1891/16.0	5473/46.4	1708/14.5	5017/42.6	4623/39.2	4340/36.8	4077/34.6
	1311/11.1	215/1.8	811/68.8	1478/12.6	8504/72.2	2388/20.3	3099/26.3	3662/31.0	4133/35.1
	4786/40.6	5126/43.5	1267/10.8	4547/38.6	1137/9.6	4165/35.3	3853/32.7	3598/30.5	3417/29.0
	1456/12.4	1563/13.3	368/3.1	1290/10.9	313/2.7	1107/9.4	983/8.3	878/7.5	741/6.3
	2459/20.9	2815/23.9	1356/11.5	2647/22.5	1260/10.7	2504/21.2	2372/20.1	2269/19.3	2189/18.6
	252/2.1	276/2.3	105/0.9	207/1.8	79/0.7	172/1.5	152/1.3	144/1.2	134/1.1
	910/7.7	1097/9.3	342/2.9	1006/8.5	306/2.6	924/7.8	851/7.2	792/6.7	756/6.4
	71/0.6	89/0.8	24/0.2	77/0.7	20/0.2	64/0.5	60/0.5	55/0.5	50/0.4
	93/0.8	101/0.9	73/0.6	89/0.8	57/0.5	78/0.7	71/0.6	71/0.6	68/0.6
	458/3.9	504/4.3	134/0.6	451/3.8	105/0.9	390/3.3	353/3.0	322/2.7	300/2.5
	1300/11.0	215/1.8	8116/31.3	1471/12.5	8508/72.2	2381/20.2	3090/26.2	3656/31.0	4130/35.1
	-0.01/1.06	1.36/1.14	1.04/2.04	-0.04/0.81	1.00/2.10	1.41/1.16	1.44/1.08	1.37/1.33	-0.05/0.82
	1.00/2.11	1.50/1.07	1.43/1.35	1.59/1.04	1.32/1.68	1.59/0.94	1.58/0.93	1.50/1.02	1.35/1.34
	1.18/1.97								1.48/1.11
SES (M/SD)									
Internalizing problems(M/SD)									
Externalizing problems (M/SD)									

SES socio-economic status.

Trajectories of behavior problems. Results showed that there were three developmental patterns of internalizing problems, the detailed information is shown in Table 2 and Fig. 1, and the names of each developmental pattern were adapted from Gong et al. (2022). As indicated, there were 5.88% of children who had low initial levels of internalizing problems with increased slopes, which easily belong to the first class (Class 1). Based on this characteristic, they can be named as “low-increased pattern”. There were 87.23% of children who had low initial levels of internalizing problems with slight increased slopes, which easily belong to the second class (Class 2), named as “low-stable pattern”. Additionally, there were 6.89% of the children had medium initial levels of internalizing problems with decreased slopes, which easily belong to the third class (Class 3), named as “medium-decreased pattern”.

Moreover, the results showed that externalizing problems had five developmental patterns, details are shown in Table 3 and Fig. 2, and each developmental pattern name was adapted from Figge et al. (2018) and Kjeldsen et al. (2021). As indicated, there were 4.05% of children with high initial levels of externalizing problems with decreased slopes, which easily belong to the first class (Class 1), named as “high-decreased pattern”. There were 11.64% of children who had medium initial levels of externalizing problems with decreased slopes, which easily belong to the second class (Class 2), named as “medium-decreased pattern”. There were 0.20% of children who had low initial levels of externalizing problems with high increased slopes, which easily belong to the third class (Class 3), named as “low-very high increased pattern”. Moreover, there were 10.45% of children who had low initial levels of externalizing problems with increased slopes, which easily belong to the fourth class (Class 4), named as “low-increased pattern”. Additionally, there were 73.66% of children who had low initial levels of externalizing problems with slight increased slopes, which easily belong to the fifth class (Class 5), named as “low-stable pattern”.

Between-class predictors for trajectories of behavior problems.

Results showed that model fit in the conditional model of internalizing problems improved with lower BIC and SSBIC (BIC: 39596.861, SSBIC: 39444.336), as did model fit in the conditional model of externalizing problems (BIC: 37181.377; SSBIC: 36819.131).

Moreover, results showed that race, gender, and self-control at Wave 1 predicted internalizing problems classifications (Table 4). Comparing Class 1 to Class 3, non-white race ($\beta = -1.05$, OR = 0.900, $p < 0.05$), girls ($\beta = -0.436$, OR = 0.647, $p < 0.001$), or children with low levels of self-control at Wave 1 ($\beta = -0.581$, OR = 0.560, $p < 0.001$) were more likely to be in the Class 3, medium-decreased pattern. Comparing Class 2 to Class 3, boys ($\beta = 0.789$, OR = 2.202, $p < 0.001$) or children with high levels of self-control at Wave 1 ($\beta = 0.401$, OR = 1.493, $p < 0.001$) were more likely to be in Class 3.

Meanwhile, results showed that gender, family socioeconomic status, and self-control at Wave 1 predicted externalizing problems classifications (Table 5). Comparing Class 1 to Class 5, children with high levels of family socioeconomic status at Wave 9 ($\beta = 1.247$, OR = 3.479, $p < 0.01$) or high levels of self-control at Wave 1 ($\beta = 1.213$, OR = 3.364, $p < 0.05$) were more likely to be in Class 5, the low-stable pattern. Comparing Class 2 to Class 5, children with high levels of family socioeconomic status at Wave 9 ($\beta = 0.882$, OR = 2.416, $p < 0.05$) or high levels of self-control at Wave 1 ($\beta = 1.714$, OR = 5.551, $p < 0.01$) were more likely to be in the Class 5. Comparing Class 3 to Class 5, children with high levels of self-control at Wave 1 ($\beta = 1.860$, OR = 6.427, $p < 0.05$) were more likely to be in the Class 5.

Table 2 Fits statistics for internalizing problems (n = 11,179).

Models	Classes No.	LL (No. of parameters)	BIC	SSABIC	Entropy	Adj.LMR-LRT (p)	BLRT (p)	Group size (%)			
								C1	C2	C3	C4
GMM	2	-42,774.656 (17)	85,708.671	85,654.647	0.845	1770.357 (.00)	1833.309(.00)	1137 (9.65)	10642 (90.35)		
	3	-42,194.375 (20)	84,576.232	84,512.674	0.833	1120.710 (0.00)	1160.561 (0.00)	692 (5.88)	10275 (87.23)	812 (6.89)	
	4	-42,363.407 (23)	84,923.669	84,856.933	0.8685	0 (.50)	0 (1.00)	589 (5.00)	0 (0.00)	9984 (84.76)	1206 (10.24)

GMM growth mixture model; The bold values indicate the final class solution.

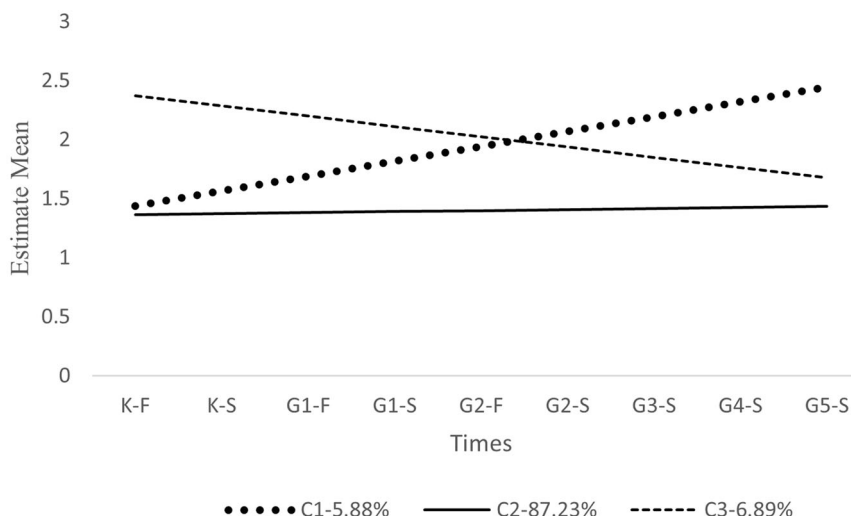


Fig. 1 Trajectories of internalizing problems from kindergarten to fifth grade. Note. K-F: Fall term in kindergarten year; K-S: Spring term in kindergarten year; G1-F: Fall term in Grade one; G1-S: Spring term in Grade one; G2-F: Fall term in Grade two; G2-S: Spring term in Grade two; G3-S: Spring term in Grade three; G4-S: Spring term in Grade four; G5-S: Spring term in Grade five; C1: Class/pattern one; C2: Class/pattern two; C3: Class/pattern three.

Comparing Class 4 to Class 5, girls ($\beta = 1.417$, $OR = 4.124$, $p < 0.05$) or children with high levels of family socioeconomic status at Wave 9 ($\beta = 0.982$, $OR = 2.670$, $p < 0.01$) or high levels of self-control at Wave 1 ($\beta = 2.900$, $OR = 18.169$, $p < 0.001$) were more likely to be in Class 5.

Within-class predictors for trajectories of internalizing and externalizing problems. The detailed results of within-class predictors for trajectories of internalizing problems are presented in Table 6. Race ($\beta = -0.008$, $p < 0.05$) or self-control at Wave 1 ($\beta = -0.134$, $p < 0.001$) negatively predicted the initial levels of internalizing problems, and gender ($\beta = 0.007$, $p < 0.05$) or self-control at Wave 1 ($\beta = 0.013$, $p < 0.001$) positively predicted slopes of internalizing problems.

Moreover, the detailed results of the within-class predictors of externalizing problems trajectories are presented in Table 7. For Class 1, self-control at Wave 1 ($\beta = -0.341$, $p < 0.01$) negatively predicted the initial levels of externalizing problems, and self-control at Wave 1 ($\beta = 0.068$, $p < 0.01$) positively predicted slopes of externalizing problems. For Class 2, race ($\beta = -0.044$, $p < 0.05$) or self-control at Wave 1 ($\beta = -0.504$, $p < 0.001$) negatively predicted the initial levels of externalizing problems, and self-control at Wave 1 ($\beta = 0.043$, $p < 0.001$) positively predicted slopes of externalizing problems. For Class 3, self-control at Wave 1 ($\beta = -0.556$, $p < 0.001$) negatively predicted the initial levels of externalizing problems. For Class 4, self-control at Wave 1 ($\beta = -0.206$, $p < 0.001$) negatively predicted the initial levels of

externalizing problems, gender ($\beta = -0.005$, $p < 0.05$) negatively predicted slopes of externalizing problems, and self-control at Wave 1 ($\beta = 0.021$, $p < 0.001$) positively predicted slopes of externalizing problems. For Class 5, self-control at Wave 1 ($\beta = -0.614$, $p < 0.001$) negatively predicted the initial levels of externalizing problems, and family socioeconomic status at Wave 4 ($\beta = 0.087$, $p < 0.001$) and self-control at Wave 1 ($\beta = 0.084$, $p < 0.01$) positively predicted slopes of externalizing problems, and family socioeconomic status at Wave 9 ($\beta = -0.046$, $p < 0.05$) negatively predicted slopes of externalizing problems.

Discussion

This study identified the trajectories of childhood behavior problems and examined predictors of these trajectories within nine waves of data from the Early Childhood Longitudinal Study. Results showed that internalizing problems had three developmental patterns, such as a low-increased pattern, a low-stable pattern, and a medium-decreased pattern, and children’s race, gender, and self-control at Wave 1 predicted these trajectories. Meanwhile, trajectories of externalizing problems had five developmental patterns, including a high-decreased pattern, a medium-decreased pattern, a low-very high increased pattern, a low-increased pattern, and a low-stable pattern, and these trajectories were predicted by children’s gender, race, family socioeconomic status, and the level of self-control at Wave 1.

Results showed that internalizing problems had three developmental patterns and externalizing problems had five

Table 3 Fits statistics for externalizing problems (n = 11,185).

Models	Classes No.	LL (no. of parameters)	BIC	SSABIC	Entropy	Adj.LMR-LRT (p)	BLRT (p)	Group size (%)							
								C1	C2	C3	C4	C5			
GMM	2	-51,442.832 (17)	103,045.031	102,991.007	0.870	2379.895 (.00)	2464.518 (.00)	1299 (11.02)	10486 (88.98)						
	3	-50,757.415 (20)	101,702.322	101,638.765	0.838	1323.763 (.00)	1370.833 (.00)	928 (7.87)	1119 (9.50)	9738 (82.63)					
	4	-50,704.585 (23)	101,624.785	101,551.694	0.871	102.033 (.00)	105.661 (.00)	9733 (82.59)	1122 (9.52)	907 (7.70)	23 (0.20)				
	5	-50,426.145 (26)	101,175.280	100,999.011	0.832	690.00 (.00)	715.116 (.00)	477 (4.05)	1372 (11.64)	23 (0.20)	1232 (10.45)	8681 (73.66)			

GMM growth mixture model; The bold values indicate the final class solution.

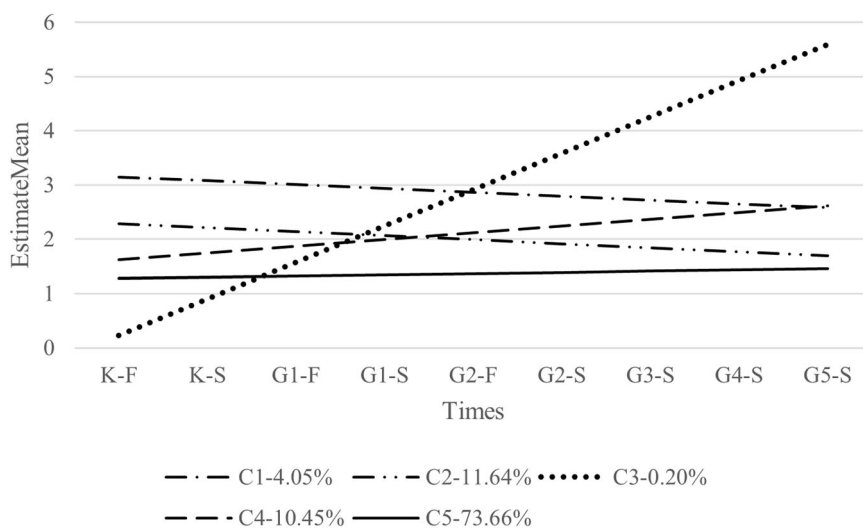


Fig. 2 Trajectories of externalizing problems from kindergarten to fifth grade. Note. K-F: Fall term in kindergarten year; K-S: Spring term in kindergarten year; G1-F: Fall term in Grade one; G1-S: Spring term in Grade one; G2-F: Fall term in Grade two; G2-S: Spring term in Grade two; G3-S: Spring term in Grade three; G4-S: Spring term in Grade four; G5-S: Spring term in Grade five; C1: Class/pattern one; C2: Class/pattern two; C3: Class/pattern three; C4: Class/pattern four; C5: Class/pattern five.

developmental patterns. This is consistent with other studies (Girard, 2021; Tabone et al., 2011). The low-stable patterns of behavior problems had almost children, suggesting that behavior problems are low and stable from kindergarten to fifth grade of elementary school. Moreover, the trajectories of behavior problems have different patterns, suggesting that individual differences may influence the development of behavior problems (Fanti and Henrich, 2010). These findings suggest that the development of behavior problems is heterogeneous that we should take individual differences into account when studying the trajectories of behavior problems in American children. These findings also suggest that the heterogeneity of the development of behavior problems is not influenced by culture (e.g., Chen, 2022), confirming the assumptions of dynamic systems theory.

Moreover, results showed that children's race influenced the classifications of internalizing problems, which is consistent with other studies (Marcal, 2020). Non-white race, as a minority race in America, may have difficulties in integrating into the society, which may contribute to high levels of internalizing problems. Meanwhile, girls had a higher probability to the medium-decreased pattern. Girls have higher levels of sensitivity to interpersonal stress, which may contribute to high levels of internalizing problems (Natsuaki et al., 2009), but the development of internalizing problems may decrease over time through socialization (Wang and Yan, 2019). Children with low levels of self-control at Wave 1 were more likely to be in the medium-decreased pattern, suggesting that self-control may be negatively

associated with the development of internalizing problems (Zhang et al., 2014). Additionally, children's race, gender, and self-control at Wave 1 influenced the development of internalizing problems within class, suggesting that the same factor may have different effects on classifications or within-class development of internalizing problems.

Additionally, results showed that children's gender influenced the classifications of externalizing problems. Specifically, girls were more likely to in the low-stable pattern of externalizing problems, suggesting that girls and boys may have different development of externalizing problems due to different sensation seeking (Gong et al., 2022). On the other hand, children with higher levels of family socioeconomic status were more likely to be in the low-stable pattern, which is consistent with other studies (Bøe et al., 2014). Families with high levels of socioeconomic status may have more resources to guide children to behave appropriately, which may contribute to low levels of externalizing problems. High levels of self-control at Wave 1 also predicted children in the low-stable pattern, suggesting that high levels of self-control may be a protective factor against the development of externalizing problems (Barry et al., 2022). Similarly, children's race, gender, family socioeconomic status, and self-control at Wave 1 influenced the development of externalizing problems within-class, suggesting that the factors not only have effects on externalizing problems classifications, but also have effects on the development of externalizing problems within class.

Table 4 Effects of covariates on latent class classification of internalizing problems.

Variables	Between-class	Covariates	Est.	OR
IP	C1 vs C3	Race	-0.105*	0.900
		Gender	-0.436***	0.647
		X1SESL	0.332	1.393
		X4SESL	-0.457	0.633
		X9SESL	-0.237	0.789
		X1CON	-0.581***	0.560
	C2 vs C3	Race	-0.004	0.993
		Gender	0.789***	2.202
		X1SESL	0.218	1.243
		X4SESL	0.010	1.010
		X9SESL	0.151	1.163
		X1CON	0.401***	1.493

IP internalizing problems, C Class, C3 was the baseline, Est. estimate, OR odd-ratios, X1/4/9SESL Wave 1/4/9 socioeconomic status, X1CON Wave 1 self-control.
*p < 0.05; ***p < 0.001; Est.: Estimate; OR: odd-ratios.

The findings suggest that the same factor has different effects on the trajectories of internalizing and externalizing problems, which may support the assumptions of ecological systems theory. Specifically, individual, family, and psychological characteristics, as factors from different systems, influence the development of internalizing and externalizing problems (Bartlett et al., 2006; Chen, 2022). Meanwhile, the findings suggest that white race, girls, and high levels of self-control are protective factors for the development of internalizing problems, and high family socioeconomic status, high levels of self-control, and girls are protective factors for the development of externalizing problems, which may provide potential program frameworks for the prevention of behavior problems. Specifically, behavior problems should be prevented by manipulating factors from different systems (Zhao et al., 2015), and more attention should be paid to boys and individuals with low levels of self-control.

Implications. There are several implications based on the findings of this study. First, the trajectories of behavior problems were heterogeneous, and internalizing and externalizing problems had different developmental patterns, suggesting that individual differences may influence the development of behavior problems. These different trajectories of behavior problems can guide the future research that the development of behavior problems may be nonlinear development, and the research design and data analysis methods that are chosen should delineate these characteristics. Meanwhile, the practical prevention to reduce the level of children’s behavior problems should be based on the developmental characteristics of behavior problems (e.g., subtype of behavior problems). Second, children’s gender, race, family socioeconomic status, and self-control at Wave 1 predicted the developmental trajectories of behavior problems within and between classes, suggesting that child and family characteristics are the most important factors in the development of behavior problems. These findings provide an overall perspective for future studies investigating factors of behavior problems. Moreover, these results also have some implications for the prevention of childhood behavior problems. For example, the governments, schools, and families should pay much more attention to boys who easily show high levels of internalizing and externalizing problems throughout childhood, and provide more strategies to reduce the levels of internalizing and externalizing problems. Similarly, the programs that increase the levels of self-control in early childhood may also reduce the levels of internalizing and externalizing problems throughout childhood. Meanwhile, the

Table 5 Effects of covariates on latent class classification of externalizing problems.

Variables	Between-class	Covariates	Est.	OR	
EP	C1 vs C5	Race	0.020	1.020	
		Gender	0.905	2.472	
		X1SESL	-0.951	0.387	
		X4SESL	-0.154	0.587	
		X9SESL	1.247**	3.479	
		X1CON	1.213*	3.364	
		C2 vs C5	Race	-0.224	0.799
			Gender	0.273	1.313
			X1SESL	-1.382	0.254
			X4SESL	-0.130	0.879
			X9SESL	0.882*	2.416
	X1CON		1.714**	5.551	
	C3 vs C5		Race	-0.003	0.997
			Gender	-0.212	0.809
			X1SESL	-1.173	0.309
			X4SESL	0.228	1.257
			X9SESL	0.389	1.476
		X1CON	1.860*	6.427	
		C4 vs C5	Race	-0.006	0.994
			Gender	1.417*	4.124
			X1SESL	-1.493	0.225
			X4SESL	0.550	1.734
			X9SESL	0.982**	2.670
	X1CON		2.900***	18.169	

EP externalizing problems, C Class, C5 was the baseline, Est. estimate, OR odd-ratios, X1/4/9SESL Wave 1/4/9 socioeconomic status, X1CON Wave 1 self-control.
*p < 0.05; **p < 0.01; ***p < 0.001. Est.: Estimate; OR: odd-ratios.

governments should implement programs to reduce poverty and provide more resources for families with low levels of socioeconomic status, and schools should pay close attention to children who come from families with low levels of socioeconomic status. Finally, the governments and schools should create an easy environment for minority children to integrate smoothly into society.

There were several limitations to this study that should be acknowledged. First, this study used teacher-report data of internalizing and externalizing problems, which may not provide the full picture of children’s behavior problems. Future research should include parent-report data of internalizing and externalizing problems, and compare the trajectories of internalizing and externalizing problems based on teacher-report and parent-report. Second, the current study examined the influence of time-invariant factors on the trajectories of internalizing and externalizing problems, which may not provide the full picture of factors for the trajectories of behavior problems. Future research should include both time-invariant and time-variant factors when examining predictors of behavior problems trajectories. Third, this study explored the trajectories and predictors of behavior problems, which may not provide evidence for the outcomes of behavior problems in child development. Future research should add outcomes of internalizing and externalizing problems, such as interpersonal skills, reading skills, and writing skills.

Conclusion

The current study identified the trajectories of behavior problems and examined the predictors of these trajectories within nine waves of data from the Early Childhood Longitudinal Study, which may provide clues for the development of behavior problems throughout childhood. Results indicated that internalizing problems had three developmental patterns, such as a low-increased pattern, a low-stable pattern, and a medium-decreased

Table 6 Effects of covariates on within-class variables of internalizing problems.

Variables	Between-class	Covariates	Intercept	Slope
IP	C1	Race	-0.008*	0.001
		Gender	0.016	0.007**
		X1SESL	0.022	0.002
		X4SESL	-0.020	-0.006
		X9SESL	-0.025	0.002
	X1CON	-0.134***	0.013***	
	C2	Race	-0.008*	0.001
		Gender	0.016	0.007**
		X1SESL	0.022	0.002
		X4SESL	-0.020	-0.006
		X9SESL	-0.025	0.002
	X1CON	-0.134***	0.013***	
	C3	Race	-0.008*	0.001
		Gender	0.016	0.007**
		X1SESL	0.022	0.002
X4SESL		-0.020	-0.006	
X9SESL		-0.025	0.002	
X1CON	-0.134***	0.013***		

IP internalizing problems, C Class, C3 was the baseline, X1/4/9SESL Wave 1/4/9 socioeconomic status, X1CON Wave 1 self-control.
*p < 0.05; **p < 0.01; ***p < 0.001.

Table 7 Effects of covariates on within-class variables of externalizing problems.

Variables	Between-class	Covariates	Intercept	Slope
EP	C1	Race	-0.019	0.003
		Gender	-0.039	0.001
		X1SESL	-0.172	0.000
		X4SESL	0.183	-0.012
		X9SESL	-0.072	0.021
	X1CON	-0.341**	0.068**	
	C2	Race	-0.044*	0.001
		Gender	-0.004	-0.003
		X1SESL	0.007	0.001
		X4SESL	-0.124	0.002
		X9SESL	0.075	0.004
	X1CON	-0.504***	0.043***	
	C3	Race	-0.025	-0.003
		Gender	-0.118	0.012
		X1SESL	-0.131	0.007
		X4SESL	0.167	-0.025
		X9SESL	0.046	-0.001
	X1CON	-0.556***	0.029	
	C4	Race	0.000	-0.001
		Gender	-0.018	-0.005*
		X1SESL	-0.031	0.002
		X4SESL	0.064	-0.007
		X9SESL	-0.034	0.004
	X1CON	-0.206***	0.021***	
	C5	Race	-0.044	0.006
		Gender	0.127	-0.025
		X1SESL	-0.055	-0.026
		X4SESL	-0.251	0.087***
		X9SESL	0.154	-0.046*
	X1CON	-0.614***	0.084**	

EP externalizing problems, C Class, C5 was the baseline, X1/4/9SESL Wave 1/4/9 socioeconomic status, X1CON Wave 1 self-control.
*p < 0.05; **p < 0.01; ***p < 0.001.

pattern, and children’s race, gender, and levels of self-control at Wave 1 predicted these trajectories. Meanwhile, the trajectories of externalizing problems had five patterns, such as a high-decreased pattern, a medium-decreased pattern, a low-very high increased pattern, a low-increased pattern, and a low-stable pattern, and these trajectories were predicted by children’s gender, race, family socioeconomic status, and the level of self-control at Wave 1. The findings suggest that the development of behavior problems is heterogeneous, and individual differences should be considered

when exploring the trajectories of behavior problems, and white race, girls, and high levels of self-control are protective factors for the development of internalizing problems; high family socioeconomic status, high levels of self-control, and girls are protective factors for the development of externalizing problems.

Data availability

The dataset used and/or analyzed during the current study are included in the supplementary material, further inquiries can be directed to the corresponding author.

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Author contributions

CC designed the study, analyzed the data, and wrote and revised the manuscript.

Competing interests

The author declares no competing interests.

Ethical approval

Ethical approval was not required as the current study used the public data, please find the detail information in the website of Early Childhood Longitudinal Study (<https://nces.ed.gov/ecls/>).

Informed consent

Informed consent was not required as the current study used the public data, please find the detail information in the website of Early Childhood Longitudinal Study (<https://nces.ed.gov/ecls/>).

Additional information

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