



I belong; hence, I engage? A cohort study of transitions between school engagement classes and academic achievement: The role of relational school climate

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Abstract

The role of the school climate in buffering disengagement remains relatively under-researched. The present study examined transitions between classes of early adolescents' school engagement and relational school climate factors influencing classes of students' (dis-)engagement, and how these were linked with academic achievement in mid-adolescence. A representative sample of 3,643 early adolescents (48.72% females) from the Growing Up in Australia cohort study was utilised. Latent transition analyses indicated three classes of school engagement, namely mostly disengaged, moderately engaged and highly engaged. Significant transitions were found between classes with fewer students becoming moderately engaged and mostly disengaged. Having a positive teacher–student relationship and higher feelings of school belonging predicted membership to the highly engaged classes. Highly engaged students were fewer by age 12 but had the best achievement only in numeracy, writing and spelling tests at age 14/15. The study underscores the importance of positive relational school climate for fostering school engagement and achievement.

Keywords School engagement · Academic achievement · Relational school climate · Teacher–student relationships · Sense of school belonging

Introduction

School engagement is a critical factor that influences student outcomes and later-life skills (Symonds et al., 2022). The term 'school engagement' refers to students being emotionally (e.g. interest, enjoyment, boredom), behaviourally (e.g. effort, persistence, concentration) and cognitively (e.g. self-regulated learning) active in school (Fredricks et al., 2004). Research studies have demonstrated that students

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who are sufficiently engaged in school have substantial academic, social and economic advantages compared to less engaged students (Fredricks et al., 2016; Wang & Eccles, 2013). Specifically, early school engagement has been connected to better health and well-being, academic attainment and job prospects (Abbott-Chapman et al., 2014; Kautz et al., 2014; Symonds et al., 2022).

Studies have indicated that, like academic motivation, school engagement declines substantially in early adolescence (Engels et al., 2021; Wang & Eccles, 2013; Wigfield et al., 2015). Reduced school engagement has been linked with multiple maladaptive outcomes, such as underachievement, increased likelihood of dropout and truancy (Fredricks et al., 2016). Yet, it is noted that most past studies explored the development of school engagement through a variable-centred perspective, neglecting the fact that students may constitute a heterogeneous population with different school engagement characteristics. Thus, it is critical to gain person-centred insights into the development of school engagement in early adolescence, the factors that reduce the probability of becoming disengaged with school, as well as the potential consequences of becoming disengaged for academic achievement.

In short, the present study addresses several important educational questions by deploying a robust person-centred analysis to account for potential heterogeneity in the development of early adolescent school engagement. Person-centred studies, in contrast to variable-centred perspectives, take a ‘whole’ person approach. Here, individual students become the units of analyses rather than being considered sources of information focussing on relations between variables (Howard & Hoffman, 2018; Laursen & Hoff, 2006). Thus, the current study can offer additional insights into students’ school engagement functioning in early adolescence. A second objective of the present study was to explore how the relational part of positive school climate influenced different patterns of adolescents’ school engagement in early adolescence. Finally, the study examined the impact of developmental transitions in early adolescent school engagement on academic achievement (the NAPLAN test) in mid-adolescence.

Person-centred studies of adolescent school engagement development

Person-centred studies of school engagement development assume that students in a sample come from multiple populations that demonstrate different levels of school engagement (Ferguson et al., 2020). The results of such studies are as of yet inconsistent since different studies reported different emerging classes of school engagement. The study by Liu et al. (2023), for example, revealed two trajectory classes of students’ school engagement, namely a low-increasing and a high-decreasing. A significant 88.91% of the adolescents in that study reported reducing school engagement. On the other hand, a study reported eight trajectory classes of school engagement that could be classified either as decreasing or increasing (Symonds et al., 2016). This study revealed that 41% of the adolescents belonged to disengaging classes. Another study reported seven trajectory classes of adolescent school engagement ranging from normative (consistently high scores) to decreasing (Janosz

et al., 2008). These scholars classified only 5% of the sample in decreasing trajectory classes. Another study indicated four emerging trajectory classes ranging from decreasing to increasing/stable with about 5% of the adolescent students belonging to the declining emotional engagement classes (Li & Lerner, 2011).

Although profiling studies can be used to identify the number of latent subgroups in the data, methodological studies (Bauer & Curran, 2003; Masyn, 2013) suggest that the latent subgroups might represent a mixture of normal distributions that can be used to approximate an overall non-normal distribution of school engagement in this instance. Past empirical evidence has reported that school engagement responses can be non-normally distributed (Archambault et al., 2009; Balwant et al., 2019; Ulmanen et al., 2016; Virtanen et al., 2014). Therefore, latent transition analysis is justified in terms of pre-existing evidence on school engagement distributional non-normality.

In short, as can be seen from the above studies, the evidence is inconclusive regarding the quantity and the quality of individual differences, with some studies indicating as few as two classes and other studies indicating as many as eight classes. The inconclusive nature of the past findings may be partially attributed to researchers' modelling choices, such as deciding on the number of latent classes (Bauer & Curran, 2003) or the number of random starting values (Nylund-Gibson & Choi, 2018).

Some of this evidence, though, comes from unrepresentative samples (Janosz et al., 2008; Li & Lerner, 2011; J. Liu et al., 2023), which signifies that it may not be representative of the development of school engagement in the respective adolescent student populations in the countries. Finally, preceding studies (Janosz et al., 2008; Li & Lerner, 2011; Symonds et al., 2016) focussed on school engagement developmental patterns across different stages of adolescence, but there is scarce evidence regarding the development of school engagement in early adolescence. Hence, the present study seeks to address these issues using a representative national sample from the Growing Up in Australia cohort study.

Relational school climate, students' school engagement and achievement

One important educational variable that has been connected to multiple adaptive student outcomes is school climate (Berkowitz et al., 2017). As will be discussed, school climate is a multidimensional construct; however, the present study focussed only on the relational aspect of school climate, namely positive teacher–student relationships and sense of school belonging, since the links between the relational aspect of school climate and school engagement development are less well-understood.

School climate is defined as subjective experiences of the school life encapsulating values, relationships, norms, organisational structures, teaching and learning (Zullig et al., 2010). School climate has been described as a powerful predictor of students' academic achievement and motivation that can buffer the socio-economic inequalities in learning and is generally associated with multiple adaptive outcomes such as reduced truancy, lower likelihood of suspension and long-term mental health (Thapa

et al., 2013; Wang & Degol, 2017). Yet, the question remains whether the school climate is predictive of adolescent students' classes of school engagement.

In the present study, teacher–student relationships are conceptualised according to Pianta's framework (Pianta, 2001), which suggests that these relationships are characterised either by closeness (positive relations) or conflict (negative relations) (Pianta et al., 2012). Theories of student engagement within classrooms suggest that teachers who make an effort to connect on a personal level with their students have more motivated students both inside and outside school (Pianta et al., 2012). A large meta-analysis of 99 studies showed that positive emotional teacher–student relationships (e.g. closeness, involvement) fostered greater student engagement, whilst negative relationships (e.g. conflict) were associated with reduced engagement (Roorda et al., 2011). Recent empirical evidence indicated that positive affective teacher–student relationships predicted greater student engagement, whilst negative emotional relationships predicted decreasing student engagement (Engels et al., 2021). Research has also shown that increasing the number of positive teacher–student relationships was also predictive of greater engagement (Martin & Collie, 2019).

Positive teacher–student relationships usually go hand-in-hand with a broader sense of belonging at school (Chiu et al., 2012). In fact, some theoretical work on school belonging and engagement suggests that teacher–student relationships are an integral component of students' sense of school belonging (Allen & Boyle, 2022). However, school belonging, defined as feeling acceptance and being included and respected by classmates and teachers alike, is conceptually broader since it encompasses student-to-student relationships as well (Williams & Downing, 1998). Therefore, given the longitudinal nature of this study, both constructs were included as predictors to be able to disentangle which aspect of relational school climate is a more salient longitudinal correlate of the school engagement profiles.

From self-determination theory (Ryan & Deci, 2000), it is known that the basic psychological need of relatedness, that is the need to belong and connect with others, has a motivational force. School engagement cannot be understood in a decontextualised way from the social network that is embedded (Goodenow, 1992). Relational models of school engagement suggest that a sense of being respected and accepted by the school community, including both teachers and fellow students, can be a significant protective factor against disengagement (Ye & Wallace, 2014). Empirical evidence underscores that sense of school belonging is linked to greater school engagement (Chiu et al., 2012; Kiefer et al., 2015). However, there is a paucity of studies examining how sense of school belonging is predictive of students' school engagement classes in early adolescence. Given the declines in school engagement in early adolescence, it would make sense to examine whether having a greater sense of school belonging would be a positive predictor of being more engaged with school.

School engagement development and academic achievement

Longitudinal evidence has shed light on the long-term consequences of school engagement (Abbott-Chapman et al., 2014; Symonds et al., 2022). Studies have connected adolescent and childhood school engagement with various indicators

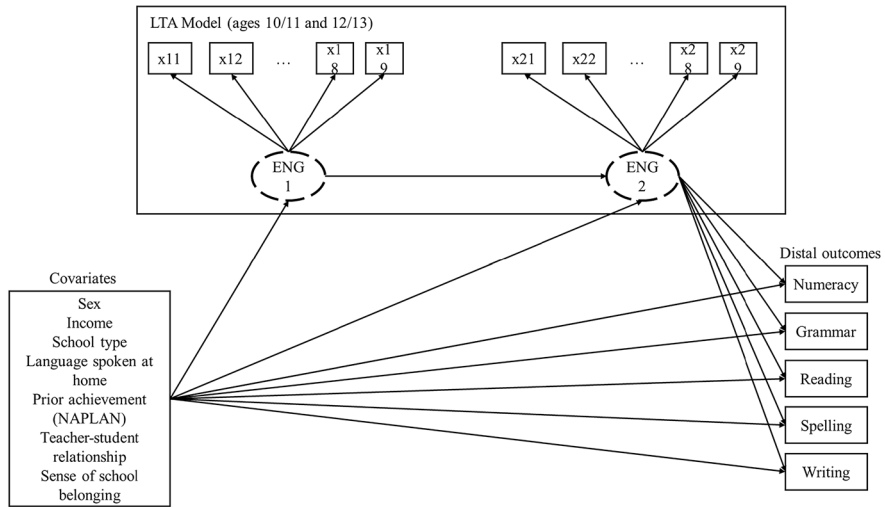


Fig. 1 The arbitrary secondary auxiliary conceptual model including LTA, distal outcomes and covariates (full model specification)

of academic achievement. For example, studies have examined the correlations between academic achievement in language and mathematics classes and school engagement over time (e.g. Engels et al., 2021; Janosz et al., 2008; Liu et al., 2023). However, there is a paucity of studies examining whether transitioning between school engagement classes in early adolescence is related to academic achievement in mid-adolescence controlling for the powerful influence of relational school climate.

The present study

Given the reported declines in adolescent school engagement and the critical role of early school engagement for later-life outcomes, the present study explored if and how early adolescent students became less engaged with school. Since positive teacher–student relationships and a greater sense of school belonging might foster school engagement, they were specified to influence early adolescents’ school engagement classes, adjusting for other relevant covariates. Finally, the links between the emerging classes in early adolescence and academic achievement (NAPLAN test) in mid-adolescence were examined conditionally on school climate and covariates (see Fig. 1). Thus, the following research questions guided this study:

RQ1: How many classes of school engagement emerge in early adolescence?

RQ2: Do early adolescent students transition between engagement classes? If so, how?

RQ3: How do teacher–student relationships and sense of belonging relate to classes of school engagement and academic achievement?

RQ4: How are engagement classes in early adolescence linked with academic achievement in mid-adolescence?

Method

Participants and data set

The data came from 3,643 adolescent students from the *Growing Up in Australia* child (K) cohort study, also known as the *Longitudinal Study of Australian Children* (LSAC) (Mohal et al., 2022). The study began in 2004 and participants are interviewed every two years. The target population was children born between March 1999 and February 2000. Data from multiple waves were utilised in the present study. Specifically, the sample of this study comprises participants who were matched at age 8/9, age 10/11, age 12/13 and age 14/15. The present sample consists of 51.28% male and 48.72% female adolescents coming from a range of socio-economic backgrounds. The overwhelming majority (90.41%) of the adolescents spoke English as the main language at home. At age 10/11, most students were studying in Year 5 (71.06%). At age 12/13, the majority of students were in Year 7 (70.72%). Across all the variables considered in this study, the percentage of missing data was 29.77%

Measures

Key outcome measures

School engagement The same nine items at ages 11 (wave 4) and 12 (wave 5) were derived from the item pool since they mapped onto emotional and behavioural school engagement. Sample item wordings include ‘at school I feel happy’, ‘school work is interesting’ (emotional) and ‘I do extra work’ (behavioural). Items were scored using a 4-point Likert-type scale ranging from 1 ‘strongly disagree’ to 4 ‘strongly agree’. Thus, these data were treated as ordered-categorical. Cronbach’s alpha indicated very good reliability across time, $\alpha_1 = 0.88$, $\alpha_2 = 0.88$.

Academic achievement Academic achievement was indexed in this study when adolescents were aged 14/15 years old (wave 6) using the NAPLAN test. The NAPLAN (National Assessment Program—Literacy and Numeracy) (Klenowski & Wyatt-Smith, 2012) standardised assessment of Australian students’ spelling, reading, grammar, writing and numeracy skills that takes place on the same days each year (Daraganova et al., 2013; Rogers et al., 2016). In the present study, adolescent students’ scores on all the NAPLAN test components, whilst studying in secondary school in Year 9, were used as distal outcomes.

School climate measures

Sense of school belonging An adapted 12 items long version of Psychological Sense of School Membership scale (Goodenow, 1993) was administered to adolescent students at age 12 (wave 5). Sample items include ‘other students like me’ and ‘teachers are interested in me’. Item response options ranged from 1 ‘not at all true’ to 5 ‘completely true’. Higher scores indicated greater sense of school belonging. Cronbach’s alpha indicated very good reliability with $\alpha = 0.85$.

Positive teacher–child relationship The quality of the teacher–child relationship was indexed through the teacher-reported Student–Teacher Relationship scale (Pianta, 2001) when students were 8/9 years old (wave 3). Sample items are ‘I share an affectionate, warm relationship with this child’ and ‘This child values his/her relationship with me’. Item response options ranged from 1 ‘definitely does not apply’ to 5 ‘definitely applies’. This is a 14-items long scale with Cronbach’s alpha indicating very good reliability, $\alpha = 0.86$.

Covariates

Sex A binary variable coding adolescents’ sex. It was recoded to reflect males (1) versus females (0).

Household income A continuous measure of socio-economic status was derived at age 10/11 (wave 4) as the average of the income group that each parent belonged to. Parents’ income ranged from 1: ‘Less than \$500 pw \$25,999 or less per year’ to 4: ‘\$2,000 or more per week \$104,000 or more per year’.

Language spoken at home Adolescents reported on the main language spoken at home. This was recoded to reflect English (yes = 1) versus other (no = 0).

School type A binary variable indexed whether the students’ school at age 10/11 (wave 4) was a government school (1 = yes) or otherwise (no = 0).

Prior academic achievement Adolescent students’ scores on the NAPLAN test age 10/11 (most were studying in Year 5, wave 4) were utilised as covariates to account for previous levels of academic achievement, when the developmental process in school engagement begun.

Analysis strategy

In the first instance, longitudinal measurement invariance of the school engagement scale was estimated using a longitudinal confirmatory factor analysis (CFA) model to ensure construct validity and comparability of the nine items across time. The longitudinal measurement invariance was tested in a single-group approach

following the procedures outlined in Liu et al., (2017). Changes in $|\Delta CFI|$ and $|\Delta RMSEA|$ less than 0.01 and 0.015, respectively, between nested models were indicating measurement invariance (Chen, 2007). Afterwards, a latent transition analysis (LTA) model was estimated without covariates and outcomes to explore developmental heterogeneity in school engagement in early adolescence. The current latent transition analysis approach to the development of school engagement goes beyond the insights offered by linear modelling approaches since it reveals *how many* of the adolescent students followed different patterns of school engagement development in the crucial transition from primary to secondary school.¹ The latent transition analysis model was estimated based on the nine items of the school engagement scale. Measurement invariance of the item response probabilities was tested in the LTA setting using a likelihood ratio test (LRT), as recommended in the literature (Nylund-Gibson et al., 2022).

For latent class enumeration, the LTA model was estimated across occasions and enumeration decisions were based on the Bayesian (BIC) and the sample size-adjusted Bayesian (a-BIC) information criteria. The classification quality of the resulting solutions was also evaluated. Since the (a-)BIC values are known to keep decreasing with the extraction of additional classes, the ‘elbow’ plot was utilised to inform the enumeration process (Masyn, 2013; Nylund-Gibson & Choi, 2018). In addition to class enumeration, stationarity of the developmental process was tested by constraining the transition probabilities (Lanza & Collins, 2008) between classes of school engagement to equal. To examine the relations outlined in the auxiliary arbitrary secondary model (Fig. 1), the ML three-step approach based on modal class assignment was adopted (Nylund-Gibson et al., 2019). Thus, the class enumeration was not affected by the inclusion of covariates and outcomes (Asparouhov & Muthén, 2014).

Missing data in the school engagement items were dealt with full-information maximum likelihood using the expectation–maximisation algorithm in LTA. However, given some missing values in covariates and outcomes, a multiple imputation was computed in *Mplus* to handle missing data in the last step of the 3-step approach to avoid class shifting due to extra variance estimation. Hence, 10 imputed data-sets were generated and analysed for the arbitrary auxiliary secondary model with the 3-step approach. Utilising the 3-step approach, the covariates were permitted to influence the latent classes and the distal outcomes (i.e. the NAPLAN test scores). Latent variable modelling was performed in *Mplus* 8.7 (Muthén & Muthén, 2017), whilst preliminary data handling was conducted through Stata 16 (StataCorp., 2021).

¹ Due to regional differences and slight differences in the dates of data collection, very few students might not have transitioned to secondary school by age 12/13 years.

Table 1 Descriptive statistics for key outcomes and covariates

Variable	Mean (SD)	Minimum–maximum
1. Male	.51 (.5)	0–1
2. Income	2.18 (.69)	1–4
3. School type	.66 (.47)	0–1
4. Language spoken at home	.87 (.34)	0–1
5. Teacher–student relationship	52.46 (25.43)	0–75
6. Sense of school belonging	48.37 (7.69)	17–60
7. Grammar score age 14/15	585.06 (80.66)	179.3–894
8. Reading score age 14/15	593.17 (70.32)	195.60–907.5
9. Spelling score age 14/15	590.15 (72.57)	316.5–802.3
10. Writing score age 14/15	561.84 (89.02)	94.5–807.2
11. Numeracy score age 14/15	599.08 (73.70)	355.7–920
12. Engagement (t1)	17.71 (4.90)	0–27
13. Engagement (t2)	17.19 (4.54)	0–27
14. Grammar score age 10/11	511.06 (86.29)	0–839
15. Reading score age 10/11	502.98 (81.48)	0–773
16. Spelling score age 10/11	491.99 (71.35)	0–672
17. Writing score age 10/11	491.62 (71.64)	89–778
18. Numeracy score age 10/11	498.40 (74.09)	0–830.4

N = 3643; Male: 1 ‘yes’, 0 ‘no’; Income: 1 ‘lowest band’, 4 ‘highest band’; School type: 1 ‘Government school’, 0 ‘non-government school’; Language spoken at home: 1 ‘English’, 0 ‘not English’; Weighted descriptive statistics

Ethics declaration

The Growing Up in Australia: Longitudinal Study of Australian Children cohort study has received ethics approval by the Australian Institute of Family Studies Ethics Committee. Informed consent was received from all involved parties.

Results

Descriptive statistics (means, standard deviation, maximum and minimum) were calculated and are presented in Table 1.

Preliminary psychometrics

Longitudinal measurement invariance of the CFA model of school engagement illustrated that the school engagement scale had excellent psychometric properties across time and strict longitudinal measurement invariance was tenable for

Table 2 Longitudinal measurement invariance of the school engagement scale (single-group CFA approach)

Model	CFI	ΔCFI	RMSEA	ΔRMSEA
Configural	.978		.047	
Metric	.981	.003	.043	.004
Scalar	.974	.007	.046	.003
Strict	.974	.000	.046	.000

N=3643

Table 3 Fit indices for latent transition analysis

N classes	Log-Lik	BIC	a-BIC	General entropy	Time 1 entropy	Time 2 entropy
2*	– 59,336.730	119,140.892	118,959.774	.814	.830	.793
2	– 59,060.103	119,030.469	118,677.766	.813	.829	.793
3**	– 55,643.716	112,648.726	112,121.261	.839	.855	.820
3	– 55,505.355	112,404.805	111,864.629	.842	.858	.824
4	– 54,367.653	110,629.636	109,895.632	.827	.834	.818
5	– 53,799.785	110,010.535	109,076.349	.781	.789	.771
6	-LL	-LL				

N = 3643; *2-profile LTA with full measurement invariance; ** Stationarity imposed

this sample. Therefore, comparisons across time were valid. The results of longitudinal measurement invariance are presented in Table 2.

Exploring longitudinal transitions between school engagement classes in early adolescence

In the first step of the LTA, a fully invariant two-profile LTA model was compared to the unconstrained two-profile LTA model. The LRT (54) = 436.9769, $p < 0.001$, indicated that the hypothesis of fully invariant item response probabilities across time should be rejected. Thus, the LTA models were estimated with freely varying item response probabilities. As seen in Table 3, the LTA model with three classes per occasion had the best classification quality as quantified by the entropy criterion. Both the Bayesian and the sample size-adjusted Bayesian information criteria indicated that more latent classes were better fitting. However, the ‘elbow’ plot (Fig. 2) indicated that the point of diminishing returns was reached at the three-profile solution and additional classes did not improve the fit substantially. Hence, the three-class solution was retained. The BIC also rejected the hypothesis of stationarity of the developmental process, indicating that the transitions between classes of school engagement were not constant.

The three latent classes per occasion were named ‘mostly disengaged’, ‘moderately engaged’ and ‘highly engaged’. Mostly disengaged students were those who disagreed a lot with the school engagement items. Moderately engaged students

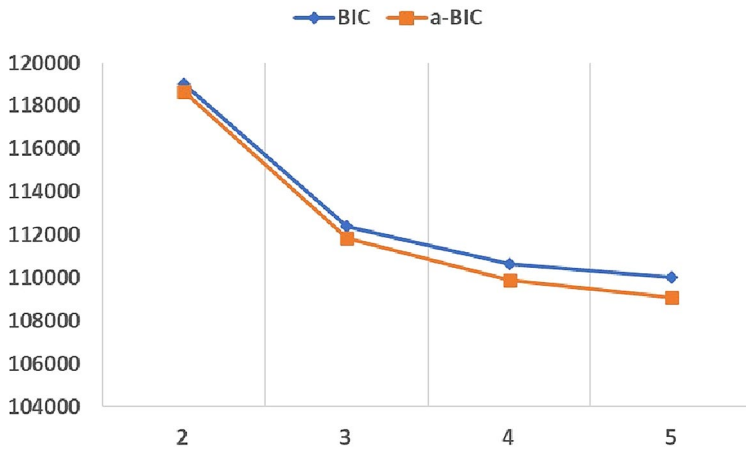


Fig. 2 'Elbow' plot of (a-)BIC values for LTA models 2 to 5 classes

Table 4 Profile denominations and transition probabilities

Profile denomination	Time 1	Time 2	
Profile 1	Mostly disengaged (15.04%)	Mostly disengaged (18.29%)	
Profile 2	Moderately engaged (51.51%)	Moderately engaged (54.31%)	
Profile 3	Highly engaged (33.44%)	Highly engaged (27.39%)	
Transition probabilities			
	T2#1	T2#2	T2#3
T1#1	.569	.340	.091
T1#2	.156	.663	.181
T1#3	.076	.416	.508

Rows (time 1 classes); Columns (time 2 classes); Profiles proportions based on the modal class assignment

were those who tended not to agree completely with most items, whereas highly engaged students were strongly agreeing with most items. The profile denominations and transition probabilities are presented in Table 4. The item response probabilities per latent profile across time were derived from the three-profile LTA and are plotted as shown in Fig. 3.

According to the transition probabilities, 56.9% of the mostly disengaged at age 11 remained mostly disengaged at age 12. Thirty-four percent of the mostly disengaged students became moderately engaged at age 12, whilst only 9.1% became highly engaged. Of the moderately engaged students at age 11, 66.3% remained moderately engaged at age 12, but 18.1% became highly engaged and only 15.6% became mostly disengaged. Finally, 50.8% of the students, who were highly engaged at age 11, remained highly engaged at age 12. However, 41.6% of highly engaged students became moderately engaged and 7.6% became mostly disengaged.

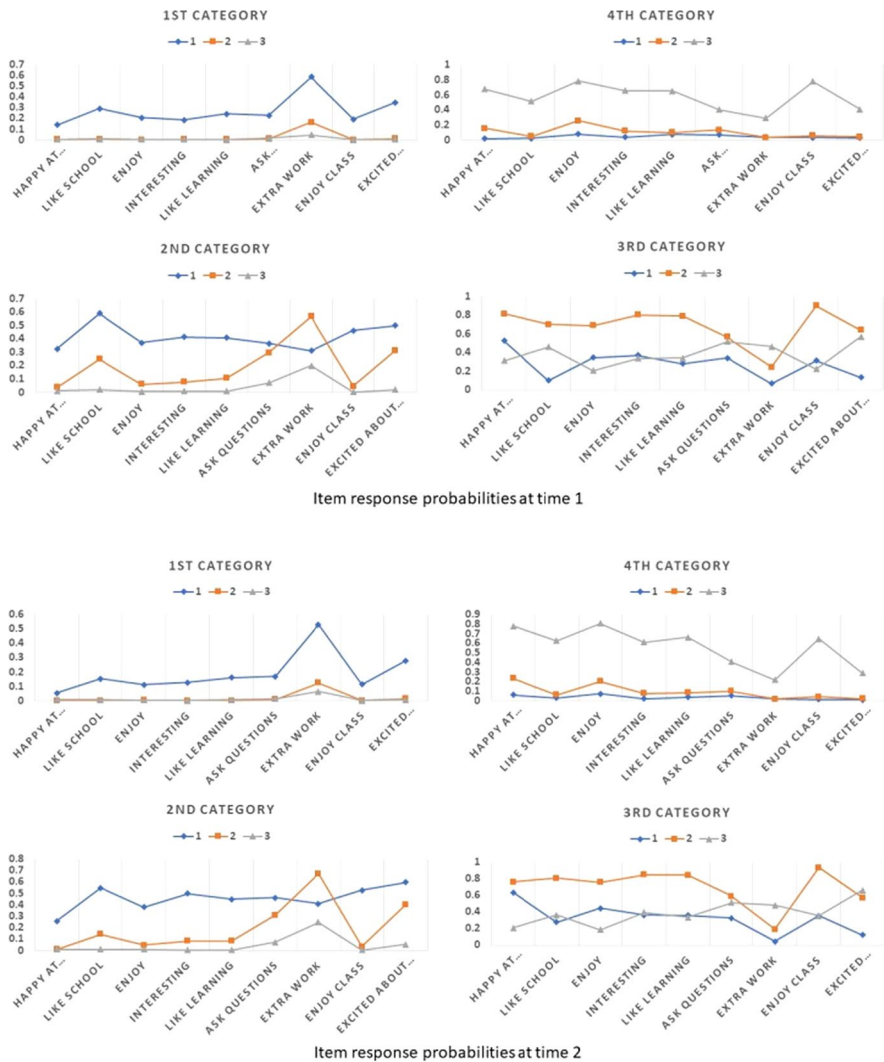


Fig. 3 Item response probabilities from latent transition analysis per latent profile per occasion

Predictors of school engagement classes in early adolescence: The role of teacher–student relationships and sense of school belonging

The results of the calculations of conditional effects are presented in Table 5. Some interesting results emerged. Being male and speaking English as the main language at home predicted greater likelihood of being mostly disengaged and moderately engaged at age 10/11. Having more positive teacher–student relationships and a greater sense of school belonging were associated with lower odds of being disengaged at age 12 in secondary school. Getting a higher-than-average score in the

Table 5 Conditional effects on latent classes

Latent Class (time)	Predictor	Logit (SE)	Z	<i>p</i> value
Mostly disengaged (T1)				
	Male	1.210 (.139)	8.732	.000
	Income	.16 (.09)	1.629	.103
	Language	1.19 (.29)	4.118	.000
	School type	.10 (.15)	.699	.485
	Grammar score age 10/11	.001 (.001)	.864	.387
	Reading score age 10/11	– .001 (.001)	– 1.012	.311
	Spelling score age 10/11	.000 (.001)	.256	.798
	Writing score age 10/11	– .005 (.001)	– 3.865	.000
	Numeracy score age 10/11	.00 (.00)	– 1.846	.065
	Teacher–student relationship	– .001 (.002)	– 0.420	.675
Moderately engaged (T1)				
	Male	.474 (.103)	4.593	.000
	Income	.131 (.071)	1.837	.066
	Language	.444 (.154)	2.883	.004
	School type	– .240 (.093)	– 2.577	.010
	Grammar score age 10/11	.001 (.001)	1.605	.109
	Reading score age 10/11	– .001 (.001)	– .701	.483
	Spelling score age 10/11	– .002 (.001)	– 1.545	.122
	Writing score age 10/11	– .001 (.001)	– 1.338	.181
	Numeracy score age 10/11	.001 (.001)	.714	.475
	Teacher–student relationship	– .001 (.002)	– 0.699	.485
Mostly disengaged (T2)				
	Male	.255 (.233)	1.091	.275
	Income	– .053 (.150)	– .349	.727
	Language	.953 (.411)	2.317	.020
	School type	.025 (.223)	.114	.910
	Grammar score age 10/11	– .002 (.002)	– .813	.416
	Reading score age 10/11	.004 (.002)	1.779	.075
	Spelling score age 10/11	.002 (.002)	.754	.451
	Writing score age 10/11	– .002 (.002)	– .784	.433
	Numeracy score age 10/11	– .003 (.002)	– 1.543	.123
	Teacher–student relationship	– .008 (.004)	– 2.085	.037
	Sense of belonging	– .349 (.023)	– 14.892	.000
Moderately engaged (T2)				
	Male	.025 (.153)	.165	.869
	Income	.088 (.099)	.888	.375
	Language	.533 (.221)	2.413	.016
	School type	– .138 (.142)	– .972	.331
	Grammar score age 10/11	– .002 (.001)	– 1.506	.132
	Reading score age 10/11	.002 (.001)	1.385	.166
	Spelling score age 10/11	.001 (.002)	.450	.653
	Writing score age 10/11	.000 (.002)	– .038	.970

Table 5 (continued)

Latent Class (time)	Predictor	Logit (SE)	Z	p value
	Numeracy score age 10/11	– .001 (.001)	– .653	.514
	Teacher–student relationship	.002 (.003)	.608	.543
	Sense of belonging	– .186 (.019)	– 9.770	.000

Reference group is highly engaged. All coefficients reflect differences from the reference group; Male: Male vs. female; School type: Government school vs. non-government school;

NAPLAN test at age 10/11 was not predictive of school engagement membership on any occasion.

Early adolescent school engagement classes and achievement in mid-adolescence

Adjusting for covariate effects on both the latent classes and the achievement outcomes, the following differences were found (Table 6). Significant differences were observed between the mostly disengaged and the highly engaged students in writing and numeracy skills. That is, students in the highly engaged classes outperformed

Table 6 Between-class differences in academic achievement in mid-adolescence conditionally on covariates

Distal outcome	Class comparison	$\Delta\mu$ (SE)	Z	p value
Grammar	C1–C2	– 1.494 (4.056)	– .368	.713
	C1–C3	– 2.221 (4.997)	– .444	.657
	C2–C3	– .726 (3.385)	– .215	.830
Numeracy	C1–C2	– 7.676 (3.132)	– 2.451	.014
	C1–C3	– 11.583 (4.088)	– 2.834	.005
	C2–C3	– 3.907 (2.675)	– 1.460	.144
Reading	C1–C2	– 4.922 (3.535)	– 1.392	.164
	C1–C3	– 4.736 (4.501)	– 1.052	.293
	C2–C3	.185 (2.612)	.071	.943
Spelling	C1–C2	– 3.651 (2.910)	– 1.255	.210
	C1–C3	– 7.789 (3.563)	– 2.186	.029
	C2–C3	– 4.138 (2.132)	– 1.941	.052
Writing	C1–C2	– 22.705 (4.866)	– 4.666	.000
	C1–C3	– 27.202 (6.298)	– 4.319	.000
	C2–C3	– 4.497 (3.892)	– 1.155	.248

$\Delta\mu$, Mean difference between classes; SE, standard error; C1, mostly disengaged; C2, moderately engaged; C3, highly engaged

the moderately engaged and the mostly disengaged students in writing and numeracy. Small gains were also observed for highly engaged students' spelling skills in comparison with the mostly disengaged students. Covariate effects on academic achievement are presented in Table S1 in the supplementary materials.

Discussion

Motivated by developmental research suggesting a decline in adolescent school engagement (Engels et al., 2021; Wang & Eccles, 2013; Wigfield et al., 2015), the present study's overarching research objective was to explore via a person-centred approach what were early adolescents' classes of school engagement and how early adolescents transitioned between these classes. Additionally, the protective effect of relational school climate against becoming less engaged with the school was examined. Finally, the last objective was to link the school engagement classes at the end of early adolescence with mid-adolescent literacy skills. This study is considered to be amongst the first to explore these associations comprehensively in early adolescence from a longitudinal perspective.

School engagement classes and transitions in early adolescence

The latent transition analyses showed that three classes were adequately describing the heterogeneity in early adolescent school engagement. These classes were called 'mostly disengaged', 'moderately engaged' and 'highly engaged', with most early adolescents falling into the 'moderately engaged' profile across time. The finding of three latent classes is incompatible with preceding evidence indicating more than three latent classes of school engagement across time (Janosz et al., 2008; Li & Lerner, 2011; Symonds et al., 2016). These discrepancies indicate that school engagement is very sensitive to contextual and developmental effects since it was not exactly possible to replicate the profiling of other studies.

Latent class membership was quite stable across time with fewer students becoming mostly disengaged and moderately engaged at the end of early adolescence. However, a sizable proportion of the students transitioned to different latent classes from age 10/11 years to age 12/13 years. Surprisingly, the proportion of students, who were best classified as mostly disengaged at the beginning of the observation period, reached 15%. This proportion was further boosted by another 2% of adolescents who transitioned to this profile by age 12/13 years. This result is unique since some preceding studies have only identified about 5% of adolescents who were best classified as having decreasing school engagement development (Janosz et al., 2008; Li & Lerner, 2011). However, this percentage is not as high as the 41% reported by Symonds et al. (2016).

To some extent, this finding disconfirms previous developmental evidence suggesting that school engagement falls sharply in adolescence (Engels et al., 2021; Wang & Eccles, 2013; Wigfield et al., 2015). The results also contradict evidence suggesting that the transition from primary to secondary school in early adolescence

is linked with lower student engagement (Wigfield et al., 2015) since most of the current adolescent students remained sufficiently engaged when they were in Year 7. The finding also raises the awareness that we need further intensive longitudinal research on the development of early adolescent school engagement. Further, it ought to be noted the present study focussed only on a specific developmental stage in adolescence and, thus, the findings may not represent what occurs across the adolescent years. Nevertheless, early adolescence is a more critical stage for developmental opportunities since many changes occur (e.g. puberty, transition to secondary school, cognitive and emotional) (Katsantonis et al., 2022; Sawyer et al., 2018; Symonds & Galton, 2014). Thus, the findings are more pertinent from a policy perspective.

Relational school climate and student engagement with school

In addition to the developmental transitions between school engagement classes in early adolescents, the impact of relational school climate was also examined. Surprisingly, no evidence was found that teacher–student relationships in early primary school at age 8/9 years predicted school engagement classes at age 10/11 years. However, having a more positive teacher–student relationship in early primary school was associated with less odds of being in the mostly disengaged class at age 12/13 years. First, this finding reinforces the idea that teachers play a critical role for how students feel at school and how they construe themselves as students (Thomas & Nair, 2022). Second, another important strength of this finding is that the teacher–student relationship was measured in a dyadic way, such as teachers reported on students’ closeness versus conflict with them and they also reported on their effort to build a close relationship (e.g. ‘When I praise this child, he/she beams with pride’). Thus, this positive influence is an important finding because the majority of past studies had student-reported teacher–student relationships (Martin & Collie, 2019). A greater sense of belonging at school, indexed at age 12/13 years as feelings of acceptance and respect by students and teachers alike, was predicting less odds of membership to the mostly disengaged and moderately engaged classes. This finding is compatible with past evidence suggesting that having more positive teacher–student relationships (Pianta et al., 2012; Roorda et al., 2011) and greater sense of school belonging (Chiu et al., 2012; Kiefer et al., 2015) is a source for greater student engagement with school. Particularly interesting is the fact that at age 12/13 years, a sense of school belonging was a significant predictor of membership to the moderately engaged class of students. In contrast, there was no evidence that positive teacher–student relationships were a buffering factor against being moderately engaged. Taken together the current results suggest that feeling valued, respected and accepted by teachers *and* classmates at age 12/13 years is an important protective factor.

Overall, the above result is further reinforced by the basic tenets of self-determination theory (Ryan & Deci, 2000, 2016), which indicate that fulfilling the basic psychological need of relatedness can enhance students’ academic motives. Nevertheless, we observe that positive teacher–student relationships in early primary

school at age 8/9 years are having a long-term protective effect against student disengagement, instead of a short-term effect. This means that students' early experiences of that aspect of school belonging take time to be internalised and their effect to be made apparent. This may be indicative of the transient nature of teacher–student relationships, demonstrating that it is highly variable across contexts and developmental periods. In short, the above evidence underscores the importance of building a safe, positive and inclusive school climate through accepting and respectful relationships between teachers, students and fellow students in order to promote school engagement in the long-term.

It is important to reiterate that the abovementioned associations remained statistically significant even after controlling for a range of covariates. Here, a brief mention of the rest of the covariates' effects is provided. Previous NAPLAN achievement was not found to be associated with either higher or lower engagement. Children's household income also had a null predictive effect. Speaking English as the main language at home was a statistically significant predictor of all latent classes. Boys were more likely to belong to the mostly disengaged and the moderately engaged latent classes, whereas sex was not predictive of the highly engaged class. Finally, studying at a government school was not predictive of either the mostly disengaged or the highly engaged classes, but predicted less chances of being classified as moderately engaged.

Mid-adolescent academic achievement and school engagement transitions

The connections between early adolescent school engagement and multiple academic domains in mid-adolescence are relatively understudied. Given the importance of adolescent school engagement for long-term educational advantages (Abbott-Chapman et al., 2014; Symonds et al., 2022), the impact of transitioning to different school engagement classes in early adolescence on mid-adolescent academic achievement was evaluated.

Most surprisingly, it was found that membership to different school engagement classes had marginal impact on most academic domains, after adjusting for a range of demographic and relational school climate factors, as well as previous achievement in the NAPLAN test. The ML 3-step approach revealed that the school engagement classes in early adolescence predicted increases only in numeracy and writing achievement and had marginal benefits for the NAPLAN spelling component at age 14 years in mid-adolescence. Specifically, belonging either to the moderately or the highly engaged latent class was associated with greater numeracy scores compared to the mostly disengaged students. Similarly, being classified either as highly or moderately engaged brought an advantage to the NAPLAN writing achievement compared to the mostly disengaged latent class. Finally, students classified as highly engaged had better scores in the NAPLAN spelling test compared to the mostly disengaged students and had marginally better scores compared to the moderately engaged students. Overall, greater engagement was associated with greater benefits for writing achievement given the larger mean differences.

Although preceding studies have reported on the links between school engagement and maths and/or language and/or school grades (Janosz et al., 2008; J. Liu et al., 2023; Symonds et al., 2016, 2022), these studies did not provide nuanced analyses of how school engagement transitions across classes are linked with specific academic domains in a literacy exam such as the NAPLAN (Klenowski & Wyatt-Smith, 2012). Despite studies illustrating the long-term benefits of adolescent school engagement for greater educational attainment (Abbott-Chapman et al., 2014; Symonds et al., 2022), the current study indicates that early adolescent emotional and behavioural school engagement has limited impact on mid-adolescent achievement in grammar, spelling and reading. This shows that any educational gains achieved by having a sustained engagement with school are taking longer to manifest, beyond middle adolescence. An alternative explanation might be linked with the nature of the NAPLAN exam. Specifically, the current finding may indicate that the nature of this exam might not be linked with early adolescent students' affective and behavioural aspects of school engagement. Another explanation might be that other aspects of school engagement, such as cognitive engagement (i.e. self-regulated learning) (Fredricks et al., 2019), that were not examined here might be more salient predictors of the NAPLAN scores.

Conclusion

The current study contributes to extant knowledge on the development of early adolescent students' emotional and behavioural school engagement by taking a person-centred approach and linking the developmental transitions with relational school climate measures and mid-adolescent academic achievement. Taken together, the present study revealed the importance of building close relationships with teachers early on in primary school, as opposed to conflicting ones, and fostering a positive sense of belonging. These factors act as buffers against disengagement. Additionally, developing greater school engagement at age 12/13 years can result in better spelling, writing and numeracy achievement later in mid-adolescence. Future research should further verify the links between emotional and behavioural school engagement latent classes and NAPLAN test scores in mid-adolescence.

All in all, the study had several strengths, such as the large representative sample size, the longitudinal cohort design, the advanced probability-based person-centred approach and the good measurement models. Nevertheless, the study was limited by the short observational span. Hence, it is recommended that future studies deploy longer observational spans in exploring adolescents' school engagement transitions across the adolescent years. Additionally, the present study did not measure school engagement in a multidimensional way by including measures of cognitive engagement, for example. Further research is also needed to cross-validate these longitudinal links and to identify what components of school climate might be more beneficial in the long term.

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Data availability Data are available through the Australian Data Archive at <https://dataverse.adfa.edu.au/dataverse/ada>

Declarations

Conflict of interest All authors declare that they have no conflict of interest.

Ethical approval The Growing Up in Australia: Longitudinal Study of Australian Children cohort study has received ethics approval by the Australian Institute of Family Studies Ethics Committee (https://growi.ngupinaustralia.gov.au/sites/default/files/certification_of_ethics_approval_for_lsac-2022.pdf). Informed consent was received from all involved parties.

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