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Abstract

Parental expectations (i.e., predictions) and aspirations (i.e., wishes and desires) for their children's academic attainment have been considered important in children's academic success. The present study tested the hypothesis that parents' expectations and aspirations influence students' positive and negative achievement emotions. We applied contemporaneous- and lagged- predictive effects models to five annual waves of data from secondary school students in Germany on achievement emotions in mathematics. Results indicated that when parents have higher expectations, students experience more positive emotions and less negative emotions (except for boredom) during the same year. In contrast, higher parents' expectations predicted higher levels of negative emotions, particularly anxiety, in the subsequent year. We also found that parents' aspirations are only weakly linked to achievement emotions, once parents' expectations are controlled for. However, when parents' aspirations exceeded their own expectations, this over-aspiration was predictive of greater anxiety and lower levels of pride in the same year. These findings highlight the complex relations between parental expectations and achievement emotions that differently manifest over time. Our results are also consistent with recent notions that parents' unrealistically high aspirations may be maladaptive for students.

Keywords: expectation, aspiration, expectancy-value theory, control-value theory, family, parents, achievement emotions

Educational Impact And Implications Statement

Raising parents' expectations (what they realistically believe their children will achieve) and aspirations (what they hope their children will achieve) is considered crucial for facilitating students' academic success in school. This study found that higher parental expectations were linked to more positive emotions and fewer negative ones during the same school year, but they were predictive of greater anxiety in students a year later. When parents' aspirations were unrealistically high and exceeded their expectations, students experienced more anxiety and less pride in the same year. These results highlight the need for parents to balance their expectations and aspirations to support their children's emotional well-being and academic success.

Parents' beliefs and perceptions about their children play important roles in children's academic success and wellbeing (for reviews see Simpkins et al., 2015; Wigfield et al., 2015). Among various beliefs and perceptions parents hold (Irwin & Elley, 2013; Ohtani et al., 2023), their academic expectations and aspirations are considered to be crucial for predicting children's academic attainment. Parental academic expectations refer to expectations/predictions parents hold for their children's academic outcomes, such as expected grades in specific subjects or expected educational qualifications (e.g., "I expect my child to achieve a B in mathematics"; "I expect my child to complete a bachelor's degree"). In contrast, parental academic aspirations refer to parents' desires and wishes concerning their children's academic outcomes (e.g., "I want my child to achieve an A in mathematics"; "I want my child to go to a college").

Previous research repeatedly observed that higher parental expectations and higher parental aspirations are predictive of students' better achievement (for meta-analyses see Fan & Chen, 2001; Jeynes, 2024; Pinquart & Ebeling, 2020). At the same time, there is also an increasing recognition that when parents' aspirations are too ambitious ("over-aspiration"), they predict poorer achievement and worse academic self-concept in students (Marsh et al., 2023; Murayama et al., 2016; Trinidad, 2019; Yamamoto & Holloway, 2010). In fact, studies in social psychology long recognized that unrealistically positive perceptions can predict negative outcomes (e.g., Robins & Beer, 2001). However, little is known about whether and how parental expectations and aspirations are related to students' emotions, despite the importance of emotions for students' academic achievement, wellbeing, and health (e.g., Pekrun, Marsh, Elliot, et al., 2023). The present study aimed to address this issue, by investigating short-term and long-term relations between parental perceptions about children's academic attainment and students' achievement emotions. Based on large-scaled longitudinal data on achievement emotions in mathematics, we examined how parental expectations and aspirations predict students' achievement emotions in the same year as well as a year later.

Achievement Emotions

Students experience a range of emotions related to their learning activities or achievement outcomes (i.e., achievement emotions). Achievement emotions are typically divided into activity emotions (i.e., emotions induced by learning activities) and outcome emotions (i.e., emotions induced by success or failure). Examples of activity emotions include enjoyment when learning one's favorite subject, boredom during a repetitive lecture, and anger about a demanding homework assignment. Examples of outcome emotions include anxiety before an important exam, pride after a successful outcome, shame after failure, and hopelessness when tasks are overwhelmingly difficult. Previous research demonstrated that these emotions play important roles in students' learning and achievement (e.g., Ahmed et al., 2013; Forsblom et al., 2022; Pekrun et al., 2010; Pekrun et al., 2017; Pekrun, Marsh, Elliot, et al., 2023).

According to control-value theory (Pekrun, 2006, 2018; 2021; 2024; Pekrun, Marsh, Elliot, et al., 2023), achievement emotions are based on students' appraisals of control and value of the learning activities and achievement outcomes. Perceived control concerns competence perceptions and expectations of success and failure. Among different value facets, the theory has a particular focus on the following two facets: intrinsic value (i.e., the importance of learning activities themselves irrespective of outcomes) and achievement value (i.e., the importance of attaining success and avoiding failure). While these two facets of value are typically related to each other (Arens et al., 2019; Trautwein et al., 2012), the theory suggests that activity emotions are more strongly associated with intrinsic value than achievement value, whereas outcome emotions are associated more strongly with achievement value. In line with these theoretical notions, previous studies revealed that enjoyment (a positive activity emotion) arises when learners perceive high control and high intrinsic value, whereas anger (i.e., a negative activity emotion) is induced when learners perceive low control and low intrinsic value (Forsblom et al., 2022; Pekrun, Marsh, Elliot, et al., 2023; Putwain et al., 2018; Sakaki et al., 2024). Boredom,

another negative activity emotion, is experienced when learners perceive a lack of control and a lack of value (Forsblom et al., 2022; Pekrun, Marsh, Elliot, et al., 2023; Putwain et al., 2018), though boredom can also occur when perceived control is too high (Goetz et al., 2023). Pride (a positive outcome emotion) is associated with perceived control and perceived value of success (Pekrun, Marsh, Elliot, et al., 2023); in contrast, anxiety, hopelessness, and shame (negative outcome emotions) are associated with low control combined with the perceived value of failure (Ahmed et al., 2012; Frenzel, Pekrun, et al., 2007; Pekrun, Marsh, Elliot, et al., 2023; Sakaki et al., 2024).

Parental Academic Expectations and Aspirations

When parents have certain beliefs and perceptions for their children's academic abilities and outcomes, those are likely to be transmitted to children by verbal communication, parenting behavior, and parents' commitment to academic studies (for reviews see Eccles & Wigfield, 2020; Muenks et al., 2018; Simpkins et al., 2015; Wigfield et al., 2015). Previous research often focused on parental expectations or aspirations given their critically important role for students' development.

Parental Expectations

Studies on parental expectations typically ask parents to indicate the grades or the final educational attainment (e.g., completing high school or university) students are likely going to achieve (Loughlin-Presnal & Bierman, 2017; Pinquart & Ebeling, 2020). Cross-sectional studies observed that these measures of parental expectations and students' academic outcomes are positively correlated (for meta-analyses see Fan & Chen, 2001; Jeynes, 2024; Pinquart & Ebeling, 2020). This observation is not surprising, given that students' previous academic outcomes should serve as a primary source of information for parents when they form their expectations. For example, when a student has shown a poor grade in math, it is reasonable for parents to lower their expectations for their child's next math exam. However, over the past

several decades, it has become clear that parental expectations are not only affected by students' past achievement but also are predictive of subsequent students' academic outcomes (Briley et al., 2014; Loughlin-Presnal & Bierman, 2017; Marsh et al., 2023; for a review see Yamamoto & Holloway, 2010). A recent meta-analysis (Pinquart & Ebeling, 2020) concluded that parental expectations predict changes in students' subsequent achievement in longitudinal studies applying cross-lagged modeling (average r = .15). This meta-analysis also found that parents' expectations are associated with children's expectations and achievement, and that those associations are stronger in older children as compared to younger children.

Multiple mechanisms likely mediate the relations between parental expectations and achievement. One potential mediator is students' perceived control; when parents express their high expectations, students may internalize them, which can result in enhanced perceived control. In line with this idea, parental expectations at Grade 10 were positively predictive of students' academic expectations at Grade 10 and Grade 12, though the effects were weaker for Grade 12 (Marsh et al., 2023). Likewise, parents' expectations were predictive of subsequent students' academic self-concept (a concept closely related to perceived control; Loughlin-Presnal & Bierman, 2017; Neuenschwander et al., 2007). In addition to perceived control, previous studies suggest that when parents have higher expectations, they change parental behavior to promote children's engagement, which may enhance students' motivation and performance (for a meta-analysis see Pinquart & Ebeling, 2020).

Parental Aspirations

In addition to parental expectations, previous research assessed parental aspirations by asking parents to indicate their wishes/hopes about the grade students would achieve or their final educational attainment (Murayama et al., 2016). Researchers often pointed out that aspirations are conceptually different from expectations, because aspirations are less achievable (Pinquart & Ebeling, 2020). Nevertheless, similar to parental expectations, higher parental aspirations were

shown to be predictive of students' better academic outcomes (Buchmann et al., 2022; Hong & Ho, 2005). For example, Trinidad (2019) revealed that children whose parents had higher educational aspirations at age 16 (Grade 10) were more likely to enter and graduate a four-year college or university after controlling for academic outcomes in Grade 10.

As in parental expectations, parental aspirations are likely associated with multiple factors important for students' achievement. First, higher parental aspirations may be interpreted by students as a sign that parents trust their academic competence, leading to higher perceived control. In fact, a study in Switzerland revealed that higher parental aspirations at the age of 9 positively predict students' self-concept at the age of 12 (Buchmann et al., 2022). In addition to perceived control, parental aspirations may be internalized into students' beliefs about the importance of academic study, enhancing their achievement value and academic goals (Sewell & Shah, 1968). Higher parental aspirations may also lead to higher levels of parental pressure on children (Pearlin et al., 1967), which can further affect students' achievement value.

It should be noted that parental aspirations and expectations are typically positively correlated (Marsh et al., 2023; Murayama et al., 2016). This is not surprising. For example, parents who expect their children to achieve a D in math would be less likely to have a desire for their children to achieve an A+ in math relative to those who expect their children to achieve a B in math (because it would be less realistic). However, previous studies did not always control for parental expectations in examining the predictive effects of parental aspirations. Thus, the significant predictive effects of parental aspirations described above may, in fact, be due to parental expectations. In addition, when they are strongly correlated to each other, it is challenging to identify the unique predictive effects of aspirations independently from expectations, even if both of them are included in the same analysis, due to multicollinearity (Marsh et al., 2023).

Parental Aspirations-Expectations Gap

One way to address this issue is to apply an orthogonal transformation, by obtaining an average between expectations and aspirations as well as their difference score. This method allows researchers to quantify the predictive effects of parental over-aspirations relative to their expectations (see Marsh et al., 2023). Using this approach, research suggests that parents' unrealistically high aspirations can lead to negative consequences on students' academic success and perceived control. For example, analyzing data from German adolescents, Murayama et al. (2016) showed that parental aspirations that exceeded their own expectations negatively predicted students' math achievement. A similar result was also reported for self-concept (Marsh et al., 2023); larger discrepancies between parental aspirations and expectations were predictive of lower levels of achievement as well as lower levels of academic self-concept. Other researchers quantified parental over-aspirations by comparing parental aspirations relative to children's aspirations (Schoon & Burger, 2022). These studies also pointed out that when parents' aspirations are too ambitious, negative outcomes can occur. For example, a study in the US showed that the likelihood of college graduation is reduced not only when both parents and students have low aspirations, but also when parents have higher aspirations than students (Trinidad, 2019). Likewise, adolescents whose parents had higher aspirations than themselves were more likely to report depressive symptoms relative to adolescents who had higher aspirations than their parents (Guo et al., 2022; see also Ma et al., 2018).

Taken together, it appears that when parents' aspirations are excessively high relative to their own expectations or their children's aspirations, negative consequences can occur. Empirical research on over-aspiration is still sparse, and the exact reasons of why over-aspiration is associated with negative outcomes are unclear. One possibility is that having a mismatch between parental expectations and aspirations has maladaptive effects on students' achievement, irrespective of whether parental aspirations are too ambitious (over-aspiration) or too low (under-aspiration) relative to their expectations (Schoon & Burger, 2022). For example, when parents

have under-aspiration as well as when they have over-aspiration, students may perceive that their parents have inaccurate expectations and/or aspirations, which may lead to frustration, lower achievement motivation, and lower performance. However, other studies suggest over-aspiration is more problematic for students' achievement emotions than under-aspiration (Murayama et al., 2016; Trinidad, 2019). Specifically, with overly ambitious parental aspirations, appraisals of achievement outcomes may be shifted in a negative direction; for example, a certain outcome that students achieve (e.g., a B) could be appraised as failure by them because the outcome does not meet their parents' aspirations (e.g., an A). This may result in perceived failure experiences for students, which can, in turn, lead to lower perceived control and fear of failure (Fong et al., 2019). Furthermore, overly aspiring parents may employ harsher punishment in case of achievement failures, thus exacerbating the negative value of failure and thus students' concerns over parental criticism (Ablard & Parker, 1997; Curran & Hill, 2022).

Parental Expectations, Aspirations and Students' Achievement Emotions

In summary, currently available evidence suggests that parental expectations and over-aspirations may affect perceived control and value beliefs. Given such effects, it is reasonable to expect that they also relate to children's achievement emotions. When parents have high expectations and communicate them to their students, students would be more likely to internalize the parents' beliefs and experience higher levels of control (Briley et al., 2014; Simpkins et al., 2012). Thus, students would experience higher levels of positive emotions (e.g., enjoyment and pride), and lower levels of anger, anxiety, shame, and hopelessness when their parents have higher rather than lower expectations. Similar relations are expected for parental aspirations given their effects on perceived control and academic goals (Buchmann et al., 2022; Sewell & Shah, 1968). In contrast, when parents' aspirations are too ambitious, students may experience a lack of control combined with an increase in the importance of avoiding failure. As a result, students would experience lower enjoyment and pride, coupled with higher levels of

anger, anxiety, shame, and hopelessness.

There are only a handful of studies that addressed the relations between parental expectations and students' achievement emotions. In addition, these previous studies are primarily based on cross-sectional data; and do not show a coherent pattern. For example, a cross-sectional study in Germany and China revealed that adolescents' perceived parental expectations were positively correlated with students' enjoyment and pride, and negatively correlated with their anger, anxiety, and shame (Frenzel, Thrash, et al., 2007). Students whose parents had higher expectations were also more likely to report enjoyment in the US (Froiland & Davison, 2016) and in Singapore (Luo et al., 2016). In addition, parents' expectations were negatively correlated with math anxiety in a US study (Kiss & Vukovic, 2021). However, another study showed that higher parents' expectations were associated with elevated levels of test anxiety in undergraduate students (Peleg et al., 2016). Such mixed results may be due to the fact that these studies did not separately consider expectations and aspirations. In addition, the role of parental over-aspirations were rarely examined. The only exception was Goetz and colleagues (2006) which showed that students experienced higher levels of anxiety, anger and boredom, when they perceived that their parents expected them to do better than they were able to do. Thus, this study highlighted the possibility that over-aspiration is harmful for achievement emotions. Nevertheless, existing studies predominantly concerned perceived parents' expectations and aspirations as reported by students, rather than by the parents themselves. While children's perceptions likely mediate the effects of parental expectations and aspirations, they can diverge from parents' real expectations and aspirations. Thus, it is important to directly examine whether and how parents' own expectations and aspirations predict students' achievement emotions.

The Present Study

The present study aimed to offer comprehensive analyses on the predictive effects of parental expectations and aspirations on achievement emotions. We examined their

contemporaneous relations (i.e., the simultaneous associations observed within the same assessment point) as well as long-term relations (i.e., the associations after a year) by analyzing data from the Project for the Analysis of Learning and Achievement in Mathematics (PALMA; Frenzel et al., 2009; Marsh et al., 2017; Murayama et al., 2016; Pekrun et al., 2017; Pekrun et al., 2007; Sakaki et al., 2024). The PALMA longitudinal study investigated German students' development in mathematics from Grades 5 to 10. The study included annual assessments of parental expectations, parental aspirations, students' school grades, and achievement emotions in math. Seven achievement emotions in mathematics were assessed: enjoyment, pride, anger, boredom, anxiety, shame, and hopelessness. Including parental expectations and parental aspirations, the data allowed us to address our hypotheses on the effects of parental expectations, aspirations, and over-aspirations (i.e., positive differences between aspirations and expectations). Given the previous notion that parental expectations are more strongly associated with students' performance in secondary school students than elementary school students (for a meta-analysis, see Pinquart & Ebeling, 2020), the PALMA dataset is ideally suited to test our hypothesis on the effects of parental expectations and aspirations on achievement emotions. A previous study based on this dataset (Murayama et al., 2016) confirmed that students' math achievement is positively predicted by parental expectations, but negatively predicted by their over-aspirations. The present study attempts to extend it further by investigating whether and how parents' expectations, aspirations, and over-aspirations are related with students' achievement emotions.

There are various approaches to estimate causal effects from longitudinal data (for reviews see Murayama & Gfrörer, 2024; Usami et al., 2019; Zyphur et al., 2020). In research on education, cross-lagged panel models or their variants have been the gold standard to analyze longitudinal data, which allows researchers to examine reciprocal lagged effects (i.e., the effects of prior measures on those in subsequent adjacent waves). This is based on the widely shared view that a certain time lag is needed for a cause to produce an outcome (Gollob & Reichardt,

1987). However, there is a growing recognition that one should also consider contemporaneous effects when the time scale of a causal process is unclear (Kuppens et al., 2022; Muthén & Asparouhov, 2024); because when the time scale of the causal process is shorter than the interval of two consecutive waves, the cross-lagged panel models would not be able to capture the causal effects (Marsh et al., 2024; Rohrer & Murayama, 2023). Given that there has been limited research on parents' expectations, aspirations, and achievement emotions, we analyzed both contemporaneous and lagged predictive effects of parents' perceptions (i.e., expectations, aspirations and over-aspirations) on students' achievement emotions in the present study.

We used the dynamic panel model with unidirectional effects to test the hypothesized causal effects, which is commonly used in other fields such as econometrics (Imai & Kim, 2019) (Figures 1-4). This was based on recommendations by Rohrer and Murayama (2023) and Lüdtke and Robitzsch (2022) which stressed the importance of choosing an appropriate longitudinal analysis model best suited to provide causal estimates for the effects of interest. We focused on unidirectional effects (rather than reciprocal effects) because (1) our research question is about the effects of parental expectations and aspirations on achievement emotions (not *vice versa*), and (2) recent simulation research has shown that this type of unidirectional effect models is more robust to model misspecifications than the reciprocal effect models (Lüdtke & Robitzsch, 2022); models testing reciprocal effects always make more assumptions than those focusing only on unidirectional effects.

First, we aimed to examine the predictive effects of parental expectations, aspirations and over-aspirations on students' achievement emotions in the same wave after controlling for baseline emotions (Figures 1-2). We hypothesized that parental expectations and over-aspirations generally have opposite contemporaneous effects on achievement emotions. Thus, we expect that higher parental expectations are linked to higher levels of enjoyment and pride, and lower levels of anger, anxiety, shame, and hopelessness. The results are difficult to predict for boredom, given

that parental expectations are expected to increase perceived control but boredom can be induced when perceived control is too high as well as too low (Goetz et al., 2023). For parental over-aspirations, we expect that parental over-aspirations would predict lower enjoyment and pride, and higher anger, anxiety, shame, and hopelessness. Once again, we refrained from making predictions for boredom given its non-linear relation with perceived control.

Second, we examined lagged predictive effects of parental expectations, aspirations and over-aspirations on achievement emotions in the following year (Figures 3-4). Here, the prior evidence is inconsistent. On the one hand, previous longitudinal studies documented that parental expectations are predictive of students' perceived control in the subsequent year (Loughlin-Presnal & Bierman, 2017; see Buchmann et al., 2022 for similar results on aspirations). These results suggest that parental expectations and over-aspirations could still predict achievement emotions even after a year. On the other hand, Marsh et al. (2023) showed that the predictive effects of parental expectations and aspirations become weaker over time. Wang et al. (2021) also revealed that parental expectations perceived by adolescents' were not significantly associated with change trajectories of anxiety in math between grades 7 and 12. Thus, the lagged relations between parental perceptions and achievement emotions may be smaller (but in the same direction as those observed in the contemporaneous effects) or nonexistent after a year.

Method

Transparency and Openness

Analysis codes are available at the Open Science Framework (Sakaki et al., 2025). The study's design and analysis were not pre-registered. The raw data and study materials (in German) are available upon request. Structural Equation Modeling (SEM) analyses were performed using *Mplus* 8.5 (Muthén & Muthén, 1998-2017). Other analyses and visualizations were performed with *R* (R Core Team, 2021). The outputs of the *Mplus* were read into R using the *MplusAutomation* package (Hallquist & Wiley, 2018). Tables were produced using the

flextable package (Gohel, 2021).

Participants and Design

We used data from the longitudinal PALMA study which assessed students' development in mathematics in German secondary schools from Grades 5 to 10 on an annual basis (Pekrun et al., 2007). The assessment was done toward the end of each year but before the end-of-the-year grade was provided to students. The project also collected data from students' parents, allowing us to examine parents' expectations and aspirations. The sample included students from 42 schools from all three school tracks in the German public-school system in the state of Bavaria: lower-track schools (Hauptschule), intermediate-track schools (Realschule), and higher-track schools (Gymnasium). They were representative in terms of core demographic characteristics (e.g., geographical locations, students' gender, family socioeconomic status). Participation rates were high for students (> 80%; see Pekrun et al., 2007 for details). The Data Processing and Research Center (DPC) of the International Association for the Evaluation of Educational Achievement conducted sampling and the assessments. All students' assessments were done by trained external test administrators. While students in higher and intermediate-track schools continue to stay at least until Grade 10, students in lower-track schools mostly finished school after Grade 9. Thus, we decided *a priori* to use the data from Grades 5 to 9 (i.e., five waves). At Grade 5, 2,070 students from 42 schools (49.6% female, M_{age} = 11.7 years) provided data on parental expectation, aspiration, and students' achievement emotions. In each subsequent year, the study tracked those who had participated in the previous assessment(s) as well as those who had newly become members of the PALMA classrooms. As a result, the sample size changed over time: Grade 6 (n = 2,059; 50.1% female, M_{age} = 12.7 years), Grade 7 (n = 2,397; 50.1% female, M_{age} = 13.7 years), Grade 8 (n = 2,410; 50.5% female, M_{age} = 14.8 years), and Grade 9 (n = 2,528; 51.1% female, M_{age} = 15.6 years). In each wave, parents of over 70% of these students provided data for expectations

and aspirations. In total, 3,424 students (50.0% female) provided data for parental expectation, aspiration, and students' achievement emotions at least in one wave. The PALMA project received Institutional Review Board approval from the Bavarian State Ministry for Education, Science, and the Arts (Reference: III/5-S4200/4–6/68 908).

Measures

Parental Expectation and Aspiration

Parental expectation was assessed by a single item, where parents indicated the grade they *believed* that their children would be able to achieve in mathematics at school ("We believe that our daughter/son can get the following grade in mathematics"). *Parental aspiration* was assessed by another item; where parents reported the grade they *wanted* their child to achieve in mathematics at school ("We wish our daughter/our son to get the following grade in mathematics"). Both items were rated on the grades as defined in the German school system (1 = excellent to 6 = unsatisfactory). To ease interpretation, we reverse-coded the scores (1 = unsatisfactory to 6 = excellent). The items were adopted from the previous literature (Goldenberg et al., 2001; Okagaki & Frensch, 1998). These two variables are moderately correlated at all waves (r = .55 – .63), supporting previous notions that there are common as well as unique components (Marsh et al., 2023; Pinquart & Ebeling, 2020).

Achievement Emotions

Students' achievement emotions in mathematics were assessed by the Achievement Emotions Questionnaire–Mathematics (AEQ–M; Bieleke et al., 2021; Pekrun et al., 2011). The questionnaire asks students to indicate how they typically feel when attending class, doing homework, and taking tests and exams in mathematics. Following previous work based on the scale (Pekrun et al., 2011; Pekrun et al., 2017), responses to items pertaining to different settings (i.e., class, homework, and exams) were collapsed (see Table S1 Cronbach's αs for each wave). The scale included items on seven achievement emotions, including enjoyment (9

items, e.g., “I enjoy my math class”), pride (8 items; e.g., “After a math test, I am proud of myself”), anger (8 items; e.g., “I am annoyed during my math class”), anxiety (15 items; e.g., “I worry if the material is much too difficult for me”), shame (8 items; e.g., “I am ashamed that I cannot answer my math teacher’s questions well”), boredom (6 items; e.g., “My math homework bores me to death”), and hopelessness (6 items; e.g., “During the math test, I feel hopeless”). Students indicated the extent of agreement on a 1 (*strongly disagree*) to 5 (*strongly agree*) Likert scale. Covering achievement emotions across study contexts, the questionnaire allowed us to test our hypothesis that parental expectations and aspirations affect students’ achievement emotions even when the emotions are not directly relevant to examinations or grades.

Time-invariant Covariates

To facilitate causal inference, we included both time-invariant and time-variant covariates. For the time-invariant covariates, we included students’ gender (0 = female; 1 = male), school track (two orthogonally coded variables to represent three different school tracks; Murayama et al., 2013), and family SES which was measured using parent reports based on the EGP classification (Erikson et al., 1979). Following prior work (Pekrun et al., 2017), SES was included as a continuous variable (higher values represent higher family SES).

School Grade

We also included students’ grade as a time-variant covariate, given that students’ previous grades likely influence parental expectations and aspirations as well as achievement emotions (Briley et al., 2014; Pekrun et al., 2017). Students’ end-of-the-year grades in mathematics were collected from school documents. These grades are summative scores based on multiple exams over the school year. The final grades were given to students at the end of the school year. The grades ranged from 1 to 6 as defined in the German school system (1 = excellent to 6 = unsatisfactory). To ease the interpretation, these scores were reversed so that

higher values represent better grades (i.e., 1 = unsatisfactory to 6 = excellent).

Data Analysis

We modeled achievement emotions as latent variables to control for measurement errors. As has been done in previous work (Pekrun et al., 2017; Sakaki et al., 2024), the model posited correlated errors of the same items over time as well as those of the items within the same situation (e.g., classroom, homework). To ensure the equivalence of the latent variables over time, we conducted a preliminary longitudinal measurement invariance analysis for each achievement emotion. Specifically, we compared three factor analytic models with increasing constraints: (1) configural invariance model (no constraints), (2) metric invariance model (factor loadings are constrained to be equal over time), and (3) error invariance models (error variances are additionally constrained to be equal over time). The results supported the most constrained model (i.e. error invariance model), ensuring the comparability of the meaning of latent variables over time (see Table S2). This most constrained model was used for the subsequent models described below.

To test our hypotheses on the effects of parental expectations, aspirations and over-aspirations, we *a priori* decided to use the dynamic panel model with contemporaneous and lagged unidirectional effects; due to the computational demands when modeling contemporaneous and lagged effects simultaneously, we estimated them separately in our main analyses. The outcome variables were each of the seven achievement emotions. Predictors were parental expectations, aspirations and over-aspirations; over-aspiration was included as a predictor in a separate model from expectation and aspiration because it is collinear with expectation and aspiration (i.e., over-aspiration is based on a linear combination of expectation and aspiration; see Marsh et al., 2023, for a similar procedure). Traditionally, the contemporaneous effects were examined using so-called fixed-effects model (Hamaker & Muthén, 2020). We extended fixed-effects model by incorporating the autoregressive paths of

achievement emotions (Allison et al., 2017) to reduce the potential bias of causal estimates due to the autoregression effects (Imai & Kim, 2019). Such autoregressive effects are likely to exist given the stability of achievement emotions over time (Pekrun et al., 2017). For school grades, parental expectations, and parental aspirations, we included pairwise correlations for all possible pairs of waves (rather than only standard lag-1 relations) to fully take into account the temporal associations of these variables over time (see Table S3 for the estimates for these correlational structures) (Arens et al., 2017). Modeling these associations implies that we did not make any assumptions about temporal correlation structures, thus, preventing possible model misspecification (Lüdtke & Robitzsch, 2022; Murayama & Gfrörer, 2024). Our model showed a better fit than a model which assumed only standard lag-1 autoregressive paths for parental expectations, aspirations and grades (Tables S4-S7).

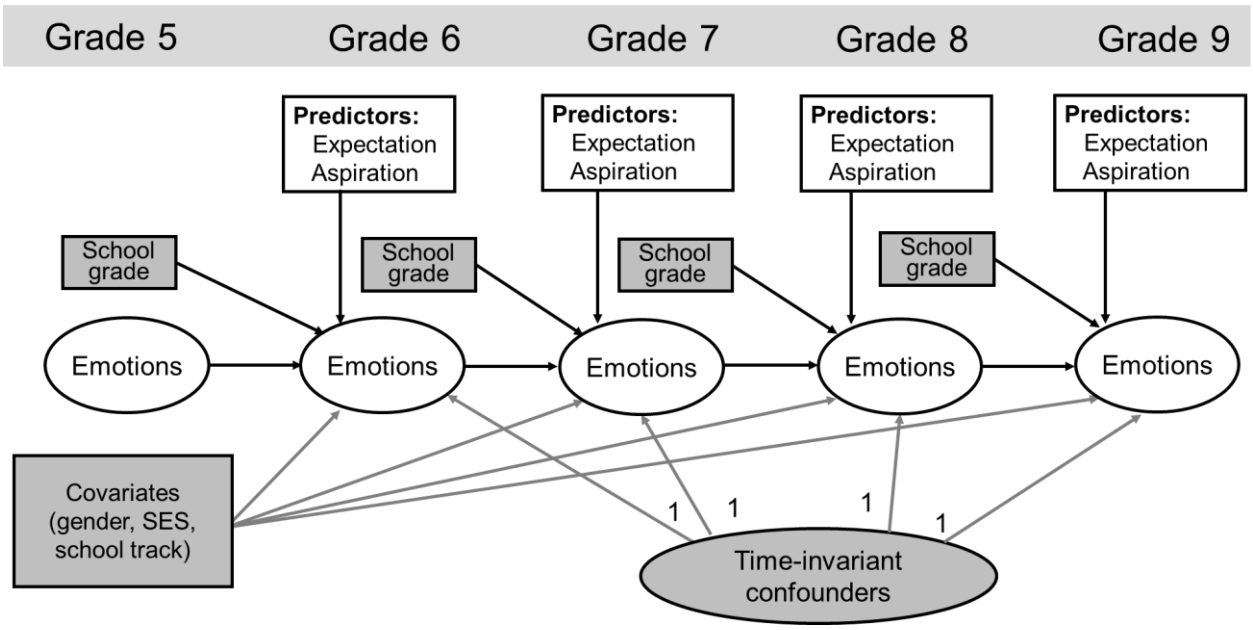
To strengthen causal inference, we included the aforementioned time-invariant covariates including gender, school track, and family SES. In addition, a latent variable was included to control unmeasured time-invariant confounders which had time-invariant relations with the predictor variable over time (hereafter we call it "time-invariant factor"; Figures 1-4). This is akin to a stable trait factor in other versions of cross-lagged panel models such as the random-intercept cross-lagged panel model (Hamaker et al., 2015; for differences between the stable trait factor and time-invariant factor, see Murayama & Gfrörer, 2024). We also included prior math grades as time-variant confounders.

We specified the model for each achievement emotion separately due to computational demand. We also constrained the path coefficients of parental expectations, aspirations, and over-aspirations on students' achievement emotions to be equal over time (the models with these constraints showed a better fit than the models without these constraints in most cases; see Table S8-S11). In addition, the autoregressive path coefficients were constrained to be equal over time due to computational demand. The model included correlations between the

latent emotion variable at the first wave and time-invariant covariates, as well as correlations across covariates (they are omitted from Figure 1-4 for visual representations). When the model did not properly converge, we fixed some correlations between covariates and the time-invariant factor to zero to stabilize the results. These idiosyncratic changes are reported in Table S12.

Figure 1

Analysis Model to Examine the Contemporaneous Predictive Effects of Parental Expectation and Aspiration on Achievement Emotions



Models on Contemporaneous Predictive Effects of Expectation and Aspiration

We simultaneously included both expectations and aspiration as predictors of students' achievement emotions from the same school year (Figure 1). As described earlier, parental and students' surveys were administered toward the end of the school year but *before* the end-of-

the-year grade was provided to students. This means that parents did not know the final grade for their child at that time of the survey assessment; thus their expectations and aspirations for their child's achievement were likely affected by the final grade from the previous year. Therefore, we included the end-of-the-year grade from the previous year as the controlling variable (Figure 1). For example, when we included parental expectations at Grade 7 as a predictor of achievement emotions measured at Grade 7, we controlled students' grades at Grade 6 to account for the possibility that students' achievement at Grade 6 should have affected parental expectations in Grade 7.

It should be noted that even though parents were not given the end-of-the-year grade at the time when they completed the surveys, they may have at least a rough idea about their child's upcoming grade based on communications with teachers/children, grades from previous exams, as well as observations of study materials. Therefore, as a robustness check analysis, we also conducted another set of analyses in which end-of-the-year math grades from the same year were included as a control variable (Figure S1). This analysis is likely to underestimate the causal estimates, as the control variables were assessed *after* the assessment of the predictor variable, likely to cause mediator or collider bias (i.e., over-control; Pearl et al., 2016). Nevertheless, the analysis should be able to confirm the robustness of the results. The results from the robustness check are reported in the Supplemental Materials (Table S13).

Models on Contemporaneous Predictive Effects of Over-aspiration

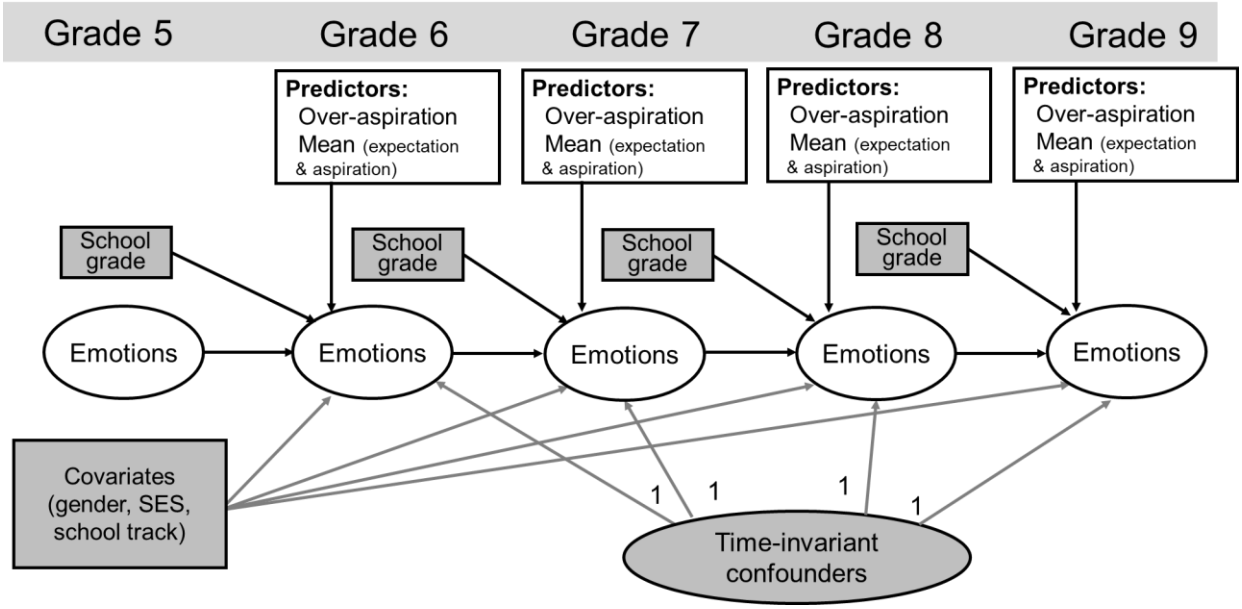
We next applied orthogonal transformation to measures on aspirations and expectations following a previous study (Marsh et al., 2023). Specifically, parental over-aspiration was defined as a within-person difference score between aspiration and expectation and included as a predictor. We also included an average of the expectation and aspiration scores as predictors of students' achievement emotions in the model (Figure 2). Including the average score into the model prevents the model from being mis-specified; without this

average score, the model is built on the unrealistic assumption that the path coefficients of parental expectations and aspirations are equal in magnitude but opposite in sign (Laird & Weems, 2011). Since the average score is orthogonal to the difference score, including the average score in the model does not change the estimates for the difference score (see Laird & Weems, 2011; Marsh et al., 2023). We also included the aforementioned time-invariant covariates and the end-of-the-year grade from the previous year as time-variant covariates in our main analysis (Figure 2).

As in the analysis described in the previous section, we also performed a robustness check analysis, where end-of-the-year math grades from the same year were included as a control variable (Figure S2; Table S14). We also conducted an additional set of analysis for another robustness check; while the orthogonal transformation (i.e., average and difference scores) allows to maintain the predictive ability of the model, the estimates for the simple difference score between parental expectations and aspirations may reflect the predictive effects of under-aspiration (i.e., aspirations lower than expectations) than over-aspirations. As such, we also performed an additional analysis where under-aspiration was excluded (see the Supplemental Materials).

Figure 2

Analysis Model to Examine the Contemporaneous Predictive Effects of Parental Over-Aspiration on Achievement Emotions



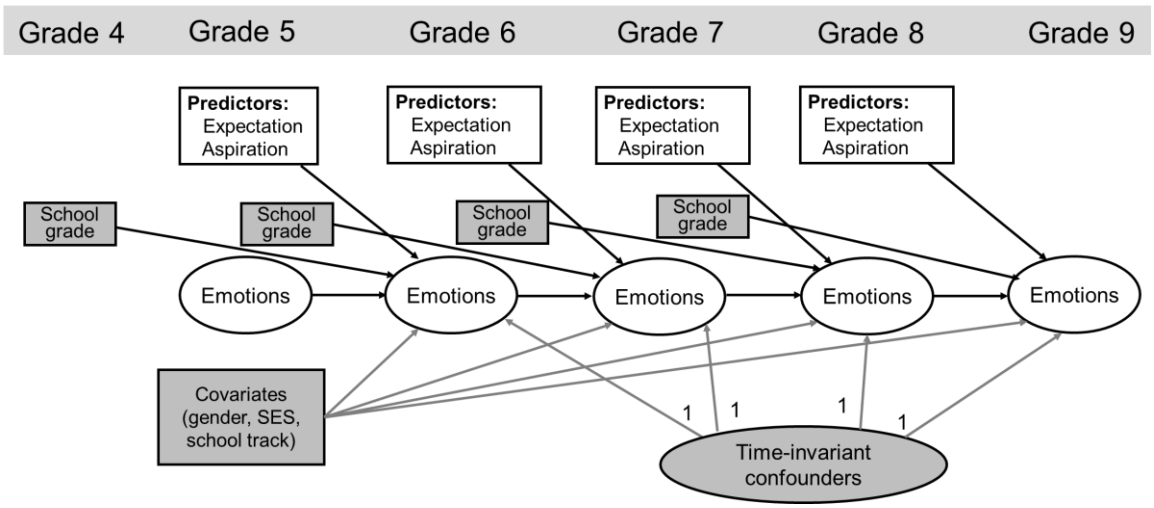
Models on Lagged Predictive Effects of Expectations and Aspirations

To examine whether parental expectations and aspirations predict students' emotions in a year later, we conducted another set of analyses (Figure 3). The analysis strategy was similar to the first analysis (Figure 1), except that a) parental expectations/aspirations at the previous wave were entered as predictors in the model; b) we included correlations between the latent variables for emotion in each wave and expectations and aspirations from the same wave, and c) the school grade from the T-2 year was included as a control. For example, for achievement emotions at Grade 7, parental expectations/aspirations at Grade 6 were included as predictors; and the final grade from Grade 5 was included as a control variable. This is because parents were not provided the final grade for Grade 6 when they indicated their expectations and aspirations and therefore parental expectations at Grade 6 (i.e., the independent variables) were

likely to be affected by the achievement grade in Grade 5. We also performed a robustness check analysis, where end-of-the-year math grades from the previous year (the same year when parental aspirations and expectations were assessed) were included as a control variable (Figure S3; Table S15). As another robustness check, we also conducted a set of analyses, in which contemporaneous and lagged predictive effects of parental expectations were included in the same model (Table S16, Figure S4).

Figure 3

Analysis Model to Examine the Lagged Predictive Effects of Parental Expectation and Aspiration on Achievement Emotions



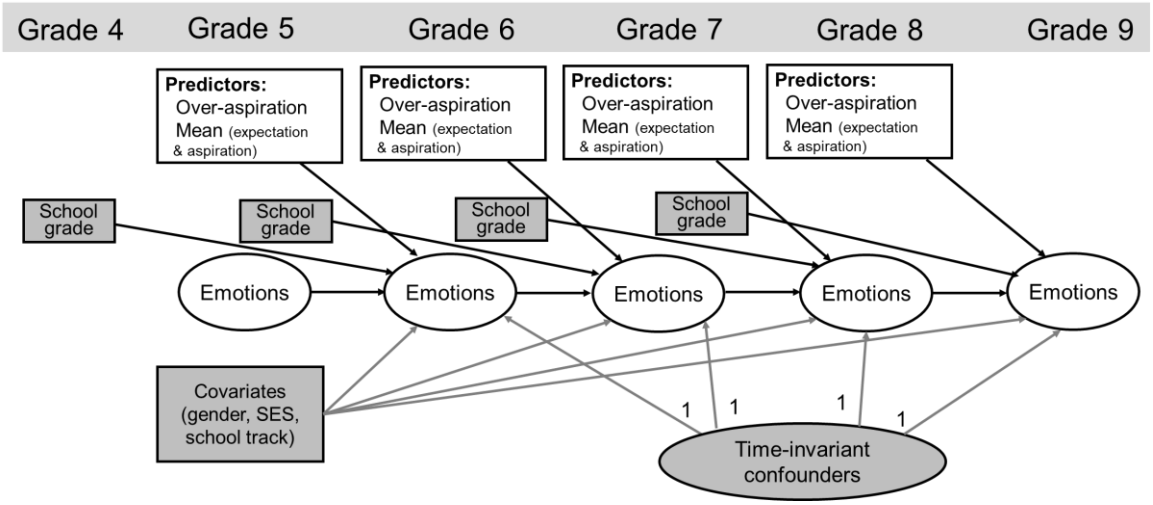
Models on Lagged Predictive Effects of Over-Aspiration

Lastly we examined whether parental over-aspirations are linked to students' achievement emotions in a year later (Figure 4). The model was similar to Figure 3 but the predictor variables were replaced by parental over-aspiration (i.e., the difference between aspiration and expectation) and the average of aspiration and expectation (i.e., an overall score of expectation and aspiration). See Supplementary Materials for the robustness check analyses,

where end-of-the-year math grades from the previous year were included as a control variable as well as for the analysis where we excluded under-aspiration (Figure S4; Table S17).

Figure 4

Analysis Model to Examine the Lagged Predictive Effects of Parental Over-Aspiration on Achievement Emotions



Estimation Method

We applied SEM with maximum-likelihood estimation using *Mplus* 8.5. We adjusted the standard errors and chi-square statistics to correct for non-normality of the data using the MLR estimator. We used cluster-robust standard errors (with the <TYPE = COMPLEX> option) to deal with the nested structure of the data (i.e., students/parents nested within schools). As noted earlier, data include missing data at every time point (see Table S18 for an attrition analysis). Potentially biased estimates due to missing data were handled by full-information maximum likelihood estimation. This method is known to produce unbiased estimates when the missing-at-random (MAR) assumption is met (Enders, 2010). MAR means

that missingness does not have to be completely random — missingness of a certain variable can be correlated with other variables in the model. MAR requires that missingness of a certain variable is not correlated with the variable itself after accounting for other variables in the model. This assumption is realistic in longitudinal data, because, even if missingness of a certain variable is correlated with the variable itself, this relationship is likely to be explained by the same variable from the previous time points (Marsh et al., 2019).

Results

Table 1 reports the descriptive statistics of the main variables for the present study.

Contemporaneous Models on Parental Expectation and Aspiration

Models on the contemporaneous effects of expectation and aspiration showed good fit (Table 2). We found that when parents have higher expectations, students experience higher levels of enjoyment and pride, and lower levels of anger, anxiety, shame, and hopelessness, though the associations were not significantly for boredom (p = .83). Parental expectations significantly predicted enjoyment, pride, anger, anxiety, and hopelessness even in our robustness check analysis (Table S13). In contrast, the path coefficients of parental aspirations were generally small; when parents had higher aspirations, students experienced lower anxiety, lower shame, and lower hopelessness but none of these associations were significant in our robustness check analysis (Table S13). These results are in line with findings from Marsh et al. (2023) that parental expectations predict students' outcome variables more strongly than parental aspirations when both are included in the same model.

Table 1.

Descriptive Statistics of the Main Variables Analyzed in the Study.

Variables	Year 5	Year 6	Year 7	Year 8	Year 9
Enjoyment	3.32 (0.85)	2.98 (0.85)	2.73 (0.82)	2.66 (0.79)	2.63 (0.78)
Pride	3.21 (0.94)	2.98 (0.94)	2.74 (0.90)	2.70 (0.90)	2.66 (0.88)
Anger	2.03 (0.93)	2.23 (0.98)	2.46 (0.97)	2.43 (0.96)	2.43 (0.94)
Anxiety	2.29 (0.83)	2.33 (0.85)	2.37 (0.86)	2.27 (0.84)	2.27 (0.83)
Shame	1.89 (0.86)	1.93 (0.90)	1.90 (0.86)	1.82 (0.84)	1.80 (0.82)
Boredom	1.98 (0.97)	2.29 (1.06)	2.57 (1.08)	2.61 (1.05)	2.60 (1.02)
Hopelessness	2.04 (0.97)	2.14 (1.03)	2.27 (1.04)	2.24 (1.06)	2.25 (1.04)
Parental expectation	4.62 (0.74)	4.55 (0.79)	4.51 (0.80)	4.53 (0.85)	4.59 (0.83)
Parental aspiration	4.87 (0.63)	4.79 (0.65)	4.72 (0.68)	4.69 (0.71)	4.69 (0.73)
Parental overaspiration	0.26 (0.65)	0.24 (0.67)	0.21 (0.70)	0.16 (0.75)	0.11 (0.68)
School grade	3.91 (0.91)	3.84 (0.96)	3.64 (0.94)	3.71 (0.95)	3.77 (1.00)

Note: Standard Deviations are in Parentheses.

Table 2

Results from Models on Contemporaneous Effects of Parental Expectations and Aspirations on Achievement Emotions (unstandardized beta values)

Dependent variable	Parental expectation effect	Parental aspiration effect	Autoregression path	X^2	df	CFI	TLI	RMSEA
Enjoyment	0.153** (0.025)	0.042 (0.024)	0.352** (0.036)	4663.223	1577	.934	.928	.024
Pride	0.167** (0.025)	0.027 (0.021)	0.319** (0.041)	2803.252	1041	.946	.94	.022
Anger	-0.134** (0.019)	-0.041 (0.023)	0.380** (0.045)	3538.513	1298	.939	.933	.022
Anxiety	-0.147** (0.017)	-0.045* (0.018)	0.497** (0.041)	9626.425	3777	.921	.917	.021
Shame	-0.130** (0.022)	-0.041* (0.020)	0.384** (0.031)	2817.004	1297	.956	.951	.018
Boredom	-0.008 (0.034)	-0.049 (0.033)	0.401** (0.047)	1570.337	810	.975	.971	.016
Hopelessness	-0.195** (0.020)	-0.081** (0.024)	0.338** (0.029)	1945.892	816	.966	.962	.02

Note: Standard errors in parentheses. ** (p <.01) * (p < .05)

Contemporaneous Models on Parental Over-Aspiration

Results from the previous analysis suggest that parental expectations, relative to parental aspirations, were more strongly predictive of students' achievement emotions. However, given the positive correlations between expectations and aspirations, their common predictive effects may be different from their unique predictive effects. To address this issue, we next included the average of expectations and aspirations as well as parental over-aspiration as predictors (Laird & Weems, 2011; Table 3).

Given that the models are mathematically identical (Laird & Weems, 2011), the model fit measures were similar to those in Table 2. We found that higher means of aspiration and expectations are linked to higher enjoyment, higher pride, lower anxiety, lower shame, and lower hopelessness. In addition, when parents' held over-aspirations, students reported reduced levels of enjoyment and pride, as well as higher levels of anger, anxiety, shame, and hopelessness. In our subsequent analysis, over-aspiration was significantly predictive of anxiety and pride even when the school grade from the same year was used as a covariate (Table S14). These results suggest that over-aspirations predict higher levels of negative emotions and lower levels of positive emotions in the same year; and that the associations are particularly robust for anxiety and pride.

Table 3

Results from Models on Contemporaneous Effects of Parental Over-Aspiration on Achievement Emotions (unstandardized beta values).

Dependent variable	Parental exp/asp mean	Parental over-aspiration	Autoregression path	X^2	df	CFI	TLI	RMSEA
Enjoyment	0.201** (0.028)	-0.056** (0.021)	0.353** (0.036)	4669.581	1577	.934	.928	.024
Pride	0.198** (0.028)	-0.071** (0.019)	0.321** (0.040)	2808.325	1041	.946	.940	.022
Anger	-0.176** (0.026)	0.049** (0.016)	0.380** (0.045)	3526.907	1294	.939	.933	.022
Anxiety	-0.194** (0.023)	0.052** (0.013)	0.498** (0.042)	9617.154	3777	.921	.917	.021
Shame	-0.175** (0.030)	0.047** (0.015)	0.383** (0.032)	2818.804	1296	.955	.951	.018
Boredom	-0.060 (0.031)	-0.018 (0.030)	0.401** (0.048)	1565.501	807	.975	.971	.016
Hopelessness	-0.279** (0.027)	0.059** (0.017)	0.337** (0.029)	1936.762	812	.966	.962	.02

Note: Standard errors in parentheses. ** (p <.01) * (p < .05). Parental over-aspiration: A gap between expectations and aspirations. Parental exp/asp mean: the average between expectations and aspirations

Lagged Models on Parental Expectation and Aspiration

We next examined whether and how parental expectations and aspirations predict students' achievement emotions a year later (Table 4). The results indicated that parental aspirations and expectations were not strongly related to students' achievement emotions after a year. However, we found significant associations for three emotions (i.e., anger, anxiety and shame). Interestingly, the sign of the path coefficients was opposite from those from the contemporaneous effects analysis, such that higher parental expectations were predictive of *higher* levels of anxiety, anger and shame. The results for anxiety were replicated when the school grade from the same year (as expectation and aspiration) was controlled (Table S15). We also found the similar pattern when we included both the contemporaneous paths of parental expectations and the lagged paths of parental expectations in the same model (Table S16). These results suggest that higher parental expectations are predictive of long-term negative achievement emotions, particularly anxiety.

Table 4

Results from Models on Lagged Effects of Parental Expectations and Aspirations on Achievement Emotions (unstandardized beta values).

Dependent variable	Parental expectation	Parental aspiration	Autoregression path	X^2	df	CFI	TLI	RMSEA
Enjoyment	-0.026 (0.023)	0.013 (0.031)	0.332** (0.031)	4501.35	1572	.936	.931	.023
Pride	0.010 (0.026)	0.002 (0.030)	0.297** (0.039)	2705.814	1034	.949	.943	.021
Anger	0.047* (0.021)	0.007 (0.030)	0.364** (0.042)	3422.217	1289	.941	.935	.022
Anxiety	0.057** (0.019)	0.036 (0.024)	0.473** (0.039)	9563.431	3774	.922	.918	.021
Shame	0.047* (0.024)	0.007 (0.028)	0.380** (0.030)	2825.077	1290	.955	.95	.018
Boredom	0.016 (0.031)	-0.010 (0.038)	0.387** (0.046)	1526.4	800	.976	.972	.016
Hopelessness	0.036 (0.024)	0.024 (0.036)	0.339** (0.028)	1866.616	806	.968	.964	.019

Note: Standard errors in parentheses. * ($p < .05$) ** ($p < .01$)

Lagged Models on Parental Over-Aspiration

Lastly, we examined whether parental over-aspirations are related to students' achievement emotions a year later (Table 5). In line with the results reported in the previous section, we found that higher means of aspiration and expectations were predictive of higher levels of anxiety. However, the predictive effects of over-aspiration were not significant for any of the achievement emotions in this and the additional analyses (Table S17).

Table 5

Results from Models on Lagged Effects of Parental Over-aspirations on Achievement Emotions (unstandardized beta values)

Dependent variable	Parental exp/asp mean	Parental over-aspiration	Autoregression path	X^2	df	CFI	TLI	RMSEA
Enjoyment	-0.008 (0.023)	0.018 (0.031)	0.331** (0.031)	4503.389	1572	.936	.931	.023
Pride	0.019 (0.026)	-0.004 (0.030)	0.296** (0.039)	2712.948	1038	.948	.943	.021
Anger	0.049 (0.021)	-0.021 (0.030)	0.364** (0.042)	3431.325	1289	.941	.935	.022
Anxiety	0.087** (0.019)	-0.011 (0.024)	0.472** (0.039)	9554.792	3774	.922	.918	.021
Shame	0.051 (0.024)	-0.021 (0.028)	0.380** (0.030)	2835.668	1291	.955	.95	.018
Boredom	0.002 (0.031)	-0.014 (0.038)	0.388** (0.046)	1529.073	800	.976	.972	.016
Hopelessness	0.054 (0.038)	-0.006 (0.024)	0.339** (0.028)	1865.586	807	.968	.964	.019

Note: Standard errors in parentheses. ** (p <.01) * (p < .05). Parental over-aspiration: A gap between expectation and aspiration. Parental exp/asp mean: the average between expectation and aspiration

Exploratory Analyses

While parental expectations significantly predicted most achievement emotions, boredom was an exception: parental expectations were not significantly linked to boredom. This may be due to the non-linear relation between parental expectations and boredom. Therefore, we conducted an exploratory analysis to check if there are quadratic/non-linear relations between parental expectations and achievement emotions. Given the generally weak linear results for aspirations and over-aspirations, we focused on parental expectations (see Supplemental Materials). In analyses on contemporaneous predictive effects, the paths for the

quadratic term were not significant for most of the achievement emotions (Table S19); the only exception was the non-linear relations between parental expectations and pride. Likewise, there were only two significant paths for the quadratic term in the analyses on lagged predictive effects (hopelessness and anxiety; Table S20). In all of these cases, the visual inspection of the significant results suggest that the relations between parental expectations and achievement emotions are relatively monotonical (Figure S6).

Discussion

Previous research repeatedly pointed out the crucial role of parental academic expectations and aspirations in predicting students' academic success (Eccles & Wigfield, 2020; Pinquart & Ebeling, 2020; Wigfield et al., 2015; Yamamoto & Holloway, 2010). However, less is known about their roles in students' emotions. Previous studies on this issue were primarily based on cross-sectional data (Frenzel, Thrash, et al., 2007; Kiss & Vukovic, 2021; Luo et al., 2016), and existing longitudinal evidence is sorely based on anxiety (Wang et al., 2021). Building on control-value theory, we hypothesized that parental expectations have generally adaptive effects on students' achievement emotions, while parental over-aspirations have maladaptive effects. Specifically, we expected that higher parental expectations are predictive of higher enjoyment and pride, and lower anger, anxiety, shame, and hopelessness. We also predicted that parental over-aspiration would be associated with lower enjoyment and pride, and higher anger, anxiety, shame, and hopelessness. We refrained from making predictions for boredom given its non-linear relation with perceived control (Goetz et al., 2023).

To address the hypotheses, we analyzed seven achievement emotions in mathematics using dynamic panel model with contemporaneous and lagged unidirectional effects of parental expectations and aspirations. Consistent with our hypotheses, results from the contemporaneous analyses revealed that higher parental expectations predicted higher positive emotions and lower negative emotions (except for boredom), whereas parental over-aspirations

were related to lower positive emotions and higher negative emotions (again except for boredom). In contrast, the lagged analysis showed a different pattern. Here, higher parental expectations were predictive of higher anger, anxiety, and shame after a year, with no significant results for parental over-aspirations. These results highlight the complex relations between parental expectations and achievement emotions that differently manifest over time.

Contemporaneous Relations between Parental Perceptions and Achievement Emotions

Parental Expectations

Our first analysis focused on the contemporaneous predictive effects of parental expectations on seven achievement emotions in math, while controlling for parental aspirations. The results were largely consistent with our predictions. Specifically, when parents had higher expectations, students reported higher levels of pride and enjoyment, as well as lower levels of anger, anxiety, shame, and hopelessness. In our supplemental analysis, most of these paths remained significant, irrespective of whether we controlled school achievement from the same year or the previous year (Table S13). Thus, it appears that the results are robust and high parental expectations are predictive of students' increased positive achievement emotions and reduced negative achievement emotions at least for a short term.

These short-term results may be due to the effects of parental expectations on students' perceived control — a key factor promoting positive achievement emotions and reducing negative achievement emotions (Pekrun, 2006, 2018, 2021). Previous studies revealed that higher parental expectations are predictive of better achievement (for a meta-analysis see Pinquart & Ebeling, 2020), which is one obvious source of perceived control (Pekrun, 2006, 2018, 2021). Importantly, however, we found the predictive effects of parental expectations even after controlling for prior achievement. This suggests that higher parental expectations can enhance perceived control above and beyond prior achievement. Bandura's social cognitive theory and research using his theory suggests that parents can affect children's self-

efficacy beliefs by providing verbal feedback as well as serving as a social model (Bandura, 2001; Bandura et al., 1996, 2001; Hammer et al., 2021; Schunk, 1999); conceptually, self-efficacy is closely related to perceived control and seen as one type of control belief in control-value theory (Pekrun, 2006, 2018, 2021, 2024). We propose that parents with higher expectations use their verbal communication, show a higher commitment to their children's academic study, and change their behavior to convey to their children the idea of "we believe you can" (Pinquart & Ebeling, 2020). Higher parental expectations may also help students attribute success to abilities and failure to the lack of effort, which could help them maintain their perceptions of control (Reschke et al., 2024). Such enhanced perceived control due to parental expectations may have enabled students to experience higher enjoyment and pride, and lower anger, anxiety, shame, and hopelessness when their parents held higher expectations.

Parental Over-Aspirations

In the analyses described above, the path coefficients of parental aspirations were mostly small and non-significant. However, parental expectations and aspirations were moderately correlated at all waves (r = .55 – .63); this means that estimating the predictive effects of aspirations independently from expectations was challenging. In addition, their common predictive effects may be different from their unique ones. To address this issue, we next applied an orthogonal transformation to aspirations and expectations (Marsh et al., 2023) and analyzed the predictive effects of over-aspiration (the difference between aspiration and expectation), while additionally including the mean of aspirations and expectations. This analysis showed that students with higher levels of parental expectations and aspirations combined (i.e., their average) reported higher levels of positive and lower levels of negative achievement emotions except for boredom. Given that the parameter value of this average term represents the magnitude of the common associations across aspirations and expectations (Laird & Weems, 2011), these results suggest that in general, higher levels of parental

expectations and aspirations are predictive of students' stronger positive emotions and weaker negative emotions, at least from a short-term perspective.

In addition, students whose parents had more ambitious aspirations than their expectations reported lower positive achievement emotions (enjoyment and pride) and higher negative achievement emotions (anger, anxiety, shame and hopelessness). It should be noted that over-aspirations were not significantly linked to students' enjoyment, anger, shame and hopelessness when we changed the way to control prior achievement (Table S14). Nevertheless, parental over-aspiration was still significantly related to higher levels of anxiety and lower levels of pride, irrespective of whether we controlled school achievement from the same year or the previous year. Thus, it appears that parental over-aspirations show robust associations with anxiety and pride. These two emotions are outcome emotions that are considered to be induced by high (for pride)/low (for anxiety) perceived control and elevated achievement value (i.e., the importance of success and failure). Thus, our results are in line with the idea that over-aspirations of parents reduce students' perceptions of control and increase their perceptions of achievement value, thus, leading to lower levels of pride and higher levels of anxiety. Previous studies revealed negative predictive effects of parental over-aspiration on students' academic achievement (Marsh et al., 2023; Murayama et al., 2016; Trinidad, 2019). Goetz et al. (2006) also revealed that students experienced more negative emotions and less positive emotions when they perceived that their parents were overly ambitious. Our findings extend these studies and suggest that parental over-aspiration is associated with students' negative emotional experiences at least in the short term.

While previous studies sometimes indicate that parental under-aspirations can be maladaptive for students' academic achievement (Schoon & Burger, 2022), in the present study, the results were largely similar even when we excluded cases of under-aspiration (i.e., cases where parental aspirations were lower than their expectations). These results are in line

with previous findings that over-aspirations are particularly maladaptive (Marsh et al., 2023; Murayama et al., 2016; Trinidad, 2019). Given the importance of achievement emotions in predicting students' achievement (e.g., Pekrun et al., 2017), our results suggest that students' achievement emotions may at least partly mediate the previously observed effects of parental over-aspirations on students' academic achievement. In contrast, achievement emotions may be less relevant to the relations between parental under-aspirations and students' achievement. For example, when parental aspirations are lower than expectations, parents may be unwilling to invest in students' academic studies, leading to negative consequences on long-term achievement outcomes. Future research is needed to fully understand how under- vs. over-aspirations affect students in different ways.

Lagged Relations between Parental Perceptions and Achievement Emotions

The second goal of the present study was to examine the lagged predictive effects of parental academic perceptions (i.e., expectations, aspirations and over-aspirations) on students' achievement emotions after a year. Here, most of the path coefficients were not significant. However, we did find significant path coefficients of parental expectations on three negative emotions — anxiety, anger and shame (Table 4). Interestingly, in contrast to the results from the contemporaneous effects analyses, higher parental expectations were predictive of higher levels of anxiety, anger, and shame in math a year later. The associations between expectations and anxiety also remained significant irrespective of the way we controlled achievement (Table S15) as well as when we focused on the means of parental expectations and aspirations (Table 5). A subsequent analysis also confirmed that parental expectations negatively predicted anxiety in the same year but positively predicted anxiety in the following year, when we modelled contemporaneous and lagged paths simultaneously (Table S16). Thus, the results appear robust at least for anxiety.

While we did not expect that the relations between parental expectations and anxiety

are opposite across the contemporaneous and lagged time frames, our results are consistent with previous findings on unrealistically positive self-evaluations (positive illusion; Taylor & Brown, 1988). These studies suggest that it is beneficial for individuals to have higher levels of aspirations and higher levels of expectations to maintain their mental health and positive emotions in the short term. However, individuals with strong positive illusions also face long-term costs. Specifically, they can be perceived more negatively by other people (Robins & Beer, 2001) and can experience decreases in academic self-concept over time (Sticca et al., 2017). Our results are consistent with these studies and suggest that higher levels of expectations may have long-term costs not only for oneself but also for one's children.

Research in clinical psychology has long focused on the potential roles of parental expectations on children's mental health problems. These studies typically assess perceived parental expectations of children by asking children to complete self-report questions (Stöber, 1998; Wang & Heppner, 2002), such as "My parents set very high standards for me" or "My parents have expected excellence from me." Using these instruments, previous studies observed that children who perceived that their parents set high expectations were more likely to show perfectionistic concerns (i.e., concerns over mistakes and discrepancy between expectations and performance; for a meta-analysis see Curran & Hill, 2022). Higher perfectionistic concerns in turn predict increased focus on academic outcome than learning activities (Fletcher et al., 2012; Hanchon, 2010) as well as higher levels of depression and anxiety (for a meta-analysis see Lunn et al., 2023). Recent studies also revealed that when adolescents perceived that their parents' academic expectations were high, adolescents were more likely to show higher levels of internalizing problems (Zhou et al., 2023). Our results, that high parental expectations predict stronger anxiety one year later, are consistent with these findings, and suggest that parental expectations may come at a long-term cost for students' emotions.

The mechanisms behind the opposite relations between parental expectations and students' anxiety in the short-term vs. the long-term delays are unclear. However, previous studies suggest that parental beliefs have multiple pathways to change children's perceptions and thereby affect anxiety (Boehme et al., 2017; Goetz et al., 2006; Loughlin-Presnal & Bierman, 2017). These different pathways may unfold differently over time.

The first pathway concerns their effects on perceived control. As described earlier, higher parental expectations should be transmitted to students, leading to higher perceived control (Buchmann et al., 2022; Loughlin-Presnal & Bierman, 2017; Marsh et al., 2023); higher perceived control should in turn help to lower anxiety in students. The second pathway is related to the first pathway. Higher perceived control due to high parental expectations should in turn predict better academic achievement over time (Loughlin-Presnal & Bierman, 2017; Marsh et al., 2023). Better academic achievement should result in lower anxiety (Pekrun et al., 2017).

The third pathway concerns the gap between parents' expectations and students' achievement. Parents' expectations may be more ambitious relative to students' achievement (Guo et al., 2022). As seen in Table 1, in our sample, parents' expectations (assessed before students were given the final school grades) were numerically higher than students' achievement grades across all the waves. Thus, students were unlikely able to fully meet parents' expectations even when their parents did not have over-aspirations. When students over time realized that they were unable to fulfill their parents' expectations, this realization could result in negative emotions, such as anxiety.

The fourth pathway concerns pressure from parents. Parents who have high academic expectations are more likely to be committed to children's academic studies than those who have low expectations (Briley et al., 2014; Davis-Kean, 2005; Sy & Schulenberg, 2005), leading to increased parental pressure and facilitating anxiety (Shadach & Ganor-Miller, 2013).

The fifth pathway concerns personality traits. As mentioned earlier, higher parental expectations are known to facilitate students' perfectionistic concerns over their mistakes (Curran & Hill, 2022; Damian et al., 2013). Students who have strong perfectionistic concerns tend to show poorer academic performance (Gaudreau et al., 2022; for a meta-analysis see Madigan, 2019) and greater test anxiety (for a meta-analysis see Burcaş & Creţu, 2021).

In summary, the relations between parental expectations and emotions are expected to be complex. These pathways may unfold differently over time, which may have resulted in the opposite relations between parental expectations and students' anxiety in short-term vs. long-term intervals. For example, parental expectations may be able to change children's perceived control in a relatively short-term period; such effects on perceived control can lead to the protective effects of parental expectations against anxiety seen in the contemporaneous analyses in the present study. In contrast, after a longer-term delay, parental expectations may start changing their own behavior, children's perceived pressure from parents, and children's personality traits, such as perfectionism. It is also possible that students slowly realize that they won't be able to meet parents' expectations over time. Such long-term changes may lead to the increased level of anxiety. Future research is needed to comprehensively understand the role of each of these pathways in the short-term and long-term development of achievement emotions.

Strengths and Limitations

The present study is the first comprehensive and longitudinal investigation into the relations between parental academic perceptions and students' achievement emotions. We examined contemporaneous predictive effects as well as lagged predictive effects using data based on a large and representative sample in Germany. We also investigated not only linear relations between parental expectations and achievement emotions but also quadratic relations. Previous research predominantly suggests that higher parental expectations predict students' better academic achievement (Pinquart & Ebeling, 2020; Yamamoto & Holloway, 2010). Our

findings provide novel insights into the effects of parental expectations; such that higher parental expectations are predictive of students' positive achievement emotions for a short term, but predict anxiety a year later. Our study also suggests that parental over-aspirations predict higher levels of negative emotions at least for a short term as seen in achievement (Murayama et al., 2016; Marsh et al., 2023).

There are also important limitations to our study. First, our study does not offer an explanation for the mechanisms underlying the relations between parental academic perceptions and students' emotions. As described earlier, there are a number of possible mechanisms that can explain these relations. Future research is required to understand the pathways by which parental expectations and over-aspirations affect children's emotions. These studies may need to obtain more detailed information about students' beliefs and parental behaviors, such as students' fear of failures, parenting styles, parents' communication styles, and their commitment to students' academic studies.

Secondly, we operationalized over-aspiration based on a difference score between parental aspirations and expectations. Such difference scores can be affected by poor reliability (Rogosa & Willett, 1983). In the present study, the standard errors of the estimates of over-aspirations were not substantially larger than those for those of expectations or aspirations, suggesting that the measure was not particularly unreliable. Our results on the over-aspirations were also consistent with results from existing studies (Goetz et al., 2006; Guo et al., 2022; Marsh et al., 2023; Murayama et al., 2016; Trinidad, 2019). Nevertheless, caution is needed when interpreting the results of over-aspirations; the significant paths of the gap between aspirations and expectations may be due to the stronger predictive effects of expectations than aspirations (Laird & Weems, 2011). Future research needs to develop better measures of parental over-aspirations not to rely on a difference score.

Thirdly, our measures on parental expectations and aspirations were based on students'

school grades. This means that we may have missed parental aspirations or over-aspirations for children's academic studies and performance beyond their grades (e.g., competing in a math Olympics). Such ambitious aspirations may be particularly seen in parents of students who already have the highest possible school grades. Thus, it is possible that we missed the predictive effects of aspirations for high-achieving students, which may have resulted in the relatively small sized effects of aspirations and over-aspirations observed in the present study. Future research is needed to examine parental aspirations and over-aspirations beyond school grades.

Fourth, we analyzed data only from adolescents in Germany. Likewise, our study focused on achievement emotions in math. As such, the results may be different in other domains. Therefore, caution is required when considering the generalizability of the results. For example, students analyzed in the present study on average did not experience strong negative achievement emotions (Table 1); thus, parental perceptions may be differently linked to achievement emotions in students who already have strong negative emotions. In addition, in the present study, we did not see a clear temporal pattern in the relations between parental perceptions and achievement emotions across waves. However, it is possible that the relations differ over the course of secondary schooling (e.g., when students approach the transition to further education or work; Heckhausen & Tomasik, 2002; Pinquart & Ebeling, 2020). It is also possible that parent-children relationships differ across cultures (Pinquart & Ebeling, 2020; Zhou et al., 2023). Future research needs to address parental expectations and over-aspirations in other contexts.

Lastly, given the focus of the present study, we did not analyze the predictive effects of students' achievement emotions on parents' expectations and aspirations. To fully understand the dynamic interactions between parents and students, future research is required to examine the effects of students' achievement emotions on parents' expectations or aspirations, and

investigate how flexibly parents are able to update their perceptions depending on students' performance and emotions. These studies may need to use more intensive assessments with shorter time intervals to understand mutual interactive effects between students and parents that are observed in the context of learning episodes.

Practical Implications

Raising aspirations and expectations of parents has become a focus of government policies in many countries (Gale & Parker, 2015; Holloway & Pimlott-Wilson, 2011). The findings from the present study highlight the importance for parents not to be too ambitious for their children's academic performance. On the one hand, we found that when their parents have high expectations, students experience more positive achievement emotions and less negative achievement emotions in the same school year. On the other hand, if parents' aspirations are too ambitious relative to their own expectations, children may start experiencing increased negative achievement emotions even in the short term. Some of the negative achievement emotions are associated with stronger extrinsic motivation and predict better performance in a short term period (Theobald et al., 2021; von der Embse et al., 2018). However, negative achievement emotions are typically associated with poorer academic achievement over time, due to reducing working memory resources, undermining intrinsic motivation, and impairing students' self-regulation of learning (Ahmed et al., 2013; Forsblom et al., 2022; Pekrun et al., 2010; Pekrun et al., 2017; Pekrun, Marsh, Elliot, et al., 2023; Pekrun, Marsh, Suessenbach, et al., 2023). Thus, our results add to a growing body of the literature (Marsh et al., 2023; Murayama et al., 2016; Trinidad, 2019) suggesting that caution is needed when teachers, policy makers and educational practitioners interact with parents not to encourage them to hold aspirations that are too ambitious. Furthermore, our results suggest that parents' expectations are predictive of weaker negative emotions in the same year, but greater anxiety a year later. Although the long-term associations were not significant for other

negative emotions, these results suggest that parents always need to monitor the role of their expectations on their children; even if they think their expectations generally support their children's emotions for a short-term period, they need to be aware of the possibility that the long-term effects may not be identical.

Conclusions

In conclusion, the results from the present study suggest that the relations between parental expectations and achievement emotions are different over time. Specifically, we found that students whose parents have high expectations experience higher levels of positive emotions and lower levels of negative emotions (except for boredom) in the same year. In contrast, higher parental expectations are predictive of higher levels of anger, anxiety, and shame a year later. In addition, students whose parents had ambitious aspirations that exceeded their own expectations demonstrated lower levels of positive emotions and higher levels of negative emotions in the same year. These results highlight the importance of managing parents' academic expectations and aspirations to foster children's positive emotions and prevent negative emotions.

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