Received: 8 December 2022 | Accepted: 6 November 2023

DOI: 10.1111/bjep.12644

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ARTICLE

Changes in control and value appraisals predict changes in learning enjoyment: A four-wave analysis among lower secondary school students

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Funding information
Deutsche Forschungsgemeinschaft, Grant/Award Number: 470282638

Abstract

Background: The control-value theory of achievement emotions postulates that it is possible to affect achievement emotions by decreasing or increasing control and value appraisals. This implies that changes in the latter should result in changes in the former. However, the assumption has been rarely tested.

Aims: This study aimed at verifying whether changes in control and value appraisals – two proximal antecedents of achievement emotions – predicted changes in learning enjoyment over the course of lower secondary school. Moreover, since studying changes requires knowledge of their overall pattern, it also investigated the developmental trajectories of the three student characteristics.

Sample: The study used longitudinal data of 5125 German students gathered between Grades 5 and 9, four measurement occasions in total.

Methods: The hypotheses were tested using univariate and multivariate latent change score models.

Results: The analyses revealed decreases in control and value appraisals and learning enjoyment between Grades 5 and 9. Moreover, the decreases in control and value appraisals predicted the decreases in learning enjoyment.

Conclusions: The study provides support for the change–change assumption, which is one of the key but under-researched elements of the control-value theory of achievement emotions. As such, it suggests that alleviating the decrease in control and value appraisals may mitigate the decrease in learning enjoyment. Moreover, by providing longitudinal

evidence on the decrease in the three constructs under study, it corroborates the inimical trend observed in past research.

KEYWORDS

change–change model, control appraisals, learning enjoyment, perceived control, perceived value, value appraisals

INTRODUCTION

Learning emotions, which for decades were largely neglected in educational psychology (Pekrun et al., 2002b; Schutz & Lanehart, 2002), have become an increasingly popular topic over the last 20 years. Particularly significant contributions to the field come from research based on the control-value theory of achievement emotions (Pekrun, 2006). They revealed that emotions are ubiquitous in learning situations and have a significant impact on student achievement (e.g., Camacho-Morles et al., 2021; Pekrun et al., 2002b).

One of the positive emotions most commonly reported in qualitative studies is learning enjoyment (Pekrun et al., 2002b). Students enjoying learning show higher study interest and effort, are more intrinsically motivated, use advanced learning strategies more often, and better self-regulate their learning (e.g., Pekrun et al., 2002a, 2011). Multiple studies have also confirmed the positive effect of enjoyment on academic achievement (e.g., Camacho-Morles et al., 2021; Pekrun et al., 2017). Besides affecting learning behaviour and learning outcomes, enjoyment is also considered an important component of student well-being (Hascher, 2003) and emotional engagement in the classroom (Skinner et al., 2008).

In this context, it seems particularly important to investigate factors shaping learning enjoyment because they provide cues as to what interventions can be undertaken to increase it or at least prevent the decline observed in research (Hagenauer & Hascher, 2010; Raccanello et al., 2019). Past studies have provided rich empirical evidence on the relationship between learning enjoyment (and other achievement emotions), and control and value appraisals, its two antecedents. However, they mostly evidenced their concurrent relationships (e.g., Bieg et al., 2013; Hagenauer & Hascher, 2010; Lichtenfeld et al., 2012; Pekrun et al., 2011). Such evidence is vastly important because, as Buff (2014) elucidated, the control-value theory posits that learning enjoyment occurs *when* both control and value appraisals are positive, which points to their co-occurrence. Nevertheless, the theory also postulates that it is possible to affect achievement emotions by decreasing or increasing control and value appraisals (Pekrun, 2006), implying that *changes* in the latter should result in *changes* in the former (Buff, 2014). However, to date, only three studies – by Buff (2014), Niculescu et al. (2016) and Held and Hascher (2022) – have investigated whether the assumption holds. Although they confirmed it, these studies share important limitations. First, two of them used data with only two measurement occasions and covered only short periods (up to one academic year; Buff, 2014; Niculescu et al., 2016). Meanwhile, people, when asked about their emotions, rely on different sources of information depending on whether they refer to a specific event, a set of specific situations, or their typical reactions (Robinson & Clore, 2002). As a result, reports referring to a specific course given at short intervals may differ from reports on highly decontextualized emotional experiences. These differences may also affect relationships with other constructs. It is therefore key to verify whether the expected relationships between achievement emotions and their antecedents hold also when reports refer to typical emotional experiences.

In turn, Held and Hascher (2022) included three measurement occasions over two academic years (Grades 7 and 8), but their sample included students from the lowest ability track only, which leaves the question on the generalizability of the theory unanswered. Moreover, the theory does not postulate any changes in the psychological mechanisms behind achievement emotions over time. It is important,

therefore, to verify whether the antecedents consistently predict achievement emotions irrespective of student age.

Furthermore, all three studies focused on subject-specific achievement emotions, which was well supported by theory and research indicating that achievement emotions differ across situations and domains (e.g., Goetz et al., 2007; Lichtenfeld et al., 2012). It seems undisputed, though, that besides subject-specific emotions, students also experience more general achievement emotions towards school and learning (see e.g., Arens et al., 2013; Vierhaus et al., 2016). To date, such emotions have rarely been investigated in the context of control-value theory.

To address these gaps, the present study tests whether changes in control and value appraisals predict changes in learning enjoyment over lower secondary school. Unlike past studies, it uses data (a) gathered at four measurement occasions between Grades 5 and 9 (b) from a large and nationwide sample of students. First, it investigates changes in the three constructs over time using latent change score models. Second, with a multivariate latent change score model, it tests whether changes in the two antecedents predict changes in learning enjoyment.

THEORETICAL BACKGROUND

Emotions are multi-component phenomena that occur in response to actions and external or internal events and comprise affective, cognitive, expressive-behavioural, and physiological processes, as well as subjective feelings (Scherer, 2005). If emotions are related to activities or outcomes that are assessed against competence-based standards, as it happens in school, they are called achievement emotions (Pekrun, 2006). According to the control-value theory (Pekrun, 2006; Pekrun & Stephens, 2010), learning enjoyment belongs to positive achievement emotions and is characterized by high arousal and a focus on the activity itself instead of its outcome. Emotions are often conceptualised as momentary and state-like (e.g., test anxiety), but they also function as habitualized but malleable reactions elicited in situations in which state-like emotions usually appear (e.g., Pekrun, 2006). In this study, we conceptualized learning enjoyment as habitualized but malleable.

Antecedents of learning enjoyment

Although emotions occur in response to a variety of factors, the control-value theory (Pekrun, 2006; Pekrun & Linnenbink-Garcia, 2012) indicates their two proximal antecedents: control and value appraisals. Control appraisals refer to the perception of having control over outcomes and actions that lead to them. It includes therefore various competence perceptions (e.g., academic self-concept) and cognitions on the contingency between own actions and outcomes (e.g., expectation of success, self-efficacy). Value appraisals refer to the subjective importance attached to a given activity or outcome, for instance, its utility, relevance, or the intrinsic incentive that it provides. Depending on the level of control and value appraisals, different achievement emotions are triggered, with learning enjoyment occurring when both control and value appraisals are high. In other words, it occurs when a student feels competent enough to successfully perform learning tasks and values the material to be learned. Contextual factors, for example, the way that the classroom environment or instruction are designed, affect achievement emotions indirectly via their effect on control and value appraisals.

As mentioned previously, two types of relationships between learning enjoyment and its proximal antecedents can be expected. First, we can expect positive concurrent links between them because learning enjoyment occurs when both are high. Second, we can expect changes in the antecedent to result in changes in learning enjoyment (Buff, 2014; Pekrun, 2006). Based on these theoretical predictions and the results of past research (Buff, 2014; Held & Hascher, 2022; Niculescu et al., 2016), we expected changes in control and value appraisals between two measurement occasions to predict change in learning enjoyment between these measurement occasions.

Changes in learning enjoyment and its antecedents

Inquiring into concurrent and longitudinal relationships between learning enjoyment and its antecedents requires investigating, as a first step, their long-term trends. It is because, besides intra-individual changes, general developmental trends may exist. Without knowledge about them, it is impossible to fully interpret the results on the relationships between changes (Henk & Castro-Schilo, 2016) or frame the results in a broader developmental context.

Past research run in different countries and on samples differing in age has indicated that learning enjoyment declines throughout primary and secondary schooling (e.g., Ahmed et al., 2013; Buff, 2014; Hagenauer & Hascher, 2010; Raccanello et al., 2019). One of the probable reasons is a developmental decline in self-efficacy and self-competence beliefs (or in other words – in control appraisals) which, unrealistically high in childhood, decrease during the school career (Scherrer & Preckel, 2019). They become more adequate in adolescence due to such factors as advancing cognitive development and improved ability to integrate feedback on performance (e.g., Marsh, 1989; Schunk & Pajares, 2002; Wigfield & Eccles, 2002). Moreover, since peer relationships gain importance (e.g., Bagwell & Schmidt, 2011), adolescents start valuing social and non-academic activities more than school and learning (Wigfield & Tonks, 2002).

Since contextual factors are supposed to affect learning enjoyment by shaping control and value appraisals, another reason behind the decrease may be inadequately designed or structured learning environments. The school, classroom, or home learning environments may not foster control and value appraisals sufficiently, contributing to their decrease. Similar explanations can be derived from the stage-environment fit theory (Eccles et al., 1993) and self-determination theory (Ryan & Deci, 2020), which both point to a mismatch between student needs and the way learning environments are organized. They are also in line with research showing a decrease in student perceptions of the quality of the school learning environment over time (Gentry et al., 2002; Maulana et al., 2016; Way et al., 2007).

Given the above-mentioned developmental trends, theory-based explanations, and past research results, we expected to see a decline in control and value appraisals, and in learning enjoyment.

The present study

This study aimed at verifying one of the key postulates of the control-value theory of achievement emotions (Pekrun, 2006; Pekrun & Linnenbink-Garcia, 2012), that is, whether changes in control and value appraisals predicted changes in learning enjoyment. Moreover, it tested concurrent links between these constructs. Since investigating changes requires knowledge on their direction, we also investigated the trajectories of change of the three. To this end, we used longitudinal data and employed uni- and multivariate latent change score models. These models allow the estimation of change between measurement occasions, which represents average intra-individual change, and their variances, representing between-person differences in change. They also allow testing concurrent links between constructs at the first measurement occasion (Geiser, 2021; Steyer et al., 2000). Since between-person differences in intra-individual change can be explained with between-person differences in intra-individual change in other constructs, the model allows a direct test of the postulates of the control-value theory of achievement emotions.

Following past research, we expected learning enjoyment (H1), control appraisals (H2), and value appraisals (H3) to decrease over the course of schooling. Moreover, in accordance with the control-value theory, we hypothesized changes in control (H4) and value appraisals (H5) to predict changes in student learning enjoyment. We also expected the initial level of control (H6) and value appraisals (H7) to predict the initial level of learning enjoyment.

METHOD

Data and sample

This study uses data from the German National Educational Panel Study (NEPS; Blossfeld & Roßbach, 2019; NEPS Network, 2022). NEPS is a multi-cohort nationwide research project that follows people of different ages, from newborns to the elderly, to better understand how their educational and occupational trajectories unfold over the life course. We used data from Starting Cohort-Kindergarten (NEPS-SC2), which comprises children who started preschool in the school year 2010/2011 when they were approximately 4 years old and have been followed since then. Detailed information on the sampling design is available in Aßmann et al. (2019) and on panel selectivity and attrition in Zinn et al. (2020).

In this study, we used data gathered in Waves 7, 8, 9, and 10, which covered the winter semester of Grades 5, 6, 7, and 9[1] in the following academic years: 2016/17, 2017/18, 2018/19, 2020/21. No measurements were taken in Grade 8 (2019/20) because the wave, scheduled for spring 2020, was cancelled due to the Covid-19 pandemic. Instead, an add-on study on the pandemic was run, which did not include constructs in the focus of this study. Information on field times is available in Table S1.

A total of 2949 children participated in Wave 1 of NEPS-SC2. In Wave 3, when the children started primary school, additional 6176 students (an augmentation sample) took part, which increased the total sample size to 9682 participants. Further information is available in Zinn et al. (2020). However, the analytical sample in this study includes students attending regular schools with data on learning enjoyment, control appraisals, or value appraisals in at least one wave; 5125 students in total. Information on the number of observations at each measurement occasion is available in Table S1.

Students in the NEPS-SC2 analytical sample were aged $M = 10.59$ ($SD = .36$) at the beginning of Wave 7 (Grade 5), 51.75% of them were female, and 16.45% spoke a native tongue other than German. Although they came from various social backgrounds, as their parents' position on the International Socio-Economic Index of Occupational Status Index (ISEI-08; Ganzeboom et al., 1992) ranged from 11.56 to 88.96, 42.44% had at least one parent with a higher education diploma, which indicated that low-SES students were underrepresented in the sample.

Procedure

The students were surveyed during a home visit using paper-and-pencil questionnaires or, if they preferred, an online questionnaire. All participants of age and legal guardians of underage participants provided written informed consent prior to study enrolment. All participants could withdraw from the study at any time. The NEPS study is conducted under the supervision of the German Federal Commissioner for Data Protection and Freedom of Information (BfDI) and in coordination with the German Standing Conference of the Ministers of Education and Cultural Affairs (KMK) and – in the case of surveys at schools – the Educational Ministries of the respective Federal States. All data collection procedures, instruments, and documents were checked by the data protection unit of the Leibniz Institute for Educational Trajectories (LIfBi). The necessary steps are taken to protect participants' confidentiality according to national and international data security regulations.

[1]In the majority of federal states, Grades 5–9 cover lower secondary school. For further information on the German education system, see the online supplement and Eckhart (2021).

Measures

Learning enjoyment

Learning enjoyment was reported by the students. The scale included three items that came from an established German scale on student emotional and social experiences at school (Rauer & Schuck, 2003). The items referred to liking school and school learning (e.g., "I really enjoy learning at school".) and used a four-point response scale from *completely disagree* to *completely agree*. Similar items were used in other studies (e.g., Meyer & Schlesier, 2022). In this study, the reliability, as measured with McDonald's ω, ranged from .877 to .897, depending on the wave.

Control appraisals

Control appraisals were measured with a three-item scale on academic self-concept. The items came from the 2000 edition of the Programme for National Student Assessment (Kunter et al., 2002). They referred to student convictions about their academic abilities (e.g., "I learn quickly in most school subjects".) and used a four-point response scale from *does not apply at all* to *applies completely*. The scale's reliability in this study (McDonald's ω) ranged from .816 to .858, depending on the wave.

Although academic self-concept represents only one aspect of control appraisals, we used it as a proxy because the study was domain-general and in such situations, academic self-concept and self-efficacy, although conceptually distinct (Bong & Skaalvik, 2003) are often impossible to distinguish empirically, as opposed to when self-efficacy items are domain-specific (and therefore task- and criterion-oriented) or refer to functional self-efficacy (see e.g., Ferla et al., 2009; Marsh et al., 2019).

Value appraisals

Value appraisals were also self-reported. The scale included three items referring to the importance of school learning (e.g., "I study for school because I consider the content very important".). It is consistent with the control-value theory (e.g., Pekrun et al., 2011), although other studies used utility value only (Buff, 2014) or a mixture of subjective task values (Held & Hascher, 2022). The items were adapted from Schiefele et al. (2002) and used a four-point response scale from *does not apply at all* to *applies completely*. The scale's reliability (McDonald's ω) ranged from .766 to .817, depending on the wave.

Statistical analyses

In the first step, we ran a series of confirmatory factor analyses (CFA) to test the longitudinal measurement invariance of the three scales used in this study. We started from configural invariance, with parameters estimated freely across measurement occasions and incrementally constrained factor loadings (metric invariance) and intercepts (scalar invariance) to equality, and verified whether imposing constraints worsened model fit. Repeated administrations of the same item were allowed to covary. Comparing the means of latent factors requires at least partial scalar invariance. For details on longitudinal invariance testing see for instance Geiser (2021).

In the second step, we estimated latent change score models for learning enjoyment, control appraisals, and value appraisals separately, three models in total. The models allowed us to investigate changes in each variable over time, which was necessary for the correct interpretation of the results of the change–change model estimated in the next step. They are schematically presented in Figure 1. We chose the neighbour change version in which the change score variables (denoted by Δ) represent interindividual differences in intraindividual change between two consecutive (neighbouring) measurement

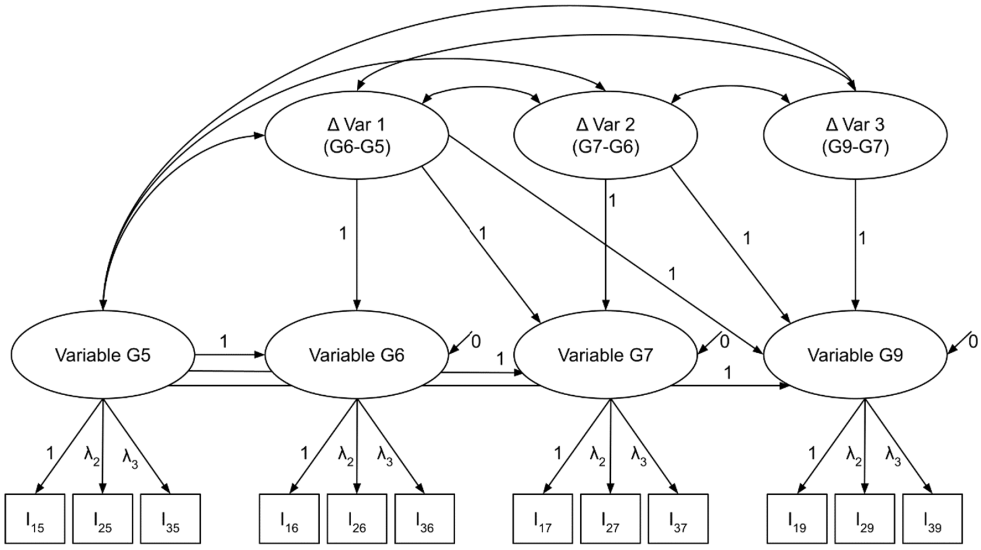

FIGURE 1 Path diagram of a latent change score model. *Note*: G, grade; I, item; Δ, change; λ, factor loading. Covariances between repeated items are omitted for the clarity of presentation.

occasions (Geiser, 2021; Steyer et al., 2000). A positive change score indicates an average increase, whereas a negative change score indicates an average decrease. The models included parameter constraints tested and selected as final in the analyses of measurement invariance. The repeated administrations of the same item were allowed to covary. Please note that the latent change score model for a variable was a reformulation of a CFA model for that variable (Steyer et al., 2000). Since all three variables were measured four times, each model included three change score variables.

In the third step, we estimated a change–change model, which allowed us to verify the change-to-change assumption and partially the co-occurrence assumption. In the model, the initial levels of control and value appraisals predicted the initial level of learning enjoyment, which was in line with the co-occurrence assumption of the control-value theory. Moreover, changes in control and value appraisals predicted changes in learning enjoyment. All exogenous latent variables were allowed to covary.

All models used the robust maximum likelihood estimator (MLR). The scales of the latent factors were identified by fixing the first factor loading to unity and the intercept of the first indicator to 0. It was not necessary to control for the clustering of students in schools because the students, by the first measurement occasion used in this study, transitioned to lower secondary schools and therefore were followed individually. We assumed that the comparative fit index (CFI) and the Tucker–Lewis index (TLI) values not lower than .95, the standardized root mean squared residual (RMSEA) not higher than .06, and the standardized root mean squared residual (SRMR) not higher than .08 indicated good fit (Hu & Bentler, 1999). With respect to measurement invariance, we followed recommendations by Chen (2007) and assumed that a decrease in CFI ≥.010 supplemented by an increase in RMSEA ≥.015 or an increase in SRMR ≥.030 indicated metric non-invariance. In turn, a decrease in CFI ≥.010 supplemented by an increase in RMSEA ≥.015 or an increase in SRMR ≥.01 indicated scalar non-invariance.

Missing data

In general, missingness in NEPS-SC2 was sizeable. A total of 46.61% of the students had data on learning enjoyment at all four measurement occasions; 46.97% had complete data on control appraisals, and 46.81% had complete data on value appraisals. Table S2 contains further information on the completeness of the data. The percentage of students without data at a given wave ranged between 19.14% (Wave

7) and 30.15% (Wave 9) for learning enjoyment, between 18.99% (Wave 7) and 30.09% (Wave 9) for control appraisals, and between 19.16% (Wave 7) and 30.20% (Wave 9) for value appraisals. Table S1 contains further information on the number of cases in each wave.

Missing data were handled using full information maximum likelihood estimation (Muthén et al., 2016) because it allowed us to use information on all available cases. To increase the probability that the missing-at-random assumption held, the models included manifold missing data correlates added as auxiliary variables (Muthén et al., 2016). These were, among others, math and reading achievement in selected waves, school grades, and various SES-related variables. The auxiliary variables were selected based on preliminary analyses of missing data correlates (not presented here).

Transparency and openness

The data that support the findings of this study are available from the Leibniz Institute for Educational Trajectories (https://www.neps-data.de/Data-Center/Data-Access). Restrictions apply to the availability of these data, which is the reason why they cannot be provided by the author of the study. Survey questionnaires are available on the NEPS study website (https://www.neps-data.de/Data-Center/Data-and-Documentation). Main analyses were run in Mplus 8.8, whereas data preparation and basic analyses were carried out in Stata 16.1. The analysis code for the latent change score model and the change–change model is available in the online supplement. The study's design and its analysis were not pre-registered.

RESULTS

Measurement invariance testing

Confirmatory factor analyses revealed that scales measuring academic self-concept and value appraisals were scalarly invariant across measurement occasions. The scale on learning enjoyment was metrically invariant but it was possible to establish partial scalar invariance by freeing one item intercept. Table S4 presents detailed information on invariance testing.

Changes in learning enjoyment, control, and value appraisals

Descriptive statistics and correlations between the variables in the study are available in Table S3. The univariate latent change score models, estimated to investigate changes in learning enjoyment, control appraisals, and value appraisals over lower secondary school, fitted the data well (learning enjoyment: $\chi^2 = 183.24$, df = 41, $p < .001$, RMESA = .026, CFI = .996, TLI = .994, SRMR = .025; control appraisals: $\chi^2 = 170.46$, df = 42, $p < .001$, RMESA = .024, CFI = .994, TLI = .991, SRMR = .041; value appraisals: $\chi^2 = 162.51$, df = 42, $p < .001$, RMESA = .024, CFI = .992, TLI = .997, SRMR = .026). They revealed a decrease in the three student characteristics, which was in line with our expectations. The decrease is depicted in Figure 2. If expressed in SD at the first measurement occasion, learning enjoyment decreased by .267 SD between Grades 5 and 6, by .251 SD between Grades 6 and 7, and by .202 SD between Grades 7 and 9. However, there was variability in the changes as the variances for the change score variables were statistically significant, which signified interindividual differences in intraindividual change. It indicated that although the average trend was negative, the level of learning enjoyment actually increased in some students. The initial level of enjoyment correlated negatively with the changes, indicating that students who enjoyed learning more decreased more over time.

The decrease in control appraisals was smaller. Control appraisals decreased by .172 SD at the first measurement occasion between Grades 5 and 6, by .169 SD between Grades 7 and 9, and by .044 SD

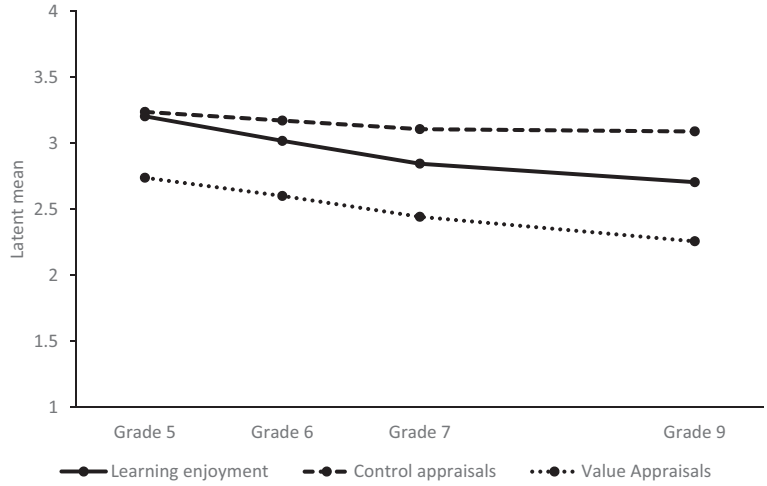

FIGURE 2 Changes in learning enjoyment, control appraisals, and value appraisals between Grades 5 and 9. *Note*: The estimates come from latent change score models specified for each variable separately. The scales of the three variables are not equated.

between Grades 7 and 9. Again, the variances of latent change scores were statistically significant and their value indicated that although control appraisals decreased on average, they increased for some students. The negative correlations between the initial level of control appraisals and change indicated that the higher the initial perceived control, the larger the decline.

Value appraisals decreased by .248 SD at the first measurement occasion between Grades 5 and 6, by .287 SD between Grades 7 and 9, and by .334 SD between Grades 7 and 9. The amount of change varied as was indicated by the significant variances of the change score variables. Again, despite a negative overall trend, interindividual differences in intraindividual change were large enough to indicate that in some students, value appraisals increased. Moreover, students who valued learning more, decreased more. Table 1 contains information on the initial level, changes between consecutive waves, their variances, as well as correlations between the initial levels and changes in the three variables. Overall, the analyses confirmed H1, H2, and H3.

Change–change relationships

The change–change model, presented in Figure 3, had a good fit to the data ($\chi^2 = 2578.90$, df = 533, $p < .001$, RMESA = .027, CFI = .973, TLI = .968, SRMR = .045). In accordance with the change–change hypothesis, changes in control appraisals between each two measurement occasions positively predicted changes in learning enjoyment between these occasions, which confirmed H4 and H5. Since overall, the two on average decreased, a decrease in control appraisals by 1 SD predicted a decrease in learning enjoyment by about .12–.15 SD. The pattern of results was the same for value appraisals. A decrease in value appraisals by 1 SD predicted a decrease in learning enjoyment by about .50 SD. Overall, changes in control and value appraisals explained about one-third of the variance of changes in learning enjoyment. Moreover, the initial level of control ($\beta = .12$, $p < .001$) and value appraisals ($\beta = .61$, $p < .001$) predicted the initial level of learning enjoyment, which was in line with the co-occurrence assumption (H6 and H7 supported).[2]

[2]We reran the analyses with student socio-economic status (as measured with parental ISEI-08) as a controlled variable. The results did not differ.

TABLE 1 The results of latent change score models for learning enjoyment, control appraisals, and value appraisals: means, variances, and latent correlations.

	Mean	Var	G5	Δ 1 (G6–G5)	Δ 2 (G7–G6)	Δ 3 (G9–G7)
Learning enjoyment						
G5	3.203 (.011)	.474 (.012)	1			
Δ 1 (G6–G5)	−.185 (.012)	.387 (.015)	−.425 (.015)	1		
Δ 2 (G7–G6)	−.173 (.012)	.390 (.016)	−.171 (.022)	−.322 (.023)	1	
Δ 3 (G9–G7)	−.139 (.013)	.427 (.017)	−.136 (.023)	−.055 (.027)	−.310 (.024)	1
Control appraisals						
G5	3.237 (.008)	.148 (.006)	1			
Δ 1 (G6–G5)	−.066 (.007)	.125 (.006)	−.388 (.019)	1		
Δ 2 (G7–G6)	−.065 (.007)	.116 (.006)	−.122 (.024)	−.317 (.026)	1	
Δ 3 (G9–G7)	−.017 (.008)	.147 (.007)	−.048 (.025)	−.061 (.030)	−.286 (.027)	1
Value appraisals						
G5	2.738 (.010)	.306 (.010)	1			
Δ 1 (G6–G5)	−.137 (.011)	.271 (.013)	−.523 (.017)	1		
Δ 2 (G7–G6)	−.159 (.010)	.221 (.011)	−.161 (.028)	−.320 (.028)	1	
Δ 3 (G9–G7)	−.185 (.012)	.296 (.013)	−.086 (.027)	$-.031^{ns}$ (.030)	−.284 (.028)	1

Note: Δ, change score variable. Standard errors are in parentheses. All coefficients are statistically significant except for the one that is marked with the ns superscript.

Abbreviation: G, grade.

DISCUSSION

This study verified whether changes in control and value appraisals predicted changes in learning enjoyment, as postulated by the control-value theory of achievement emotions (Buff, 2014; Pekrun, 2006). It also investigated overall changes in learning enjoyment and control and value appraisals over the course of lower secondary school (Grade 5–Grade 9). The analyses revealed a decrease in all three student characteristics over all four measurement occasions and confirmed the change–change assumption.

Changes over lower secondary school

The decrease in control and value appraisals and learning enjoyment revealed in this study was in accordance with our expectations. It was also in line with other research on subject-specific learning enjoyment (e.g., Ahmed et al., 2013; Hagenauer & Hascher, 2010; Raccanello et al., 2019), academic self-concept (Marsh, 1989; Postigo et al., 2022), and value attached to school subjects (e.g., Jacobs et al., 2002). A similar decline has been reported for other school-related constructs, for example, school attachment (Fischer & Theis, 2014), intrinsic motivation (Scherrer & Preckel, 2019), or homework effort (Trautwein et al., 2006), which suggests a wider developmental trend with several intertwined processes and perhaps partially shared causes.

Although we saw an overall decline in the three school-related characteristics, the substantial variability in the intraindividual changes in all three constructs indicated that some students experienced increases, which suggests that the worrying negative trend is not inevitable. As the stage-environment fit (Eccles et al., 1993) and self-determination theory suggest (Ryan & Deci, 2020), it may be avoidable if learning environments match student needs. However, some of the observed trends may be driven not only by contextual factors but also by normative developmental changes, including cognitive maturation. Cognitive maturation is supposed to at least partially explain the decrease in control

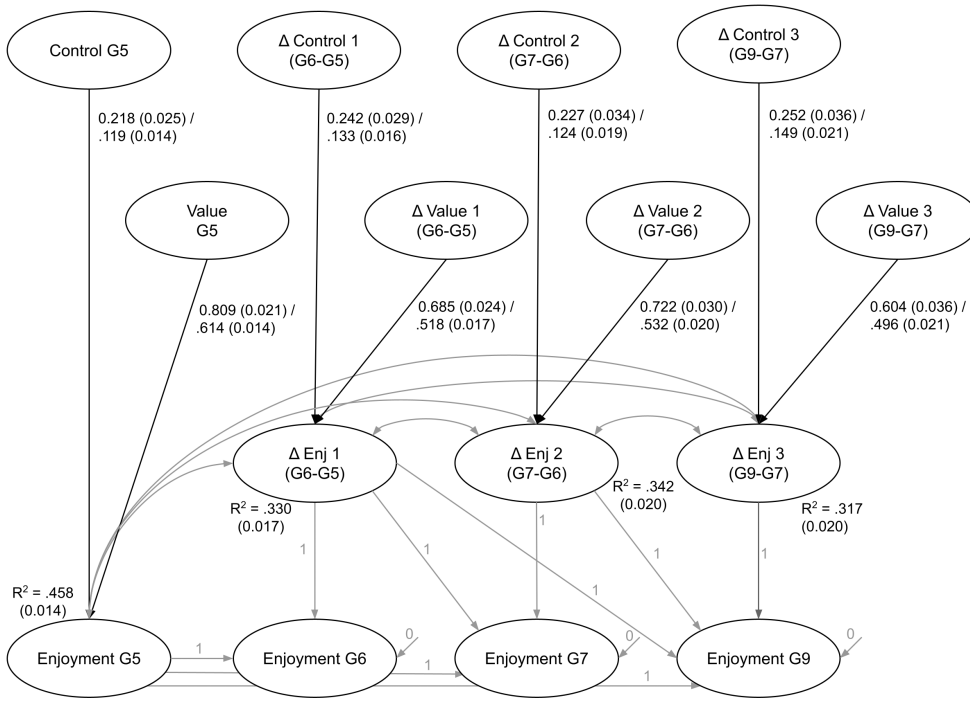

FIGURE 3 The change–change model for learning enjoyment. *Note*: Control, control appraisals; G, grade; R^2, explained variance; Value, value appraisals; Δ, change. The measurement models and covariances between control and value appraisals are omitted for the clarity of presentation. Unstandardized and standardized estimates are given before and after the slash sign, respectively. Standard errors are in parentheses. All coefficients are statistically significant. Model fit: χ^2 (533, 5125) = 2578.9, $p < .001$, RMSEA = .027, CFI = .973, TLI = .968, SRMR = .045.

appraisals, including academic self-concept and self-efficacy, between childhood and adolescence (e.g., Marsh, 1989; Schunk & Pajares, 2002). Since such appraisals are often unrealistically high in childhood (e.g., Schunk & Pajares, 2002), their decrease may therefore be unavoidable and to some extent beneficial. Therefore, efforts to stop the decline in control appraisals entirely may be neither possible nor desirable. However, it does not imply that efforts to increase learning enjoyment are undesirable too. Empirical evidence on the role that learning enjoyment plays for, for instance, academic achievement, is very rich (e.g., Camacho-Morles et al., 2021; Pekrun et al., 2017).

Implications for the control-value theory of achievement emotions

In this study, changes in control and value appraisals were positively linked to changes in learning enjoyment, providing support for the change–change assumption of the control-value theory of achievement emotions (Buff, 2014; Pekrun, 2006). They therefore agree with the results obtained in previous studies on the topic (Buff et al., 2017; Held & Hascher, 2022; Niculescu et al., 2016). However, unlike past studies, this study used multiple waves of data and a large nationwide sample, which allowed us to see that the relationships were consistent over time and their strength remained similar over the whole period under study. In other words, it provided support for the generalizability of the theory with respect to proximal antecedents of learning enjoyment to heterogeneous groups of students and over age. It also confirmed the predictions when measures of habitualized emotions are used. Additionally, the study supported the co-occurrence assumption.

The positive relationships of changes in control and value appraisals to changes in learning enjoyment suggest that reducing the decrease in the former may prevent the decrease in the latter. This, in

turn, points to the importance of designing learning environments in a way that supports control and value appraisals, even if the decrease in these appraisals is to some extent developmental. Past research has confirmed the positive effect of various interventions on control (e.g., O'Mara et al., 2006) and value appraisals (e.g., Hulleman & Harackiewicz, 2020) as well as the role of control and value appraisals as mediators between the classroom (e.g., Lazarides & Buchholz, 2019; Wang & Hu, 2022) or home (e.g., Dong et al., 2020; Luo et al., 2016) learning environments and learning enjoyment. Therefore, creating appropriate conditions for learning both at school and at home, for instance by providing students with support and cognitively activating tasks by teachers (Lazarides & Buchholz, 2019) or assuring support and involvement in the child's learning by parents (Luo et al., 2016), may help strengthen the appraisals. However, strengthening only one of them, for example, value appraisals only, may not be sufficient because learning enjoyment requires both types of appraisals to be high. Students who highly value learning but do not feel competent enough to perform learning tasks will probably experience frustration instead of enjoyment (see e.g., Pekrun, 2006).

The Covid-19 pandemic

In this study, the last measurement occasion took place in late 2020 and early 2021 – after the onset of the Covid-19 pandemic. As a result, the study provides information on the level of learning enjoyment, control appraisals, and value appraisals of Grade 9 students at that time. It also evidences a decrease in the three student characteristics from prior (Grade 7) to during the pandemic (Grade 9) as well as shows that the students whose control and value appraisals decreased, decreased also in learning enjoyment. However, the decreases should not be interpreted as a result of the pandemic because they may be part of normative developmental trends. Similar declines have also been observed in students of similar age surveyed in the past. For instance, Kleinkorres et al. (2023) reported a decrease in learning enjoyment by .18 SD between Grades 7 and 8 in another German sample, whereas Jacobs et al. (2002) – a decrease in domain-specific academic self-concepts and subjective task values between Grades 7, 8, and 9 in an American sample. However, although we did not observe any major deflections from these developmental trends after the onset of the pandemic, the conclusion that the pandemic did not affect them is also unwarranted because we do not know what would have happened had there been no pandemic. Unfortunately, research on the causal effect of the pandemic on student learning-related emotions and motivation is lacking, and available research, just as this study, mostly documents their decline (e.g., Hornstra et al., 2022; Tannert & Gröschner, 2021). Nevertheless, we clearly see that the strength of the relationships between changes in learning enjoyment and its antecedents remained consistent and of similar strength as before the pandemic.

Limitations and future research directions

While interpreting the results of this study, several limitations should be taken into account. First, we used self-reports only, which might have increased the amount of shared variance and led to the overestimation of regression coefficients. To alleviate the problem, future studies could use other sources of information, for example, parental and/or teacher assessments of student characteristics. Additionally, to get a deeper understanding of student experience and its potential sources, future studies could also use qualitative methods, for instance, interviews.

Second, we measured control appraisals with a scale on academic self-concept. Meanwhile, control appraisals encompass also other control-related beliefs, for example, self-efficacy or expectancy of success. As a result, we might not have fully captured the construct under study. Future studies should include more differentiated measures of control appraisals. A similar limitation concerns the measure of value appraisals. We used a scale combining information on attainment and, to some extent, utility value. Meanwhile, it is conceivable that different types of value appraisals weigh on enjoyment to a

different extent. Therefore, future studies should use more fine-grained measurement tools in order to verify their potentially differing importance for learning enjoyment.

Third, this study focused on learning enjoyment only, which is far from exhaustive with respect to achievement emotions. Including other emotions would provide stronger empirical evidence. We also did not include any distal antecedents of learning enjoyment, neither personal nor contextual. Research on contextual antecedents, for example, on the role of instructional quality, teaching style, or teacher need-supportive practices for control and value appraisals, is particularly important because it can provide specific practical recommendations for teachers and parents. Future studies should include comprehensive longitudinal measurements of various aspects of learning environments in order to better understand how they affect achievement emotions, including enjoyment.

Furthermore, this study, although longitudinal, cannot give a definite answer whether the studied relationships are causal. On the other hand, although experimental research could provide stronger evidence on causation, it is often run on small and selective samples, which puts the generalizability of the results into question.

Finally, although we used a large nationwide sample, it was not representative due to significant missingness and attrition (see also Zinn et al., 2020). This, in turn, might bias the results. For instance, the underrepresentation of low-SES students could lead to overestimated mean levels of all three constructs under study. However, to prevent bias, we included various correlates of missingness in the analyses, for example, SES-related variables and past achievement. Nevertheless, future studies should make attempts to improve participation rates.

CONCLUSION

Overall, the study provides empirical support for the decline in control appraisals, value appraisals, and learning enjoyment over lower secondary schooling. Therefore, its results corroborate the inimical trend observed in other studies. It contributes to the field by providing robust longitudinal evidence on the decrease and by showing that value appraisals, one more school-related student characteristic that has been rarely studied longitudinally, decline over time. It also provides further empirical support for the change–change assumption, which is at the core of the control-value theory of achievement emotions. As such, it suggests that the decline in learning enjoyment may be alleviated by diminishing the decrease in its proximal antecedents.

AUTHOR CONTRIBUTIONS

Anna Hawrot: Conceptualization; methodology; data curation; formal analysis; writing – original draft.

ACKNOWLEDGEMENTS

This paper uses data from the National Educational Panel Study (NEPS; see Blossfeld & Roßbach, 2019). The NEPS is carried out by the Leibniz Institute for Educational Trajectories (LIfBi, Germany) in cooperation with a nationwide network. This research was funded by the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) grant 470282638 awarded to Ilka Wolter. Open Access funding enabled and organized by Projekt DEAL.

CONFLICT OF INTEREST STATEMENT

I have no conflicts to disclose.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the Leibniz Institute for Educational Trajectories (https://www.neps-data.de/Data-Center/Data-Access). Restrictions apply to the availability of these data, which is the reason why they cannot be provided by the author of the study. Survey questionnaires are available on the NEPS study website (https://www.neps-data.de/Data-Center/

Data-and-Documentation). Analysis code is available in the online supplement and by emailing the corresponding author.

ETHICS STATEMENT

The NEPS study is conducted under the supervision of the German Federal Commissioner for Data Protection and Freedom of Information (BfDI) and in coordination with the German Standing Conference of the Ministers of Education and Cultural Affairs (KMK) and – in the case of surveys at schools – the Educational Ministries of the respective Federal States. All data collection procedures, instruments, and documents were checked by the data protection unit of the Leibniz Institute for Educational Trajectories (LIfBi). The necessary steps are taken to protect participants' confidentiality according to national and international regulations of data security. All participants of age and legal guardians of underage participants provided written informed consent prior to study enrolment. All participants could withdraw from the study at any time. The analyses are secondary analyses of data published previously.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

How to cite this article: Hawrot, A. (2024). Changes in control and value appraisals predict changes in learning enjoyment: A four-wave analysis among lower secondary school students. *British Journal of Educational Psychology*, *94*, 231–247. https://doi.org/10.1111/bjep.12644