

Relationships between inter- and intra-individual emotions and learning outcomes of vocational students

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ABSTRACT

Emotions are significant predictors of learning and academic achievement. However, much of the existing research has predominately focused on understanding inter-individual differences in students' emotions, overlooking the dynamic intra-individual processes that unfold over time. The present study aims to examine differences in inter- and intra-individual relationships of two learning emotions (*enjoyment*, *boredom*) and three facets of learning outcomes: *concentration* as a cognitive aspect of the learning process, *learning time* as a behavioral aspect, and *learning satisfaction* as an evaluative aspect. We collected weekly data of 119 vocational students over 14 weeks and used multilevel linear mixed effect models. Results revealed that inter-individual enjoyment positively predicted the three learning outcomes, while intra-individual enjoyment positively predicted concentration and learning time. Inter-individual boredom negatively predicted learning satisfaction, while intra-individual boredom was not a significant predictor. These results highlight the importance of enjoyment for the learning process and point to the more unclear role of boredom. Also, the findings emphasize the importance of differentiating between inter- and intra-individual relations.

Educational relevance statement: The present study highlights the crucial role of emotions, specifically enjoyment and boredom, in learning. By investigating 119 vocational students over 14 weeks, we discovered that enjoyment significantly predicts learning outcomes such as concentration and time spent learning, both across different individuals and within the same individual over time. On the other hand, while boredom negatively impacts satisfaction with learning, no significant effects were found within the same individual over time. These findings underscore the importance of fostering positive emotions like enjoyment in educational settings and the need to consider both differences between students and changes within students over time to enhance learning experiences and outcomes.

Learning is a cognitive and emotional endeavor. For example, existing research has shown that emotions are significant predictors of learning and academic achievement (e.g., enjoyment or boredom; Pekrun et al., 2017, p. 86; Pekrun, Marsh, Elliot, et al., 2023). However, much of the existing research has predominately focused on understanding inter-individual differences in students' emotions, overlooking the dynamic intra-individual processes that unfold over time (Ahmed et al., 2010). While inter-individual analyses provide valuable insights, they often fail to capture the nuanced developmental trajectories of emotion and learning outcomes within individuals. These intra-individual processes can vary over time and depend on the learning situations and not only on individual characteristics of the students

(Dirk & Nett, 2022; Molenaar, 2014).

Recognizing this research gap, the present study aims to examine both inter- and intra-individual relationships of emotions (*enjoyment* and *boredom*) and three facets of learning outcomes (*concentration*, *learning time*, and *satisfaction with learning*). By investigating these relationships, we seek to highlight the complex dynamics that characterize students' emotional experiences and their impact on learning on the individual level.

Moreover, our study extends the focus to students in vocational education, a student group that remains underrepresented in the existing research on learning emotions. Unlike students in compulsory education or high school, vocational students engage in a dual education system,

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spending two days a week in school and the remaining three days in an apprenticeship company. This structure creates specific challenges, such as balancing practical training with theoretical learning, managing workloads, and navigating different learning environments. These factors might influence their emotional experiences, making it essential to study how emotions like enjoyment or boredom interact with their learning. By highlighting vocational students, we seek to fill a gap in current research and offer valuable insights into the emotional experiences and learning in this student group. An understanding of the unique challenges and opportunities faced by vocational students allows us to broaden our perspective on school learning and inform teaching and support mechanisms tailored to this specific student population.

1.1. Students' emotions and their link to learning

To conceptualize the link between achievement emotions and learning, we follow the control-value theory (CVT; Pekrun, Marsh, Elliot, et al., 2023). Thereby, emotions can be taxonomized according to the criteria of object focus (activity vs. outcome), valence (positive vs. negative), and activation (activating vs. deactivating). Acknowledging that students experience a wide range of different emotions in learning and achievement related settings, we focused on the emotions of *enjoyment* and *boredom* for three main reasons. First, enjoyment and boredom are known to be two of the most commonly experienced emotions in the learning processes of adolescents (Goetz et al., 2013). Second, they differ on the dimensions that characterize emotions, namely valence and activation: enjoyment represents a positive, activating emotion while boredom is a negative, deactivating emotion (Pekrun, Marsh, Elliot, et al., 2023). Third, enjoyment and boredom differ in their effect on learning behavior and outcomes. According to CVT, emotions can affect students' learning and learning outcomes by influencing motivational and cognitive processes (e.g., use of learning strategies or regulation of learning; Pekrun et al., 2011; Pekrun, Marsh, Elliot, et al., 2023). Specifically, enjoyment can help to sustain activity through motivation, focus attention on the task and facilitate self-regulation (Pekrun, Marsh, Elliot, et al., 2023; Schweder, 2020). In contrast, boredom seems to undermine learning by distracting attention from the task and results in shallow learning (Tze et al., 2016). By including enjoyment and boredom, we cover two frequent emotions that are associated with desirable and undesirable learning outcomes respectively.

The focus of the present study is on the relationship between enjoyment and boredom, and learning outcomes such as concentration, learning time, and satisfaction with learning. Thereby, concentration reflects a cognitive aspect of the learning process, learning time a behavioral aspect, and learning satisfaction covers an evaluative aspect. We understand concentration, learning time, and satisfaction with learning as proximal learning process-related outcomes that differ from distal learning outcomes such as knowledge or competencies, which are typically assessed through tests (Clements et al., 2011). Thus, concentration, learning time, and satisfaction with learning are important indicators of distal learning outcomes, as they affect how well students engage with the materials, how efficiently they process the study content, and how positively they assess their learning experience, which in turn influence the acquisition of knowledge and competencies (e.g., Jez & Wassmer, 2015; Li & Yang, 2016; Ortega-Maldonado & Salanova, 2018). Therefore, these proximal learning process-oriented outcomes are crucial for achieving the more distal outcomes of learning.

1.2. Inter-individual investigations on emotions and learning outcomes

Educational research based on CVT has predominantly focused on inter-individual differences (Dirk & Nett, 2022; Pekrun & Marsh, 2022). Inter-individual differences are important to understand how emotions and learning outcomes are associated across students. Specifically, this

enables researchers to address questions like 'Is there a difference in concentration for students who reported more enjoyment in learning compared to students who reported lower enjoyment?'

These inter-individual differences in the relationship between emotions and learning outcomes are widely studied, indicating that emotions can affect students' learning and performance (Botes et al., 2022; Dirk & Nett, 2022). For instance, results from existing research have revealed that positive emotions, such as enjoyment, can reinforce task activity and are thus positively associated with favorable learning outcomes such as higher effort regulation (e.g., Camacho-Morles et al., 2019), engagement (e.g., Liu et al., 2018) or grit (Elahi Shirvan et al., 2021) across individuals. Additionally, enjoyment has been found to positively predict concentration (Lohbeck et al., 2016) and learning satisfaction (i.e., students' positive evaluation of their learning; Wu et al., 2021). Similarly, Lonka and Ketonen (2012) found that enthusiasm positively correlated with self-study time, and students in a positive emotional profile ("engaged") reported higher learning time than students in an unstressed or negative emotional ("anxious") profile.

The conclusion from these studies is that students who reported higher enjoyment during learning activities also showed improved learning outcomes. In contrast, boredom likely results in attention reduction and activities drifting away from the task and is linked to lower intrinsic value (e.g., Golle et al., 2022), lower concentration (Lee & Son, 2023), lower learning satisfaction (Lee et al., 2021; Wu et al., 2021), and lower achievement (e.g., Li & Wei, 2023).

While these inter-individual findings offer valuable insights into how emotions shape learning outcomes across students, they do not necessarily reflect the processes that unfold within a student over time (cf. ergodic theorem; Dirk & Nett, 2022; Molenaar & Campbell, 2009). For example, students who reported higher enjoyment during learning on average might also report more concentration on average, resulting in a positive association between students (i.e., inter-individual relationship). However, concentrating on learning is demanding and strenuous and thus perhaps less enjoyable, indicating a negative association within students (i.e., intra-individual relationship). This emphasizes the need to investigate not only inter-individual differences but also intra-individual dynamics to fully understand the complex role of emotions in learning (Dirk & Nett, 2022; Pekrun & Marsh, 2022).

1.3. Intra-individual investigations on emotions and learning outcomes

In an emerging intra-individual perspective, emotions are acknowledged to be dynamic and fluctuating (Elahi Shirvan & Taherian, 2021; Reitsemä et al., 2022; Scherer, 2009). Longitudinal studies have suggested a linear decrease in positive (state and trait) emotions in school from late childhood to late adolescence, while negative emotions tend to increase (Griffith et al., 2021; Maciejewski et al., 2017). Moreover, existing research indicated that there is more variability in emotions during early adolescence than in mid-adolescence (Larson et al., 2002; Maciejewski et al., 2015). Research in lower secondary education also showed that on average, negative emotions related to learning showed higher within-person variability than the positive emotions, suggesting that positive emotions are more stable than negative emotions (e.g., Ahmed et al., 2010). In addition, in the foreign language learning setting, research has highlighted the heterogeneity in growth in enjoyment and boredom over time: students with initially high levels of enjoyment experienced less change during a semester, while students with low levels of enjoyment exhibited more change (Elahi Shirvan et al., 2021; Elahi Shirvan & Taherian, 2021). A similar result was also found regarding boredom: students with initially higher levels of boredom showed a greater decline, while students with lower levels of boredom experienced a smaller decrease over time (Kruk et al., 2022). These findings emphasize the dynamic nature of emotions within individuals over time.

Building on this understanding of emotional variability, intra-

individual differences aim to understand how such fluctuations influence outcomes within an individual. Thus, intra-individual investigations seek to answer research questions such as ‘Is an increase in positive emotions associated with higher concentration within a student?’ (cf. Wang & Maxwell, 2015; Zhang & Wang, 2014). Although studies on this intra-individual relationship of emotions and learning outcomes remain limited, existing research suggests important co-developments. For example, in foreign language acquisition, a joint development between enjoyment and grit (Elahi Shirvan et al., 2021) and achievement over time (Gao, 2023) has been found. In secondary school education, research indicated positive within-person effects between positive emotions and grades, and negative within-person effects for negative emotions and grades (Pekrun, Marsh, Suessenbach, et al., 2023). These results are in line with the inter-individual associations between emotions and grades (Pekrun et al., 2017; Pekrun, Marsh, Suessenbach, et al., 2023).

Similar findings were currently reported by Zhu et al. (2024): Students who reported greater positive emotions on average tended to report greater learning progress and students who reported greater positive emotions on a day tended to report greater learning process on this day. For the negative emotions, Zhu et al. (2024) only found a significant relationship on the inter-individual but not on the intra-individual level. Similarly, Obergrösser and Stoeger (2020) found that primary students’ intra-individual enjoyment (i.e., higher enjoyment on a given day) positively predicted subsequent cognitive learning strategy use in daily measures over five weeks, while inter-individual enjoyment did not predict the effective cognitive learning strategy use. These results suggest that inter- and intra-individual relationships may differ and a generalization of inter-individual results to the intra-individual level may not be appropriate.

2. The present study

The present study aims to understand the inter- and intra-individual relationship between students’ emotions (enjoyment and boredom) and proximal learning outcomes (concentration, learning time, and satisfaction with learning). While prior research has explored the general impact of emotions such as enjoyment or boredom on learning outcomes, there remains a lack of insight into how these emotional experiences unfold in individuals over time, particularly in vocational education settings. By focusing on inter- and intra-individual relationships, we seek to shed light on the dynamic processes that underlie vocational students’ emotional experiences and their influences on different proximal learning outcomes. To address this research gap, the following research questions are investigated:

- How do students’ level of enjoyment and boredom predict proximal learning outcomes (concentration, learning time, and satisfaction with learning) across different individuals (i.e., inter-individual level)?
- How do fluctuations within students’ emotions over time predict their proximal learning outcomes (i.e., intra-individual level)?

To examine these relationships, we collected weekly data over one semester and investigated inter-individual emotion effects—representing between person differences—as well as intra-individual effects—representing changes within a person over time. This approach allows us to extend the traditional focus on inter-individual differences and explore the similarities and differences in how emotions shape proximal learning outcomes within individuals over time (Pekrun & Marsh, 2022).

By bridging the gap between inter- and intra-individual perspectives, our study aims to contribute to a more comprehensive understanding of the role of emotions in the learning process. Additionally, by including vocational students, we seek to broaden the scope of existing research and provide insights into this specific student group. Vocational students

may face unique learning challenges due to the nature of the dual training program, where they split their time between vocational school and an apprenticeship company. This dual-track system can lead to fragmented learning experiences and limited time for formal education, which might directly affect proximal learning outcomes such as concentration, learning time, and satisfaction with learning. Furthermore, it requires that vocational students constantly adapt to different learning environments, which could influence their emotions as well as their learning process. By focusing on this student group, we not only address a research gap but also provide insights that are crucial for developing tailored educational strategies that account for the specific challenges vocational students might face in managing their learning.

Based on previous research (Goetz et al., 2016), we expected that proximal learning outcomes were positively predicted by enjoyment and negatively predicted by boredom at the inter-individual level. This expectation aligns with the findings of studies that focused primarily on lower secondary school or university students (e.g., Wu et al., 2021). Although there are tentative indications of the inter-individual relationships, it remains unclear whether these patterns hold at the intra-individual level, where emotions fluctuate within the same individual over time. Theoretical considerations and previous research (e.g., Elahi Shirvan et al., 2021) suggested that fluctuations in enjoyment and boredom within students should also influence their proximal learning outcome. Therefore, we expected that at the intra-individual level, proximal learning outcomes will likewise be positively predicted by enjoyment and negatively predicted by boredom. By examining both inter- and intra-individual relationships, this study seeks to clarify whether the emotional dynamics that impact proximal learning outcomes across students also apply to variations within individuals over time.

3. Method

3.1. Study and context

The data used in this study were collected as part of the project “Selbstgesteuertes Lernen in der Berufsbildung” (self-regulated learning in vocational education). The study received full ethical consent by the Ethics Committee of the Faculty of Human Science of the University of Bern (reference: 2019–07-00001) and is in accordance with the guidelines of the APA. The project took place in Switzerland and employed a quasi-experimental design with an intervention and a control group. The present study does not focus on the intervention itself but rather analyses the relationships between emotions and proximal learning outcomes using data from this larger project. The primary objective of the intervention was to test whether a learning environment designed to promote self-regulated learning (SRL) could improve students’ SRL skills in vocational education. In the SRL-setting, the students worked most of the time independently on individual assignments, while students in the regular classroom setting attended regular classes with regular timetables where subjects were scheduled during the school days (for more detail on the intervention setting see Held & Mejeh, 2024; Mejeh & Held, 2022).

However, the current study does not assess the effectiveness of the intervention but instead examines the relationship between emotions and proximal learning outcomes across both groups. We assumed that how student emotions affect their proximal learning outcomes such as concentration work in the same way for both groups. Based on this assumption, the two groups were handled equally in the analysis, and the learning environment was considered as a covariate, allowing to check for systematic differences between the two groups (e.g., if students in the SRL-setting reported different learning time compared to the students in the regular classroom setting).

The study was conducted in a vocational school in Switzerland, where students follow a dual track system: They attend classes at the vocational school for two days per week, while spending the remaining

three days working in their apprenticeship companies, with no school classes on those days. The subjects at the vocational school included: Societal language (German), Information, first foreign language (French), Business and Society, second foreign language (English), and Communication and Administration. Students are required to complete their compulsory schooling and secure an apprenticeship contract with a training company in order to attend vocational school and become a commercial employee.¹ To obtain a commercial apprenticeship, students must generally have good mathematics and language skills (school and foreign language), but the allocation of apprenticeships is the sole responsibility of the training companies, which may have different requirements (Held & Hascher, 2023).

3.2. Participants

The sample included 119 commercial employee students with a mean age of 16.64 years ($SD = 2.23$), in the first year of vocational education. The sample was composed of 60 female, 42 male students, and no information on gender is available for 17 students. Of the sample, 46 students (38.7 %) participated in the SRL-setting and 73 (61.3 %) attended the regular vocational school setting. The option to join the SRL-setting was offered by the school to all students on voluntary basis. All prospective vocational school students received information from the school about the structure and content of the SRL-setting prior to enrollment. Based on this information, they could choose whether they wanted to participate in the SRL-setting or regular classroom setting. This process was determined by the school.

3.3. Measures

The questionnaires addressed students' enjoyment ("I enjoy vocational school") and boredom ("I get bored in vocational school classes") that were measured using single items adapted from the Achievement Emotions Questionnaire (Pekrun et al., 2011). Enjoyment and boredom were rated on a four-point Likert scale ranging from 1 ("Disagree") to 4 ("Agree"). Split-half reliability analysis indicated excellent reliability for enjoyment ($r_{split} = 0.94$) and good reliability for boredom ($r_{split} = 0.84$). The single item for concentration ("While I'm learning something, I concentrate fully on it") was based on Metzger (2006), and was rated on a four-point Likert scale ranging from 1 ("Disagree") to 4 ("Agree"). Concentration showed adequate reliability ($r_{split} = 0.74$). Single items for learning time ("How long did you study this week?") and learning satisfaction ("How satisfied are you with your learning since the last survey?") were based on a study by Schmitz and Wiese (2006). Learning time was indicated in minutes per week and satisfaction was also rated on a four-point Likert scale ranging from 1 ("Very dissatisfied") to 4 ("Very satisfied"). Learning time ($r_{split} = 0.86$) and satisfaction with learning ($r_{split} = 0.85$) showed good reliabilities. The questionnaires were presented in German.

3.4. Procedure

For the present study, data were collected once a week over 14 weeks during the first semester of the school year 2019/2020 via a smartphone application (1666 data entries). The students received once a week (on one of the two school days) a push notification on their smartphones informing them that a questionnaire was available and waiting for their responses. A semi-randomized time interval was used to ensure that the results are not biased by a specific subject or day (Himmelstein et al., 2019). Completing this questionnaire took about two minutes. If the students did not complete the questionnaire, they received five more

push notifications as reminders over the following days. All student responses that were received before the start of the next school week were included in the dataset, all others were marked as missing.

3.5. Data analyses

Data on students' emotions and learning strategies are hierarchically structured: Measurements are nested within individual students (level 2), and these students are further nested within classes (level 3). To determine the appropriate levels for our model, intraclass correlations (ICC) were calculated. Intraclass correlations were computed from unconditional models to evaluate the proportion of variance attributable to each level. At the person level (level 2), ICCs were relatively high (see Table 1), indicating that a significant amount of variability was due to individual differences. In contrast, the ICCs for the class level (level 3) were low (≤ 0.07), suggesting that the variability attributable to differences between classes was minimal compared to the variability within and between students. Based on these findings, we determined that a two-level model was more appropriate for our analyses.

To investigate the associations of emotions and learning outcomes, multilevel linear mixed effect models using the *nlme* package (version 3.1-163; Pinheiro et al., 2021) in R (R Core Team, 2024) were estimated. Across all participants and assessments, 37.75 % of the data was missing. Missing data were assumed to be 'missing at random' (MAR), as the causes for missing could be accounted for by time, and thus time was included in all subsequent models (for more information on missing data and missing data analyses, see Supplementary Materials). Maximum likelihood estimation was used to handle missing data.

Emotions were disaggregated into a between-person and a within-person variable in order to separate inter-individual and intra-individual effects. To obtain the between person variable, the person-mean values were grand-mean centered, representing each student's mean in the two emotions across all 14 measurement points (inter-individual value). By applying the person-mean centering approach, as suggested by Wang and Maxwell (2015), intra-individual values for the two emotions were obtained. To test for a trend over time, time was included as covariate in the linear mixed effect models. In order to control for potential differences between students in the SRL-setting and students in the regular classroom setting, the school setting was included as covariate in the analyses.

4. Results

Means, standard deviations, intraclass correlations (ICCs), and correlations for each variable are provided in Table 1. For the descriptive statistics, the values are based on person-aggregated scores over 14 weeks. Overall, results showed medium values in enjoyment, rather low values in boredom, and rather high scores in concentration and learning satisfaction. The ICC indicated, for example, that the proportion of variance explained by a student is 0.60 in the case of enjoyment, while the proportion of variance explained by the class is 0.06.

Inter-individual correlations are displayed above the diagonal and intra-individual correlations are reported below the diagonal. Correlations between emotions and learning outcomes differ between inter- and intra-individual analyses. For example, enjoyment is significantly correlated with learning satisfaction ($r = 0.39, p < 0.001$) on the inter-individual level, while there is no correlation ($r = 0.02, p = 0.67$) on the intra-individual level. This result indicates that, within individual students, fluctuations in enjoyment are not associated with changes in learning satisfaction over time. However, when comparing students to one another, those who reported higher average enjoyment across weeks also reported higher scores in learning satisfaction.

4.1. Concentration and inter- and intra-individual emotions

All results of the linear mixed effect models are reported in Table 2.

¹ Commercial employees work in a variety of ways in business management processes. They advise customers, negotiate with suppliers, coordinate internal processes and carry out industry-specific tasks.

Table 1
Descriptive statistics and correlations.

Variable	<i>M</i>	<i>SD</i>	ICC L2	ICC L3	1	2	3	4	5
1. Enjoyment	2.88	0.75	0.60	0.06	–	–0.39***	0.27**	0.25*	0.39***
2. Boredom	2.08	0.67	0.46	0.07	0.04	–	–0.31**	–0.17	–0.35***
3. Concentration	3.07	0.50	0.35	0.01	0.21***	–0.02	–	0.20	0.38***
4. Learning time	142.19	69.33	0.56	0.00	0.09*	–0.02	0.06	–	0.17
5. Learning satisfaction	3.73	0.66	0.38	0.03	0.02	0.02	0.15**	0.24***	–

Note. L2 = student level, L3 = classroom level. Above the diagonal are inter-individual correlations and below the diagonal are intra-individual correlations. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$. Min = 1, max = 4 (except learning time).

Table 2
Model results of the linear mixed effect models.

	Concentration		Learning time		Learning satisfaction	
	<i>B</i> (<i>SE</i>)	<i>f</i> ²	<i>B</i> (<i>SE</i>)	<i>f</i> ²	<i>B</i> (<i>SE</i>)	<i>f</i> ²
Fixed effects						
Intercept	3.14 (0.16) ***		137.34 (24.35)***		4.14 (0.23) ***	
Enjoyment inter-individual	0.15 (0.07)*	0.03	21.63 (10.90)*	0.03	0.23 (0.10)*	0.04
Enjoyment intra-individual	0.22 (0.05) ***	0.02	12.36 (5.74)*	0.01	0.08 (0.08)	0.00
Boredom inter-individual	–0.14 (0.08)	0.02	–11.64 (12.01)	0.01	–0.22 (0.11)*	0.03
Boredom intra-individual	–0.03 (0.05)	0.00	–1.89 (5.02)	0.00	0.03 (0.07)	0.00
Time (weeks)	0.00 (0.01)	0.00	–1.39 (0.65)*	0.01	–0.02 (0.01)*	0.01
SRL-setting	–0.05 (0.10)	0.00	7.79 (14.93)	0.00	–0.21 (0.14)	0.01
Random effects						
Student	Variance 0.36		Variance 62.14		Variance 0.48	
Residual	0.28		3149.45		0.44	
Marginal R ²	0.10		0.06		0.14	
Conditional R ²	0.39		0.58		0.44	

Note. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Students' emotions (enjoyment and boredom) are included as predictors for concentration, learning time, and learning satisfaction along with time and the SRL-setting as covariates. Results for *concentration* revealed that inter-individual enjoyment positively predicted concentration, indicating that students with higher enjoyment on average reported higher values in concentration ($B = 0.15$; $p = 0.039$). In addition, intra-individual enjoyment positively predicted concentration ($B = 0.22$; $p \leq 0.001$), suggesting that when students reported higher enjoyment in one week than in the others, they also reported higher concentration in this week. According to Cohen (1988), both represent a small effect ($f^2 = 0.03 / 0.02$). In contrast, inter-individual ($B = -0.14$; $p = 0.078$) and intra-individual boredom ($B = -0.03$; $p = 0.587$) did not significantly predict concentration. Students with higher boredom on average did not report significantly lower concentration and students who reported higher boredom in one week than in the others, did not report lower concentration in this week. Additionally, there was no significant change in concentration over time ($B = 0.00$; $p = 0.730$; see Fig. 1) and no difference between the settings ($B = -0.05$; $p = 0.642$).

4.2. Learning time and inter- and intra-individual emotions

Similar, the second model (see Table 2) showed that inter- and intra-individual enjoyment were positive predictors of *learning time*. Higher enjoyment on average was positively related to higher learning time ($B = 21.63$; $p = 0.049$) and students who reported higher enjoyment in one week than in others also reported higher learning time in this week ($B = 12.36$; $p = 0.032$; small effect). Again, boredom (inter- and intra-individual) was not a significant predictor of learning time. Finally,

time was a significant predictor ($B = -1.39$; $p = 0.032$), indicating that the learning time decreased significantly over the 14 weeks (see Fig. 2). Students in the two settings (SRL vs. regular setting) did not differ significantly regarding learning time ($B = 7.79$; $p = 0.603$).

4.3. Satisfaction with learning and inter- and intra-individual emotions

Finally, results for *satisfaction with learning* revealed a different picture (see Table 2). Learning satisfaction was significantly positively predicted by inter-individual enjoyment ($B = 0.23$; $p = 0.022$) and negatively by inter-individual boredom ($B = -0.22$; $p = 0.047$; both small effects). Students who reported on average higher enjoyment than other students, also reported significantly higher learning satisfaction. Intra-individual enjoyment was not a significant predictor ($B = 0.08$; $p = 0.334$), indicating that students who reported higher enjoyment in one week than in others did not report higher learning satisfaction in this week. In contrast, higher boredom on average (inter-individual) was negatively related to learning satisfaction, while intra-individual boredom was not significant ($B = 0.03$; $p = 0.666$). Time was again significant ($B = -0.02$; $p = 0.014$), indicating that learning satisfaction decreased over time (see Fig. 3), while no significant difference was found between the two settings ($B = -0.21$; $p = 0.137$).

5. Discussion

The present study aimed to understand the inter-individual—representing between person differences—as well as the intra-individual—representing changes within a person over time—relationships between vocational students' emotions and learning outcomes. Rather than analyzing variations as the primary focus, we used emotions as a reference point to understand their role in learning outcomes. Specifically, the study addressed two key research questions: *How do students' levels of enjoyment and boredom predict proximal learning outcomes (concentration, learning time, and satisfaction with learning) across different students?* and *How do fluctuations within students' enjoyment and boredom over time predict their proximal learning outcomes?*

5.1. Effects of inter- and intra-individual enjoyment

Our results on inter-individual enjoyment are in line with CVT, which posits that positive emotions such as enjoyment have positive effects on students' learning (Pekrun, Marsh, Elliot, et al., 2023) and with previous research in lower secondary or university students (e.g., Wu et al., 2021; Zhu et al., 2022). Our findings indicate that students who reported higher enjoyment on average also more likely reported higher concentration, learning time, and learning satisfaction. This highlights the relevance of positive emotions also for vocational students. Moreover, these findings support the assumption of CVT that enjoyment as positive emotion helps to focus attention on the task (Pekrun, Marsh, Elliot, et al., 2023) and contributes to successful learning (Gao, 2023; Li & Wei, 2023; Pekrun & Marsh, 2022).

Interestingly, our intra-individual analyses revealed that fluctuations in enjoyment were also linked to variations in concentration and learning time. These results suggest an alignment of inter-individual

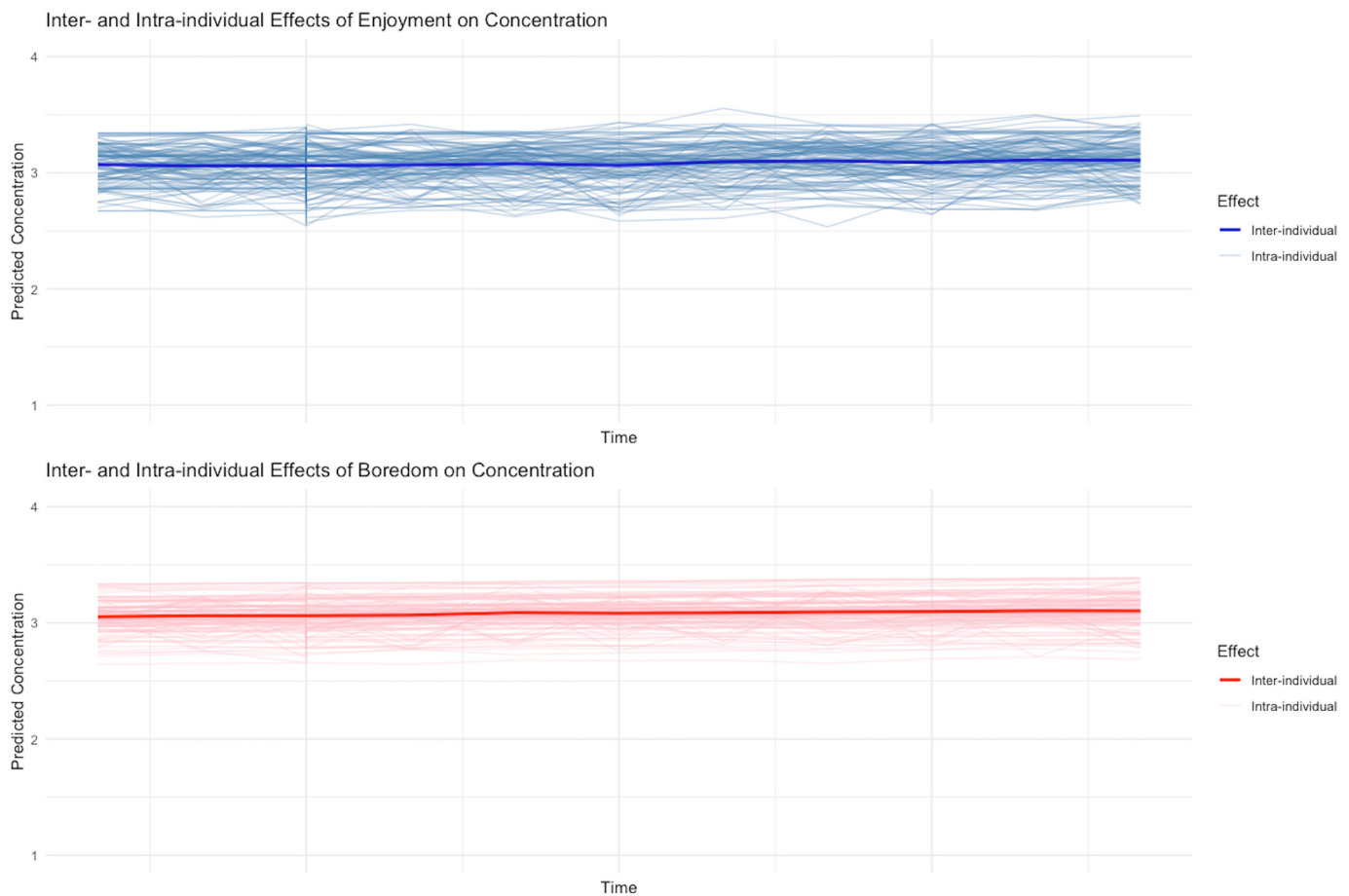


Fig. 1. Inter- and intra-individual effects of enjoyment and boredom on concentration.

with intra-individual relationships of enjoyment with concentration and learning time. Similarity of inter- and intra-individual relationships was also found in other studies between emotions and grades (Pekrun, Marsh, Suessenbach, et al., 2023), achievement goals (Goetz et al., 2016), and the perceived learning process (Zhu et al., 2024). In addition, these results also highlight that emotions and learning follow an intra-individual process that depends on the situation (Dirk & Nett, 2022). The individual characteristic (e.g., having on average higher enjoyment in vocational school classes) might be important, but the weekly fluctuations also play a significant role within the learning process and should be considered (cf. Elahi Shirvan et al., 2021; Elahi Shirvan & Taherian, 2021). These within-person relationships also highlight the importance of considering fluctuations in students' emotions by using activating teaching methods and engaging learning materials on a daily basis (Dewaele & Li, 2021; Kulakow & Raufelder, 2020; van der Walt et al., 2024).

Although enjoyment can directly affect concentration and learning time within a student, its impact on learning satisfaction seems to be less sensitive to weekly fluctuations. While week-to-week enjoyment may vary, learning satisfaction might be influenced by a broader range of factors such as the quality of instruction or material, or the overall learning environment (Cornillez Jr, 2019; Lin et al., 2023). This also underlines the importance of considering the differences between inter- and intra-individual relationships. While inter-individual enjoyment significantly predicted satisfaction with learning, this association was not observed at the intra-individual level. This suggests that individual differences in the average level of enjoyment may not translate into weekly fluctuations in satisfaction with learning.

5.2. Effects of inter- and intra-individual boredom

Moreover, our study highlights the role of boredom in the learning process. In line with CVT and previous research in university students, inter-individual boredom was primarily associated with lower levels of learning satisfaction (Lee et al., 2021; Wu et al., 2021), while intra-individual boredom did not significantly predict any of the learning outcomes examined (cf., Pekrun, Marsh, Suessenbach, et al., 2023; Zhu et al., 2024). At least in our sample, weekly fluctuations in boredom might not consistently coincide with changes in concentration, learning time, or learning satisfaction. Factors beyond boredom seem to have a greater impact on these proximal learning outcomes. Students might have employed coping strategies to mitigate the effects of boredom on their learning experiences (Daniels et al., 2015; Nett, Goetz, & Daniels, 2010).

These results also challenge the assumption of a universal negative impact of boredom on learning outcomes. While CVT assumes that boredom tends to undermine learning by distracting attention from the task and leading to shallow learning (Tze et al., 2016), our results suggest that the relationship between boredom and learning outcomes is more complex. This complexity may be explained by the moderating role of metacognitive awareness in the link between negative emotions and concentration: For example, Lee and Son (2023) suggested that negative emotions have a greater impact on students with low levels of metacognitive awareness, whereas students with higher metacognitive awareness are less affected by negative emotions. Similarly, Elahi Shirvan et al. (2024) demonstrated that strategies for coping with boredom moderated the relationship between boredom and engagement in second language learning. Cognitive- (e.g., daydreaming) and behavioral-avoidance strategies (e.g., chitchatting) resulted in

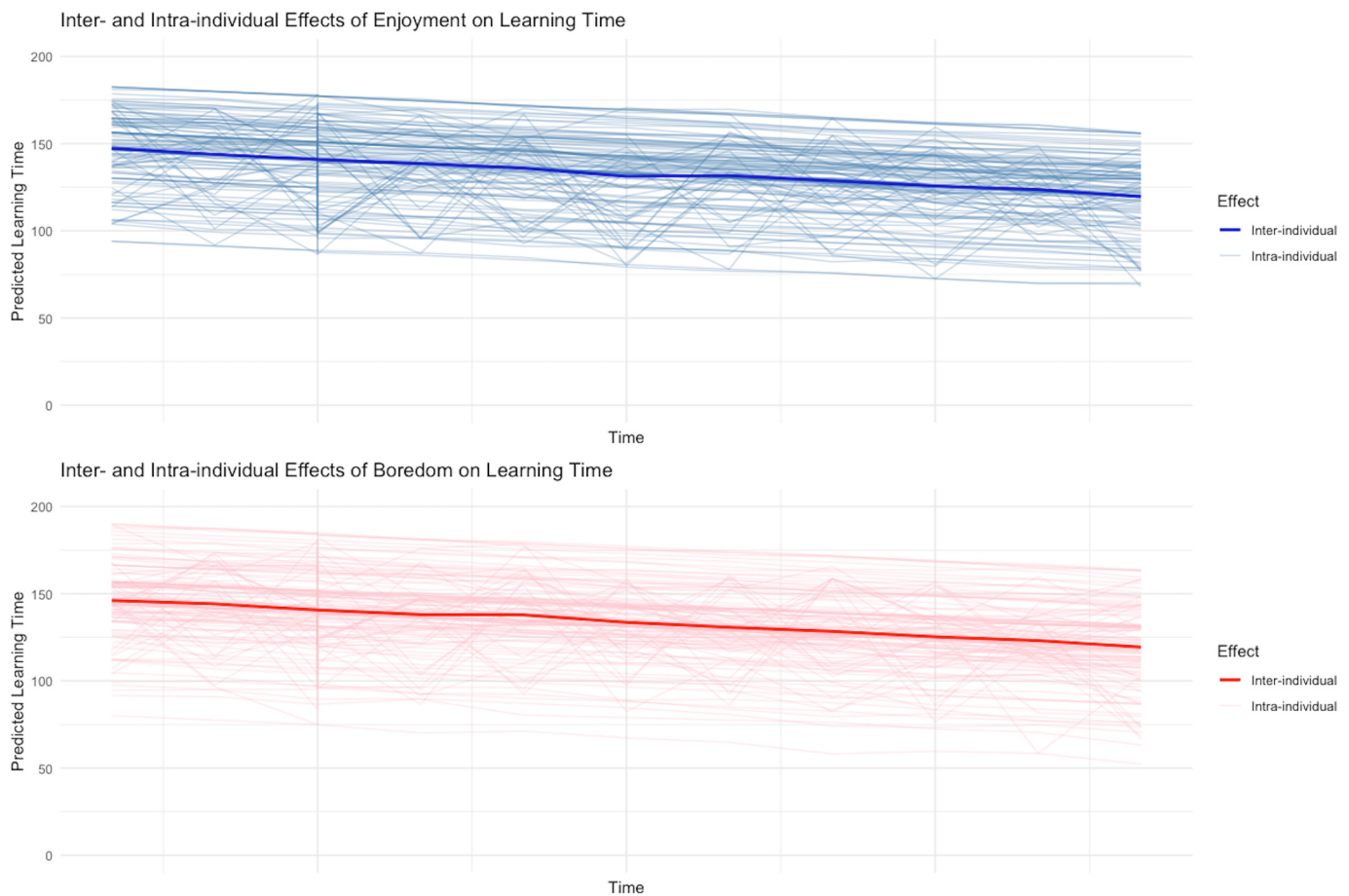


Fig. 2. Inter- and intra-individual effects of enjoyment and boredom on learning time.

disengagement from learning, while cognitive- and behavioral-approach strategies could encourage students to stay focused, leading to sustained engagement (Elahi Shirvan et al., 2024). These findings emphasize the importance of considering the moderating effect of factors such as metacognitive awareness and coping strategies when assessing the impact of boredom on learning outcomes. Rather than being inherently detrimental, boredom may lead to either reduced or sustained learning outcomes, depending on how students respond to it.

Additionally, boredom can be caused by over- or under-challenge (e.g., Acee et al., 2010). Some students may have experienced boredom due to being over-challenged due to the new dual learning setting (two days of vocational school and three days in apprenticeship companies), while other students may have felt underchallenged, as they came from different secondary schools and classes, with varying levels of prior knowledge. Therefore, boredom due to under-challenge may have masked the effects of boredom due to over-challenge and vice versa.

In sum, our findings on the effects of inter- and intra-individual enjoyment and boredom on learning outcomes revealed some similarities but also differences, highlighting the importance of differentiating between- and within-person relationships (Dietrich et al., 2022; Falkenström et al., 2017; Reitzle & Dietrich, 2019). The assumption that inter-individual findings reflect the development within a student requires further research (Dirk & Nett, 2022; Molenaar, 2014).

Finally, over the first semester of vocational education, learning time and learning satisfaction decreased significantly. This is in line with previous research, suggesting a decrease in motivation (e.g., Gaspard et al., 2020; Gnambs & Hanfstingl, 2016) or interest (e.g., Höft & Bernholt, 2021; Wild, 2023) over time. This negative trend in learning satisfaction needs to be addressed by school and teachers by providing a learning environment and learning contents that better meet students'

needs.

5.3. Limitations and future directions

The present study provides insights into the inter- and intra-individual relationship between vocational students' emotions and their learning outcomes. However, we would also like to emphasize some limitations and use them to provide suggestions for future research. First, we used single items to measure emotions and learning outcomes. This type of pragmatic measurement is currently increasingly requested and used in order to adequately depict the fluctuation between lessons or weeks (Allen et al., 2022; Kosovich et al., 2019). Although single items have adequate psychometric properties and represent a suitable alternative for multi-item scales when those are not applicable, they only cover one facet of a latent construct (Allen et al., 2022; Gogol et al., 2014). Therefore, future research using multi-item scales is needed to validate the results and capture the multidimensional nature of emotions and learning outcomes. In addition, the items on the emotions pertained specifically to vocational school classes, while the learning outcomes encompassed both in-class and out-of-class learning experiences. This discrepancy in context may lead to variability in students' responses. Future studies should consider adapting these items to ensure consistency across contexts.

Second, the sample consisted of students in an SRL-setting and students in the regular classroom setting. Although we used the learning setting as a covariate and assumed that the underlying interaction structure is similar between the two groups, it is important to acknowledge that additional factors, including variations for example in peer- or student-teacher relationships, may have influenced the groups differentially. In addition, the sample of vocational students in the first

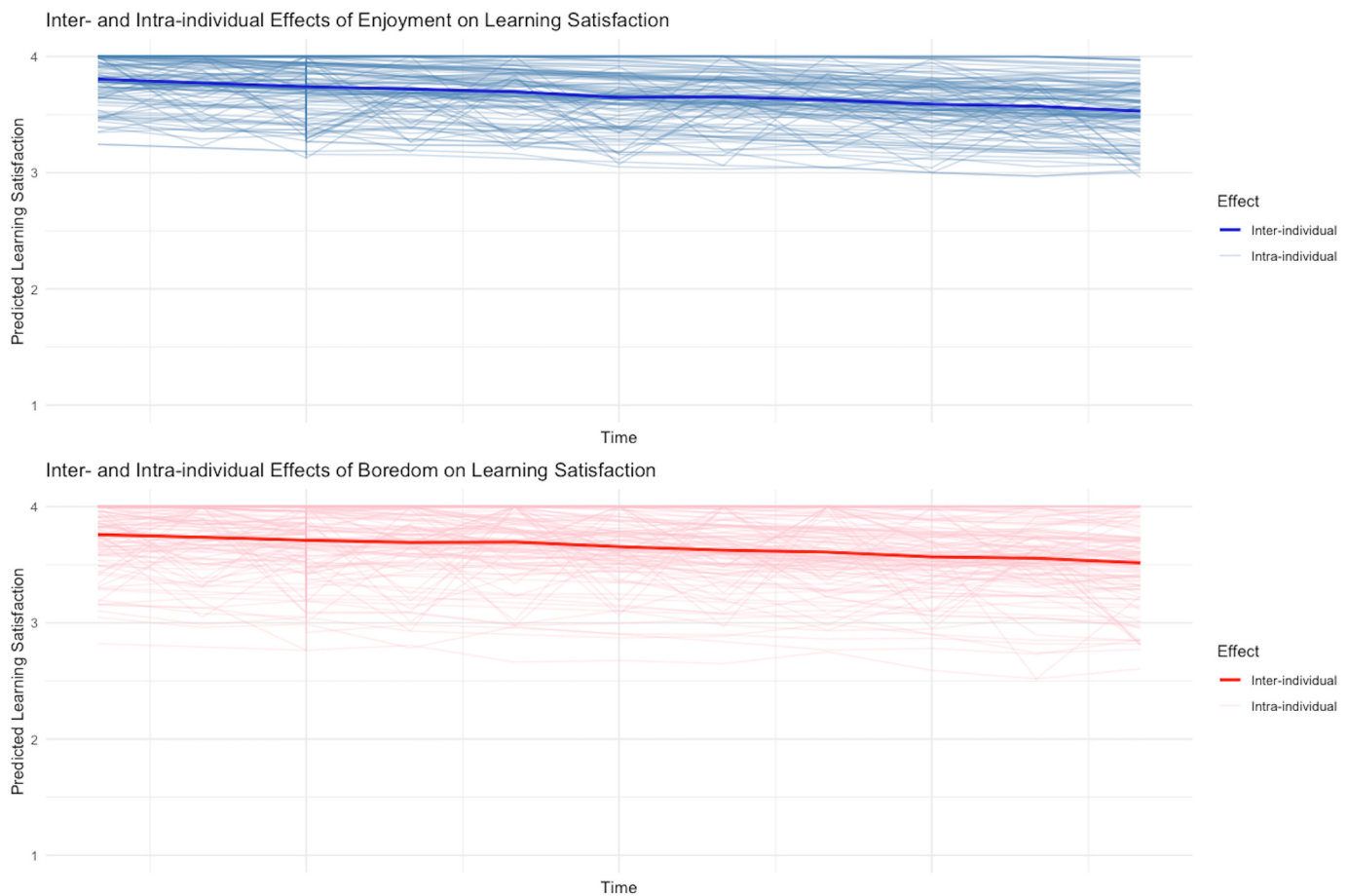


Fig. 3. Inter- and intra-individual effects of enjoyment and boredom on learning satisfaction.

year of vocational education represents a special group of students due to the nature of their dual education program (e.g., Houtte et al., 2012). Thus, a larger sample without difference in the learning environment is needed to validate the results of our study.

Third, enjoyment and boredom represent only two learning emotions and concentration, learning time, and learning satisfaction only three different aspects of proximal learning outcomes. Although, valuable insights in inter- and intra-individual relationships were achieved, more detailed research is needed, especially regarding boredom. It remains unclear how different facets of boredom (e.g., boredom due to over- or underchallenge) affect learning on the inter- and intra-individual level (Acee et al., 2010). Furthermore, as suggested by Elahi Shirvan et al. (2024), the moderating role of coping strategies should be further investigated to better understand how these strategies influence the relationship between boredom and learning outcomes. Similarly, in terms of enjoyment, examining the associations between different dimensions of enjoyment (e.g., achievement-related enjoyment or learning-related enjoyment) could provide deeper insights into their impact on learning outcomes (cf. Dewaele, 2022; Jin & Zhang, 2021; Pekrun & Marsh, 2022). Thus, future research may uncover more specific results on inter- and intra-individual differences in learning outcomes by including different enjoyment dimensions or causes of boredom. In addition, according to CVT, learning outcomes can influence subsequent academic emotions (e.g., Clem et al., 2021; Putwain et al., 2022; Sutter-Brandenberger et al., 2018). Therefore, future research should also examine reciprocal effects to better understand the dynamic relationships between emotions and learning outcomes. Furthermore, our study focused on three specific proximal process-related learning outcomes, which are crucial for learning and are associated with achievement. However, further research encompassing

distal outcomes (e.g., skills, knowledge), assessed through measures as achievement tests, is important to fully understand the relationships.

Fourth, we used weekly measures over 14 weeks according to the dual training system in Switzerland. Thus, our data represent week-to-week fluctuations, while most intense longitudinal studies used daily measurements and investigated day-to-day fluctuations. Our results represent an extension of the existing research but are also associated with limited comparability with existing results. More research on different time scales is needed to fully understand the impact of emotional fluctuations across lessons, days, weeks, months, semesters.

6. Conclusion

The findings of the current study contribute to the understanding of the relationship between vocational students' enjoyment and boredom and their concentration, learning time, and learning satisfaction. Our findings underscore the importance of enjoyment in fostering learning across and within students. The results align with CVT and prior research, emphasizing the relevance of positive emotions for effective learning in vocational education, while negative emotions seem to have less impact on learning outcomes. Although CVT generally assumes intra-individual relationships, more explicit assumptions on within-person associations would be necessary to clarify the nuanced dynamics of emotional experiences and learning outcomes within students across varying contexts and temporal fluctuations.

In addition, the present study underscores the importance of considering between- and within-person relationships in understanding the role of emotions in learning. While inter-individual enjoyment demonstrated consistent associations with learning outcomes, intra-individual fluctuations also influenced concentration and learning

time, highlighting the dynamic nature of the relationship for future research. These nuanced findings underscore the need for future research to further explore the complex interplay between individual characteristics and situational factors in shaping students' emotional experiences and learning outcomes over time. Despite some similarities between inter- and intra-individual relationships, our results also showed some discrepancies, suggesting that intra-individual fluctuations not always have an immediate or universal effect on learning outcomes. Future research should investigate how intra-individual moderators (e.g., coping strategies) affect these relationships.

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CRediT authorship contribution statement

Tanja Held: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Mathias Meje:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Investigation, Data curation, Conceptualization. **David W. Putwain:** Writing – review & editing, Writing – original draft, Supervision, Methodology. **Tina Hascher:** Writing – review & editing, Writing – original draft, Supervision, Resources, Methodology, Conceptualization.

Declaration of competing interest

We have no known conflict of interest to disclose.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.lindif.2025.102682>.

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