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Department of English Studies, Faculty of Pedagogy and Fine Arts, Adam Mickiewicz University, Kalisz
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When time matters: Mechanisms of change in a mediational model of foreign language playfulness and L2 learners' emotions using latent change score mediation models

Mariusz Kruk ✉
University of Zielona Góra, Poland
https://orcid.org/0000-0001-5297-1966
mkruk@uz.zgora.pl

Mirosław Pawlak
Adam Mickiewicz University, Poznań, Poland
University of Applied Sciences, Konin, Poland
https://orcid.org/0000-0001-7448-355X
pawlakmi@amu.edu.pl

Tahereh Taherian
Yazd University, Iran
https://orcid.org/0000-0003-2583-8224
taherian87@yahoo.com

Erkan Yüce
Aksaray University, Turkey
https://orcid.org/0000-0003-2716-5668
erkanyuce@aksaray.edu.tr

Majid Elahi Shirvan
University of Bojnord, Iran
https://orcid.org/0000-0003-3363-8273
elahishmajid@gmail.com; m.elahi@ub.ac.ir

Elyas Barabadi
University of Bojnord, Iran
https://orcid.org/0000-0002-8457-3046
elyas.ba1364@gmail.com

Abstract

In a dynamic system, time-dependent links *between* affective factors can provide more information than the level of response *within* a single isolated system. In the present study, influenced by the positive psychology movement and the complex dynamic systems theory in the domain of second language acquisition, first, we dealt with change in terms of short-term dynamics and long-term trajectories of foreign language enjoyment (FLE), foreign language boredom (FLB), and foreign language playfulness (FLP) in a sample of 636 learners of English as a foreign language (EFL) using univariant latent change score (LCS) models. Then, we explored the developmental processes involved in how changes in FLE and FLP were associated with changes in FLB. In particular, we tested mediation models to see whether the growth of FLP acts as a mediator between FLE and FLB changes in a multivariant LCS mediation (LCSM) model. The findings showed that (a) in a multivariant LCS model, FLE and FLP increases independently predicted decreases in FLB over time and (b) the growth of FLP acted as a mediator between variation in FLE and FLB. Participants showed interindividual and intraindividual divergences in their L2 emotions, not just on the first time of measurement, but also in short-term dynamics and long-term trajectories. The findings facilitate understanding of the complicated mechanism of variation in L2 emotions, thus potentially contributing to enhancement of pedagogical practices and learning outcomes.

Keywords: CDST; foreign language boredom; foreign language enjoyment; foreign language playfulness; latent change score mediation model

1. Introduction

Positive psychology (PP) serves to help individual communities and societies flourish through encouraging a shift away from the obsession with human weaknesses to understanding, developing, and building human strengths (Derakhshan, 2022; Seligman & Csikszentmihalyi, 2000). When PP found its way into the field of second language acquisition (SLA), it was followed by a line of innovative research on learners' emotions (e.g., Derakhshan, Dewaele et al., 2022; Dewaele, Botes et al., 2022; Elahi Shirvan & Taherian, 2020; Wang et al., 2021). Scholars working on second and foreign language (L2) learners' affective factors found the time ripe for a more holistic approach and concluded that, rather than concentrating primarily on negative emotions, it was

essential to set their sights on positive emotions as well (Derakhshan, Dewaele et al., 2022; Dewaele & MacIntyre, 2014). It was also soon uncovered that teachers can increase L2 enjoyment more easily than reduce anxiety. Furthermore, longitudinal studies suggest that students who experience positive emotions demonstrate greater psychological and cognitive involvement and accomplish greater L2 gains (Dewaele, Botes et al., 2022; Elahi Shirvan et al., 2020, 2021). As a result, both negative emotions, such as foreign language boredom (FLB) and positive emotions, such as foreign language enjoyment (FLE), are currently the foci of empirical investigations.

The association of FLB and FLE has been investigated both in one-shot, cross-sectional studies and in longitudinal perspective (Dewaele, Saito, et al., 2022; Kruk et al., 2022c). What limits previous studies which have mainly focused on the relationship between the two emotions is the lack of research on the role of mediators as mechanisms of change in this relationship. One such potentially important mediator is foreign language playfulness (FLP) because it can serve as a means of (re-)framing a boring condition into an enjoyable, inspiring and amusing one by, for example, employing cognitive reconstruction or imagination (cf. Barnett, 2012). Importantly, the investigation of the dynamic changes within and among L2 emotions requires longitudinal models that can incorporate constant and dynamic variation. *Latent change score* (LCS) models (McArdle, 2009) are flexible enough to address such variation together with linear or exponential variation of variables. LCS models are structural equation models which facilitate exploration of latent constructs which undergo fluctuations in the short and long run. These models can also be extended to shed light on the role of mediators in the dynamic association of emotion-related variables. Such expanded models are called *latent change score mediation* (LCSM) models.

The present study aims to illuminate the mechanisms of variation (e.g., both short- and long-term dynamics) of FLE, FLB, and FLP. It is also intended to analyze the bivariate LCS models of FLE and FLB, and the directionality of variation between these two variables, taking into consideration the way in which FLP mediates the relationship between these two emotions. The findings enhance our understanding of the complex processes underpinning L2 learning emotions, demonstrating how they interact with and affect each other over time.

2. Literature review

2.1. Theoretical foundations of CDST

Investigating emotions in SLA has been significantly influenced by complex dynamic systems theory (CDST). Scholars following this approach commonly assume that affective constructs that are seemingly constant for a long period of

time (e.g., weeks, months) can be subject to considerable change in the short run (i.e., seconds, minutes, days) and that such change may happen at the individual rather than group level (Elahi Shirvan et al. 2020, 2021). Variability, although appearing randomly and being as frequent as "apple pie," offers a rich source of information (Verspoor et al. 2021, p. 1). According to CDST, it is assumed that dependent and independent variables are continuously interacting with each other and are influenced by the context and settings. Thus, a variety of factors interact with each other to create specific patterns that vary through time. This applies in equal measure to the emotions that L2 learners experience in their efforts to master the target language (TL) (Elahi Shirvan et al., 2020).

2.2. Foreign language boredom

Boredom is an affective construct marked by dissatisfaction, attention deficit, disengagement, altered time perception and limited liveliness (Fahlman, 2009). It is often regarded as one of the most prevalently experienced and strongest learner emotions (Pekrun et al., 2010), marked by a loss of interest and reduced involvement in and commitment to learning (Chen & Kent, 2019). A number of theories have been proposed in educational psychology to explain the causes of boredom and these theories have also provided a point of reference for SLA researchers. The under-stimulation theory (Larson & Richards, 1991) emphasizes the boredom-inducing effect of inadequately engaging class activities (e.g., recurrent uninteresting tasks, unchallenging activities). The forced-effort theory (Hill & Perkins, 1985) traces the roots of boredom to limited choices and chances for one's own communicating opinions, resulting from excessive teacher control. The attention deficit theory (Eastwood et al., 2012) attributes the main causes of boredom to reduced attentional control, low degrees of self-awareness and memory lapses. The perceived control and value theory (Tulis & Fulmer, 2013) ascribes the major reasons for boredom to learners' awareness of reduced control over tasks and limited value attached to those tasks. The menton theory (Davies & Fortney, 2012) posits that students are bored as they tend to misuse mental energy units (i.e., mentons). Lastly, the dimensional approach (Pekrun et al., 2010) implies that boredom can have both facilitative and debilitative effects.

The literature has revealed a wide array of variables that influence FLB such as too much teacher control, unchallenging activities, a general tendency to get bored, unsuitable organization and presentation of class activities, problematic goal-setting, and unappealing topics (e.g., Derakhshan et al., 2021a; Pawlak et al., 2020). As a result of the adoption of CDST, emphasis has shifted to changes in the intensity of FLB and its relationship with other variables. Several studies have shown that FLB is a complex, developmental, and multi-dimensional

construct (Elahi Shirvan et al., 2021; Kruk et al., 2021, 2022a, b, c). Individual developmental processes (Kruk et al., 2022a; Yazdanmehr et al., 2021) as well as the potential causes of FLB (Kruk et al., 2022b) have been explored via an individual-oriented method, also referred to as the idiographic position. On the other hand, the variable-oriented method, known as the nomothetic approach, has allowed exploration of the dynamic nature of FLB (Kruk et al., 2021), the longitudinal validity of its measurement scale (Derakhshan et al., 2021b; Elahi Shirvan et al., 2021), and its parallel development with other constructs such as FLE and grit (Derakhshan, Fathi, et al., 2022; Kruk et al., 2022c; Solhi et al., 2023).

2.3. Foreign language enjoyment

The notion of FLE as conceptualized by Dewaele and MacIntyre (2014) is based on PP and the study published by Csíkszentmihályi (1990). Dewaele and MacIntyre (2016) approached FLE as an intricate affective variable that entails the interaction of several aspects of challenge and perceived ability to represent the individual to strive for achievement when confronted with challenging activities. Enjoyment is experienced when individuals find their needs met and go a step further to achieve something new or even unprecedented, thus extending beyond the simple feeling of pleasure (Dewaele & MacIntyre, 2016). Enjoyment is described in terms of valance, ranging from mid-way (small to average FLE) to maximum, positive end of the continuum where FLE turns into an experience of flow. More specifically, FLE can appear both in moderate-arousal tasks including silent reading or writing and high-arousal activities like discussions or oral presentations in class.

Based on CDST (Larsen-Freeman & Cameron, 2008), a number of recent studies have investigated the causes, growth and co-development of L2 FLE in the long run using different statistical procedures (Kruk et al., 2022a, c). The causes and within-individual developmental quality of FLE have been explored via the idiographic approach (Elahi Shirvan & Taherian, 2020). The co-development of between-individual variation in FLE trajectories has been investigated via the nomothetic position (De Ruiter et al., 2019; Dewaele & Dewaele, 2020). Some scholars have also used a mixed-methods approach for the exploration of dynamics of FLE (Dewaele & MacIntyre, 2019).

2.4. Foreign language playfulness

FLP is an individual difference factor that helps individuals frame and reframe everyday routine events so that they can find them amusing, intellectually interesting, and/or individually stimulating (Proyer, 2017). Research has supported a positive association between playfulness in general education and several other

PP variables including satisfaction, creativity, well-being, self-evaluation, and self-esteem (Barnett, 2012; Proyer et al., 2020). Proyer et al. (2020) used modifications of tasks created in online PP intervention research to implement a set of strategies designed to increase playfulness and investigate its influence on self-reported happiness and depressive symptoms. The results of both the immediate and delayed post-tests suggested that all treatments might improve not only various facets of playfulness but also enhance well-being in the short term.

When it comes to playfulness in the SLA domain, Barabadi et al. (2022) investigated the playfulness among EFL learners within the context of Iran. The participants were interviewed about the perceived functions of FLP in their L2 learning. Qualitative content analysis resulted in the derivation of two components of FLP: *other-directed* playfulness (e.g., a tendency to communicate with others playfully by, for instance, minimizing anxiety with the help of humor) and *intellectual* playfulness (e.g., indicating an inclination to play with opinions and to get engaged in complicated and demanding activities, thus prioritizing complexity over simplicity). While this study is an important step in examining FLP in L2 learning and teaching, it is also important to determine how this attribute can be enhanced in the classroom perhaps with the help of the tasks that Proyer et al. (2020) used in the hope of assisting L2 students in regulating their emotions and invigorating their learning experience. Before this can be done, however, it seems warranted to shed more light on how FLP interacts with emotions, a goal that is pursued in the present paper.

2.5. The link between FLB, FLE, and FLP

Since it is hypothesized that emotions mutually affect learning in an academic context, researchers are interested in not only examining L2 emotions alone but also their associations. As for the interaction between FLE and FLB, previous research has substantiated a negative two-directional link between these two emotions. More specifically, Li and Han (2022) addressed the association among foreign language classroom anxiety (FLCA), FLE and FLB. They uncovered a meaningful negative association between Chinese EFL learners' FLE and FLCA, their FLE and FLB, and a statistically meaningful positive association between FLCA and FLB. Comparable trends with a substantial negative association between FLE and FLB, and a strong positive association between FLCA and FLB were reported by Li and Wei (2022). Dewaele, Botes et al. (2022) looked into the relationship among FLE, FLCA, and FLB, the way they were related to several learner-internal and learner-external factors, and their influence on students' FL achievement. The results showed that instructor behaviors positively influenced FLE, with no significant effect on FLB or FLCA. Only FLCA proved to exert a (negative)

impact on learning outcomes. Investigating the longitudinal dynamics of students' FLE and FLB, Kruk et al. (2022a) used LGCM to show the two emotions interactively developed in an online classroom context. The results indicated a strong correlation between the two emotions' rates of development throughout time. The correlation between FLE and FLB was stronger at the developmental level (i.e., slope level) than their initial correlation (i.e., intercept level). The findings also showed a strong relationship between reduced boredom in an L2 online program and emotional involvement (i.e., enjoyment).

Though prior research has examined the correlation between FLE and FLB, there is a shortage of empirical research data that would allow constructing and testing a comprehensive dynamic model to illuminate why and how enjoyment may affect FLB in L2 learning. FLP could act as an important mediator in the relationship between these two emotions as it has the potential to help L2 learners (re-)frame everyday events or boring classroom conditions in such a way that they become enjoyable, motivating and/or appealing experiences (Barnett, 2012). This is because research findings show that individuals who enjoy a high level of playfulness recognize opportunities for leisure and may tend to experience less boredom in comparison to less playful counterparts (Barnett, 2012). Besides, greater playfulness in adults has been correlated with positive emotions and better emotion regulation (Barabadi et al., 2022) as well as the tendency to experience flow (Proyer, 2017). Thus, the present study is motivated by the assumption that more complete understanding of the complex, dynamic interplay of L2 emotions may improve pedagogical efforts and translate into better learning outcomes. In addition, this investigation expands this line of inquiry by employing the LCS method which is characterized in more detail in the following section.

3. The latent change score method

Several researchers have recently started to use the dynamic longitudinal analytic method to trace the dynamic mechanism of different affective factors in and their co-development within language courses in a variety of settings (e.g., Dewaele, Saito, et al., 2022; Kruk et al., 2022a). Examples are cross-lagged panel analyses and growth curve body of research. Although the former present many advantages, such as the capability of evaluating reciprocal and directional effects on variations among variables and controlling for autoregressive effects at the same time, they neglect growth over time as only covariances, and not mean structures, are included in the models (Hamaker et al., 2015). The latter studies have investigated temporal changes of L2 affective constructs (Elahi Shirvan, Yazdanmehr, et al., 2021; Kruk et al., 2022c). Despite the advantages of growth modeling processes, these models fail to explain the effect of prior conditions on further

development (i.e., autoregressive impacts) within or between systems. Therefore, such models are still not capable of answering main questions about relevant forms of mutual growth over time (e.g., decrease or increase of growth). In other words, the existing research on L2 affective variables has addressed the *quantity* or *degree* of growth of L2 affective variables; yet, there is still a need for evaluating the *quality* or *pattern* of growth of these variables to fully describe their development.

LCS models represent a common means of investigating dynamics in longitudinal studies. Such models describe mechanisms through which short-term development has explicit and implicit effects on the patterns of the system in the long run (McArdle, 2009). LCS models mix several dimensions of autoregressive and *latent growth models* (LGMs; McArdle, 2009). The LCS approach facilitates the measurement of within-individual variation between two or more points of time as the target outcome by developing latent constructs that reflect the variation in true scores between the two measurement times, $t - 1$ and t (Hilley & O'Rourke, 2022).

The intercept in LCS models displays the initial true scores, which indicate each person's starting point for the desired longitudinal construct. An LCS model consists of components for change (Grimm et al., 2006). The constant change component, also called the slope or additive component parameter, is best understood when variation is linear and stable across time. The latent variable with stable change may function as a predictor or outcome in more complicated models (Cancer et al., 2021). The proportional change component, or self-feedback parameter, is the second variation component which reflects acceleration across time (Grimm et al., 2006). The LCS model's major advantage is related to the proportional variation component, which enables the investigation of nonlinear variation by examining how the past values of a construct affect the impending change (Grimm et al., 2006). Due to the incorporation of both constant change and proportional change components, LCS models are called dual change score models (Grimm et al., 2006). By employing dual change parameters, it is feasible to concentrate on both the quality or pattern of growth and the quantity or degree of growth.

LCS models can be categorized into two types (Grimm et al., 2006). The first type is the *univariate LCS model*. Here only one construct is evaluated and modeled repeatedly throughout time (Hilley & O'Rourke, 2022). The second type is the *multivariate LCS model*, which is an extension of the univariate model and may account for changes in more than one construct over time. One benefit of the multivariate model is the incorporation of change parameters from each univariate model to be an outcome or a predictor. As a result, it is feasible to incorporate pathways between the t – 1 latent levels of one construct and the latent change between t – 1 and t of another construct. This effect is described as the coupling effect (McArdle, 2009) and it provides an estimate of the extent

to which a change in one variable's trajectory on a prior occasion is influenced by a change in that variable's level on a later occasion.

In sum, by incorporating the benefits of autoregressive cross-lagged panel analyses and growth models, LCS models offer a holistic foundation to model both within- and between-person variability in development (Grimm et al., 2006). Specifically, LCS models incorporate constant and proportional change parameters that might be crucial for grasping the overarching rate of change and variations in the rate of change across the parallel developments, respectively (Cancer et al., 2021). This allows modeling complex patterns of change. Using LCSM, we scrutinized the dynamic mechanisms through which FLE and FLP are associated with FLB.

4. Current study

To evaluate the dynamic developmental interrelationship of FLE, FLB and FLP, this research used multivariant LCSM models to assess the dynamic parallel growth of FLB and FLE at four times of measurement while also explaining the mediational effect of the development of FLP over time. In particular, we measured whether the growth of FLE acted as a mediator between variation in FLP and FLB, or, alternatively, whether FLP growth acted as a mediator between variation in FLE and FLB. Therefore, we addressed the following research questions:

1. What are the degrees (decelerating or accelerating) and patterns (decreasing or increasing) of trajectories for FLE, FLB and FLP within latent processes?
2. What are the short-term dynamics and long-term developmental trajectories for FLE, FLB and FLP within latent processes?
3. What are the short-term dynamics and long-term developmental trajectories between latent processes?
4. How do the trajectories of FLE and FLP influence trajectories of FLB via longitudinal mediation analysis?

4.1. Methodology

4.1.1. Participants and setting

661 (412 females and 249 males) university students, foreign language learners, in general English courses from three Turkish universities in two major Turkish cities (N = 151) and three Iranian universities in three major Iranian cities (N = 510) participated in this study via convenience sampling. The general English

course was a three-credit unit including 24 sessions which began in February 2022 and ended in May 2022. Participants' language proficiency, as determined by the Oxford Placement Test, varied from lower-intermediate to upper-intermediate, and their age was in the range of 18 to 32.

In accordance with Hair et al. (2010), we used the mean values to impute the missing data for the participants on four measurement occasions with a response rate of at least 90%. The responses of 16 participants were disregarded because they had missed two of the four rounds of data collection. We employed the boxplot approach to identify outliers and extreme values. Any number that deviated significantly from the norm by more than three interquartile ranges was regarded as an extreme outlier (Hoaglin & Iglewicz, 1987). After screening the data on four measurement occasions, we detected three participants with outliers for FLE, four with outliers for FLP and two with outliers for FLB and eliminated them for final analysis. As a result, the analysis was done on data from 636 respondents (398 females and 238 males). The final sample size for the current study was deemed adequate to reach 0.80 power to identify a large effect size using longitudinal mediation analysis (see Pan et al., 2018). Due to the nesting of learners within universities and classrooms, an analysis of intraclass correlations (ICC) revealed a minimal degree of class-level dependency of data (0.02-0.06). Hence, multilevel analysis was not necessary.

4.1.2. Instrumentation

4.1.2.1. *Boredom in Practical English Classes-Revised (BPELC-R) Scale*

The scale was developed by Pawlak et al. (2020). It consists of 23 items on a 7-point Likert scale (1 = "I totally disagree" and 7 = "I totally agree") representing two sub-factors, *disengagement, monotony and repetitiveness* (14 items, e.g., "It would be very hard for me to find an exciting task in language classes") and *lack of satisfaction and challenge* (9 items, e.g., "I often have to do repetitive or monotonous things in my language classes").

4.1.2.2. *Short Form Foreign Language Enjoyment Scale*

The 9-item scale was developed by Botes et al. (2021) and is an abridged version of the initial 21-item tool constructed by Dewaele and MacIntyre (2014). The constituent factor structure of the questionnaire involves a global FLE factor and three subfactors, including *personal enjoyment* (three items, e.g., "I enjoy my FL class"), *social enjoyment* (three items, e.g., "There is a good atmosphere in my FL classroom"), and *teacher appreciation* (three items, e.g., "My FL teacher is

encouraging"). Items were rated on a five-point Likert scale ranging from "totally disagree" to "totally agree."

4.1.2.3. *Foreign Language Playfulness Scale*

This 10-item scale was originally developed by Shao et al. (2022) to assess L2 FLP (see Appendix). This scale was evaluated by three applied linguists and one emotion psychologist. They were asked to (1) ascertain whether each item measures playfulness in the context of L2 learning, (2) judge whether each item is suitably worded, and (3) select one of the factors to which an item belongs. The scale is comprised of two constituent constructs of playfulness: *other-directed playfulness* (five items, e.g., "I can use my playfulness to do something nice for my language classmates") and *intellectual playfulness* (five items, e.g., "I can always think of delightful things to do in the language class"). A seven-point Likert type scale varying from "totally agree" to "totally disagree" was employed to rate the items.

In order to verify the FLP's factor structure in the current study, we initially used confirmatory factor analysis (CFA) with Mplus 7.4. (Muthen & Muthen, 2013). We evaluated different CFA models for subjects at Time 1 (N = 661). Because the main concern of this study was the global factor of FLP, as opposed to specific factors, it was crucial to consider the global levels of FLP while correspondingly considering the dimensionality of the construct. Hence, we assessed three CFA models:

- Model 1: Unidimensional CFA model of global FLP (see Figure1A in supplementary materials)
- Model 2: Correlated two first-order CFA model including other-directed playfulness and intellectual playfulness (see Figure 1B in supplementary materials)
- Model 3: Bifactor CFA model of global FLP (see Figure 1C in supplementary materials).

The standardized factor loadings and standard errors were used to assess the degree of reliability for the various factorial models. Additionally, the average variance extracted (*AVE* >.50, Kline, 2015) and McDonald's omega coefficient of composite reliability (ω > .70, Morin et al., 2020) were employed to evaluate factor level reliability for the best fitting model of the construct of FLP. Furthermore, item representation of the linked factor was estimated using the corrected item-total correlations (CITC), which reflects each item's unique association with the general factor. According to Zijlmans et al. (2019), an item properly represents the overall factor on which it was described if the CITC score is more than 0.30.

In addition, explained common variance (ECV) and the item level ECV (IECV) were supplied to assess the item level reliability (Dueber, 2017). ECV is a

measure of statistical reliability that provides information on the proportion of the common variance that can be described by the global latent component. Furthermore, IECV serves as a measure of unidimensionality at the individual item level by indicating the extent to which an item's responses can be described exclusively by changes on the latent global construct (Stucky et al., 2013, p. 51). IECV values greater than .80 indicate a unidimensional general factor. Thus, IECVs smaller than .80 were interpreted as providing support for the multidimensionality of the FLP scale.

The results indicated that first-order and unidimensional CFA models did not adequately fit the data but a bi-factor structure model with a global FLP component and two specific factors (i.e., *other-directed playfulness* and *intellectual playfulness*) was supported to be the best model fit (see Table 3 in supplementary materials). Also, the findings showed a well-defined bifactor CFA of FLP with meaningful factor loadings (λ >.35). Moreover, item uniqueness met expectations (δ > 0.10 but .9). Table 1 provides the reliability information of the three scales in the current study.

Table 1 Reliability of the scales in four time-occasions

Scales/subscales	Number of items	ω				A			
		T_1	T_2	T_3	T_4	T_1	T_2	T_3	T_4
BPELC-R	23	.93	.92	.92	.94	.91	.89	.89	.91
FLE- short form	9	.89	.90	.90	.90	.87	.88	.87	.88
Foreign language playfulness	10	.88	.89	.89	.88	.86	.87	.87	.86

4.1.3. Data collection

The first round of data collection took place at the start of the course in February 2022. The second, third, and fourth administration of the questionnaires occurred in March, April, and May of 2022, respectively. The participants expressed their agreement to take part in the study and received assurances about the confidentiality of the information they gave.

4.1.4. Data analysis

4.1.4.1. LCS analyses

Mplus 7.4. was used to run all LCS analyses (Muthen & Muthen, 2013). Both univariate and multivariate normality tests were run for the data. The dynamic co-development of the three variables was examined using multivariate LCSM models, which assisted in modeling the dynamic trajectories of the variables taking into account within-person variation and between-person variation over time.

4.1.4.2. Model fit

Model fit was tested sequentially according to Grimm et al. (2006). Given the fact that the χ^2 evaluation is highly sensitive to the sample size (Browne & Cudeck, 1992), other fit metrics were also used. These include Tucker Lewis Index (TLI; Tucker & Lewis, 1973), Comparative Fit Index (CFI; Bentler, 1990), and Root Mean Square Error of Approximation (RMSEA; MacCallum et al., 1996). An adequate model fit was represented by TLI and CFI values > .90, and RMSEA < .08 (Hu & Bentler, 1999). To compare different nested models, we evaluated overall model fit criteria, using $\Delta\chi^2$ and ΔCFI. If the *p* values of $\Delta\chi^2$ are significant and the value of ΔCFI is more than .010, we can conclude that the differences is statistically meaningful. The following LCS models for FLE, FLB and FLP were separately tested to compare fit among the possible models:

- Model 1: A *no change model*. It assumed no change over time.
- Model 2: A *constant change model*. It assumed a linear change over time (similar to the slope factor in growth curve analysis).
- Model 3: A *proportional change model.* Development was assumed as a function of the prior levels of the variables under investigation. It was intended to capture how variations in the system between adjacent measurements were determined by the variable level at the preceding phase.
- Model 4: A *dual-change model.* It included a combination of constant and proportional change parameters to identify the extent to which linear change was accelerated or decelerated by the same or another construct's level at the preceding phase.

The analyses provided support for the dual change model as the best univariate model for ELE, FLP, and FLB compared to their constant change model and proportional change model. Thus, it could be concluded that proportional and constant models could better represent variation of three variables over time.

After testing different univariate models for FLE, FLP, and FLB separately, a bivariate model assessed the coupling impacts in the FLE and FLB co-development over time:

- Model 1: *No coupling model.* It restricted all FLE and FLB coupling parameters to zero and acted as a baseline with no cross-variable or time-sequential relationships.
- Model 2: *Unidirectional FLE model.* It assumed that variation in FLE predicted variation in FLB in a unidirectional way.
- Model 3: *Unidirectional FLB model.* It assumed that variation in FLB predicted variation in FLE in a unidirectional way.

- Model 4: *Full coupling model.* It jointly estimated FLE and FLB variation to assess whether FLE and FLB each anticipated change in the other variable in a bi-directional way.

Model fit comparison showed a statistically meaningful improvement in fit indices from the uncoupled to the bidirectional coupled model. In other words, variations in FLE through time caused subsequent variations in FLB and vice versa.

Lastly, after evaluating the bivariant model, the mediation model was tested in two ways: first, with FLE as a mediator in the relations between variation in FLP and FLB, and, second, with FLP as a mediator in the relations between variation in FLE and FLB. Comparing model indices showed a significant rise in fit from FLE as a mediator for FLP→FLB to FLP as a mediator for FLE→FLB ($\Delta\chi^2(1) = 350.772$, $p < .001$; ΔCFI = .151). Thus, the findings of the mediation models clearly showed that FLP is a mediating mechanism for the longitudinal correlation between FLE and FLB, while FLE is not a mediating mechanism for the longitudinal relationship between FLP and FLB.

4.1.4.3. Measurement invariance over time

To ensure that comparisons of latent variables are reliable over time, it is crucial to verify the invariance of measurement models (Wickrama et al., 2021). Thus, we evaluated the latent variables' configural, weak and strong invariance in unidimensional and mediational LCS models across the four measurement points. The results indicated that weak and strong invariance models did not significantly change the fit for unidimensional and mediational LCS models. Differences in CFI, TLI, RMSEA, and SRMR were smaller than proposed cutoff ranges (ΔCFI ≤ 0.010, ΔRMSEA ≤ 0.015, and ΔSRMR ≤ 0.030, Cheung & Rensvold, 2002). In other words, the findings provide support for measurement invariance for all models across time.

4.1.4.4. Test of mediation

We generated confidence intervals for the *ab*, as the product of the *a* [coupling FLE→FLP], and *b* [coupling FLP→FLB] paths to assess mediation. Because the product of a and b has a nonnormal distribution, asymmetric confidence intervals were developed using Monte Carlo methods including bootstrapping (see MacKinnon et al., 2007). According to latest studies, the percentile bootstrap approach to developing confidence intervals for mediation with structural equation models considers the possible correlation between *a* and *b* and has a desirable balance of power and Type I error (Valente et al., 2016). We used these confidence intervals for the indirect effect *ab* alongside the joint significance assessment in the current study.

4.2. Results

4.2.1. Univariant latent change score models

Regarding the first and second research questions, estimations of different parameters from the FLE multivariate dual change model are illustrated in Figure 1. The initial FLE showed a positive trend through the passage of time (i.e., the mean initial true score of FLE was 1.478 and the mean constant change for FLE was .292). A significant change was found in initial mean values showing learner variations in initial states for FLE ($\sigma_{I\text{-}FLE}$ = .252, p < .001). Besides, there was a significant between-person change in growth of FLE over time ($\sigma_{S\text{-}FLE}$ = .009, p < .001). The initial true score and constant variation of FLE covaried significantly and negatively ($\sigma_{S\text{-}FLE/I\text{-}FLE}$ = -.608, p < .001). This means that learners with higher FLE initial true scores were predicted to have lower continuous variation in FLE over time and significant individual differences were found in these patterns. Self-feedback parameter proved to be negative and significant (β_{FLE} = -.252, p < .001), which points to a deceleration of FLE over time. To summarize, FLE increased through time but this increase decelerated at each respective wave.

As for FLB, a decreasing pattern through time (i.e., the mean initial FLB true score was 3.633, and the mean constant change in FLB was –.246) was identified. Significant variation was found in the initial mean values of FLB, pointing to the impact of individual differences in relation to this construct ($\sigma_{I\text{-}FLB}$ = .135, p < .001). Besides, significant between-person variation was revealed in the growth of FLB through time ($\sigma_{S\text{-}FLB}$ = 005, p < .001). More specifically, the initial true score and constant change of FLB positively and significantly covaried ($\sigma_{S\text{-}FLB/I\text{-}FLB}$ = .594, p < .001). That is to say, learners with lower initial true FLB scores were also expected to have lower constant FLB change, and significant individual differences were found in these patterns. Self-feedback parameter was negative and significant (β_{FLB} = –.271, p < .001), which shows the slowing of FLB deceleration through four times of measurements. The positive proportional change parameter alongside the negative slope mean showed that FLB decreased over time, and this decrease tended to decelerate.

As regards FLP, the mean initial true score was 2.184, and the mean constant change was .215, which indicates a positive trend in FLP through time. There was a significant change in initial mean values pointing to intraindividual variation in FLB initial values ($\sigma_{I\text{-}FLP}$ = .113, p < .001). Besides, there was significant between-person variation in the growth of FLP over time ($\sigma_{S\text{-}FLP}$ = .005, p < .001). Moreover, the covariance between the initial true score and constant change was significant and positive ($\sigma_{S\text{-}FLP/I\text{-}FLP}$ = -.473, p < .001); those with higher FLP initial true scores were also expected to have a higher constant variation in FLP. Self-feedback parameter was negative and significant (β_{FLP} = -.158, p < .001),

showing a reduced speed of FLP throughout the term. FLP was predicted to rise over time, with this increase decelerating at each measurement point.

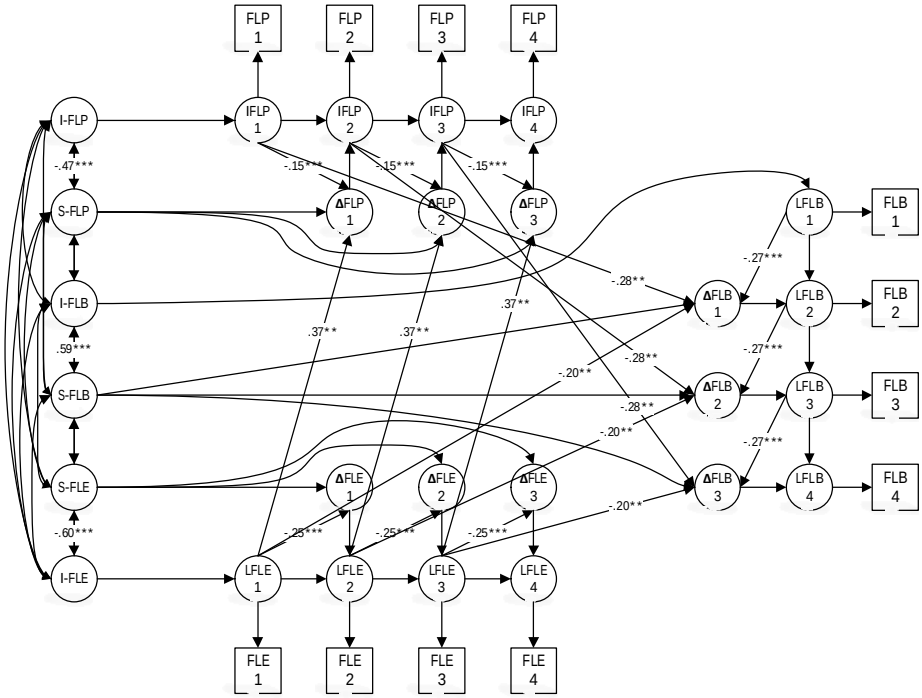

Figure 1 LCSM model of FLE predicting FLB, mediated by FLP. Unlabeled paths are set at 1. FLE: foreign language enjoyment, FLP: foreign language playfulness, FLB: foreign language boredom, I: Intercept, S: Slope. *p < .05, **p < .01, ***p < .001

4.2.2. Latent change score mediation analysis

Coupling parameters were utilized to describe each of the mediation pathways, including a, b, and c'. Findings (see Table 2 and Figure 1) indicated that earlier levels of FLE positively anticipated a subsequent increase in FLP (i.e., coupling from FLE to FLP; a =.373, p = .001), and they significantly predicted further decrease in change in FLB over time (i.e., coupling from FLE to FLB; c' = -.207, p = .001). Earlier FLP levels had a substantial impact on the prediction of the subsequent decrease in FLB (coupling between FLP and FLB; b = -.288, p = .001). In other words, utilizing joint significance analysis, earlier levels of FLE significantly predicted subsequent development in FLP, and earlier states of FLP significantly predicted subsequent dynamic trajectories in FLB. The 95% percentile bootstrap confidence interval of the product of the coupling parameters ab likewise did not include zero, 95% CI = [0.03, 0.05], showing the existence of mediation and verifying the findings of the joint significance analysis.

Table 2 Estimates from the LCSM Model with FLP as mediator

Parameter	Estimate	SE	95% CI
Univariate information for FLE			
Mean			
$\mu_{I\text{-}FLE}$	1.478***	.038	[1.384 – 1.551]
$\mu_{S\text{-}FLE}$	.292***	.091	[.276 – .322]
Variance			
$\sigma^2_{I\text{-}FLE}$	.252***	.041	[.241 –.273]
$\sigma^2_{S\text{-}FLE}$	.009***	.005	[.004 –.011]
Constant change			
$\sigma_{S\text{-}FLE/I\text{-}FLE}$	-.608***	.029	[(-.594) – (-.621)]
Proportional change			
β_{FLE}	-.252***	.034	[(-.256) – (-.302)]
Univariate information for FLP			
Mean			
$\mu_{I\text{-}FLP}$	2.184***	.041	[2.071 – 2.314]
$\mu_{S\text{-}FLP}$	.215***	.164	[.207 – .234]
Variance			
$\sigma^2_{I\text{-}FLP}$	.113***	.036	[.108 – .129]
$\sigma^2_{S\text{-}FLP}$	.005***	.004	[.004 – .007]
Constant change			
$\sigma_{S\text{-}FLP/I\text{-}FLP}$	-.473***	.051	[(-.456) – (-.482)]
Proportional change			
β_{FLP}	-.158***	.043	[(-.139) – (-.212)]
Univariate information for FLB			
Mean			
$\mu_{I\text{-}FLB}$	3.633***	.032	[3.358 – 3.868]
$\mu_{S\text{-}FLB}$	-.249***	0.152	[(-.212) – (-.277)]
Variance			
$\sigma^2_{I\text{-}FLB}$	.135***	.026	[.112 – .143]
$\sigma^2_{S\text{-}FLB}$	.005***	.004	[.003 – .007]
Constant change			
$\sigma_{S\text{-}FLB/I\text{-}FLB}$	.594***	.033	[.577 –.612]
Proportional change			
β_{FLB}	-.271***	.023	[(-.244) – (-.311)]
Mediation portion			
a [coupling FLE → FLP], (constrained to be equal through time)	.373**	.038	[.341 – .395]
b [coupling FLP → FLB], (constrained to be equal through time)	-.288**	.011	[(-.233– (-.296]
c' [coupling FLE → FLB], (constrained to be equal through time)	-.207**	.012	[(-.297) – (-.322)]
ab (product of *a* and *b*)	.18***	.005	[(.101) – (.227)]

Note. LCSM: latent change score mediation, 95% CI: bootstrap confidence interval, *SE*: standard error, FLE: foreign language enjoyment, FLP: foreign language playfulness, FLB: foreign language boredom, I: Intercept, S: Slope. ***p* < .05; ****p* < .01; *****p* < .001

5. Discussion

With respect to the first and the second research questions, the analysis allowed identification of several mechanisms of change in long-term associations of FLB, FLE and FLP. One such mechanism was the between-person variability within latent processes of the three variables. The results indicated two sources of between-individual variability: (1) the initial level, which encompasses the mean

and variance in the latent level at T_1 and (2) the additive component, with mean and variance in the subsequent waves. Specifically, we considered the variances of the initial level and additive component in the models, permitting learners to start from different baselines and trend toward variation (see Figure 2). As for FLE and FLP, the results indicated general growth over time. The variation (see Figure 2, A and B) of FLE and FLP decreased over time as it was continually multiplied by the negative self-feedback component. As regards FLB, the results indicated a general reducing trend over time. Also, the variation of FLB decreased over time (see Figure 2, C) as it was continually multiplied by the negative self-feedback component, meaning that individual trajectories converged over time. Thus, it can be concluded that initially, the levels of FLE, FLP, and FLB differed substantially among participants, but eventually they tended to converge.

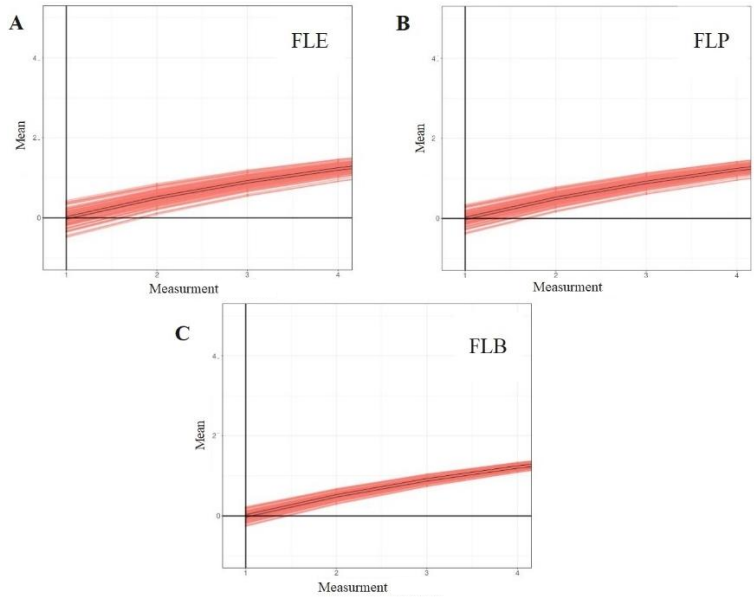

Figure 2 Inter-individual trajectories for the variance of additive component for FLE(A), FLP (B) and FLB (C) univariate LCS models

Embedded in the response to the first and second research questions, the convergence of inter-individual variation of the three variables over time can be discussed in relation to the concept of emotion contagion according to which students receive feelings from each other (Hatfield et al., 1994). Investigations of emotion contagion have shown that exposure to positive and negative emotional expressions can induce changes in the observer's emotional state. Such emotional states appear unconsciously and are stimulated by contextual cues which exert distinctive effects on an individual's mood (Berntsen, 2007). With respect to the present findings, it can be

postulated that L2 emotions are noticed and transferred from one learner to another through verbal and nonverbal signals (e.g., gestures, facial expression, postures, and vocalics) over time. This assumption is also supported by the findings of Elahi Shirvan and Talebzadeh (2020), which indicate that the emotional states in learning a foreign language are automatically conveyed to other learners via their facial expressions, posture, movement, and vocalization in their L2 interactions.

Another mechanism of change in long-term associations of FLB, FLP, and FLE was within-person variability within latent processes of the three variables. This variability was reflected in the covariance between intercepts and slopes of FLE, FLP, and FLB. Participants with lower initial FLE and FLP levels were more likely to undergo change than those with higher initial FLE and FLP levels. On the other hand, participants with lower initial FLB level manifested less change than those with higher initial levels of FLB. As can be seen in Figure 3 showing intraindividual variation in the trajectories of the three variables over time, the self-feedback parameters of these variables were negative. This indicates that participants with higher FLE, FLP and FLB at t - 1 manifested smaller variation at time t compared to participants with lower FLE, FLP and FLB. Since this trend was stable over time, it can be interpreted that all learners exhibited smaller developmental variation with the passage of time. This resulted in long-term fluctuations, where rapid progress in FLE, FLP and FLB in the initial language course was accompanied by a gradual deceleration. In this study, more negative self-feedback values for FLB, compared to those of FLE and FLP, is interpreted as a faster rate of decline in FLB.

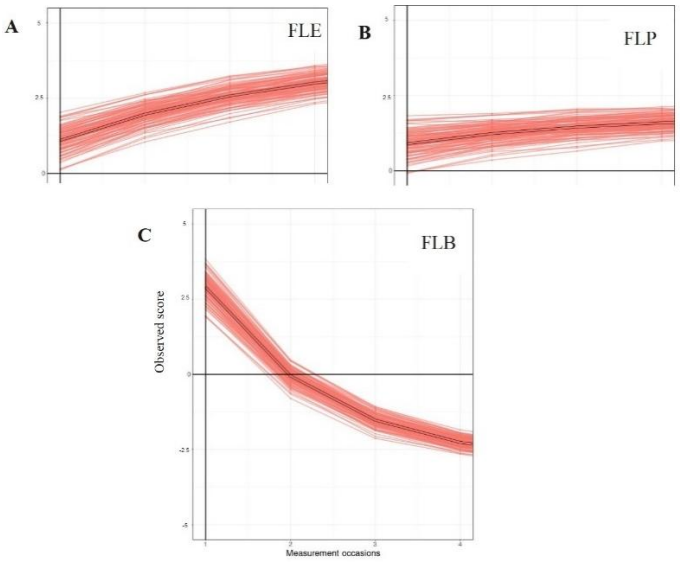

Figure 3 Within-individual trajectories for the mean additive component of FLE(A), FLP (B) and FLB(C) univariate LCS models

In light of CDST, these inter- and intra-individual variations imply a noticeable feature of the dynamic system of these variables from a developmental point of view (van Dijk & van Geert, 2023). In particular, they represent a prominent indicator of their complexity under the influence of their multi-causal nature.

Such findings underscore the importance of applying a modeling framework that allows for individual variation in developmental trajectories. By using the LCSM models, we revealed that, on average, participants were changing in a systematic manner. At the same time, however, there was interindividual variation around the mean score of change. Specifically, the intraindividual variations within interindividual differences of the variables over time show that the early condition of an affective construct such as boredom, playfulness, or enjoyment does not predict the extent of variation of the construct over time. Therefore, it can be argued that no matter what the level of affective states is at each time point, the growth levels of these states can change in different directions at other time points. One major factor contributing to the development of learners' affective states is the teacher's behavior (Dewaele & Dewaele, 2020; Elahi Shirvan et al., 2020). In fact, such teacher behaviors as interest, approachability, and supportive manner have been revealed to be positively associated with learners' positive affective variables such as enjoyment and negatively with negative emotions like boredom (Elahi Shirvan et al., 2020; Goetz et al., 2014). In addition, Dewaele and Li (2022) demonstrated through a mediation analysis that teacher enthusiasm was positively associated with FLE and negatively with FLB.

With respect to the third research question, the mechanisms of change in the three variables incorporated their short-term and long-term between-latent processes. The short-term between-latent processes of the three variables were reflected in the coupling parameters (a, b, and c). It should be noted that, like the self-feedback parameters, positive (or negative) couplings implied that higher levels in one construct resulted in greater (or slighter) changes occurring subsequently in other constructs. That is, the positive coupling between FLP and FLE showed that larger values in FLE resulted in more subsequent variation in FLP. On the other hand, the negative coupling between FLE and FLB as well as FLP and FLB showed that larger values in the FLE and FLP led to lower subsequent changes in FLB.

Concerning the long-term between-latent processes of the three variables, as measured by the constant interaction between self-feedback parameters (β) and the couplings parameters (a, b, and c), the long-term trajectory patterns of the link between FLE and FLP were revealed to manifest a decelerated growth pattern (see Figure 4). Furthermore, the long-term trajectory patterns of the association between FLE and FLB and the relationship between FLP and FLB turned out to be decelerated decline patterns (see Figure 4).

Besides, the present results showed that both mechanisms of development in FLE and FLB affected each other through time. This indicates a bidirectional as

well as mutually reinforcing relationship and nonlinear interactions between the developmental processes of the two variables over time. This finding can be regarded as confirmation for the conceptualization of the two emotions in terms of complex dynamic systems. This is quite consistent with CDST principles as researchers are invited to conceptualize varying developmental relationships among variables in terms of dynamic procedures rather than investigating unidirectional and/or linear influences from predictors to outcomes. Importantly, the negative association of FLE and FLB over time is in line with the findings of a study of the link between the two variables over time conducted by Kruk et al. (2022a).

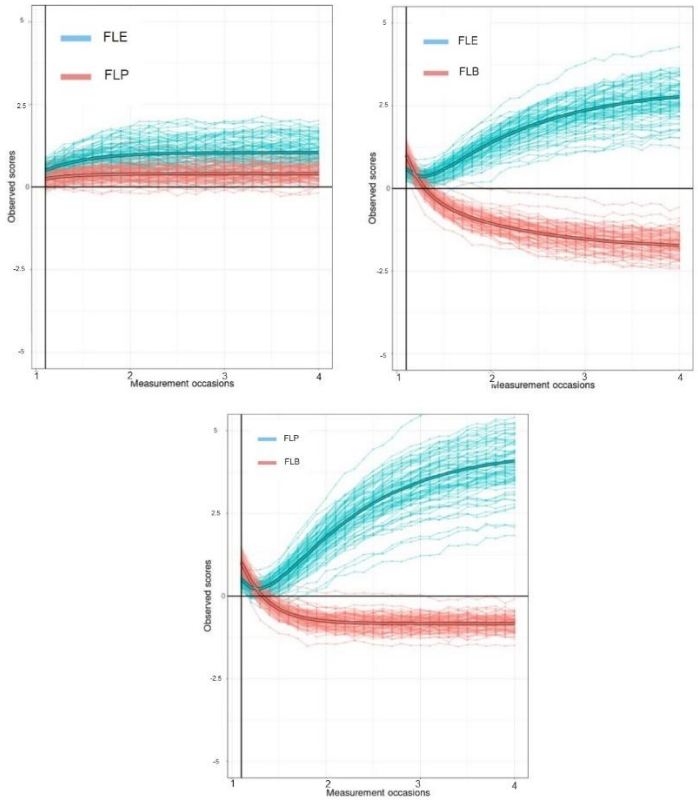

Figure 4 Trajectories from a Multivariate LCS model for the relationship between FLE and FLP, between FLE and FLB, and between FLP and FLB

Finally, regarding the fourth research question, the results of mediation analysis showed that FLP explained the statistically significant total effect of FLE on FLB. This indirect mediation needs special attention as it sheds light on resources enabling L2 learners to change their negative emotions to positive ones. Based on the findings, a main resource for promoting FLE and, at the same time,

lowering FLB is playfulness (Barabadi et al., 2022). According to the attention deficit theory (Eastwood et al., 2012), the primary sources of boredom can be associated with poor attentional control and lapses in memory. Given the salient role of playfulness as a mindset allowing a change of boring situations into enjoyable ones, it would seem that providing a playful context for L2 learning can be an important tool for increasing learners' attentional control over the task in hand. After all, as indicated by Dewaele, Saito, et al. (2022), constructing a positive emotional classroom climate plays a pivotal role for heightening FLE and lowering FLB. In this study, the ability to actualize their playfulness with respect to its intellectual and other-directed dimensions over time allowed participants to enhance the emotional climate of the classroom by making it more positive. FLP seems to have played a salient mediating role in accounting for the relations between FLE and FLB, possibly because the participants tended to experience less FLB and more FLE as their FLP level increased. As pointed out by Barabadi et al. (2022), the provision of a playful learning environment can be specifically needed for providing L2 learners with more chances of positive emotional experiences.

The long-term moderate negative association between FLE and FLB mediated by FLP can also be discussed in light of the control-value theory (Pekrun, 2006), which posits that the major reasons for boredom are learners' low appraisals of control over tasks and value attributed to those tasks. The learners' experience of boredom over time can be interpreted in terms of these two factors. It can thus be conjectured that the increase in participants' playfulness might have provided them with more perceived control over the classroom tasks and activities and resulted in more positive values attached to them. Put differently, students who displayed positive attitudes toward classroom tasks via the increase in their other-directed and intellectual playfulness were more successful in gaining more control over these tasks. In effect, they experienced a decrease in FLB and a rise in their FLB.

6. Conclusion

In CDST, dynamicity is approached in terms of constant interlinks among all constituent parts of a system as it unwraps over time (Hiver & Al-Hoorie, 2019; Verspoor et al., 2021) and the observed variations are reflected as contingent on the prior conditions of the system (Hiver & Al-Hoorie, 2019; Verspoor et al., 2021). Considering L2 affective development in language classes, the multivariate repeated measures used for the participants can be perceived as dynamic systems wherein variations are at least partly specified by the previous states of the systems (Lowie & Verspoor, 2019). To explore the developmental and multivariate quality of dynamic processes of L2 affective variables, appropriate statistical models are required to represent the process in which previous phenomena

have prospective outcomes and the processes of variation can be constantly influenced by external and internal factors. LCS models used in the current study are flexible and adaptable enough to examine developments in longitudinal investigations (Cancer et al., 2021; Hilley & O'Rourke, 2022). On the whole, the findings showed that the quantity (i.e., the decreasing and increasing trend) and quality (i.e., the acceleration and deceleration of rate of change) of one L2 affective variable can increase the patterns of change of other related affective variables over time. These results confirm the importance of adopting a holistic perspective on the mechanisms of change in the exploration of the co-development of L2 affective variables since both the constant and proportional change in one variable influences change in other variables over time.

This study can serve as a basis for pedagogical implications as it provided evidence for the importance of FLE and FLP developmental trajectories in reducing FLB. This might sensitize L2 practitioners to the need for providing different playful recourses in classroom environment (e.g., games, puzzles, problem-solving communicative tasks). The study is also theoretically informative in two ways. First, it offers implications for theorizing intra- and inter-individual differences in the developmental processes of FLE, FLP and FLB as well as short- and long-term consequences of these differences. Second, findings from the LCSM model based on the incorporation of FLP changes in the explanation of the co-development relationship between FLE and FLB can lead to theory development based on illuminating mechanisms of change in these emotions.

The study is not free from limitations. First, the one-month-interval design did not permit us to explore the impact of changes in FLE, FLP and FLE over longer periods of time (e.g., years). Future research should consider such timescales in the investigation of the between- and within-latent processes of these variables. Second, the coupling *a*, *b*, and *c* pathways as well as self-feedback parameters used in the LCS models were fixed to be equal in four waves. It should be noted, however, that these pathways could be freely estimated. In this case, the models would then offer different estimations of the mediation paths. This approach might not be representative in some circumstances, and various recent methods allow the consideration of the free estimations for the coupling and self-feedback parameters.

Based on the LCSM models, further empirical investigations in the domain of positive psychology in SLA can explore mechanisms of change in other variables. For example, in line with previous research (Elahi Shirvan et al., 2020), future empirical investigations should evaluate the extent to which L2 learners' emotions are influenced by teacher-related factors such as emotional intelligence, supportive behaviors or feedback. Moreover, future studies using LCSM could include other learner-related variables such as the learner's growth mindset, grit, and need satisfaction.

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APPENDIX

Foreign language playfulness scale

F1: Intellectual playfulness

1. Classroom discussion should involve an exchange of delightful ideas.
2. If I want to develop a new language idea, I like to do it in a playful manner.
3. If I have to learn new things under time pressure, I try to find a playful learning approach.
4. I can always think of delightful things to do in the language class.
5. I enjoy language learning activities when the rules allow for something curious, unpredictable, playful, or surprising to happen.

F2: Other-directed playfulness

6. I have language classmates with whom I can just fool around and be silly.
7. I like to play good natured, funny tricks on my language classmates.
8. I can use my playfulness to do something nice for my language classmates.
9. I enjoy re-enacting things I have experienced with my close classmates (e.g., a funny incident that we like to remember).
10. I can use English to express myself to my classmates in a playful way (for example, by cracking a joke).

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