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Latent Profile Analysis for the Investigation of Emotional Factors in Second Language Acquisition

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Abstract

Exploring L2 affective variables requires innovative research analytic approaches that can adequately address the complexity and dynamicity of the variables. Not always can the normality of distribution and linearity of relationships be assumed. Neither can the homogeneity of variance be always met. Latent profile analysis (LPA) is suggested to deal with the heterogeneity of data and non-linear relationships. It allows for hypothesis testing and model testing to tackle the ergodicity issue in second language acquisition (SLA) research from a person-centered approach. LPA, which primarily serves to classify a population or sample into several sub-groups, can be effectively employed in SLA research to classify L2 teachers or learners in terms of the different positive and negative emotions (e.g., enjoyment, boredom, anxiety, etc.) they experience while learning a foreign or second language. A classroom-based L2 learning experience occurs interactively with several personal and contextual variables involved. The relationship between any single affective variable can hardly be conceived as linear. Thus, LPA holds promises for dealing with these non-linear relations and provides insightful information about the profiles of learners or teachers concerning a particular affective variable. The purpose of this conceptual analysis is to provide a review of the basic tenets of LPA and to explain how it can contribute to the exploration of emotional variables in SLA. By identifying distinct emotional profiles, the study offers guidance on tailoring instructional strategies to address the specific emotional needs of language learners, thereby enhancing the effectiveness of language acquisition interventions.

Keywords: affective variable, ergodicity issue, latent profile analysis, person-centered approach, second language acquisition

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1. Introduction

One of the most common approaches to investigating L2 emotional variables is variable-centered approach, which is based on mean estimation collected from groups of learners. However, applying this approach has a serious issue since the mean of an affective variable is not generalizable to the individual learner (Alamer & Lee, 2021; Derakhshan & Fathi, 2024; Massaro, 2023; Wirtz & Pfenninger, 2023; Wang & Reynolds, 2024). Indeed, heterogeneity of data as well as the non-linear and bidirectional interplay between individual and environment build up limitations for interpreting the association between affective variables based on the variable-centered approach (Lowie & Verspoor, 2019; Molenaar, 2013; Van Geert & Van Dijk, 2002; Verspoor et al., 2021).

Emotions play a crucial role in SLA. Positive emotions, such as enjoyment and motivation, can enhance learning, while negative emotions, such as anxiety and frustration, can hinder progress (Derakhshan & Shakki, 2024; Derakhshan et al., 2023; Li & Dewaele, 2020; Dewaele et al., 2023; Gregersen et al., 2021; Papi & Khajavy, 2021; Wang, Gao, Sun et al., 2024; Wang, Gao, Wang et al., 2024; Wu, Wang et al., 2024b). Despite their significance, emotional factors in SLA have often been studied in isolation, without considering the complex interplay between different emotions (Hu & Hemchua, 2023; Lowie & Verspoor, 2019; Verspoor et al., 2021; Chen et al., 2022; Elahi & Talebzadeh, 2018; Elahi Shirvan et al., 2020). Traditional methods of studying emotional factors in SLA tend to focus on individual variables or simple correlations (Teimouri et al., 2022; Wu, Wang, et al., 2024a;). However, these approaches may overlook the multifaceted nature of emotions and how they interact within learners. There is a need for a more holistic approach that captures the nuanced emotional profiles of language learners. LPA offers a sophisticated statistical method for identifying distinct subgroups within a population based on observed data (Bong et al., 2022). In the context of SLA, LPA can be used to identify different emotional profiles among learners, providing a deeper understanding of how various emotional factors combine and influence language learning (Lowie & Verspoor, 2019; Elahi Shirvan et al., 2020; De Ruiter et al., 2019; Van Geert & Steenbeek, 2005; Wang, Wu and Wang, 2024; Wang & Hemchua, 2022). By applying LPA to the study of emotional factors in SLA, this study aims to contribute to the field by offering a novel analytical approach that can uncover hidden patterns and relationships. The findings could inform more targeted and effective interventions to support language learners' emotional well-being and enhance their learning outcomes. This study also serves as an introduction to LPA

for researchers in the field of SLA (Al-Hoorie & Hiver, 2024). By demonstrating its application in investigating emotional factors, the study aims to encourage the adoption of LPA in future research, potentially leading to new insights and advancements in the understanding of emotions in language learning. This study sets the foundation for exploring the complex emotional landscape in SLA using Latent Profile Analysis, emphasizing the importance of this innovative approach in advancing research in the field.

To be more precise, CDST views the individual learner as a none-ergodic ensemble. Nonergodicity suggests that the average estimate from a group or ensemble is not essentially a representation of an individual learner's outcome. Thus, a valid analysis should consider the nonergodic and heterogenous assumptions of the ensemble when they explore a heterogeneous group. As a consequence, the issue now is to employ statistical models that can characterize and measure the nonergodicity and heterogeneity. Latent profile analysis is one of these techniques (LPA). LPA is a person-centered modeling method that categorizes latent constructs based on the nonergodicity and heterogenous assumptions (Howard & Hoffman, 2018). In other words, LPA focuses on discovering the underlying sub-groups of a study population by employing a specific set of constructs.

This approach has been used in recent years in the field of applied psychology (Spurk et al., 2020), yet the existing literature in the field of second language acquisition (SLA) using this approach is truly limited in size. There are no principled justifications for this neglect in SLA. One reason for this neglect might be related to the fact that in most of the SLA studies, it was assumed that the structure of inter-individual variation in a homogeneous population of subjects was believed to be equivalent to the structure of intra-individual variation in that population. As a result, most of the previous studies accepted that it is enough to consider the pattern of interindividual variation and then generalize this pattern to the level of intra-individual variation. Another reason for the limited application of this approach is because of researchers' unfamiliarity with the distinctive features and the promises LPA holds for model testing, hypothesis testing and creating internally homogenous and externally heterogeneous sub-groupings of the research population via the maximum likelihood analysis (Wang et al., 2021).

This review paper introduces LPA as a powerful statistical tool that can revolutionize the study of emotional factors in SLA. By highlighting the potential of LPA to uncover distinct emotional profiles among language learners, the paper

provides researchers with a novel approach to analyzing complex emotional dynamics, moving beyond traditional methodologies that often oversimplify these factors. Emotions significantly influence language learning outcomes. However, the complexity of emotional experiences has often been underexplored. This review emphasizes the importance of recognizing and analyzing the interplay of multiple emotional factors simultaneously, rather than in isolation, which can lead to a more nuanced understanding of how emotions affect SLA. By applying LPA to the study of emotional factors in SLA, this review bridges the gap between theoretical research and practical application. The insights gained from this approach can inform the development of targeted interventions and pedagogical strategies that cater to the diverse emotional needs of language learners, ultimately enhancing their learning experiences and outcomes.

2. Literature Review

2.1. Theoretical foundation: Complex Dynamic Systems Theory (CDST)

Complex Dynamic System theory (CDST) offers a theoretical foundation for understanding the significance of using person-centered approaches, such as LPA, that can capture variation between individuals as well as variation within individual. CDST posits that a dynamic language system has nine fundamental features, including dependency to the initial conditions, attractor states, non-linearity and interconnectedness, internal and external interactions, iteration, variation, and emergent characteristics (De Bot, 2013). By the introduction of CDST to field of SLA, a shift has been accrued in the research emphasis. Instead of focusing on the linear causal correlation among different constructs, the interconnectedness and non-linear interactions of various language learning factors are at the center of attention (Gao et al., 2024). Instead of treating variability as short-come, CDST treats it a rich source of information (Verspoor et al., 2021). CDST focuses on the importance of interindividual and intraindividual variations within a system, emerging from the interactions between the system's internal and external factors (Lowie & Verspoor, 2019). These interactions result in individual non-ergodic processes (Lowie & Verspoor, 2019; Molenaar, 2013). Within the realm of CDST, analytical LPA approach could inform us about the non-linear relations, revealing inter- and intra-individual variability of the system by considering the profiles of learners or teachers for a particular affective variable.

2.2. Purpose and Assumptions of LPA

As a categorical latent variable modeling method (Collins & Lanza, 2013), LPA attempts to identify the latent sub-groups of a specific population according to a specific number of factors (Howard & Hoffman, 2018). In recent years, this analytic approach has attracted researchers' attention in organizational sciences (e.g., Woo et al., 2018). The assumption of LPA is that people can be grouped with different probability levels into categories (sub-groups) with various configural personal and environmental features. More specifically, as Woo et al. (2018) describe, these categorical latent construct models facilitate a parsimonious delineation of structures as groupings. Because groupings and categories are natural properties of cognition because of the simplicity and efficiency they allow (Macrae & Bodenhausen, 2000), the grouping structures based on categorical latent construct models are hypothetically significant and methodologically beneficial to the data-based typology development and incorporation (Costa et al., 2002).

As mentioned previously, the main purpose of LPA is to identify groups or types of people with distinctive personal characteristics. In the vocational behavior domain, where LPA has been used more, the prevalent personal characteristics consist of psychological traits (e.g., various kinds of perceived environmental support, various aspects of career adaptability, and commitment); thus, LPA may also be perceived to serve the purpose of unraveling construct-based profiles (Woo et al., 2018), which are known as clusters too, groups or classes (Macrae & Bodenhausen, 2000).

2.3. Distinctive Features

Considering the underlying assumptions of LPA and its methodological features, this analytic approach is both capable of addressing particular research questions and developing and expanding theoretical knowledge about the presence of various configurations of profiles in specific variables in different fields of study. As raised by Spurk et al. (2020), although different scholars (e.g., Wang & Hanges, 2011; Woo et al., 2018) have increasingly demanded that LPA strategies be potentially used more to explore many different hypothetical models in organizational and psychological research, the use of LPA in many academic fields of study including SLA research is still limited. The latest review (Woo et al., 2018) which addressed LPA research in applied management and psychology journals only found 37 published works of research using LPA. Such an evident dearth of research, in comparison to continuous

latent construct models (especially structural equation modeling analysis of one distribution of the population) might be because of the lack of perception in categorical latent variable ways, or because of confusion about the procedures of doing and interpreting LPA analyses (e.g., the procedures of model specification, or decision-making on the frequency of profiles).

In comparison to the conventional, non-latent clustering procedures (e.g., hierarchical clustering, k-means clustering), profile membership is treated in LPA as an unobserved categorical construct, the value of which shows the profile to which someone belongs with a particular probability level. LPA has certain advantages over conventional, non-latent clustering procedures (Nylund-Gibson & Choi, 2018). Firstly, the basis of classifying individuals into clusters based on membership probabilities is directly from the model. Secondly, the constructs can be interval, categorical (i.e., ordinal or nominal), frequencies, or these mixed together. Thirdly, for profile description, demographics or other covariates may be used (Magidson & Vermunt, 2002). Therefore, LPA deals with the patterns the variables show (which are known as the indicators of LPA). The individuals' profiles with common trend of variables are found and contrasted with the other profiles, both regarding the way the variables are mixed to constitute the profiles, and the way these mixtures are differentially associated with the precursors or outcomes of learning (Collins & Lanza, 2013; Wang et al., 2021).

LPA best matches the research questions which address the impact of configurations of many variables that are qualitatively different and may not be easily represented through other methods, including the moderated regression analysis, with multiple terms for interaction according to a common distribution of the population (Zyphur, 2009). The compositions of variables that are qualitatively different are also called the divergent shapes between profiles (e.g., specific indicators of a profile enjoy levels relatively higher than the mean of the sample, yet others might have comparatively lower levels below the average in a profile and the opposite in another). The compositions of variables that are quantitatively different are also called the level differences of profiles (e.g., the levels of all profile indicators are rather higher than the sample mean in one profile yet lower than the mean in another). As an instance, LPA has been effectively used in the literature on organizational commitment to exploring a set of four commitment targets (i.e., normative, affective, high sacrifice, and lack of alternatives), and the way such quantitative and qualitative combinations are associated with outcomes differentially (Hom et al., 2012). Yet, the

use of LPA in SLA research has been significantly more limited. That is why we will show how LPA can be as efficiently used in SLA studies specially to investigate the personality traits and affective variables involved in language learning. Before that, we review the few existing LPA studies in the SLA domain.

2.4. LPA in Language Studies

As mentioned previously, still the number of LPA studies is limited because many researchers are not adequately aware of the distinctive features of this analytic approach. In SLA studies, there are a few LPA studies too, as will be addressed here. Yet, there are hopes that many more works of research are conducted in the future to explore language teacher and learner personality traits, cognitive and affective factors.

With respect to the application of LPA, Chon and Shin (2019) used the method to conceptualize and evaluate intraindividual differences in the patterns of language learners' motivational-metacognitive profiles with regard to their listening skill on the basis of earlier individual-oriented works of research. Questionnaires for metacognitive awareness and academic motivation were used with more than three hundred Korean secondary school English language learners from intact classes after using a listening test. An individual-oriented approach through latent class analyses showed solutions with four clusters, which included a motivated-translators, externally motivated-introjected-totally alert group, and the high autonomous motivation achievement strategists, which varied from the lowest to the highest scores for listening. Chon and Shin (2019) confirmed the multiple groups of self-regulated language students to offer theoretical explanations to demonstrate how students' motivational-metacognitive profiles can act as a cluster for efficient L2 listening.

Also, Holopainen et al. (2020) used the LPA to investigate the prevalence and heterogeneity of latent reading profiles among hundreds of German- and Finnish-reading learners within their first and second school years in Italy, Germany and Finland. The LPA revealed three latent profiles among Finnish students, one being reading at the sentence-level as it was gradually developed. In students reading German, four latent profiles were identified, half of which were found to be smoothly developing. The ordinal logistic regression modeling results revealed that the rapid automatic naming (RAN) was associated with poorer reading profiles significantly

among German- and Finnish-reading readers. Moreover, the poorer findings in the letter-sound test of association in the German-reading group showed to be significantly associated with poorer profiles for reading. Holopainen et al. discussed that although the educational systems are different in the Germany with the German-speaking parts of Italy, no statistically significant country influence was evidenced. Also, the spoken language and the child age did not influence the learners' reading profile significantly.

Regarding the use of LPA among L2 affective variables, Wang et al. (2021) used an individual-oriented LPA to investigate self-efficacy profiles and examine their associations with language proficiency and academic emotions. To this aim, three hundred undergraduates of academic majors other than English from two colleges in China filled out the questionnaire surveys to measure the self-efficacy-related attitudes, educational emotions and L2 proficiency in a standardized test at a national level. The LPA records managed to find three groups that represented low, medium and high levels of self-efficacy. L2 learners with a high self-efficacy level showed to have the most desirable emotions (pride and enjoyment), the least undesirable emotions (shame, anxiety and anger), and they received the highest scores in comprehensive language tests, as well as the listening and reading sections. Students in the medium and low self-efficacy groups revealed variations in many academic emotion measures yet not in language proficiency. Wang et al.'s study could provide insights into the self-efficacy patterns of Chinese university students of the English language and also contribute to the EFL educational domain of practice.

Chen et al. (2022) found three self-regulated learning (SRL) profiles that varied quantitatively in terms of self-efficacy while conducting LPA with learners of English as a foreign language (EFL). The efficacious self-regulators with the highest levels of SRL cognitive, metacognitive, and motivational components reported the highest levels of self-efficacy, preceded by the moderate strategists. Their findings indicated that EFL learners with the lowest levels of SRL cognitive, metacognitive, and motivational components reported the lowest level of writing self-efficacy. In a writing achievement evaluation, learners of various profiles differed considerably, with efficacious self-regulators outperforming the other two profiles. Considering the potentially significant contributions of LPA to SLA studies, we go on to emphasize the need for using LPA more than before in exploring L2 affective variables. The promises that LPA holds for exploring L2-related variables will be included here.

2.5. LPA vs. Conventional Approaches to L2 Research

Influenced by the advent of humanistic psychology, the significance of affective factors in education has increased (Bao & Liu, 2021; Derakhshan et al., 2022; Derakhshan & Nazari, 2022; X. Wang & S. Wang, 2024). Yet, more enthusiasm, for years, was shown for investigating negative emotions like anxiety, inhibition, and stress, until SLA launched a revolutionized era of affective exploration marked by a focus for both positive and negative emotions (Derakhshan & Nazari, 2022). This turn was called the advent of positive psychology (MacIntyre & Gregersen, 2022; MacIntyre & Mercer, 2014; M. Wang & Y. Wang, 2024; Wang et al., 2022; Wang et al., 2021; Wang & Kruk, 2024; Elahi Shirvan, Taherian, & Yazdanmehr, 2021) and welcomed the exploration of new attractive topics of research, such as foreign language enjoyment and grit. Besides the new shift in SLA research from the dominant concern for negative emotions to both negative and positive emotions, the SLA research also entered its third phase of maturity, from domain-free to domain-specific and then to the dynamic phase, affected by the complexity and dynamic systems theory (CDST). A dynamic view of L2 affective constructs admits to the inherent complexity in the development of the affective variables (Elahi Shirvan & Talebzadeh, 2018). Thus, it is not expected that researchers always face homogenous research populations or samples. It should be noted that the dynamic approach in the field of applied linguistics has mainly adopted three types of methods for the exploration of language-domain-specific variables. These methods include time-intensive, relation-intensive, and time-relation-intensive approaches (Freeborn et al., 2022). Most CDST-based studies on emotions in the realm of applied linguistics have used time-intensive methods but LPA adopts a relation-intensive method for the exploration of emotions with a focus on the relationships among latent profiles of emotional variables. Quite consistent with the emerging dynamic phase of research on emotions in the field of applied linguistics, LPA regards a state-oriented perspective towards emotions in the acquisition of foreign languages and is an analytic approach that can be used with heterogenous research populations (Spurk et al., 2020).

   In comparison to more conventional variable-oriented analytical procedures, LPA serves a number of benefits to study the affective variables. For example, to explore an emotion or cognitive variable (e.g., self-efficacy) involved in the four language skills, conventional methods treat them as four different interval constructs (Nylund-Gibson & Choi, 2018). Yet LPA manages to deal with the unobserved heterogeneity in the sub-

categories of the research population (e.g., L2 teachers or learners) and, therefore, reveal different patterns of student emotion, and assign them to various groups through showing the multiple compositions of the affective (or some other) variable in four skills of language (Wang et al., 2021; Fan & Wang, 2022). Therefore, it helps to identify students with various patterns in the four skills (e.g., rather low emotion in writing and speaking yet high emotion in reading and listening).

Furthermore, LPA is a probability- and model-based analytic procedure in which the profiles are not merely classified based on mean scores and standard deviations, as it was the case in the conventional cut-off score approach, yet to different model fit metrics (e.g., AIC, BIC) through estimating a maximum likelihood. Using these metrics, users are able to assess the representativeness and interpretability of the produced profiles. For instance, if four classes were recommended as the optimal choice by the software, yet one class comprises just 1% of the entire sample, we could then further decide whether or not we want to keep this class. Therefore, LPA combines the fit indices of the objective model and an all-inclusive evaluation based on the existing literature, to enjoy excellent validity and reliability. LPA can be used robustly with the data that violate the assumptions of homogeneity of variance, linear relationships and normal distribution and, therefore, is beneficial over the conventional linear regression analysis (Magidson & Vermunt, 2002).

The number of affective variables potentially influencing and influenced by the process of L2 learning seems to be endless. L2 motivation and aptitude are among the most frequently investigated affective constructs in L2 literature, and studies focusing on personality traits (e.g., introversion vs. extraversion) have had a long history of investigation too (Lowie & Verspoor, 2019). In recent years in the dynamic stage of SLA studies, newer affective constructs have been studied including negative and positive emotions (e.g., foreign language enjoyment, foreign language learning boredom) (MacIntyre, 2002; Pawlak et al., 2021; Kruk et al., 2022a; Kruk et al., 2022b; Kruk et al., 2022c), narrative identity (Dörnyei & Ryan, 2015), circadian rhythm (De Bot, 2013) and holistic individual personality (McAdams & Pals, 2006). Optimally, all these variables should be incorporated in a single model yet it is not possible in any actual research.

The affective factors involved in L2 learning are complex and hard to conceptualize, and the estimated impacts significantly rely on the instrumentations to operationally define them (De Ruiter et al., 2019). Thus, the distinctive feature of complexity lies at the heart of L2 affective variables and is expected to account for

significant individual differences (Elahi Shirvan et al., 2020). This complexity necessitates an analytic approach like LPA, which is well-suited to capture and represent the complexity in the underlying procedures. The older traditional tests mostly considered the normality of distribution assumption as well as the homogeneity of variance. Besides, they tended to assume that mean scores were representative of the emotional states of individuals. This raised the ergodicity issue in L2 studies (Lowie & Verspoor, 2019). However, newer analytic procedures including LPA can solve the ergodicity issue, by firstly viewing the development of L2 affective variables as complex and dynamic, and then being able to deal with abnormal distributions and heterogeneity of variance. That is why we acknowledge that LPA is among the innovative CDST-compatible research methods that can benefit the investigation of L2 affective constructs.

2.6. Potential Areas for LPA of L2 Affective Variables

Under the influence of the positive psychology movement in the realm of SLA, researchers in this field have been encouraged to expand the nomological network of emotional variables in SLA (Pan, 2022). One way to do so is through the configuration of latent profiles of emotional variables. As the only L2 affective variable investigated through LPA so far is self-efficacy, all other affective variables are still left for LPA research. Some of these variables have been introduced into the SLA research only within the past few years, and are still under-researched. Examples are L2 grit, mindset, foreign language enjoyment, foreign language learning boredom and compassion. Sample relevant research questions for each can be: What are the associations between [L2 affective variable] latent profiles and L2 proficiency? What are the associations between [L2 affective variable] latent profiles and other academic emotions?

Concerning the above points, Pekrun et al. (2002) suggested that there are two dimensions to academic emotions, one valence (positive vs negative) and the other activation (activating vs deactivating). Accordingly, academic affects can be divided into four kinds: positive activating emotions (e.g., pride, foreign language enjoyment), positive deactivating affects (e.g., relief, relaxation), negative activating affects (e.g., anger, anxiety), and negative deactivating affects (e.g., hopelessness, boredom). Concerning the valence dimension, in the light of the broaden-and-build theory (Fredrickson, 2001), positive academic emotions are capable of extending students' activities, increasing their effort and commitment (Shakki, 2022; Zhang et

al., 2020), enabling them to encounter new challenges (Fredrickson & Joiner, 2018) and finally improving learning while negative academic emotions can reduce students' adaptability (Derakkshan et al., 2009; Fu & Wang, 2022), limit engagement and lower proficiency (Zhang et al., 2020). These academic emotions are worth investigation in combination within the ecology of an L2 classroom. For example, Wang et al. (2021) categorized three different self-efficacy profiles in Chinese English language learning undergraduates and correlated the profiles with students' academic affects and language proficiency.

Moreover, Wang et al. (2021) found that learners' affective experience and language learning outcomes were dependent on the extent to which students felt confident to master the four language skills. Particularly, the more the L2 learners were confident in their ability to learn a language, the more positive emotions (e.g., enjoyment) and less negative emotions (e.g., shame) they experienced. Despite the fact that L2 learners with a low self-efficacy obtained lower rates in the whole exam and in the reading and listening skills than L2 learners with a high self-efficacy, peers with a medium self-efficacy level obtained similar academic achievement to the other two groups. It is also both surprising and interesting to remind that no differences were found in language scores of L2 learners with low and medium self-efficacy, which can point to a curvilinear association between language proficiency and self-efficacy in an L2 learning context in spite of an overall pattern of better L2 achievement conceived for more self-efficacious L2 learners. Though, so far, there has been almost no direct evidence for this, former works of research have shown curvilinear associations among other motivational variables (e.g., outcome expectancy, self-regulated learning strategies,) and academic achievement (Hinkin, 1995). Due to the curvilinear behavior of growth for self-efficacy offered in the pre-existing research (Hornstra et al., 2013), its association with L2 achievement is, thus, perceivably more complicated.

The results reported by Wang et al. (2021) contributed greatly to the SLA research by providing insights into the self-efficacy profiles in the Chinese English language learning environment and developed the control-value approach further to the SLA domain. Thus, it can be expected that the LPA studies of other L2 affective variables provide as insightful knowledge as well.

3. Conclusion

3.1. Major Findings

In the present paper, LPA was introduced as a useful and robust analytic approach, which could be effectively used to explore dynamic and complex phenomena and to classify a research sample or population based on the latent profiles of certain person-centered constructs. Among the advantages of LPA, awareness was raised of the ability to deal with distributions that are not normal and also heterogenous variance. Moreover, we drew attention to the ability of LPA to deal with non-linear relationships in model testing. It is worth noting that the application of LPA for the exploration of emotions in the field of SLA has been susceptible to the interplay between the positive psychology movement and the CDST approach. The former has recently invited researchers in the realm of SLA to conduct research on both negative and positive emotions. The latter puts emphasis on a shift from a nomothetic lens to emotions in SLA to an idiographic that regards the emergence of emotions, or their network in SLA, as dynamic variables which go through change and stability over time. Thus, the need for the application of CDST-compatible methods like LPA as a relation-intensive method for the exploration of the association among latent emotional factors, and the configurations of these factors, is felt more than before. Why we recommend LPA to be used more pervasively in investigations of L2 affective constructs is that in the interactive system of forces in a language learning class, the development of L2 teacher's or learner's positive or negative emotions is marked by both dynamicity and complexity. The interrelationships among these variables are marked by non-linearity, another feature of complex and dynamic systems, which makes LPA again an appropriate analytic alternative.

Still another point raised was that LPA is able to solve the ergodicity issue of traditional research methods in SLA studies. LPA can contribute as a solution to the ergodicity issue by considering the divergence and inter-individual differences in the configurations of latent profiles. That is, indicators of a given profile might have relatively lower or higher levels than the mean of the sample. More specifically, LPA does not aim to generalize any average score obtained from the measurement of any affective variable to the individual language learners. Thus, we contended in the present paper that LPA is an innovative analytic approach which is compatible with the CDST, which has begun to influence SLA research in the present century. Recent years have seen more interest in the investigation of L2 affective variables. This interest was preceded by more attention to cognitive factors than emotional traits.

Thus, the L2 affective variable studies are bound to the past few years, especially those adopting a CDST approach to exploring emotions.

The CDST-guided line of inquiry into L2 affective variables cannot use traditional research methods due to the problems some of which were already addressed here. Innovative qualitative and quantitative analytic procedures are needed to be able to deal with the dynamic and complex development of L2 affective variables. LPA can adequately be used for hypothesis or model testing in SLA studies when non-linear relations are assumed among different affective variables and language learning.

3.2. Theoretical and Practical Implications

By applying LPA, this paper challenges and potentially refines existing theoretical models of emotions in SLA. Traditional models often treat emotions as isolated variables, but LPA encourages a shift towards understanding emotions as interconnected and multidimensional constructs. This approach could lead to the development of more comprehensive and integrative theories that account for the complex interplay of emotions in language learning. The use of LPA in this study highlights the need for SLA theories to incorporate the complexity of learners' emotional experiences. Emotional factors are not monolithic; learners may exhibit a range of emotional profiles that influence their language acquisition differently. This realization pushes theoretical frameworks to evolve from linear, single-factor models to more sophisticated, multi-dimensional perspectives that better capture the realities of language learning. LPA enables the identification of distinct emotional profiles or subgroups within the learner population, leading to a reconceptualization of learner typologies in SLA theory. Instead of categorizing learners based solely on cognitive or behavioral traits, this approach emphasizes the importance of emotional characteristics, which can profoundly influence learning outcomes. This theoretical shift could inform more personalized and emotionally-responsive approaches to language teaching. The use of LPA in investigating emotional factors expands the affective domain within SLA research, encouraging scholars to explore a broader range of emotions and their interrelations. This expansion enriches the theoretical landscape of SLA by acknowledging the diverse emotional experiences of learners and their impact on language acquisition, leading to more holistic and inclusive theories.

By identifying distinct emotional profiles among language learners through LPA,

educators can tailor their instructional approaches to better meet the emotional and motivational needs of individual students. For example, learners with profiles characterized by high anxiety and low motivation may benefit from supportive, low-pressure learning environments, while those with profiles of high enthusiasm might thrive with challenging and engaging tasks. The insights gained from LPA can inform the development of targeted intervention strategies aimed at addressing specific emotional challenges faced by different learner subgroups. For instance, learners who display a profile with a mix of high frustration and low self-confidence might benefit from interventions focused on building resilience and self-efficacy, thereby enhancing their language learning outcomes. Understanding the emotional profiles of learners allows educators to design classroom activities and curricula that are more engaging and emotionally supportive. By aligning instructional practices with the emotional needs of learners, educators can foster a more positive and motivating learning environment, which can lead to increased student engagement and better retention of language skills. LPA can inform the development of more nuanced assessment practices that take into account the emotional factors influencing learners' performance. Traditional assessments may overlook the impact of emotions on language acquisition, but with the insights from LPA, educators can design assessments that are more reflective of students' emotional states, providing a more accurate measure of their language abilities. The identification of emotional profiles can lead to the implementation of programs and resources that support the emotional well-being of language learners. Schools and institutions can develop counseling services, workshops, and peer support systems tailored to the emotional needs identified through LPA, helping students manage stress, anxiety, and other emotional challenges that may hinder their language learning. Curriculum developers can use the findings from LPA to design language programs that incorporate emotional learning as a core component. By integrating activities that address emotional factors, such as mindfulness exercises, collaborative learning, and reflective practices, curricula can be more responsive to the emotional dynamics of language learning, leading to more effective and enjoyable educational experiences. The practical insights from this research can inform educational policymakers in designing language education policies that prioritize emotional factors. By recognizing the critical role of emotions in language acquisition, policies can be developed to ensure that emotional support is integrated into language programs, thereby improving student outcomes at a systemic level.

4. Suggestions for Further Research

There is a significant dearth of research in SLA studies using LPA. The gap is wider for the exploration of affective variables. One reason might be that attention to language learners' and teachers' emotions has been attracted in SLA research only recently, especially through a dynamic lens. As for the suggestions for prospective researchers in the field, first of all, it needs to be reminded that, more generally speaking, researchers are not yet adequately aware of the suggesting standards of LPA like those that already exist for some other analytic approaches (Hinkin, 1995; Kepes et al., 2013). Thus, researchers and methodologists are recommended to develop the required reporting standards, which can be useful for future nominal/ordinal latent construct model methods too. If these standards are provided, the findings of different studies and their interpretation will become better comparable in the future. Within the SLA domain, LPA can be used in hypothesis or model testing of cognitive and affective variables together or in combination with language proficiency. Then, language learners can be classified in terms of the underlying profiles of the emotions and proficiency level together. These classifications can provide a more comprehensive and representative image of the class to the teacher to, for example, find ways to motivate the low-motivated underachiever group.

Many L2 affective variables together or in combination with other cognitive variables or academic achievement await investigation using LPA. Among them are foreign language enjoyment, boredom, anxiety, motivation and L2 grit. Some have been more explored in SLA research overall (e.g., L2 anxiety and motivation), yet some others are new to the field and still need many more in-depth studies (e.g., L2 grit, enjoyment, boredom). LPA is capable of analyzing both positive and negative emotions in the context of L2 learning. More longitudinal studies are needed to take a wider perspective to better reveal the dynamic and longitudinal development of emotions during a whole L2 learning course (Wang & Wanberg, 2017). These studies can include how a network of affective variables vary from early to late language learning experience. Such research can find whether the substantive quality of profiles varies from time to time or not, and use latent transition approach to see how L2 learners move from one profile to another through the passage of time, and what factors can explain these variations (Collins & Lanza, 2013).

Future studies could apply LPA across different cultural contexts to examine how emotional factors in SLA vary among diverse learner populations. This cross-cultural

approach would help uncover cultural influences on emotional profiles, revealing universal versus context-specific emotional factors in SLA. Longitudinal research could track how these emotional profiles evolve over time during language acquisition, investigating the impact of such changes on learning outcomes. By doing so, researchers could identify critical periods where emotional shifts most significantly affect language acquisition. Additionally, targeted interventions could be designed and tested to improve language outcomes, tailored to the emotional profiles identified through LPA. For example, interventions could address specific emotional needs such as anxiety reduction or motivation enhancement. The integration of digital tools and AI into SLA research could provide real-time monitoring and support for these emotional factors, offering personalized feedback and adaptive learning environments that respond to learners' emotional states. Further research could delve into the intricate interplay between motivation and emotion in SLA, refining existing theoretical models. Expanding the scope of emotional factors studied beyond anxiety and motivation—incorporating emotions like boredom, curiosity, and frustration—would offer a more comprehensive understanding of their roles in language learning. Finally, the findings from such studies could inform educational policy and curriculum development, ensuring that emotional factors are adequately considered in language education, leading to more effective and empathetic teaching practices.

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113