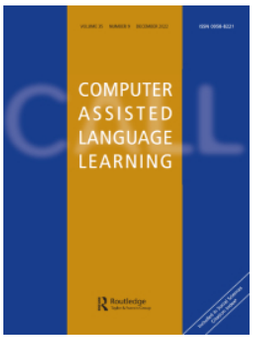

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A person-centred approach to L2 learners' informal mobile language learning

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ABSTRACT

Mobile technologies provide opportunities for L2 learners to engage in complex interactions involving a multitude of cognitive, meta-cognitive, and affective factors. Understanding the process of learners' mobile language learning thus needs holistic approaches that integratively consider learner attributes and their interaction with mobile technologies. In this study, we applied a holistic person-centred approach to examining L2 learners' self-initiated engagement with mobile learning activities. Data were collected with a questionnaire and follow-up interviews. A cluster analysis performed on the questionnaire data yielded six types of learners with distinctly different learning experiences. We further found that each learner type brought along a distinct package of motivational, emotional, and linguistic interaction, and that the distinct learning experiences of each learner type bore different relationship to learners' perceived L2 improvement. This study offers theoretical and methodological insights into the complexity and variety inherent in informal mobile language learning. Findings also inform teachers about the design of adaptive and tailored instruction and scaffolding.

KEYWORDS

Cluster analysis; IMLL experiences; learner types; person-centred approach

Introduction

Practice, conceptualized as repeated meaningful language use, has long been emphasized in many second and foreign language (L2) learning theories as "a primary shaper of linguistic form and the foundation for language learning" (Tyler, Ortega, Uno, & Park, 2018, p. 5). L2 learners' language use has traditionally been conceived as happening mainly within the classroom where learners engage in drills or decontextualized

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Supplemental data for this article can be accessed here.

exercises. However, there is a growing recognition that the opportunities for language use have largely expanded because of emerging innovative mobile technologies.

Considering these learning opportunities afforded by mobile devices (e.g., mobile phones, tablets), Kukulska-Hulme, Traxler, and Petit (2007) made a distinction between formally designed activities, and informal learner-initiated activities which arise from their own needs and interests. Greater language gains were found from learning informally in recent studies (e.g., Cole & Vanderplank, 2016). Our view is that a greater understanding of learners' self-initiated language learning *in the wild* can help learners better self-regulate their language learning and also help instructors design instruction which provides a context wherein imported learning experiences from the wild can be analysed and enhanced (Dubreil & Thorne, 2017). As such, we took particular interest in how L2 learners informally engage in language learning activities that are mediated by mobile technologies, and how their informal learning experiences taking place out of school might be further supported.

Despite its considerable learning potential, informal mobile language learning (IMLL) remains largely uncharted territory (Godwin-Jones, 2019). The limited research on IMLL often adopts a variable-centered approach, viewing learners' IMLL experiences, their linguistic and educational background, motivation and emotion, as well as learning outcomes as separate variables, and examining the association and interaction between them (e.g., Lai & Zheng, 2018; Ma, 2017). In the wake of an increasingly accepted view that recognizes language learning as a dynamic process in which learner-internal and -external variables are concurrently at play (e.g., de Bot, Lowie & Verspoor, 2007), a shift of paradigm from variable-centredness to person-centredness is occurring. In line with this shift, the present study adopted a person-centred approach to researching IMLL, embracing a holistic view that recognizes variables as inseparable components shaping learners' IMLL experiences (see also Peng, Jager, Thorne, & Lowie, 2020). This approach enables us to identify and classify learners with shared patterns of IMLL experiences in a bottom-up manner, and interpret each pattern in relation to learner characteristics in affective, cognitive, and metacognitive dimensions.

Another reason for us to adopt a person-centred approach is the recognition of individual heterogeneity in IMLL. While we have gained some understanding of the nature, experiential and developmental affordances of IMLL, researchers (e.g., Kusyk, 2017) have increasingly observed that learners' IMLL experiences are highly individualized. This heterogeneity across learners is largely due to the diversity inherent in IMLL: different learners with different learning interests and goals

interact with a diverse set of devices and resources in multiple ways. To unpack the learner heterogeneity, one needs a bottom-up approach, looking for emergent patterns that arise from the data and building hypotheses, rather than using *a priori* categories for analysis (see Godwin-Jones, 2019). The identification of typically occurring IMLL patterns could lead to a more predictable manifestation of individual variety, and reveal hidden groups of learners who share similar IMLL patterns. In other words, by classifying individuals with shared learning patterns into groups, distinct homogeneous groups can be identified and a careful generalization of individual cases can be made.

Overall, we believe that adopting a person-centred approach can make a significant contribution to the IMLL field, as it provides an innovative way of researching complex IMLL phenomena. In this article, we begin with a rationale for researching IMLL, and then present the theoretical tenets and analytic methods for this study. What follows is a detailed description of research questions, method, and our findings. We further discuss the findings in relation to theoretical models and previous studies, and provide pedagogical suggestions and research implications. This article concludes by highlighting the importance of using person-centred methods in future L2 research in general and IMLL research in particular.

Background

Mobile-assisted language learning in informal contexts

During the past two decades, Mobile-Assisted Language Learning (MALL), defined as the use of "mobile technologies in language learning" (Kukulska-Hulme, 2013, p. 3701), has been widely investigated. Early MALL studies were mostly accomplished in formal instructional contexts (see Burston, 2015), examining learning resources and materials developed purposely by the teacher or researcher. Although meta-analyses of MALL research (Sung, Chang, & Liu, 2016) have quantitatively confirmed the positive effect of MALL on listening, speaking, reading, writing, and vocabulary, Levy (2015) noted that those carefully controlled experiments often require modification of naturally occurring settings and thus may obscure factors (e.g., learner motivation, emotion) that might moderate the MALL effect (Ma, 2017).

Taking this into account, recent thinking on MALL foregrounds learner agency and researchers start to explore learners' self-initiated language learning with mobile technology, as they believe "[i]t is vital to develop some understanding of learner-led activities and learners' practices in informal mobile language learning if we are to make the best use

of MALL and to advise learners accordingly" (Jones et al., 2018, p. 8). The informal learning opportunities that mobile technologies facilitate are numerous and diversified (Reinhardt & Thorne, 2019). For example, learners have access to authentic learning materials by listening to songs and watching TV series or films. They can use L2 in personally meaningful and purposeful ways, posting on social media, playing digital games, creating videos, or communicating with other learners on social networks. In the current study, we will use the term IMLL to include all activities that involve the use of mobile technologies and the language learning occurring outside the classroom.

There may be favoured learning activities (e.g., songs or movies) that motivate learners to engage with linguistically rich materials. That is, using mobile technologies for informal language learning may have a positive motivational impact on learners. For example, Lamb and Arisandy (2020), by using Dörnyei's (2009) L2 Motivational Self System (L2MSS) as the main framework, investigated the relationship between learners' online informal use of English and their motivation to learn English, and found that high levels of online English use and learning were associated with high global motivation to become competent in English. Besides being motivated, learners may also feel less nervous or embarrassed as they engage in informal learning activities. To take speaking as an example, in IMLL contexts learners have more opportunities for oral communication via videoconferencing or online game playing, which makes them less anxious than classroom contexts where speaking practices have to be under the watchful eye of the instructor. That is, individual learner characteristics like motivation (Lamb & Arisandy, 2020) and L2 anxiety (Lee, Warschauer, & Lee, 2019) have been found related to different informal learning experiences, which further lead to differing learning achievement in terms of speaking and vocabulary (e.g., Lee & Dressman, 2018). In these studies, learners' motivation, emotion, and learning achievement were regarded as distinct variables and investigated separately.

This variable-centred analysis has gradually been challenged, as more interrelated, holistic views are emerging in the MALL field (Godwin-Jones, 2019; Kusyk, 2017; Sockett & Toffoli, 2020) and other fields related to language learning (e.g., de Bot et al., 2007; Larsen-Freeman & Cameron, 2008). For example, Demouy, Jones, Kan, Kukulska-Hulme, and Eardley (2016), in reviewing learners' use of mobile devices for language learning, found that actively engaged learners displayed "a high level of curiosity and knowledge regarding the affordances of mobile devices and what potential resources are available" (p. 20). González-Lloret and Ortega (2014) suggested that technology-mediated tasks might reduce learners' anxiety while increasing their motivation, thus promoting learners' participation. Lai and Zheng (2018) further showed that

learners' selective use of mobile technologies in L2 learning was an outcome of the interaction between learner attributes (e.g., motivation, emotion), learners' perception of learning activities, and the tempo-spatial learning context. As such, variables are interrelated in a dynamic manner and it is their interplay that gives rise to individuals' learning experiences. This holistic idea is inherent in the person-centred approach recently emerging in L2 field (Larsen-Freeman, 2018; Peng et al., 2020), an approach that is ecological (Levine, 2020) as well because it sees the learner, learner attributes, and learning resources in the environment in terms of their interconnections.

A person-centred approach to researching IMLL

Instead of taking separate variables as analytic units, the person-centred approach views each individual as a functioning whole, with interwoven components jointly contributing to the process of individual development (Peng et al., 2020). Components here refer to, for example, learning behaviors, learner motivation and emotion, and learning contexts. They are traditionally viewed as distinct variables influential for L2 learning, but in the person-centred approach they are used to concurrently shape individuals' learning patterns and should be interpreted in relation to each other. In other words, the interconnectedness of components is core to a person-centred perspective, which is in line with the complex dynamic system theory (CDST) thinking that has increasingly been embraced in the language learning field (de Bot et al., 2007; Larsen-Freeman & Cameron, 2008).

Basic tenets of the person-centred approach are presented in Peng et al. (2020): (1) The learning process is partly specific to individuals; (2) The learning process is complex and is conceptualized as involving factors (i.e., learner-internal and -external factors) that interact at various levels; (3) There is a meaningful structure in individual growth and also in differences between individuals' characteristics; (4) Learning processes involve structures organized and functioning as patterns of operating factors, where each factor derives its meaning from its relations to others. Although there is, theoretically, an infinite variety of differences with regard to process characteristics at the level of the individual, at a more global level typical learning patterns across individual variety tend to emerge (see also Bergman & Magnusson, 1997).

Applying these tenets to IMLL, the person-centred approach pursues an integrative consideration of learners' attributes (e.g., motivation, emotion, language proficiency) and their interaction with mobile technologies. Different learners, with personal goals and learning interests, may differently interact with mobile learning materials available, which results

in potentially divergent IMLL experiences. As implied by the last tenet of the person-centred approach, there may exist typical learning patterns (often limited in number) that transcend the individual variety. Molenaar and Campbell (2009) suggested identifying the typical patterns by way of uncovering a particular group that is composed of individuals with similar learning experiences. Cluster analysis (CA) might perfectly serve this purpose.

As a statistical technique, CA has the ability to cluster individuals into groups based on their similarities, and identify non-overlapping clusters/groups wherein individuals have similar patterns (Staples & Biber, 2015). These data-generating learner groups diverge largely from the learner groups targeted in traditional group studies. In traditional group studies, it is the researcher who selects or creates learner groups based on pre-conceived categorizations, while person-centred methods, in a more ecologically valid manner, identify learner groups composed of similar learning patterns that emerge from the data (Lee et al., 2019; Papi & Teimouri, 2014).

In sum, the current study adopts a person-centred approach and applies the clustering technique to examine learners' informal participation in mobile learning activities in the context of mainland China, where learners have limited use of English (as a foreign language) for daily communication and the medium of English instruction is mainly Chinese. As mobile technologies nowadays generate multifarious English learning opportunities for Chinese students outside the classroom, understanding their self-initiated use of mobile technologies for English learning is of great importance. Specifically, we intend to identify the number and composition of distinct learner types based on the similarities and differences of their IMLL experiences. A related goal is to reveal how these learner types with distinct IMLL experiences relate to their learner attributes (e.g., linguistic, emotional, motivational characteristics) and their perceived learning improvement. Specific research questions to be addressed are:

RQ1: Do Chinese learners of English display different IMLL engagement that characterizes them into distinct learner types?

RQ2: How do these learner types (if any) relate to learner attributes and their use of mobile technologies?

RQ3: What is the relationship between learners' IMLL engagement and their perceived learning improvement?

Methodology

This research consisted of two stages. In the first stage, we, in reference to previous studies on out-of-class language learning with technology

(e.g., Kusyk, 2017; Lai, Hu, & Lyu, 2018; Ma, 2017), developed and distributed a questionnaire to gather information on learners' IMLL experiences, their learning motivation and emotion. In the second stage, interviews were conducted to find explanations for the (different) patterns of relations between IMLL experiences and learner attributes identified in the questionnaire data.

Participants

Convenience sampling strategy (Dörnyei, 2007) was adopted to select the participants of the study. A total of 240 students from a university located in Southwest China were included. These students were taking English classes at the time of data collection towards the end of the 2017–2018 academic year. A link to an online questionnaire was sent to 240 students. After discarding incomplete questionnaires, 238 survey responses were collected, in which 100 participants (42%) were male, and 138 (58%) were female. Specifically, they were studying Economics (10.9%), Horticulture (18.5%), Law (10.9%), Chinese language and literature (22.7%), Physics (21%), and Veterinary Medicine (16%). The participants were all freshmen and none of them had experience of being abroad. 47 of the participants volunteered to take part in the follow-up interview.

Instruments and procedure

The questionnaire consisted of four parts: Part I included items regarding learners' background information such as gender, educational level, and self-reported English proficiency. English proficiency, as an indicator of learners' linguistic states in this study, was self-assessed by the participants based on a criterion-referenced self-assessed checklist (i.e., DIALANG statements in CEFR, Council of Europe, 2001). The checklist concerning reading, writing and listening ability was sent to the participants together with the questionnaire, and all participants were required to consult it when self-assessing their proficiency. A 6-point Likert scale was used for this self-assessment, with 1 indicating *very poor* and 6 referring to *very good*.

Part II concerned learners' IMLL experiences, encompassing varied learning activities such as searching English learning websites, watching English movies, television series, listening to English songs and news, chatting in English over WeChat, etc. Given that the access to some resources (e.g., Google+, Facebook, Twitter, YouTube) is limited in Mainland China, it was decided to sideline these resources in the

questionnaire. As we were particularly interested in students' self-initiated English learning with mobile devices (e.g., mobile phones, tablets, laptops), following Trinder (2017), we asked the participants to report the specific learning activities they performed to practice their reading, listening, writing and speaking skills, as well as language features such as grammar and vocabulary on their own initiative. The participants were also asked to report the amount of time they spent on practicing each English skill every day on a 6-point Likert scale (1 indicating *no time spent*, 2 indicating *within ten minutes*, 3 indicating *ten to thirty minutes*, 4 indicating *thirty minutes to one hour*, 5 indicating *one to two hours*, and 6 indicating *more than two hours*). Note that some IMLL activities can promote the practice of more than one English skill. For instance, TV series, films, and other video clips might be used to practice listening, speaking, and pronunciation; therefore, we left it to the participants to decide which skill they had practiced with these activities.

Parts III and IV included items that measured learners' motivational and emotional states. Motivation was operationalized in line with Dörnyei's (2009) L2MSS, following Lamb and Arisandy (2020). The variables (Cronbach Alpha reliability indexes included) indicative of learner motivation and emotion included ideal L2 self, ought-to L2 self, L2 learning experience, motivated learning behavior, and L2 anxiety:

Ideal L2 Self (5 items, $\alpha = .894$), indicating learners' aspiration and desire for language learning (e.g., 'I can imagine myself speaking English with international friends or colleagues').

Ought-to L2 Self (6 items, $\alpha = .856$), measuring the attributes that one believes one ought to possess (i.e., various duties, obligations, or responsibilities) in order to avoid possible negative outcomes (e.g., 'If I fail to learn English, I'll be letting my parents and teachers down').

L2 Learning Experience (6 items, $\alpha = .866$), concerning learners' attitudes, as well as situation-specific motives, related to the immediate learning environment and experience (e.g., 'Do you really enjoy learning English on mobile devices').

Motivated Learning Behavior (8 items, $\alpha = .884$), examining the regulation of one's learning behavior (e.g., 'I would like to use mobile devices to learn English, even if I were not required').

L2 Anxiety (8 items, $\alpha = .889$), assessing the "degree of anxiety [in English], as evidenced by negative performance expectations and social comparisons, psychophysiological symptoms, and avoidance behaviours" (Horwitz & Young, 1991, p. 37) (e.g., 'I always feel that the other students speak the English better than I do').

Items indicative of participants' motivation and emotion were mostly adapted from previous research instruments (e.g., Papi & Teimouri, 2014). Another 6-point Likert scale was used for the measure of the

items, with 1 indicating *strongly disagree* or *not at all* and 6 referring to *strongly agree* or *very much*. The questionnaire was translated into Chinese, using the back translation method (Lai et al., 2018). The Chinese questionnaire version was fine-tuned via a pilot study with 15 college students. After completing the questionnaire, they were asked about the difficulties they had encountered in understanding and answering the items, and unclear items were modified. Online Appendix A presents a full list of the items concerning IMLL activities, and learner motivation and emotion.

Semi-structured interviews were conducted in Chinese by the first author through WeChat (a social communication app) individually with 47 volunteers. They were asked to confirm the IMLL activities they used to practice different English skills (revealed in the questionnaire), narrate their most frequently engaged IMLL activities, and explain how useful they considered these activities to be for the development of different skills. During the interviews, the researcher took detailed notes of interviewees' responses to each question. The interview questions are presented in Online Appendix B.

Data analysis

The questionnaire data concerning participants' IMLL experiences were cluster-analyzed using R 3.5.0. The hierarchical cluster analysis (HCA) applied in the study is a multivariate exploratory technique used for identifying *new* groups or patterns in a bottom-up manner (Staples & Biber, 2015). Within HCA, Ward's method as a linkage method was adopted to minimize within-cluster variance in the clustering process. Significant differences between the clustered groups were examined by means of one-way analyses of variance (ANOVAs). Following this, each group's motivational, emotional and linguistic characteristics were examined.

To gain further insight into participants' IMLL experiences, the interview responses were translated into English, and analysed using thematic analysis, a general method for qualitative analysis (Attride-Stirling, 2001). Specifically, we coded each interview for themes related to the specific IMLL activities the participant engaged in, the tools and resources he/she used, and the English skills he/she perceived as having improved.

Results

In this section, we present the results associated with each research question, beginning with a summary of the learner types that were characterized by different IMLL experiences.

Do Chinese learners of English display different IMLL engagement that characterizes them into distinct learner types?

Through the clustering procedure, we observed six learner types with distinct IMLL experiences emerging from the questionnaire data. We examined how the six learner types were configured differently based on their engagement with IMLL activities, results of which are presented in Table 1.

Learner Type 1 (N = 53) was found having the lowest scores in all aspects of English learning (i.e., about 1.00 in reading, listening, writing, speaking, and specific language features on a 6-point Likert scale), which indicates that this learner type barely learned English on their own initiative. In stark contrast, Learner Type 6 (N = 28) had the highest scores in almost all English aspects (i.e., about 4.00 in each aspect). That is, they engaged in IMLL activities related to English reading, listening, speaking, and writing respectively for about one hour every day, and learned vocabulary, grammar and pronunciation for another one and a half hour. Similar to Type 6, Learner Type 5 (N = 49) also practiced each English skill to an equal extent, though the time (i.e., about half an hour per day) to was shorter than Type 6 learners.

Learner Type 4 (N = 16) was distinct from other learner types in that learners of this type basically involved themselves in comprehension-based IMLL activities. They spent about one hour each day practicing their English reading and listening respectively, and focused on vocabulary learning. However, they had little time devoted to speaking and writing practice. This case also held for Learner Type 2 (N = 74), albeit with less time spent on reading- and listening-related IMLL activities than Type 4 learners. Of all the participants surveyed in this study, 31% belonged to this group. There was still another learner type (Type 3, N = 18), wherein learners focused specifically on their listening practice and spent more than one hour every day listening to English. Apart from listening, learners of this type seldom engaged in IMLL activities related to other skills.

ANOVAs confirmed significant differences among the six learner types in terms of their reading-related activity engagement [$F(5, 232) = 110.19$, $p = .00$], listening-related activity engagement [$F(5, 232) = 106.49$, $p = .00$], speaking-related activity engagement [$F(5, 232) = 85.53$, $p = .00$], writing-related activity engagement [$F(5, 232) = 68.34$, $p = .00$], and specific feature-related activity engagement [$F(5, 232) = 75.11$, $p = .00$].

It is worth noting that, despite the amount of time the six learner types devoted to IMLL activities being distinctly different from one another, interview data revealed similarities across learner types with regard to their most frequently engaged IMLL activities. For example,

Table 1. Informal mobile learning activities of the six learner types.

Learner Type (N)	Type 1 (53) M(SD)	Type 2 (74) M(SD)	Type 3 (18) M(SD)	Type 4 (16) M(SD)	Type 5 (49) M(SD)	Type 6 (28) M(SD)	df	Tukey's post-hoc tests	F/*p*	η2
Reading	1.06(.23)	2.69(.93)	1.61(.77)	4.38(.95)	3.45(.58)	4.14(.80)	5	1, 3 < 2 < 5 < 4, 6	110.19/.00	0.70
Listening	1.53(.69)	2.39(.77)	4.50(1.09)	4.31(.87)	3.10(.62)	4.79(.63)	5	1 < 2 < 5 < 3, 4, 6	106.49/.00	0.70
Speaking	1.23(.54)	1.72(.60)	2.67(1.13)	1.69(.79)	3.04(.49)	3.82(.72)	5	1 < 2, 4 < 3, 5 < 6	85.53/.00	0.65
Writing	1.15(.41)	1.62(.59)	2.33(1.13)	2.31(.87)	3.16(.62)	3.54(1.13)	5	1 < 2 < 3, 4 < 5, 6	68.34/.00	0.60
Language features	1.28(.53)	2.08(.85)	2.11(1.13)	3.25(.93)	3.43(.67)	4.32(.90)	5	1 < 2, 3 < 4, 5 < 6	75.11/.00	0.62

learners would turn to English TV series, films, and other video clips for listening and speaking practice, turn to English news, websites and learning apps for reading practice, and rely on social communication such as sending text messages and writing emails in English for writing practice. As one interviewee from Learner Type 3 commented, 'I enjoy my time listening to English songs when I'm in bed at night. It soothes me after a long day's study. Every time when the singer sings a song, I'd like to mouth the lyrics along. I think it helps with my listening and speaking abilities.' The interviews also suggested that some learners had limited knowledge of efficient ways to integrate mobile technologies into their English learning. One interviewee from Learner Type 1 mentioned that she always did what the English teacher asked, and was ignorant of some popular apps (e.g., *Ximalaya FM*, a listening learning application) available for English learning.

How do these learner types relate to learner attributes and their use of mobile technologies?

We further examined the six learner types in terms of their self-reported proficiency, learning motivation and anxiety, as indicative of their linguistic, motivational and emotional characteristics. The comparative results are presented in Table 2.

In terms of English proficiency, we found that Type 1 learners had the lowest score (M = 2.73, SD = 0.79) while Type 6 learners had the highest score (M = 3.56, SD = 0.62). Although the self-reported proficiency of the six learner types were found significantly different [$F(5, 232) = 6.68$, $p = .00$], post hoc comparisons using the Tukey HSD test indicated that there were no statistically significant differences among Learner Types 4, 5, 6 and between Learner Types 2, 3.

As regards learner motivation, significant differences among the six learner types were found in the aspects of ideal L2 self [$F(5, 232) = 2.85$, $p = .02$], learning attitude [$F(5, 232) = 12.88$, $p = .00$], and motivated behavior [$F(5, 232) = 6.08$, $p = .00$]. Similar to L2 proficiency, the highest scores for ideal L2 self, learning attitude, and motivated behavior were all found in Learner Type 6, whereas Type 1 learners got the lowest scores. Still, there existed no significant differences among Learner Types 4, 5, 6 and between Learner Types 2, 3 in their ideal L2 self, learning attitudes, and motivated behavior. We also observed that the ought-to L2 self of the six learner types was not significantly different [$F(5, 232) = 0.45$, $p = .81$]. Interestingly, all learner types got relatively high scores for the ideal L2 self, and relatively low scores for ought-to L2 self, suggesting that these Chinese students had strong visions of themselves as future users of English.

Table 2. Linguistic, motivational, and emotional differences of the six learner types.

Learner Types (N)	Type 1 (53)	Type 2 (74)	Type 3 (18)	Type 4 (16)	Type 5 (49)	Type 6 (28)	df	Tukey's post-hoc tests	F/*p*	η2
	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)	M(SD)				
Self-reported Proficiency	2.73(.79)	2.90(.79)	3.10(.65)	3.40(.96)	3.27(.66)	3.56(.62)	5	1 < 2, 3 < 4, 5, 6	6.68/.00	0.13
Ideal L2 Self	3.47(1.26)	3.52(1.00)	3.72(1.31)	4.32(1.19)	3.74(1.05)	4.14(.77)	5		2.85/.02	0.06
Ought-to L2 Self	2.82(.95)	3.02(.98)	2.92(1.06)	3.17(1.32)	3.00(.91)	2.86(1.08)	5		0.45/.81	0.01
Learning Attitude	3.02(.90)	3.50(.72)	3.63(1.09)	4.16(.67)	4.05(.88)	4.28(.84)	5	1 < 2, 3 < 4, 5, 6	12.88/.00	0.22
Motivated Behavior	3.46(.96)	3.87(.76)	4.02(1.03)	4.16(.62)	4.31(.89)	4.20(.72)	5	1 < 2, 3 < 4, 5, 6	6.08/.00	0.12
L2 Anxiety	3.97(1.16)	3.75(.91)	3.77(.75)	3.42(.85)	3.53(.87)	3.14(.79)	5	6 < 4, 5 < 1, 2, 3	3.41/.01	0.07

The situation for anxiety is opposite to the pattern identified in English proficiency and learner motivation: Type 1 learners exhibited the highest level of anxiety whereas Type 6 learners were the least anxious ones. Again, although we found significant differences among the six learner types [$F(5, 232) = 3.41$, $p = .01$], post hoc comparisons showed that the differences were not significant for Learner Types 1, 2, 3, and for Learner Types 4, 5. Noteworthy is that all learner types experienced some level of anxiety when learning English as a foreign language, including Learner Type 6, the type of learners with the highest English proficiency and learning motivation.

The quantitative analyses reported above showed no significant differences in learners' motivational, emotional and linguistic states among Learner Types 4, 5, and 6. And yet meaningful distinctions among these learner types were observed in their engagement with specific IMLL activities: While Type 6 learners opted for more traditional ways to improve their English skills (e.g., watching video, listening to audio, searching e-news websites), more dynamic patterns were observed in Types 4 and 5. Specifically, Types 4 and 5 learners were prone to use social communication apps (e.g., *WeChat Public Platforms*) to practice reading and listening. They also tended to engage in less popular writing activities such as online forums discussion.

This distinction between a more conservative and a more socially integrated learning was corroborated by our interview data. For example, an interviewee from Learner Type 6 was keen on learning English by watching TV series. She was a big fan of *Criminal Minds*, an American crime drama television series: 'I started watching this series years ago. At the beginning and end of each episode, there are quotations from some famous people. I always took notes of these quotations, memorizing them or sharing with my friends'. Another interviewee from Learner Type 5 was goal-oriented and wanted to develop 'a native-like competence in both spoken and written English'. He loved to share English learning resources and materials in a systematic manner via *Weibo* (a *Twitter*-like social media platform), where he had more than a thousand followers who were active in discussing English learning with him.'

What is the relationship between learners' IMLL engagement and their perceived English improvement?

To explore the relationship between learners' IMLL engagement and learning outcomes, we analyzed the interview data concerning the participants' (47 volunteers) perceived English improvement. Specifically, we calculated the proportion of learners who perceived improvement in

Table 3. Proportion of learners who perceived having improved English skill.

Group (N)	Group1 (3)	Group2 (8)	Group3 (2)	Group4 (12)	Group5 (16)	Group6 (6)
Listening	67%[a](2)	75%(6)	0	58%(7)	50%(8)	67%(4)
Reading	33%(1)	37%(3)	50%(1)	50%(6)	62%(10)	67%(4)
Speaking	33%(1)	0	0	17%(2)	37%(6)	50%(3)
Writing	0	0	50%(1)	25%(3)	31%(5)	50%(3)
Language features	33%(1)	62%(5)	100%(2)	75%(9)	56%(9)	83%(5)

[a]67% here indicates that, out of the three interviewees who came from Learner Type 1, two perceived their listening as having improved through their IMLL engagement.

terms of different English skills for each learner type, as shown in Table 3. Because the volunteered interviewees were unevenly distributed over the six learner types, results should be interpreted with caution. We excluded Learner Types 1 and 3 from our analysis here due to the limited number of interviewees from these two learner types.

For the remaining learner types, the English skills learners perceived as having improved were found largely consistent with their actual IMLL engagement (i.e., how much time they spent on practicing those particular skills). As aforementioned, Type 5 and Type 6 learners allocated a comparably large amount of time to listening-, reading-, speaking-, writing-, and language feature-related IMLL activities every day, in accord with which we found that learners from these two types viewed mobile technologies as effective in improving their listening, reading, speaking, writing, and helpful for their language feature learning. This tight link between learners' IMLL engagement and their perceived English improvement was also observed in Learner Types 2 and 4. For learners of these two types who mainly engaged in comprehension-based IMLL activities, they perceived that the use of mobile technologies had improved their listening and reading, but not speaking and writing.

Discussion

One of the challenges in IMLL research is the profiling of learners for adaptive scaffolding and intervention (Kusyk, 2017; Sockett & Toffoli, 2020). The present study aimed to address the challenge by taking a person-centred approach to identifying *multivariate* profiles of learners using a set of behavioral, motivational, emotional, and linguistic variables that concurrently shaped learners' IMLL.

Different learner types emerging based on their IMLL engagement

By applying the clustering technique to analyze Chinese students' self-initiated mobile English learning, we found different learner types with

distinct IMLL experiences. There is, for example, one learner type that barely spent time on English learning outside the classroom. Other types of learners (i.e., Type 5 and Type 6) tended to allocate a comparably large amount of time to performing reading-, listening-, writing-, speaking-, and language feature-related IMLL activities. Still other types of learners (i.e., Type 2 and Type 4) were likely to engage in comprehension-based (e.g., listening and reading) IMLL activities, falling short of English use for communication.

That is, by taking a person-centred approach, this study shed light on unidentified learner types that were overshadowed by the learner variety that characterizes learners' IMLL experiences (Kusyk, 2017). As the different learner types had meaningfully distinct IMLL patterns, combining them would produce a poorly defined "one-size-fits-all" scenario for language learning and teaching. This finding renders strong support to Staples and Biber (2015) view that clustering techniques can "provide a bottom-up way to identify new groups that are better defined with respect to target variables" (p. 243).

Motivational, emotional, linguistic interaction of different learner types

The study examined the linguistic, motivational, and emotional profiles of the different learner types. There was some evidence that each learner type brought along a distinct configuration of motivational, emotional, and linguistic interaction. To take Learner Types 2 and 4 as an example, although these two types had similar IMLL experiences, namely engaging mainly in receptive learning activities (albeit to different degrees), they differed significantly in terms of their motivation, anxiety, and self-reported proficiency. In other words, the similar learning patterns were formed as a result of an interplay of different motivation, anxiety, and proficiency levels, which mirrors what Ma (2017) found in her multi-case study.

A related observation is that, for some learners (Type 5 and Type 6) having similar learning patterns, even though they were consistent in their linguistic, motivational, and emotional states, they might still diverge in their ways of engaging in specific IMLL activities. We noticed in our questionnaire data that, while Type 6 learners opted for more traditional ways to improve their English, Type 5 learners displayed a higher level of curiosity and a better awareness of potential technological learning resources (e.g., social communication apps, online forums) (Demouy et al., 2016). Previous studies (e.g., Lai & Gu, 2011) revealed a limited use of web 2.0 technologies in language learning. According to our study, it makes sense to empower Type 5 learners with more meta-

cognitive, self-regulating capabilities to embrace the web 2.0 technologies.

Our findings corroborate the ecological view that Levine (2020) proposes, which sees the learner, learner attributes, and technological resources in terms of their interconnectedness. The present study highlights the importance of exploring underlying mechanisms of the intricate interaction between learner attributes and learning resources. To this end, an integrative consideration of learner-internal and environmental variables is warranted. As the person-centred approach views each individual as a relationally constituted whole where intra- and extra-individual attributes and resources jointly contribute to the learning process (Peng et al., 2020), we expect more studies that adopt person-centred methods to advance our understanding of the complex IMLL phenomena.

The relationship between learners' IMLL experiences and their perceived L2 improvement

The study also considered the relationship between learners' IMLL experiences and their perceived learning improvement. We found that the language skills they perceived improved were consistent with the specific language aspects they practiced with mobile technology. This finding partly corroborates the relation between learners' learning patterns and their perceived usefulness of mobile technologies in language learning revealed in Lai et al. (2018). Broadly speaking, the stronger learners perceived the usefulness is, the more engaged they would be, echoing Thoms (2014) idea that "the value of an affordance is partly determined by how a participant perceives it, and this perception in turn affects his/her decision whether to make use of it or not" (p. 726). While this finding is potentially interesting, we are cautious in our interpretation of its importance, because the participants who were interviewed were not evenly represented from the six learner types.

Methodological and pedagogical implications

The identification of different learner types (each type composed of learners with similar multivariate profiles) allows us to conduct research on relatively homogeneous learner groups that emerge from the data rather than on the groups precategorized by the researcher. The validity of those precategorized groups has been challenged, as L2 researchers (Godwin-Jones, 2019; Lowie & Verspoor, 2019) increasingly recognized that individuals comprising *a priori* categories, such as gender, age, or language proficiency, are remarkably heterogeneous in other learner

attributes such as motivation, emotion, preferred way of learning. As such, we recommend to complement standard variable-centred analysis of experimental data with a clustering procedure. That is, before implementing an intervention or a treatment, researchers could issue a series of pre-tests and questionnaires to collect data on individual differences and use clustering techniques to ascertain the existence of different, yet meaningful, learner types. Researchers could then examine possible interaction effects between different learner types and the intervention, which could provide valuable findings for the design of more effective learning materials, tools, and tasks.

Also noteworthy is that various analytic algorithms and models for describing and profiling learning processes and outcomes have proliferated in recent years. For example, Lee et al. (2019) employed a model-based clustering technique in their analysis of data obtained from an earlier experimental design, and identified different (hidden) groups/patterns that had been overshadowed by the average obtained through data analysis at the group level.

This study not only brings methodological contribution to advance our understanding of IMLL but also informs the design of adaptive instruction that better integrates and complements learners' preferred IMLL experiences. For instance, to motivate the learners (Type 1 in our study) who barely engage in any IMLL on their own, teachers can incorporate existing mobile technologies (e.g., films, songs, social networking, digital games) into in-class instruction for a supplementary purpose (Reinders & Wattana, 2014). This is quick and practical, as teachers can keep their traditional instruction (often test-oriented and form-focused) while potentially having more students become increasingly engaged in IMLL activities.

For the learners (Type 2 and Type 4) who mainly participate in comprehension-based IMLL activities, teachers can have students engage in an IMLL-integrated project (preferably production-driven) as mandatory. A nice example would be Sauro and Sundmark (2019), in which a fanfiction project was carried out as part of a mandatory course at a Swedish university. This course organizes students into groups of three to six to collaboratively write blog-based role-play fanfiction. In completing the required writing tasks, students can make use of the available mobile devices and resources. And for the learners (Type 5 and Type 6) already having equal practice in all language aspects on their own, teachers can keep an inventory of the mobile learning resources these students typically employ, together with their learning goals and interests, based on which teachers can help students construct their own IMLL programs (see also Lee, 2020). In this way students can practice IMLL activities

effectively and continuously, independent of teachers' intervention. This brings us one step closer to Hubbard's (2020) desirable and viable vision that "teachers today have an opportunity not available to previous generations of preparing their students for lifelong learning" (p. 408).

Limitations and future research

The limitations of the present investigation should also be acknowledged. First, the different learner types observed in this study were based on a sample of college English learners in China. More studies that adopt person-centred methods are needed to examine the IMLL phenomena in other socio-educational contexts. In addition, although large-scale questionnaires have been considered as valuable research tools to generate and test hypotheses, the data obtained are retrospective in nature, which may not accurately reflect learners' individual attributes. Future research that triangulates the questionnaire data with more objective measures of L2 proficiency and L2 improvement would yield more robust results.

Another limitation concerns learners' IMLL engagement, which we categorized into reading-, listening-, writing-, speaking-, and language feature-related learning activities. As we noted in the *Instruments* section, sometimes different skills can be practiced in the same IMLL activity, so it may be difficult to categorize the activity accurately. Future studies may consider splitting up a general skill (e.g., listening) based on the specific purpose of the learning activity (e.g., listening for global understanding, listening for details) (see Vandergrift & Goh, 2012).

Last but not the least, the generalizability of the results may be restricted by the cross-sectional design. We acknowledge the fact that learners may change their IMLL patterns over time in response to changes in learning contexts and their developing awareness of the potential of mobile technologies in language learning. Therefore, we suggest more studies to be carried out to analyze and cluster learners based on their IMLL experiences at different time points, thus providing nuanced profiling of IMLL dynamics.

Conclusion

Although there have been attempts to profile L2 learners' IMLL experiences (e.g., Lai & Zheng, 2018), such attempts seldom examine the underlying assumption for profiling learners and clustering them into homogeneous groups. By adopting person-centred methods, the present study identified a set of variables that characterize learners' distinct

experiential, motivational, emotional, linguistic, and achievement profiles in a bottom-up manner.

Results of this study can serve as building blocks to further scale the ecological learner profiling. More research that exploits the emerging data-mining analytic techniques, either exploratory (as in our case) or model-based (Lee et al., 2019), is needed to determine personalized IMLL learner profiles, experiential and developmental patterns. The learner types established in this study can also provide clear guidance for determining effective feedback and scaffolding tailored to learners' different IMLL experiences, and their current motivational and emotional states. From a practical point of view, this endeavor helps learners—and teachers—more powerfully "integrate semiotic engagement and structured reflection as mutually beneficial activities" (Dubreil & Thorne, 2017, p. 3).

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