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Untangling the Relationship Between AI-Mediated Informal Digital Learning of English (AI-IDLE), foreign Language Enjoyment and the Ideal L2 Self: Evidence From Chinese University EFL Students

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ABSTRACT

Artificial intelligence-mediated informal digital learning of English (AI-IDLE) might strengthen second language (L2) learners' motivational self-concept (e.g., the ideal L2 self) and enhance their foreign language enjoyment (FLE) by enabling them to build confidence, engagement, and willingness to practice their English skills in a self-directed, instant feedback, and non-judgemental learning environment. In our explanatory mixed-method study, we collected questionnaire data from 299 Chinese undergraduate English as a foreign language (EFL) learners and interviewed 12 of them. Structural equation modelling showed that students who participated in AI-IDLE more often reported a clearer ideal L2 self and greater FLE, but those with a greater ideal L2 self did not report more FLE. In addition, gender did not moderate the impact of AI-IDLE on FLE. Analysis of the interview data not only corroborated the quantitative results but also highlighted that while EFL learners can acquire a sense of FLE and vivid ideal L2 selves as they agentively negotiate the affordances of generative AI for informal language learning purposes, the sense of FLE and motivational force may shift across contexts to shape their continued investment in AI-IDLE practices. By comparing and integrating the quantitative and qualitative insights, this study highlights the pedagogical potential of AI-IDLE activities that can strengthen EFL learners' motivation, enjoyment, and commitment to English learning.

1 | Introduction

Generative artificial intelligence (GenAI) is changing how we learn second languages (L2) by offering new ways to teach and learn (e.g., Cong-Lem, Soyoof, and Tsering 2024; Kohnke, Moorhouse, and Zou 2023; Liu and Fan 2024; Rezai, Soyoof, and Reynolds 2024). However, we are only at the start; these tools will spread, especially where people can access them (Godwin-Jones 2024). To fully capitalise on AI technologies represented by GenAI, we need to understand how motivation and emotion affect L2 learning when using AI tools. Motivation and emotion shape students' commitment to learning L2 (Darvin and Norton 2023; Dornyei 2009; Dewaele 2022; Liu 2023). We draw on the key idea of what an L2 student aspires to be (*ideal L2 self* in the L2 motivational self-system; Dornyei 2009; Papi 2010). We also examine their enjoyment of learning L2, the most common and observable positive emotion (Dewaele 2022; Dewaele and MacIntyre 2014; Li, Jiang,

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and Dewaele 2018). Finally, we analyse how AI-mediated tools aid informal learning of English (Liu, Darvin, and Ma 2024a, 2024b). By untangling their complex links, we shed light on how using AI tools to informally learn L2 is related to their ideal L2 selves and L2 enjoyment. This understanding can inform the design of AI-mediated language learning environments that support learners' individual needs and preferences, making L2 learning more effective and enjoyable in this new age.

2 | Literature Review

This section first covers the theoretical underpinnings of AI-mediated informal digital learning of English, the ideal L2 self as a crucial motivational construct, and foreign language enjoyment, a prominent affective variable in L2 development. It then examines the potential cause–effect mechanisms of the three variables to formulate the research hypotheses.

2.1 | AI-Mediated Informal Digital Learning of English (AI-IDLE)

Building on the body of literature on IDLE (e.g., Lee and Lee 2021; Soyoof et al. 2023; Zhang and Liu 2023), AI-IDLE is defined by Liu, Darvin, and Ma (2024a, 2024b) as how language learners negotiate access to AI tools for self-directed learning of English outside the classroom. It captures informal English learning activities that L2 English learners take only by exploring what AI can offer (*affordances*, such as instant feedback and error correction) while tapping into its abundant resources that expose them to the L2's diverse genres, styles and registers (Liu, Darvin, and Ma 2024a). Recent studies have explored L2 learners' AI-IDLE practices (e.g., Guan, Zhang, and Gu 2024; Liu, Darvin, and Ma 2024a, 2024b). For example, Chinese university students who see it useful are more willing to use it as they experiment with it to learn what works (Liu, Darvin, and Ma 2024a). Furthermore, learners with greater motivation to achieve than others enjoy L2 learning more and are more likely to dive into productive AI-IDLE activities (Liu, Darvin, and Ma 2024b). This motivation pushes learners to seek personal growth and mastery of English, which drives them to take on challenging tasks. As they succeed, they feel accomplished and satisfied, which in turn makes learning more enjoyable and strengthens their drive to learn English. This cycle of motivation and engagement keeps them actively involved in AI-IDLE activities.

2.1.1 | The Ideal L2 Self

L2 motivation is a multifaceted construct that has been conceptualised in various ways over time. One of the most influential and widely accepted frameworks for operationalising and assessing L2 learners' motivational orientations is Dörnyei (2005), and Dornyei (2009) L2 Motivational Self System (L2MSS). Central to the L2MSS is the ideal L2 self, which represents learners' envisioned future selves that they strive to become (Dörnyei 2005; Dornyei 2009). This construct encompasses both integrative and internalised instrumental motives. The former reflects a desire to identify with and integrate into the target language community, whereas the latter is associated with personal goals and aspirations in language learning (Dornyei 2009). The ideal L2 self often serves as a powerful motivational force that propels learners to narrow the discrepancy between their current self-concept and their desired future self (Dornyei 2009; Papi 2010). This is because learners with well-developed ideal L2 selves are capable of internalising their motives and transforming them into self-determined learning behaviours. The ideal L2 self, as a motivational construct, is typically oriented towards self-improvement and personal growth. Consequently, it is considered to be promotion-focused, as opposed to prevention-focused (Liu 2024). Learners who are guided by their ideal L2 selves are more likely to actively seek out opportunities for self-growth, embrace challenges, and persist in the face of L2 learning obstacles. They are driven by a desire to realise their full potential as language learners and to achieve their aspirations for the future. In this sense, the ideal L2 self acts as a compass that guides learners' goal-directed behaviours and sustains their motivation throughout their L2 learning journey.

2.1.2 | Foreign Language Enjoyment (FLE)

Foreign language enjoyment (FLE), a prominent affective factor that is intimately connected to L2 motivation (Dewaele 2022; Li, Jiang, and Dewaele 2018; Liu, Li, and Yan 2023), refers to 'a complex emotion, capturing interacting components of challenge and perceived ability that reflect the human drive for success in the face of a difficult task' (Dewaele and MacIntyre 2016, 216). Given that learners often face uncertainty regarding the outcomes of their L2 learning endeavours, positive feedback derived from L2 learning behaviours can evoke feelings of FLE (Dewaele and MacIntyre 2014; Wang, Derakhshan, and Zhang 2021; Zhao and Wang 2023). Although the experience of enjoyment may be fleeting, it can exert enduring influences on L2 learners by allowing them to expand their 'momentary thought-action repertoires and build their enduring personal resources ranging from physical and intelligent resources to social and psychological resources' (Fredrickson 2003, 335). Furthermore, enjoyment in L2 learning encompasses both social and private dimensions (Dewaele and MacIntyre 2016). The social dimension pertains to learners' recognition and appreciation of positive learning environments, such as a supportive and encouraging classroom atmosphere. The private dimension relates to learners' emotional perceptions of and reactions to their own language learning experiences, such as finding the process of acquiring an L2 to be enjoyable, engaging, and personally fulfilling.

2.2 | The Cause–Effect Mechanisms of the Ideal L2 Self, Foreign Language Enjoyment and AI-IDLE

2.2.1 | Research on AI-Mediated Language Learning and the Ideal L2 Self

While there is limited research investigating the motivational and affective benefits of AI-IDLE, a few studies have delved into how engaging with generative AI tools enhances L2 English learners' motivation and positive emotions (e.g., Huang and Zou 2024; Lee, Shin, and Noh 2023; Song and Song 2023;

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Yıldız 2023). These studies suggest that AI-mediated L2 learning can be a significant predictor of students' motivation to learn English because AI-powered language learning tools can offer personalised and motivation-enhancing learning experiences tailored to each student's goals, interests, and proficiency level (Kohnke, Moorhouse, and Zou 2023; Liu, Darvin, and Ma 2024b). By providing content and activities that align with learners' aspirations and desired L2 self-concepts, such as simulating real-life scenarios or offering authentic materials relevant to their target domains (e.g., academia or travel), AI can help learners visualise themselves as competent and successful L2 users in their desired future roles (Liu, Darvin, and Ma 2024b). Furthermore, the adaptive nature of AI systems allows L2 learners to continuously adjust the difficulty and complexity of language tasks based on learners' performance, ensuring that students are consistently challenged within their zone of proximal development (Ferguson, van den Broek, and van Oostendorp 2022). As learners engage with AI-IDLE activities that push them to grow and improve, they can witness tangible progress in their language abilities, which may reinforce their belief in their capacity to achieve their ideal L2 selves. For instance, Song and Song (2023) investigated the effects of ChatGPT-assisted language learning on Chinese EFL learners' writing skills and learning motivation. By randomly assigning 50 students to experimental (ChatGPT-assisted instruction) and control (traditional instruction) groups, the study revealed significant improvements in both writing skills and motivation among students receiving AI-assisted instruction compared to those in the control group. In a similar vein, Yıldız (2023) employed a quasi-experimental design and collected data from 60 second-year university students in Turkey. The study found that the experimental group, which used ChatGPT to support vocabulary learning, exhibited higher levels of motivation than the control group, as they found the learning process engaging, interesting, and responsive to their unique learning needs. Furthermore, students in the experimental group demonstrated a greater inclination to improve and use their English in authentic learning contexts rather than solely to pass English exams. Given the potential of AI-mediated English learning to enhance L2 English learners' self-promotion motivation, the present study proposes the following hypothesis:

Hypothesis 1. *AI-IDLE positively predicts the Ideal L2 Self.*

2.2.2 | Research on AI-Mediated L2 Learning and Foreign Language Enjoyment

Studies have also explored the reciprocal relationship between AI-mediated L2 learning behaviours and FLE, suggesting that positive experiences in AI-assisted language learning environments can foster learners' enjoyment, which, in turn, leads to greater engagement and motivation to continue learning with AI tools (Huang and Zou 2024; Lee, Shin, and Noh 2023; Liu, Darvin, and Ma 2024b; Zhang, Meng, and Ma 2024). The potential mechanism may be that AI-mediated learning environments offer a safe space for students to make mistakes without fear of embarrassment, as their mistakes are not exposed to classmates or teachers. This sense of privacy can foster greater engagement in the language learning process. Moreover, AI provides instant, tailored feedback that adapts to each student's language performance (Jeon and Lee 2023; Kohnke, Moorhouse, and Zou 2023). When language learners provide correct answers in their interactions with AI, the AI's positive reinforcement bolsters their self-efficacy, self-concept, and motivation to continue L2 learning (Huang and Zou 2024; Lee, Shin, and Noh 2023; Liu, Darvin, and Ma 2024b). In case of an error, the AI promptly identifies the error, offers explanations, and suggests corrective measures. This immediate feedback loop enables students to recognise, comprehend, and rectify their misconceptions, ultimately enhancing their learning outcomes and self-perceptions.

Such a mechanism may also make sense through the lens of the self-determination theory (SDT hereafter, see Deci and Ryan 1985). According to SDT, learning environments that support learners' basic psychological needs for autonomy, competence, and relatedness foster intrinsic motivation and positive emotions, such as enjoyment (Ryan and Deci 2000). AI-mediated L2 learning tools can support learners' sense of autonomy by providing personalised L2 learning experiences tailored to their interests and goals (Lee, Shin, and Noh 2023). Moreover, the instant feedback and scaffolding provided by AI tools can enhance the perceived competence of L2 learners, as they feel more capable of tackling language learning challenges (Zhang, Meng, and Ma 2024). Additionally, the interactive and conversational nature of AI assistants can create a sense of relatedness or connections, as learners feel supported and connected in their learning journey (Liu, Darvin, and Ma 2024a; Huang and Zou 2024; Zhang, Meng, and Ma 2024). For example, Zhang, Meng, and Ma (2024) examined the impact of Lora, an AI-speaking assistant, on Chinese EFL learners' FLE and willingness to communicate (WTC). Their findings highlighted the positive role of AI-speaking assistants in enhancing students' FLE and WTC while reducing their anxiety in speaking English. Also noteworthy is that Lora's ability to provide a safe, non-judgemental space for practicing and its conversational support fostered learners' sense of relatedness and competence, thereby increasing their enjoyment and willingness to communicate in English. Considering the potential influence of AI-mediated learning environments on learners' enjoyment, the second hypothesis is proposed:

Hypothesis 2. *AI-IDLE positively predicts foreign language enjoyment.*

2.2.3 | Research the Impact of the Ideal L2 Self on Foreign Language Enjoyment

Students with clearer ideal L2 selves than others enjoy EFL learning more (Dewaele 2022; Liu, Darvin, and Ma 2024b; Wang, Derakhshan, and Zhang 2021). When they try to grow into their ideal selves, they often dive deeper into English learning activities. Such effort often yields greater accomplishment and satisfaction, which boosts their enjoyment of learning English (Liu 2024). Greater clarity of the ideal L2 self offers a roadmap for language learning with meaningful goals to persist despite challenges. As they move closer to their envisioned self, they feel pride, self-actualisation, and greater enjoyment of the L2 learning (Dornyei 2009; Guan, Zhang, and Gu 2024; Lee and Lee 2021; Liu, Darvin, and Ma 2024a, 2024b; Papi 2010). Hence, we hypothesise:

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Hypothesis 3. *Learners with clearer ideal L2 selves than others enjoy L2 learning more.*

2.2.4 | Gender as Moderator for AI-IDLE

Some studies showed the positive link between learners' emotions and their informal learning performance was stronger for girls than for boys (e.g., Lee, Xie, and Lee 2024; Liu, Ma, Bao, and Liu, 2023). This finding aligns with Dewaele et al. (2018) who noted that 'female learners were more emotionally involved in the [L2] learning, experiencing more emotional highs and lows than their male peers' (p. 691). As AI-IDLE can be personalised and adaptive, it can meet learners' emotional needs by giving supportive feedback and creating a richer learning experience (Liu, Darvin, and Ma 2024b). As a result, female learners may develop a stronger emotional connection to L2 learning, which can spark greater enjoyment and motivation. Hence, we hypothesise:

Hypothesis 4. *AI-IDLE's positive link with L2 enjoyment is stronger for girls than for boys.*

Taken together, these hypotheses help to address two major research questions:

RQ1. *To what extent, if any, does AI-IDLE influence EFL learners' ideal L2 self and foreign language enjoyment?*

RQ2. *Can gender moderate the interplay of AI-IDLE, the ideal L2 self, and foreign language enjoyment?*

3 | Methodology

3.1 | Research Context and Participants

This study drew upon data from a larger project that employed an explanatory mixed-method design comprising quantitative and qualitative phases (Creswell and Creswell 2017). The research project was conducted within the Chinese university EFL context using purposive sampling techniques. Participants were recruited through the dissemination of online questionnaire QR codes. Initially, electronic posters containing the QR codes were distributed across discussion groups on Chinese social media platforms. These groups were autonomously formed by individuals with a shared interest in ChatGPT or similar generative AI tools. Given the diverse educational backgrounds and learning environments of the group members, specific recruitment criteria were established. Potential subjects were required to meet three conditions: first, they must be undergraduate students enrolled in Chinese universities; second, they must be learning English as a foreign language; and third, they must have experience using generative AI for out-of-class English learning purposes.

This study involved a data set from a total of 299 questionnaire respondents who are undergraduate students from various regions of China. The sample comprised 105 male students (35.1%) and 194 female students (64.9%). The majority ($n = 244$, 81.6%) were aged between 19 and 22 years. Participants were enrolled in diverse programmes, including arts and social sciences ($n = 157$, 52.5%), science or engineering ($n = 48$, 16.1%), medicine ($n = 34$, 11.4%), business ($n = 19$, 6.4%), and other programmes ($n = 13$, 4.4%). The sample comprised students from different years of study, with third-year students forming the largest subgroup ($n = 99$, 33.1%), followed by second-year ($n = 79$, 26.4%), first-year ($n = 52$, 17.4%), fourth-year ($n = 45$, 15.1%), and fifth-year or above (n = 24, 8%) students. Furthermore, in the final optional question of the survey, participants were asked if they would be willing to participate in a post-survey interview and, if so, to provide their contact information. Ultimately, 12 participants finally attended the semi-structured post-survey interviews.

3.2 | Quantitative Data Collection and Analysis

For the quantitative data collection, a revised questionnaire was employed that consisted of 25 items. The questionnaire was divided into two parts. The first part comprised demographic information questions, primarily designed to investigate the participants' background information (e.g., age, sex, undergraduate program, registration year). The second part consisted of scale-type questions, which included items from three scales (i.e., AI-IDLE, the ideal L2 self, and FLE). Participants were required to select the most appropriate description from six response options, ranging from '1' (strongly disagree) to '6' (strongly agree). The sources of the three scales were described in further detail in the following section:

a. *AI-IDLE* (Liu, Darvin, and Ma 2024b; 8 items; Cronbach's $\alpha = 0.85$): Based on the frequently used scales in IDLE research by Lee and Drajati (2019) and Lee and Lee (2021) and the study by Liu, Darvin, and Ma (2024b), eight items were developed to measure the frequency and diversity of L2 learners' use of generative AI (e.g., ChatGPT) to assist their English learning activities outside the classroom. The content validity of these eight items was effectively evaluated. An example item is 'I engage in discussions with AI-powered chatbots to deepen my understanding and knowledge of English language culture.'

b. *The ideal L2 self* (You, Dornyei, and Csiz´er 2016; 6 items; Cronbach's $\alpha = 0.88$): Based on the L2MSS scale developed and validated by Dornyei (2009) and the study by You, Dornyei, and Csizér (2016), this scale was selected after the content validity was examined by three experienced computer-assisted language learning (CALL) researchers. The scale consists of six items and aims to measure the promotion-focused motivation of Chinese EFL learners. A sample item is 'I can imagine myself speaking English with international friends or colleagues.'

c. *FLE* (Liu, Darvin, and Ma 2024b; 5 items, Cronbach's $\alpha = 0.87$): Multiple scales exist in applied linguistics for measuring enjoyment in L2 learning (e.g., Dewaele and MacIntyre 2014; Li, Jiang, and Dewaele 2018). To adapt to the Chinese EFL context, the *FLE scale* with 11 items, developed and validated by Li, Jiang, and Dewaele (2018), was initially adopted. In addition, informed by the FLE scale validated by Liu, Darvin, and Ma (2024b) in the informal learning context, the 11 items were reduced to five items to measure Chinese L2 learners' enjoyment. A

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sample item is 'I have learned many interesting things in learning English'.

The data were analysed using SPSS 26.0 and AMOS 26.0, employing structural equation modelling (SEM) (Collier 2020). The analysis process was conducted in five main steps. First, data screening and cleaning were performed by checking for missing values, outliers, and invalid questionnaires with excessively short response times. Second, the normality of the data distribution and descriptive statistics was assessed. Skewness and kurtosis were calculated to evaluate the normality of the data set, while means and standard deviations were used for descriptive statistical analysis. Third, internal consistency was examined by calculating Cronbach's alpha (α) for each construct to assess the reliability of the scales. Fourth, the validity of the instruments was investigated through a comprehensive confirmatory factor analysis. Finally, the structural model was constructed and validated to explore the relationships among AI-IDLE, the ideal L2 self and FLE, and several control variables, including born year, undergraduate programme, and year level (i.e., students' year of attendance). Notably, following Collier (2020), we tested for moderation effects via a multigroup analysis within the SEM. Specifically, we assessed the model fit across groups and compared their parameter estimates (e.g., path coefficients) across different subgroups (e.g., gender) with a chi-squared difference test.

3.3 | Qualitative Data Collection and Analysis

For the qualitative data collection, 12 semi-structured interviews were conducted, with each lasting 30–40 minutes. Participants were given the option to respond to the interview questions in their preferred language (i.e., Mandarin). All interviewees chose to use their first language (i.e., Mandarin) to share how they employed generative AI tools to assist their out-of-class English learning activities and how they developed stronger L2 motivation and FLE as they engaged in AI-IDLE practices across contexts. An interview protocol was developed based on previous AI-IDLE or digital literacies studies (i.e., Liu 2023; Liu and Darvin 2024; Liu, Darvin, and Ma 2024b). An example interview question is: 'What are some moments when you think you enjoy learning English? Could you please give us some examples?' The qualitative interview data were analysed using deductive thematic analysis (Braun and Clarke 2021). The coding scheme was continuously refined, and potential thematic categories were generated while iteratively exploring the relationships between variables (e.g., how AI-IDLE affects learners' L2 enjoyment). By constantly comparing emerging themes, the qualitative data provided robust and detailed evidence to interpret the quantitative hypotheses (Creswell and Creswell 2017).

4 | Findings

4.1 | Quantitative Findings

4.1.1 | Descriptive Statistics

In Table 1, the descriptive statistics showed a snapshot of Chinese L2 learners' ideal L2 self, FLE, and AI-IDLE activities. The mean (M) values of all items varied between 3.52 and 4.98, indicating that learners possessed strong promotion-oriented L2 motivation, experienced a high level of enjoyment when learning English, and frequently utilised generative AI for informal language learning purposes. The standard deviations (SDs) of these items ranged from 0.92 to 1.71. The absolute values of kurtosis (K) and skewness (S) of these data were within Kline's (2023) normality criteria, below 8 and 3, respectively.

4.1.2 | Reliability and Validity Testing

Regarding the reliability of the modified survey in this study, Cronbach's alpha (α) values were higher than the benchmark (i.e., 0.7) suggested by Kline (2023). Specifically, the α values of Ideal L2 self, FLE, and AI-IDLE were 0.87, 0.85, and 0.85, respectively, which indicated that the questionnaire had an internal consistency.

The average variance extracted from the three constructs all exceeded 0.5, and their composite reliability values all exceeded 0.7, evidencing convergent validity (Hair et al. 2009). The heterotrait–monotrait ratio of correlation (HTMT) values (Henseler, Ringle, and Sarstedt 2015) for these variables all fell below 0.9, indicating discriminant validity.

Furthermore, a measurement model was constructed using AMOS to double-check the construct validity. To evaluate the degree of fit between the data set and the measurement model, seven model fit indices were employed, including the ratio of chi-square to degrees of freedom (χ^2/df), comparative fit index (CFI), incremental fit index (IFI), Tucker–Lewis index (TLI), normed fit index (NFI), root mean square error of approximation (RMSEA), and standardised root mean squared residual (SRMR). As shown in Table 2, all seven indices fell within the recommended ranges, so the measurement model fits well with the data set.

4.1.3 | The Structural Model and Moderation Effects Analysis

The initial indices of the SEM did not fully meet Collier's (2020) recommended values, so we removed observed variables based on the modification indices (i.e., A2 and A8). In Table 3, all seven indices fell within the recommended threshold range, indicating that the second SEM showed a good fit with the data set. Hence, AI-IDLE was positively linked to both ideal L2 self (H1: $\beta = 0.86$, $p < 0.001$, t value = 10.08) and FLE (H2: $\beta = 0.59$, $p < 0.001$, t value = 4.61). However, the ideal L2 self was not linked to FLE (H3: $\beta = 0.21$, $p = 0.071$, t value = 1.80) (Table 4). In terms of the R^2 values, AI-IDLE accounted for 74% of the variance in the Ideal L2 Self and 60% of the variance in FLE (see Figure 1).

To investigate whether gender differences (i.e., male vs. female) moderate the impact of AI-mediated English learning out-of-class on FLE, a two-group difference examination was conducted using the developed structural model depicted in Figure 1. As shown in Table 5, the overall model fit indices fall within the recommended ranges. The two hypothesised paths showed no significant group differences, indicating that gender did not moderate AI-IDLE's links with FLE.

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TABLE 1 | Descriptive statistics.

Factors		Items	*M*	SD	*K*	*S*	α (>0.7)
Ideal L2 Self	I1	Whenever I think of my future career, I imagine myself using English	4.85	1.06	1.90	−1.15	0.87
	I2	I can imagine a situation where I am doing business with foreigners by speaking English	4.28	1.41	−0.45	−0.54	
	I3	I can imagine myself speaking English with international friends or colleagues	4.98	0.92	2.16	−1.02	
	I4	I imagine myself as someone who is able to speak English	4.90	1.07	1.16	−1.06	
	I5	I can imagine myself speaking English in the future with foreign friends in informal settings	5.16	1.03	3.92	−1.77	
	I6	I can imagine myself living or travelling abroad and having a discussion in English	4.98	1.04	1.19	−1.15	
FLE	F1	Learning English is fun	4.11	1.22	−0.29	−0.32	0.85
	F2	There is a good atmosphere around me for learning English beyond the classroom	4.81	0.97	1.37	−0.82	
	F3	I have learned many interesting things in learning English	3.53	1.29	−0.49	0.12	
	F4	I am proud of my English proficiency	3.91	1.20	−0.28	−0.31	
	F5	I am not tired of learning English	4.34	1.23	−0.14	−0.52	
AI-IDLE	A1	I engage in English conversations with AI-powered chatbots on various topics to increase my exposure to English	4.17	1.39	−0.58	−0.52	0.85
	A2	I use AI-powered speech recognition tools to practice speaking English and receive immediate feedback on my fluency and intonation	4.21	1.37	−0.32	−0.69	
	A3	I play AI-powered language learning games to expand my English vocabulary	3.94	1.44	−0.75	−0.25	
	A4	I interact with AI-powered chatbots to acquire personalised English learning tips and strategies	4.72	1.15	0.96	−0.97	
	A5	I use new AI technologies to find and obtain English learning resources	3.99	1.43	−0.76	−0.32	
	A6	I engage in discussions with AI-powered chatbots to deepen my understanding knowledge of English language culture	4.26	1.40	−0.67	−0.47	
	A7	I interact with AI-powered chatbots to practice my English writing skills beyond the classroom	4.35	1.52	−0.62	−0.64	
	A8	I use AI technologies to simulate real-life English language use situations	3.52	1.71	−1.33	0.06	

4.2 | Qualitative Findings

The qualitative findings were consistent with the quantitative results, indicating that learners who frequently engaged in AI-IDLE activities often experienced a heightened sense of enjoyment and a more clearly defined Ideal L2 self-image. Meanwhile, the analysis also suggested that learners with high levels of enjoyment and vivid ideal L2 selves were more likely to invest substantial time in AI-IDLE activities. The reciprocal influence and interplay among motivation, enjoyment, and AI-IDLE reflected how language learners navigate their individual learning conditions and needs within specific contexts. To provide a more

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TABLE 2 | Convergent validity and discriminant validity.

		AVE (>0.5)	CR (>0.7)	HTMT (<0.9)		
				1	2	3
1	IdealL2	0.57	0.88	—		
2	FLE	0.54	0.85	0.75	—	
3	AI-IDLE	0.54	0.85	0.89	0.72	—

nuanced understanding of these findings, we analysed the following interview excerpts.

4.2.1 | How AI-IDLE Interacts with the Ideal L2 Self

Eight of the 12 interviewees expressed that participating in AI-IDLE activities helped them construct an image of their ideal L2 selves. For example, Jun,[1] a third-year law student, said:

TABLE 3 | Model fit indices.

	χ^2/df	CFI	IFI	TLI	NFI	RMSEA	SRMR
The measurement model	2.09	0.96	0.96	0.95	0.93	0.06	0.05
The structural model	2.12	0.94	0.94	0.93	0.92	0.06	0.05
Cut-off values (Kline 2023)	<3	>0.90	>0.90	>0.90	>0.90	<0.10	<0.08

TABLE 4 | Hypotheses test results.

Hypotheses	β	p	t-value (>1.96)	Results
H1: AI-IDLE −> IdealL2	0.86***	$p<0.001$	10.08	Supported
H2: AI-IDLE −> FLE	0.59***	$p<0.001$	4.62	Supported
H3: IdealL2 −> FLE	0.21	0.070	1.80	Unsupported

***$p<0.001$.

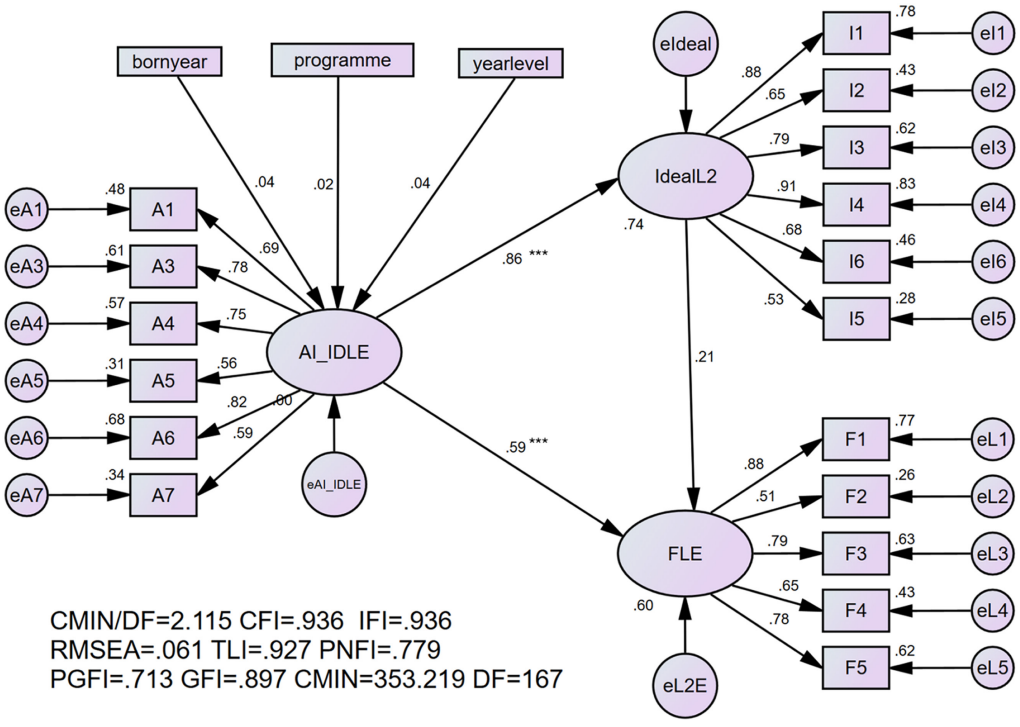

FIGURE 1 | The structural model. (1) R^2: The Ideal L2 Self = 74%, FLE = 60%. (2) Born year, programme and year level were all included in the structural model as control variables, and they did not significantly predict AI_IDLE. (3) ***$p<0.001$.

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TABLE 5 | Multi-group difference test with gender as the moderator.

	Male ($N=105$)	Female ($N=194$)	Group Differences	
Hypothesised paths	**Std. regression weights (*t* values)**	**Std. regression weights (*t* values)**	$\Delta\chi^2$	***p***
H2: AI-IDLE ➔ FLE	0.46 (1.96)	0.65 (4.23)	3.71	0.054

Note: Model fit across the groups (χ^2/df = 1.72, CFI = 0.94, NFI = 0.93, IFI = 0.94, RMSEA = 0.05, TLI = 0.93, SRMR = 0.05).

> I often chat with ChatGPT in English to improve my English proficiency. Since I am majoring in international law, sometimes we also discuss some related cases. This often makes me imagine that perhaps in the future, I can also speak more English in my professional field... This kind of imagination makes me even more eager to learn English well, so naturally, I will use AI software more as my English practice tool beyond the classroom.

By regularly chatting with ChatGPT in English, Jun is not only working on improving his English proficiency but also exploring content related to his major, international law. These AI-mediated discussions about legal cases have sparked Jun's imagination of a future self who can communicate effectively in English within his professional domain. The vivid and contextually relevant ideal L2 self that Jun has developed through his AI-IDLE experiences serve as a powerful motivator, intensifying his desire to 'learn English well' and participate in future AI-IDLE activities (e.g., using AI as an English practice tool). Likewise, Lingling, a fourth-year communication major, said in the interview:

> I am a frequent user of "Call Annie" [an AI-powered speaking assistant] to practice English, especially my British accent, because it allows me to choose different English accents for video chatting. As I use this software more and more, I feel like I can better imagine myself speaking with a British accent. This makes me more eager to explore different AI tools to practice English.

Lingling's quote demonstrates how her frequent use of CALL Annie, an AI-powered speaking assistant, has contributed to the development of her ideal L2 self and how this self-image supports her engagement in AI-IDLE. By using CALL Annie to practice her English with a British accent, Lingling could visualise herself as a proficient English speaker with the desired accent, strengthening her ideal L2 self. The development of a vivid Ideal L2 self, in turn, serves as a powerful motivator for Lingling to further engage in AI-IDLE.

4.2.2 | How AI-IDLE Relates to FLE

In the interviews, 11 participants highlighted how they developed a sense of enjoyment after extensive engagement with generative AI tools for self-directed language learning purposes. During AI-IDLE, learners felt safe and less anxious about learning/using English outside of the classroom:

> My spoken English is not good, and I am usually too shy to speak English in class... However, when I actively practice speaking with some AI software, I feel more relaxed and am willing to open my mouth. Gradually, I found that learning English makes me happy (Juan, a first-year English major).

> I like using AI to help me discover English vocabulary learning techniques...I find using AI for studying English effective and dependable. Naturally, it has made me grow to enjoy English as well (Xiaoshuai, a second-year English major).

Juan and Xiaoshuai's experiences demonstrate how engaging in AI-IDLE can foster FLE. For Juan, AI-IDLE provides a low-stress environment to practice speaking English, which he finds challenging in class due to her shyness. By actively using AI software, Juan feels more relaxed, more willing to communicate, and more enjoyable in learning English. Xiaoshuai's quote illustrates how AI-IDLE can support effective language learning strategies, such as vocabulary acquisition techniques. By finding AI tools helpful and reliable for studying English, Xiaoshuai has developed a growing enjoyment of the English language.

The interview data also highlighted how participants who were emotionally engaged in learning English invested more time in AI-IDLE activities. For example, as a final-year student majoring in Education, Shuhua shared that:

> I think interacting with AI in English can grow my interest in English learning...It is precisely because of my growing enjoyment of learning English that I am willing to spend more time exploring various effective ways of using AI to learn English, especially given the fact that it is quite difficult for Chinese students to access many foreign AI software (e.g. ChatGPT).

Shuhua's experience highlighted the reciprocal relationship between FLE and AI-IDLE. While AI-IDLE can foster enjoyment by providing learners with positive and effective learning experiences, enjoyment can also drive learners to more actively explore and utilise AI tools for language learning. As her enjoyment of learning English grows, she becomes more intrinsically motivated to invest time and effort into AI-IDLE, which may foster a virtuous cycle of increased engagement and further enjoyment.

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5 | Discussion

This explanatory mixed-method study has examined the relationships between the ideal L2 self, FLE, and AI-IDLE. The quantitative results revealed that AI-IDLE could positively and strongly influence EFL learners' enjoyment and ideal L2 self, but the ideal L2 self failed to influence FLE. In addition, gender could not moderate the impact of AI-IDLE on FLE. Adding nuances to the quantitative results, the interview data highlighted the non-linear and reciprocal relationship between AI-IDLE, FLE, and the ideal L2 self. It disclosed that while EFL learners can acquire a sense of FLE and vivid ideal L2 selves as they agentively negotiate the affordances of generative AI for IDLE purposes, the sense of FLE and motivational force may shift across contexts to shape their continued investment in AI-IDLE practices. The following section presents a synthesis of the quantitative and qualitative findings to address the two research questions.

5.1 | The Interplay of AI-IDLE, Ideal L2 Self and Foreign Language Enjoyment

This study demonstrated that AI-IDLE could be a strong predictor of Chinese EFL learners' ideal L2 selves and FLE, which contributed to unpacking the interplays of motivation, emotion, and informal language learning in the context of generative AI. Specifically, consistent with prior findings on how AI-assisted language learning can bring EFL learners an increased sense of enjoyment (Huang and Zou 2024; Lee, Shin, and Noh 2023; Zhang, Meng, and Ma 2024) and strengthen L2 motivation (Song and Song 2023; Yıldız 2023), this study found that AI-IDLE could predict the ideal L2 self (H1: $\beta = 0.86$, $p < 0.001$, t value = 10.08) and FLE (H2: $\beta = 0.59$, $p < 0.001$, t value = 4.61). In addition, the strong effect sizes reflected in the high R^2 value added evidence to the explanatory power of AI-IDLE in developing EFL learners' promotion-focused motivation and FLE.

However, echoing what Liu, Darvin, and Ma (2024b) have cautioned regarding the motivational and affective basis of AI-IDLE, the qualitative findings highlighted that the influence of AI-IDLE on the ideal L2 self and FLE is bidirectional and rather dynamic because learners who experience greater enjoyment and have a clear vision of their ideal L2 self tend to dedicate more time and effort to engaging in more creative AI-IDLE activities. We interpret this finding as indicative of the complex and reciprocal relationship between AI-IDLE, motivation, and emotion in the context of AI-mediated informal language learning. On the one hand, engaging in AI-IDLE appears to positively predict learners' ideal L2 selves and levels of FLE, likely due to the novel, personalised, and interactive learning experiences afforded by generative AI technologies. The sense of agency, creativity, and progress learners derive from these AI-mediated activities may boost their motivation to envision themselves as proficient L2 users and heighten their intrinsic enjoyment of the L2 learning process. On the other hand, learners who already possess a strong ideal L2 self and experience high levels of FLE in language learning may be more inclined to seek out and engage in AI-IDLE in the first place. Their clear vision of their desired L2 competence and positive emotional associations with language learning could drive them to explore innovative ways to practice and improve their L2 skills outside the classroom, with generative AI tools providing an attractive avenue for such self-directed informal learning.

Furthermore, this study is different from prior studies in terms of how L2 motivation could serve as an antecedent for FLE (Dewaele 2022; Liu, Darvin, and Ma 2024b; Wang, Derakhshan, and Zhang 2021). The quantitative finding demonstrated that the ideal L2 self failed to influence FLE (H3: $\beta = 0.21$, $p = 0.071$, t value = 1.80), while the interview findings also did not provide support for such an impact. This may suggest that, in the environment of AI-mediated informal language learning, the relationship between L2 motivation and enjoyment is more complex than previous thought. One possible explanation for this finding is that the inherently enjoyable nature of AI-mediated learning activities may override the influence of learners' ideal L2 selves on their emotional experiences. In other words, the novelty, interactivity, and personalisation afforded by generative AI tools may be sufficient to elicit enjoyment, regardless of learners' pre-existing motivational orientations. Another interpretation is that the ideal L2 self may only be able to indirectly influence enjoyment, possibly because of the presence of mediating factors (e.g., L2 anxiety, computer self-efficacy) in shaping L2 learners' positive emotional responses (Dewaele et al. 2018; Liu and Ma 2024).

5.2 | The Insignificant Moderating Effects of Gender

Different from how the impact of IDLE on L2 learners' emotions could be more clearly observed in female L2 learners (Lee, Xie, and Lee 2024), the results of two-group difference tests showed that the moderating effects of gender were non-existent. In addition, while the interview data added contextual information and a more nuanced understanding of the quantitative findings, no evidence showcases the gender difference in how participants developed their ideal L2 selves and a sense of FLE through participating in AI-IDLE activities. Based on these findings, we argue that the influence of AI-IDLE on learners' FLE may be less dependent on gender than what prior research has suggested. In other words, while some L2 emotion studies have indicated that female L2 learners may be more emotionally responsive to L2 learning than their male counterparts (Dewaele 2022; Dewaele et al. 2018), our results may suggest that both male and female learners can benefit equally from AI-mediated learning in terms of developing their motivation and positive emotions. One potential explanation is that the affordances of generative AI tools, such as personalisation, interactivity, and creativity (Godwin-Jones 2024; Jeon and Lee 2023), may appeal to learners across gender boundaries. The ability to engage in meaningful, authentic, and self-directed language learning experiences through AI-IDLE may be equally valuable and enjoyable for both male and female learners, regardless of their potentially different communication styles or emotional expressiveness.

5.3 | Implications

The findings of this study suggest several implications for future L2 teaching practices. First, AI-IDLE's strong positive

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link with students' ideal L2 self suggests testing AI-IDLE interventions in controlled experiments. If these experiments align with our results, they would suggest that educators explore integrating AI-IDLE activities into the curriculum. If so, education designers and/or language educators can consider using AI tools to create personalised learning materials or scenarios that mirror students' desired L2 identities, such as simulating job interviews or academic presentations in the target foreign language. By offering students chances to envision and enact their ideal L2 selves through AI-IDLE, educators can boost their motivation and commitment to learning English. Second, both the SEM and thematic analysis findings show that AI-IDLE is positively linked with students' FLE, which likewise suggests testing this result more rigorously (as in the above AI-IDLE intervention-controlled experiment). If the results align, they would suggest that education designers and/or language educators should design AI-IDLE activities that enhance students' FLE. Such activities can include interactive games, creative writing exercises, or other enjoyable tasks that challenge students in a fun, low-stakes, and out-of-class environment. By tapping into the enjoyment potential of AI-IDLE, educators might offer their students more emotionally supportive and engaging learning experiences. Finally, language educators should create a supportive environment, encouraging students to engage in AI-IDLE and reflect on their experiences. This includes giving students regular opportunities to set personal goals, track their progress, and share their AI-IDLE experiences with peers (see Liu and Li 2023). By building a supportive community around AI-IDLE, teachers can help students develop a more self-directed and sustainable approach to language learning with AI tools.

5.4 | Limitations and Future Research

This study's limitations include its sample, cross-sectional data, and explanatory variables. Due to practical constraints, we used a purposive sampling technique to recruit participants from social media discussion groups in Hong Kong that discussed using generative AI. This may have skewed the sample towards students who are particularly enthusiastic and knowledgeable about AI-IDLE. Hence, future studies can recruit a more diverse sample, including students outside Hong Kong and non-Chinese, with varying levels of AI skills and interests. This study's cross-sectional data do not allow inferences across time (e.g., causality). Hence, future research can track students across time. Furthermore, this study collected data for a few explanatory variables, so future research can collect data for more variables (e.g., age, proficiency level, etc.). By examining the complex interplay of these characteristics (*intersectional*), researchers can gain a more nuanced understanding of how to design and implement AI-IDLE to meet the diverse needs and preferences of L2 students.

6 | Conclusion

This study has contributed to the growing body of research on AI-IDLE by untangling the complex relationships between AI-IDLE and Chinese EFL learners' ideal L2 self and FLE. The findings have revealed that AI-IDLE positively influenced EFL learners' enjoyment and ideal L2 self, while the ideal L2 self could not predict FLE. Additionally, gender did not moderate the impact of AI-IDLE on enjoyment. The interview data not only corroborated the quantitative results but also highlighted the dynamic and reciprocal relationships between AI-IDLE, FLE, and the ideal L2 self. Despite these insights, future research should further investigate the multifaceted nature of these relationships and advance the research agenda of AI-IDLE.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Endnote

[1] All interviewee names are pseudonyms.

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