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Modelling trait and state willingness to communicate in a second language: An experience sampling approach

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Abstract

This study investigates whether demographics, L2 enjoyment, L2 anxiety, psychological well-being, or informal digital learning of English (IDLE) affect willingness to communicate in L2 (L2 WTC) at trait or state levels. Across two weeks, 16 Hong Kong EFL students completed pre-and post-trait-level surveys and generated 1,120 state-level responses via the *experience sampling method* (ESM). The survey findings revealed that students who were older, had higher language proficiency, or had higher pre-WTC digitally reported higher L2 WTC in the classroom. Students who had studied English longer, had higher language proficiency, had higher pre-psychological well-being, had a higher standard deviation L2 WTC over 14 days, or had higher teacher appreciation showed higher L2 WTC outside of class. Students with higher language proficiency, higher pre-WTC digitally, or higher post-psychological well-being reported higher L2 WTC in digital settings. The ESM findings revealed that students with higher teacher appreciation, currently engaged in productive IDLE or both receptive and productive

types of IDLE, currently experienced greater L2 enjoyment, or currently experienced greater well-being had higher *L2 WTC now*. Our findings are relevant to: (a) L2 WTC, informal language learning, and positive psychology theories, and (b) strategies that can be used to enhance students' L2 WTC overall and at a particular moment.

Keywords: willingness to communicate in a second language; informal language learning; positive psychology in SLA; experience sampling method

1. Introduction

A person's willingness to communicate in a second language (L2 WTC), or "readiness to enter into discourse at a specific time with a specific person or persons, using an L2" (MacIntyre et al., 1998, p. 547), is a key precursor of L2 use (Elahi Shirvan et al., 2019). Previous research suggests several potential antecedents of trait L2 WTC: demographics (age, gender, and discipline; MacIntyre et al., 2003), L2 enjoyment (Botes et al., 2022a), L2 anxiety (Dewaele, 2019), and informal digital learning of English (IDLE; Lee et al., 2024).

Ryff (1989) proposed a six-component framework for understanding a person's psychological well-being: (a) purpose in life, (b) personal growth, (c) autonomy, (d) environmental mastery, (e) self-acceptance, and (f) positive relations with others. While some studies have suggested a conceptual link between psychological well-being and L2 WTC (Dewaele et al., 2019), no past study has tested whether well-being is directly linked to L2 WTC (see Zhang et al., 2018; Shamsi & Bozorgian, 2021). As well-being is part of a mechanism that might increase L2 WTC, our study tested a direct link between the two constructs.

Moreover, L2 students are increasingly using *digital* platforms for L2 communication, while also engaging in *in-class* discussions (primarily with peers on curriculum-related topics) and having *out-of-class* conversations (e.g., authentic L2 interactions with friends and foreigners on various topics). Lee et al.'s (2022) structural equation model showed that EFL students' L2 WTC differed across these three settings. However, past studies have not determined whether L2 WTC, its antecedents, or its mechanisms vary across in-class, out-of-class, and digital settings (see Sudina, 2023).

Furthermore, trait-like (e.g., stable enjoyment) and state-like (e.g., momentary enjoyment) factors can affect L2 WTC at multiple levels (Cao & Philp, 2006; Pawlak & Mystkowska-Wiertelak, 2015; Pawlak et al., 2016; Peng, 2012; Zhang et al., 2019, 2020). However, existing studies have often relied on self-report measures obtained in classroom or laboratory settings, which are susceptible to recall bias and limit the external validity of the findings (Gregersen et al., 2023).

As the experience sampling method (ESM) captures one's real-time self-reports of thoughts, moods, or behaviors in natural settings, it can mitigate the burden of recall bias and improve the external validity of findings (Beyens et al., 2020). While real-time assessment of L2 WTC remains elusive, ESM can: (a) advance the precision of measurements, (b) enhance external validity, and (c) provide data to model both trait-like and state-like factors in L2 WTC across multiple levels.

In this study, we seek to determine whether demographics, L2 enjoyment, L2 anxiety, psychological well-being, or IDLE are linked to L2 WTC at the trait (in-class, out-of-class, and digital) or state (momentary) level. Specifically, we examined pre- and post-trait-level survey responses and state-level experiences of each participant via advanced statistics (*systems of equations* and *multilevel cross-classification ordered logit*, respectively). This study is the first to theoretically propose and empirically show L2 WTC mechanisms at the trait and state levels.

2. Theoretical framework

2.1. L2 WTC

Unlike emotions that focus on "short-lived, feeling-arousal-purposive-expressive phenomena" (Reeve, 2005, p. 294), L2 WTC concerns both stable and temporary factors (MacIntyre & Wang, 2021). Stable trait-like factors that remain consistent across time and situations (e.g., gender and extroversion) alone do not determine L2 WTC (MacIntyre et al., 2003). Dynamic interactions between L2 learners and transient state-like factors (e.g., anxiety in speaking situations and group dynamics; Dewaele & Dewaele, 2018) might also affect L2 WTC. Hence, MacIntyre et al. (1998) proposed a versatile, comprehensive L2 WTC pyramid framework of traits and states. The trait-like and stable social and individual context (Layer VI) comprises intergroup atmosphere and personality. For example, students with more international experience, a greater desire to learn about global issues and interact with foreigners, or less communication anxiety are more likely to initiate an L2 conversation (Lee, 2018; Öz et al., 2015; Yashima, 2002). The affective-cognitive context (Layer V) includes intergroup attitudes, social situation, and communicative competence. For instance, students who are more confident in speaking or who enjoy learning language with peers or teachers have higher L2 WTC (Dewaele & Dewaele, 2018; Song et al., 2022). Motivational propensities (Layer IV) comprise interpersonal motivation, intergroup motivation, and L2 self-confidence. For example, students who have higher self-perceived communicative competence or lower L2 anxiety have higher L2 WTC (Elahi Shirvan et al., 2019; Lin, 2019; MacIntyre & Wang, 2021; see also Jin & Lee, 2022).

L2 WTC situational antecedents (Layer III) are more transient, context-specific, and state-like than the previous layers; they include a desire to communicate with a specific person and state communicative self-confidence. When students are asked to speak about unfamiliar topics, or encounter technical difficulties during synchronous online class, or receive less affective peer support, they report lower L2 WTC (Kruk & Pawlak, 2022; Lee & Liu, 2022). L2 WTC is a behavioral intention; hence it is the closest precursor to communication behavior (Layer I). Notably, students with greater L2 WTC show greater L2 communication frequency and fluency (Sato & Lam, 2021; Zabihi et al., 2021).

Lee et al.'s (2022) structural equation model showed that EFL students' L2 WTC varied across three contexts: one academic (*in-class*) and two non-academic (*out-of-class* and *digital*). *L2 WTC in the classroom* refers to students' willingness to speak in L2 with familiar interlocutors (e.g., peers) in class, often about curriculum topics in structured and predictable communication scenarios. *L2 WTC outside the classroom* refers to students' willingness to communicate in L2 in more authentic, unanticipated communication scenarios with familiar (e.g., friends) or unfamiliar (e.g., foreigners) interlocutors on a variety of topics. Lastly, *L2 WTC in digital settings* refers to students' willingness to talk or write in L2 about a wide range of topics in natural, volatile communicative situations with both familiar (e.g., offline friends) and unfamiliar interlocutors (e.g., online gamers). Considering the established link between higher psychological well-being and increased social media use among university students (Bano et al., 2019), we propose that psychological well-being may positively influence L2 WTC at both trait and state levels in non-academic settings, particularly in digital environments. Overall, we posit that the factors influencing L2 WTC may directly or indirectly affect L2 WTC across levels across these three settings.

Trait data help identify enduring factors that influence a person's overall language communication disposition (MacIntyre et al., 2003). By contrast, state data capture situational factors or specific emotional states that affect communication behaviors in real time (Pawlak & Mystkowska-Wiertelak, 2015). Hence, we combine both trait and state data to begin building a comprehensive theory of L2 communication to inform interventions and instructional strategies (Zhang et al., 2019, 2020).

2.2. Antecedents of L2 WTC

Previous research has suggested several potential antecedents of L2 WTC, including demographics, L2 enjoyment, L2 anxiety, and IDLE. Regarding *demographics*, studies of students showed that those who were male (Lee & Hsieh, 2019), younger

(Lee & Lee, 2020), English majors (Lee & Lee, 2020), in school for more years (Lee & Lee, 2020; MacIntyre et al., 2003), studying abroad (Kang, 2014; Lee, 2018), more proficient in the language (Zhang et al., 2019; Zhou et al., 2020), or higher achieving (specifically higher course grades; Joe et al., 2017) reported higher L2 WTC.

L2 enjoyment is "a broad positive emotion that language learners experience when their psychological needs are met during challenging language-learning activities" (Botes et al., 2021, p.1; see also Dewaele & MacIntyre, 2014). L2 enjoyment encompasses how much students enjoy learning L2 (*personal enjoyment*), how effectively their L2 teachers fulfill their psychological needs (*teacher appreciation*), and how adequately their social and psychological needs are satisfied in the classroom (*social enjoyment;* Botes et al., 2021). Unlike excitement, which focuses on "a feeling of elation" (Kang, 2005, p. 284), L2 enjoyment encompasses a broader spectrum of positive emotions (e.g., pleasure, satisfaction or fulfillment). Based on Fredrickson's (2001) broaden-and-build theory, when students have a positive experience learning the L2, feel appreciated by their L2 teacher, or have their social and psychological needs met in the classroom, they are more likely to be motivated to participate in language learning activities and have more opportunities to acquire vocabulary and topical knowledge, which yield greater WTC (Botes et al., 2022a, 2022b; Kruk, 2021, 2022; Lee et al., 2022). Hence, students with more L2 enjoyment than others show greater L2 WTC (Khajavy et al., 2018; Li et al., 2022; see also Botes et al., 2022a).

L2 anxiety, defined as "the worry and negative emotional reaction aroused when learning or using a second language," is a common problem among language learners (MacIntyre, 1999, p. 27). Unlike fear, which is often an immediate emotional response, L2 anxiety can manifest as immediate, ongoing, or chronic states of unease (Horwitz et al., 1986). L2 anxiety is linked to being judged, fear of making mistakes, and inability to communicate effectively (Lee et al., 2024), so students with higher L2 anxiety than others have lower L2 WTC (Botes et al., 2020; Jin & Lee, 2022). In light of Fredrickson's (2001) broaden-and-build theory, L2 students' anxiety can narrow their attention to worry about small details (e.g., grammar) rather than focusing on the broader situation (e.g., context). As a result, they may become less proactive (e.g., participate less in class activities, express fewer ideas in L2), more reticent, and reluctant to speak English (Dewaele, 2019; Kruk, 2022; Lee et al., 2024).

Students who spent more time learning and using English in extramural digital settings (*IDLE*) reported higher levels of L2 WTC (Lee et al., 2024, 2022; Soyoof, 2022). Unlike extramural English, which encompasses both offline and online English-mediated activities (Sundqvist & Sylvén, 2016), IDLE specifically focuses on online activities (Lee et al., 2024). According to Lee et al. (2022), receptive

IDLE (e.g., consuming English-language content online) helps EFL students expand their lexical and topic knowledge, which can improve their L2 WTC. Also, productive IDLE (e.g., interacting with other English users online) allows students to hone their communication abilities and increase their confidence to communicate with others in English, resulting in higher L2 WTC.

2.3. Psychological well-being as a potential antecedent of L2 WTC

Positive psychology theories in the context of L2 learning emphasize the importance of well-being, which includes both "feeling good" (*hedonia*) and "functioning well" (*eudaimonia*; Oxford, 2016; Ryan & Deci, 2000). While hedonia involves subjective *positive emotions*, which are often tangible and momentary (e.g., ecstasy, warmth, comfort, ease, satisfaction), eudaimonic elements are linked to broader meaning and values. *Meaning* is an ontological view on the significance of life, which can be achieved through attaining difficult goals (*accomplishment*) or mutually caring and valued relations with other people (*positive relationships*, Berscheild & Reis, 1998). Meaningful accomplishments and positive relationships often require deep commitment, intense immersion, and involvement in relevant activities (*engagement*). Together, positive emotions, engagement, relationships, meaning, and accomplishment constitute Seligman's (2011) five-dimensional PERMA model. *Subjective well-being* explores how people perceive and feel about their own well-being (Diener, 1984; Diener et al., 2010); it comprises three components: (a) *life satisfaction*, (b) *positive affect*, and (c) *negative affect*. Both external circumstances (e.g., income) and internal factors (e.g., personality traits) can influence subjective well-being (Diener & Chan, 2011).

Ryff (1989) proposed a six-component framework for understanding a person's overall mental health and well-being (*psychological well-being*): (a) sense of a meaningful, purposeful life (e.g., making a positive contribution to the world; *purpose in life*), (b) openness to new experiences for personal development (*personal growth*), (c) self-regulated ability to make decisions/act independently without being influenced by external pressures or norms (*autonomy*), (d) ability to effectively manage life events by making constructive choices to reach desired goals (*environmental mastery*), (e) appreciation of oneself, including acceptance of flaws and weaknesses (*self-acceptance*), and (f) formation/maintenance of satisfying relationships with other people (*positive relations with others*). In their school well-being model, Konu et al. (2002) identified four dimensions: (a) *school conditions* (e.g., group sizes), (b) *social relationships* (e.g., school climate), (c) *means for self-fulfillment* (e.g., the value placed on student's work), and (d) *health status* (e.g., chronic diseases).

Recent research in L2 learning has shown a growing interest in well-being (Dewaele et al., 2019; MacIntyre et al., 2016, 2019; MacIntyre & Mercer, 2014; Mercer & Gregersen, 2023). For example, Oxford (2016) used Seligman's (2011) PERMA model to develop the EMPHATICS model that constitutes: (a) emotion/empathy, (b) meaning/motivation, (c) perseverance, (d) agency/autonomy, (e) time, (f) hardiness/habits of mind, (g) intelligences, (h) character strengths, and (i) self-factors. Mercer (2021) adopted an ecological perspective and defines well-being in ELT as "the dynamic sense of meaning and life satisfaction emerging from a person's subjective personal relationships with the affordances within their social ecologies" (p. 3). She underscored the need to integrate hedonic and eudaimonic perspectives and considered both individual and social aspects of well-being in ELT.

Rad and Jafarpour (2023) applied Konu et al.'s (2002) model to enhance students' well-being by improving school conditions, fostering social relationships through student-teacher interaction, and promoting self-fulfillment. Their intervention enhanced Iranian EFL students' well-being and their writing skills. However, past studies have mainly focused on the well-being of L2 teachers (Ebadijalal & Moradkhani, 2022; Ergün & Dewaele, 2021; Jin et al., 2021), and no published study has tested a direct link between well-being and L2 communication, such as WTC. Students with greater personal growth, autonomy, environmental mastery, or positive relations with others might have more confidence to interact with others, and possibly greater L2 WTC (Dewaele et al., 2019; Huo, 2022). Moreover, those with greater self-acceptance are more resilient to mistakes or even failures, so the occurrence of such phenomena during L2 interactions are less likely to undermine their L2 WTC (Derakhshan et al., 2022; Dewaele et al., 2019; Rad & Jafarpour, 2023). Therefore, psychological well-being might be linked to L2 WTC.

Methodologically, researchers following the principles of L2 positive psychology have adopted ESM to collect real-time data on moods, thoughts, and behaviors in natural settings, moving away from relying on retrospective surveys. For instance, Gregersen et al. (2023) studied six ESL/EFL teachers with varying levels of PERMA, using ESM to measure their stress levels and well-being. Their findings shed light on the complex relationship between stress, well-being, and health in both work and home environments. While ESM has the potential to reduce recall bias and enhance the external validity of research, its application in L2 research remains limited (Gregersen et al., 2023; Hiver & Al-Hoorie, 2020).

2.4. Aims of this study

Our literature review identified three research gaps. First, while past studies have linked demographics, L2 enjoyment, L2 anxiety, and IDLE to L2 WTC, no

published study to date has shown a link between psychological well-being and L2 WTC (see Shamsi & Bozorgian, 2021; Zhang et al., 2018). Second, although L2 students are increasingly communicating both offline (in-class and out-of-class) and online, past studies have not determined whether L2 WTC, its antecedents, or its mechanisms differ across these settings (Sudina, 2023). Third, while trait-like (e.g., stable enjoyment) and state-like (e.g., momentary enjoyment) factors can influence L2 WTC at both trait and state levels, no published study has modelled their mechanisms at both trait and state levels (Zhang et al., 2018). To address these gaps, this study investigates whether demographics, L2 enjoyment, L2 anxiety, psychological well-being, or IDLE are related to L2 WTC at the trait (in-class, out-of-class, and digital) and state (momentary) levels. We address two research questions (RQ) in this study:

RQ1: How are demographics, L2 enjoyment, L2 anxiety, psychological well-being, or IDLE related to L2 WTC at the trait level (in-class, out-of-class, and digitally)?
RQ2: How are demographics, L2 enjoyment, L2 anxiety, psychological well-being, or IDLE related to L2 WTC at the state (momentary) level?

3. Methods

In this study, we collected university students' pre- and post-survey responses and experience samples (five times per day for 14 days) regarding L2 WTC and its potential antecedents. We analyzed the survey responses with *systems of equations*, and the experience samples with *multilevel cross-classification ordered logit*.

3.1. Context and participants

We recruited 16 Hong Kong EFL undergraduate and postgraduate students (M = 21.8 years old, range: 17-27 years; 81% females, 19% males). 50% of these students majored in English, 19% in non-English language majors, and 31% in other disciplines (e.g., child education, finance, science, and information technology). Among these participants, 31% had studied abroad, typically for less than a year. While Putonghua/Mandarin was their native language, 88% of them had learned English for more than ten years and 12% for seven to ten years. As these participants had high previous English grades (75% A and 25% B), their mean self-perceived English proficiency was 7 (max: 10, range: 3 to 9). Lastly, they spent a mean of 4 hours 34 minutes per day on IDLE during the past month (range: 30 minutes to 10 hours).

3.2. Recruitment procedure

After our university's ethics committee approved our study, we advertised for study participants at a public university in Hong Kong. We informed them about this study's goals, benefits, risks, and confidentiality measures (e.g., ensured data anonymization by using arbitrary ID numbers and restricting access to the data). Potential participants were also informed about their right to withdraw from the study at any point. Then, interested students provided their informed consent to participate.

3.3. Statistical power

Statistical power differed across levels of students and their survey responses. For $\alpha = .05$ and a medium effect size of 0.3, statistical power for 16 students is very low but for 1,120 experience samples it exceeded .99 (Konstantopoulos, 2008). As this small sample had low statistical power at the student level, the likelihood that a non-significant student-level result was a false negative was high, but we retained our usual confidence in our significant results.

3.4. Variables

The pre- and post-online survey of traits has five sections: demographics, L2 WTC, L2 enjoyment, L2 anxiety, and psychological well-being. *Demographic* questions included gender, age, English major, duration of English study, duration of overseas study, language proficiency, course grade, and IDLE frequency.

L2 WTC (Lee et al., 2022) has three subscales: (a) L2 WTC in-class (5 items; Cronbach's $\alpha = .837$; e.g., "When you are given an opportunity to talk freely in an English class"), (b) L2 WTC out-of-class (5 items; $\alpha = .805$; e.g., "When you and a small group of foreign friends engage in a discussion outside of school"), and (c) L2 WTC digitally (4 items; $\alpha = .910$; e.g., "When you have a chance to talk to other game players in English"). These Likert-type scales ranged from 1 (*definitely not willing*) to 5 (*definitely willing*).

L2 enjoyment (Dewaele & MacIntyre, 2014; Lee et al., 2022) has three subscales: (a) personal enjoyment (6 items; $\alpha = .859$; e.g., "I enjoy learning English"), (b) teacher appreciation (5 items; $\alpha = .838$; e.g., "The English teacher is supportive"), and (c) social enjoyment (6 items; $\alpha = .903$; e.g., "The classmates are nice in English class"). The scales of L2 enjoyment, L2 anxiety, and psychological well-being range from 1 (*strongly disagree*) to 5 (*strongly agree*).

L2 anxiety (Lee et al., 2024) has two subscales: (a) face-to-face L2 anxiety (6 items; α = .938; e.g., "I feel nervous when I speak English in front of other students") and (b) digital L2 anxiety (8 items; α = .972; e.g., "I feel nervous when I speak English with other fans in an online community").

Psychological well-being was adopted from Ryff and Keyes (1995, 11 items; α = .850; e.g., "I like most parts of my personality").

3.5. Experience sampling method

To measure state-level responses, we collected real-time data from participants using the *experience sampling method* (Gregersen et al., 2023; Hiver & Al-Hoorie, 2020). We used Google Forms, a free, easy-to-use, survey tool, which piped respondents' data into an Excel spreadsheet. The ESM survey has six sets of questions: (a) five reporting timeslots (e.g., 9 am-12 pm), (b) IDLE type (receptive IDLE, productive IDLE, and both receptive and productive IDLE) and duration, (c) L2 enjoyment level, (d) L2 anxiety level, (e) L2 WTC level, and (f) psychological well-being level. At each assessment, participants indicated their levels of *L2 enjoyment* ("How much did you enjoy learning and using English during this time?"), *L2 anxiety* ("How much anxiety did you have while learning and using English during this time?"), *L2 WTC* ("How much were you willing to communicate with others in English during this time?"), and *psychological well-being* ("How happy were you during this time?"). To reduce response burden and fatigue, we used a single-item, Likert-type scale ranging from 1 (*not enjoyable/anxious/happy at all*, *extremely unwilling*) to 5 (*extremely enjoyable/anxious/happy*, *extremely willing*), as in most ESM studies (Beyens et al., 2020).

A research assistant sent WhatsApp messages to participants between 9:01 am and 9:01 pm daily for 14 days to report their IDLE, L2 enjoyment, L2 anxiety, L2 WTC, and psychological well-being levels. Except for the final timeslot (9:01 pm to 9 am [night until morning]), the time window was divided into four 3-hour intervals for participants (e.g., 3:01 pm-6 pm). Following standard ESM procedures, we required participants to reply to each message within three hours, except for the final timeslot (9 pm to 9 am). For missed responses, the assistant sent reminders or calls before the end of the day. For ESM data collection, participants used Google Forms polls within WhatsApp, which automatically piped these data into an Excel spreadsheet.

3.6. Data analysis

To accurately analyze these data, we addressed the following issues with statistical strategies: (a) similarities versus differences of responses of students across

time with *multilevel* (ML) *cross-classification analysis* (Hox et al., 2017), (b) time differences with *Q-statistics* (Ljung & Box, 1979), (c) ordered outcomes with *ordered Logit/Probit* (Martinez et al., 2017) and *odds ratios* (Martinez et al., 2017), (d) multiple outcomes/dependent variables with *systems of equations* (Kennedy, 2008) (e) sequences across time with *vector auto-regression* (VAR, Kennedy, 2008), (f) indirect, ML mediation effects with *multilevel M-tests* (MacKinnon et al., 2004), (g) *cross-level interactions* (student x time) with *random parameters* in *random effects models* (Hox et al., 2017), (h) many hypotheses' false positives with the *two stage linear step-up procedure* (Benjamini et al., 2006), (i) comparison of effect sizes with *Lagrange multiplier tests* (Bertsekas, 2014), and (j) consistency of results across data sets (*robustness*) with separate multilevel, single outcome models and analyses of data subsets (Kennedy, 2008; see Table 1; see Ahn et al., 2021).

Table 1 Statistical strategies addressing each analytic difficulty

Analytic difficulty	Statistics strategy
Dataset	
• Cross-classified data (surveys across time and across students)	• Multilevel cross-classification (Hox et al., 2017)
Outcome variables	
• Similar adjacent talk ($t_3 \sim t_4$)	• Q-statistics (Ljung & Box, 1979)
• Differences across time (Non-stationarity)	• Multilevel cross-classification (Hox et al., 2017)
• Ordered variable (yes/no)	• Ordered logit/probit; odds ratios (Martinez et al., 2017)
• Multiple outcomes (Y_1, $Y_{2, \ldots}$)	• System of equations (Kennedy, 2008)
Explanatory variables	
• Sequences across time (X_{t-2} or $X_{t-1} \rightarrow Y_0$)	• Vector auto-regression (VAR, Kennedy, 2008)
• Indirect, multi-level mediation effects ($X \rightarrow M \rightarrow Y$)	• Multilevel *M-test* (MacKinnon at al., 2004)
• Cross-level interactions (Student x Time)	• Random effects model (Hox et al., 2017)
• Many hypotheses' false positives	• Two-stage linear step-up procedure (Benjamini et al., 2006)
• Compare effect sizes ($\beta_1 > \beta_2$?)	• Lagrange multiplier tests (Bertsekas, 2014)
• Consistency of results across data sets (Robustness)	• Separate multilevel, single outcome models • Analyses of subsets of the data (Kennedy, 2008)

3.7. Explanatory model

First, we modeled a vector of *Bartlett factor scores* (Joreskog & Sorbom, 2018) of student *Post-WTC* with a *system of equations* (Kennedy, 2008).

(1) $Post\text{-}WTC_{yi} = \beta_y + e_{yi}$

In *Post-WTC*$_{yi}$, outcome *y* (*WTC in-class, WTC out-of-class, WTC digitally*) of student *i* had a grand mean intercept β_y, with unexplained components (*residuals*) at the student-level (e_{yi}).

We entered explanatory variables in temporally ordered, sequential sets to estimate the variance explained by each set and to test for mediation effects (Kennedy, 2008). After entering *Demographics* (*gender, age, English major, duration of studying English, duration of overseas study, language proficiency, course grade*), we added measures before the intervention *Pre* (*pre-teacher appreciate, pre-personal enjoyment, pre-social enjoyment, pre-anxiety, pre-psychological well-being, pre-WTC*), followed by *Experience* (*hours of IDLE receptive only [14-day mean, 14-day standard deviation [SD]], hours of IDLE productive only [mean, SD], hours of IDLE both [mean, SD], enjoy [mean, SD], anxiety [mean, SD], well-being [mean, SD], WTC [mean, SD]*), and then *Post* (*post-teacher appreciate, post-personal enjoyment, post-social enjoyment, post-anxiety, post-psychological well-being*).

$$(2)\ WTC_{yi} = \beta_y + e_{yi} + \beta_{yu}Demographics_{yi} + \beta_{yv}Pre_{yi} + \beta_{yw}Experience_{yi} + \beta_{yx}Post_{yi} + \beta_{yz}Interactions_{yi}$$

A *nested hypothesis test* ($\Delta\chi^2$LL) determines the significance of each set of explanatory variables (Kennedy, 2008). For greater precision and less *multicollinearity*, we omitted *non-significant* variables (which do not cause *omitted variable bias*, Cinelli & Hazlett, 2020).

Second, we modeled *WTC_now* with a *multilevel cross-classification ordered logit* (Hox et al., 2017).

$$(3)\ WTC\_now_{(it)} = \beta + e_{it} + f_i + g_t$$

WTC_now of student *i* at time *t* had grand mean intercept β, with residuals at the student-time moment (e_{yi}) for each student (f_i) at each time (g_t).

$$(4)\ WTC\_now_{(it)} = \beta + e_{it} + f_j + g_t + \beta_r Demographics_i + \beta_s Pre_i + \beta_{iu}Now_{(it)} + \beta_{iv}Previous_{(i[t-1])} + \beta_{iw}Earlier_{(i[t-2])} + \beta_{ix}Cumulative_{(it)} + \beta_{iz}Interactions_{ij}$$

Demographics and then *Pre* were entered as above. Next, we entered *Now* (*IDLE receptive only now, IDLE productive only now, IDLE both now, IDLE neither now, enjoy now, anxiety now, well-being now*), followed by *Previous* (*IDLE receptive only in the previous time period [-1], IDLE productive only [-1], IDLE both [-1], IDLE neither [-1], enjoy [-1], anxiety [-1], well-being [-1], WTC [-1]*). Then, we entered *Earlier* (*IDLE receptive only [-2], IDLE productive only [-2], IDLE both [-2], IDLE neither [-2], enjoy*

[-2], anxiety [-2], well-being [-2], WTC [-2]), followed by *Cumulative* (*IDLE receptive cumulative mean, IDLE productive cumulative mean, IDLE both cumulative mean, IDLE neither cumulative mean, enjoy cumulative mean, anxiety cumulative mean, well-being cumulative mean, IDLE receptive cumulative SD, IDLE productive cumulative SD, IDLE both cumulative SD, IDLE neither cumulative SD, enjoy cumulative SD, anxiety cumulative SD, well-being cumulative SD*), and then *Interactions*.

We used an alpha level of .05. Also, we analyzed residuals for influential outliers. To test whether the results differ across link functions (logit vs. probit), we also used *multilevel, cross-classification probit*.

4. Results

4.1. Summary statistics

Summary statistics are included in Tables 2 and 3 (see Appendix Tables A1 and A2 for correlation-variance-covariance matrices). Notably, the mean daily IDLE via ESM (4.86 hours; range: .94 to 8.88) resembled the mean daily IDLE via survey (4.57 hours, range: .50 hours to 10.00 hours). This similarity implies that a survey asking about IDLE frequency in the previous month is nearly as accurate as IDLE frequency captured by ESM.

Table 2 Summary statistics of students (*N* = 16)

Variable	*M*	*SD*	Min	Median	Max
Outcomes					
Post-WTC in-class	4.098	.598	3.035	4.160	5
Post-WTC out-of-class	4.021	.854	1.739	4	5
Post-WTC digitally	4.094	.917	2	4	5
Demographics					
Student	8.500	4.761	1	8.5	16
Age	21.750	2.543	17	21.5	27
Female	.813		0	1	1
Studying English duration (years)	11.125	1.088	7.5	11.5	11.5
Overseas study	.313		0	0	1
Major English	.250		0	0	1
Course grade A	.750		0	1	1
Language proficiency	7.000	1.592	3	7.5	9
Pre-experience					
Pre-WTC in-class	4.380	.742	2.625	4.780	5
Pre-WTC out-of-class	4.283	.663	2.931	4.362	5
Pre-WTC digitally	4.531	.670	3	5	5
Pre-face-to-face anxiety	7.608	1.216	6	7.936	9.763
Pre-digital anxiety	7.496	1.480	6	7.261	9.979

Pre-enjoy teacher appreciates me	9.152	.696	7.983	9.064	10
Pre-personal enjoyment	8.850	.762	6.962	8.909	9.872
Pre-social enjoyment	9.376	.532	8	9.500	10
Pre-well-being	8.797	.705	7.557	8.870	10
Experience					
Mean hours of IDLE receptive only	2.288	1.552	.238	2.071	7.048
Mean hours of IDLE productive only	.766	1.274	0	.363	5.286
Mean hours of IDLE both	1.803	2.157	0	.893	8.512
Mean hours of IDLE total	4.858	2.433	.940	4.821	8.881
Mean enjoy over 14 days	3.919	.769	1.943	4.064	4.886
Mean anxiety over 14 days	1.755	.512	1	1.75	2.7
Mean WTC over 14 days	3.688	.866	1.957	3.671	4.943
Mean well-being over 14 days	3.719	.722	2.029	3.779	4.757
SD hours of IDLE receptive only	1.446	.810	.601	1.030	2.904
SD hours of IDLE productive only	.708	.591	0	.497	2.134
SD hours of IDLE both	1.464	.866	0	1.368	3.105
SD hours of IDLE total	1.810	.713	.703	1.533	2.866
SD enjoy over 14 days	.795	.331	.391	.829	1.693
SD anxiety over 14 days	.763	.285	0	.833	1.123
SD WTC over 14 days	.808	.332	.234	.783	1.689
SD well-being over 14 days	.805	.295	.490	.749	1.719
Post-experience					
Post-face-to-face anxiety	7.923	1.059	6	8.019	9.618
Post-digital anxiety	7.177	1.083	6	7.170	9.353
Post-teacher appreciates me	8.970	.611	7.876	8.983	9.983
Post-personal enjoyment	8.654	.785	7.120	8.842	9.816
Post-social enjoyment	9.084	.675	7.832	9.033	10
Post-well-being	8.598	.646	7.315	8.595	9.771

Note. For dichotomous variables, the mean indicates the proportion of participants with the attribute, and *SD* was not meaningful

Table 3 Summary statistics of students in time (*N* = 1,120)

Variable	*M*	*SD*	Min	Median	Max
WTC now	3.688	1.204	1	4	5
Demographics					
Student	8.500	4.612	1	8.5	16
Day	7.500	4.033	1	7.5	14
Time	3.000	1.415	1	3	5
Age	21.750	2.463	17	21.5	27
Female	.813	.390	0	1	1
Studying English duration (years)	11.125	1.054	7.5	11.5	11.5
Overseas study	.313		0	0	1
English major	.250		0	0	1
Course grade A	.750		0	1	1
Language proficiency	7.000	1.542	3	7.5	9
Pre-experience					
Pre-WTC in-class	4.380	.719	2.625	4.780	5
Pre-WTC out-of-class	4.283	.642	2.931	4.362	5

Pre-WTC digitally	4.531	.649	3	5	5
Pre-face-to-face anxiety	7.608	1.178	6	7.936	9.763
Pre-digital anxiety	7.496	1.434	6	7.261	9.979
Pre-personal enjoyment	8.850	.738	6.962	8.909	9.872
Pre-social enjoyment	9.376	.515	8	9.500	10
Pre-enjoy teacher appreciates me	9.152	.674	7.983	9.064	10
Pre-psychological well-being	8.797	.683	7.557	8.870	10
Now					
IDLE receptive only now	.458	.721	0	0	3.5
IDLE productive only now	.153	.514	0	0	3
IDLE both now	.361	.796	0	0	4
Enjoy now	3.919	1.131	1	4	5
Anxiety now	1.755	.946	1	1	5
Well-being now	3.719	1.099	1	4	5
Previous time period					
IDLE receptive only (-1)	.458	.722	0	0	3.5
IDLE productive only (-1)	.155	.517	0	0	3
IDLE both (-1)	.356	.791	0	0	4
Enjoy (-1)	3.916	1.134	1	4	5
Anxiety (-1)	1.761	.950	1	1	5
WTC (-1)	3.687	1.205	1	4	5
Well-being (-1)	3.714	1.101	1	4	5
Earlier time period					
IDLE receptive only (-2)	.460	.724	0	0	3.5
IDLE productive only (-2)	.155	.520	0	0	3
IDLE both (-2)	.354	.791	0	0	4
Enjoy (-2)	3.916	1.138	1	4	5
Anxiety (-2)	1.760	.951	1	1	5
WTC (-2)	3.685	1.207	1	4	5
Well-being (-2)	3.712	1.104	1	4	5

Note. For dichotomous variables, the mean indicates the proportion of participants with the attribute, and *SD* was not meaningful

4.2. Explanatory models

4.2.1. Post-survey WTCs

Demographics, pre-experience, experience, and post-experience variables were linked to WTC in-class, WTC out-of-class, and WTC digitally (see Table 4).

Demographics (age, language proficiency) and pre-experience (pre-WTC digitally) were linked to WTC in class. Among these students, those who were a year older or with one level higher language proficiency were more likely to report one level higher WTC in class (+1% or +6%, respectively). Also, those with one level higher pre-WTC digitally were 8% more likely to indicate one level higher WTC in class. This model accounted for nearly 78% of the differences in these students' WTC in class.

Demographics (studying English duration, language proficiency), pre-experience (pre-well-being), experience (SD WTC over 14 days), and post-experience (the teacher appreciates me) were linked to WTC out-of-class. Among these students, those having studied English for a year longer or with one level higher language proficiency were more likely to report one level higher WTC out-of-class (+9% or +14%, respectively). Students with greater pre-psychological well-being than others were 19% more likely to indicate one level higher WTC out-of-class. Among these students, those with one standard deviation greater WTC over 14 days were 33% more likely to report one level higher WTC out-of-class (largest effect size). Students who perceived that their teacher appreciated them more than others (by one level) were 22% more likely to indicate one level higher WTC out-of-class. This model accounted for over 89% of the variance in these students' WTC out-of-class.

Table 4 Summary of system of equations' unstandardized regression coefficients (standard errors in parentheses) and odds ratios modeling WTC in-class, WTC out-of-class, and WTC digitally

Explanatory variable	WTC in class		WTC out-of-class		WTC digitally	
Age	.056	**				
	(.016)	+1%				
Studying English duration (years)			.378	***		
			(.047)	+9%		
Language proficiency	.228	**	.555	***	.345	**
	(.074)	+6%	(.061)	+14%	(.078)	+9%
Pre-psychological well-being			.800	***		
			(.088)	+19%		
Pre-WTC digitally	.315	*			.648	**
	(.106)	+8%			(.197)	+16%
SD WTC over 14 days			1.606	***		
			(.224)	+33%		
Post-teacher appreciates me			.965	***		
			(.069)	+22%		
Post-psychological well-being					.594	**
					(.172)	+14%
R^2	.777		.891		.757	

Note. Each outcome was modeled with a constant term. *$p < .05$, **$p < .01$, ***$p < .001$

Demographics (language proficiency), pre-experience (pre-WTC digitally), and post-experience (post-well-being) were linked to WTC digitally. Among these students, those with one level greater language proficiency were 9% more likely to report one level higher WTC digitally. Students with one level higher pre-WTC digitally were 16% more likely to indicate one level higher WTC digitally. Among these students, those with one level greater post-psychological well-being were 14% more likely to report one level higher WTC digitally. This model accounted for nearly 78% of the variance in these students' WTC digitally.

4.2.2. WTC now experience samples

Most of the differences in WTC now were across time (67%) rather than across students (33%; see Table 5). All results discussed below described first entry into the regression, controlling for all previously included variables. Ancillary regressions and statistical tests are available upon request.

Table 5 Summary of multilevel cross-classification logit's unstandardized regression coefficients (standard errors in parentheses) and odds ratios modeling WTC now

Explanatory variable	Regressions predicting WTC now					
	Model 1		Model 2		Model 3	
Pre-enjoy: teacher appreciates me	.878	*	.878	*	.987	**
	(.430)	+21%	(.428)	+21%	(.328)	+23%
IDLE productive now			.385	**	.631	***
			(.121)	+10%	(.147)	+15%
IDLE both now			.498	***	.558	***
			(.083)	+12%	(.097)	+14%
Enjoy now					.631	***
					(.100)	+15%
Well-being now					1.223	***
					(.107)	+27%
Variance at each level	Explained variance at each level					
Student (33%)	.108		.151		.728	
Time (67%)	.065		.103		.492	
Total variance explained	.080		.119		.570	

Note. Each model included a constant term. *$p < .05$, **$p < .01$, ***$p < .001$

Pre-experience, IDLE, and current psychological measures were linked to WTC now. Among these students, those perceiving that their teacher appreciated them one level more were 21% more likely to report one level higher WTC now. Among these students, those currently engaged in productive IDLE or both types of IDLE were more likely to report one level higher WTC now (+10% or +12%, respectively). Students perceiving greater enjoyment or well-being now were more likely to indicate one level higher WTC now (+15% or +27%, respectively). The final model accounted for 57% of the variance in WTC now.

All other results were non-significant. Notably, no mediation tests or interactions were significant. Robustness tests with single outcomes, data subsets or multilevel cross-classification probit showed similar results. Analysis of residuals show no influential outliers.

5. Discussion

Unlike previous piecemeal testing studies that examined L2 WTC at the trait or state level, this study proposed and tested a comprehensive theoretical model

of how demographics, L2 enjoyment, L2 anxiety, psychological well-being, or IDLE were related to L2 WTC at both the trait (in-class, out-of-class, and digitally) and state (momentary) levels.

5.1. L2 WTC trait

Specifically, *in the classroom*, students who were older, had higher language proficiency, or had higher pre-WTC digitally reported higher L2 WTC, aligning with past studies (Lee & Lee, 2020; Zhou et al., 2020). Building on past studies showing that *WTC digitally* was linked with *WTC in-class* (Lee & Lee, 2020), this study showed that *pre-WTC digitally* affects *post-WTC in-class* to add nuance to our understanding. This is the first evidence showing that students who were more likely to engage in English conversations in digital settings became more willing to subsequently speak English in the classroom.

Outside of class, students who studied English longer, had higher language proficiency, had higher pre-psychological well-being, had a higher standard deviation L2 WTC over 14 days, or perceived that their teacher appreciated them showed higher L2 WTC, aligning with past studies (Lee et al., 2022; Lee & Lee, 2020; MacIntyre et al., 2003; Zhou et al., 2020). Notably, this is the first study to show that students with higher pre-psychological well-being had higher L2 WTC outside the classroom. This result suggests that students with better psychological health were more likely than others to subsequently engage in English communication outside the classroom. This study also shows the first evidence that students with a higher standard deviation L2 WTC over 14 days than others had higher L2 WTC outside the classroom (largest effect size). This result suggests that such students who encounter a wider variety of easy (with friends in familiar settings) and difficult (with strangers in unfamiliar settings) communicative situations than others (higher L2 WTC volatility) are more willing to subsequently communicate in L2. If future studies (especially intervention studies) confirm this finding, then a teacher should expose their students to a greater variety of L2 communicative situations that range in difficulty (not only easy ones and not only hard ones) to improve their L2 WTC outside the classroom.

In digital settings, students with higher language proficiency, higher pre-WTC digitally, or higher post-psychological well-being reported higher L2 WTC. Building on past studies showing that students with higher language proficiency have higher L2 WTC *offline* (Zhang et al., 2019; Zhou et al., 2020), our findings offer the first evidence that higher language proficiency yields higher L2 WTC *online*. Consistent with the above WTC in class and WTC out-of-class results, students with higher pre-WTC digitally or higher post-psychological well-being reported higher post-L2 WTC digitally. These findings suggest that students who are psychologically

healthy with a positive attitude toward their lives are more likely to subsequently engage in English communication in digital environments.

5.2. ESM

Our immediate, fine-grained, ESM results revealed that students who perceived that their teacher appreciated them, currently experienced greater L2 enjoyment, currently engaged in productive IDLE or both receptive and productive IDLE, or currently experienced greater psychological well-being had higher *L2 WTC now*. Building on past trait L2 WTC research (Botes et al., 2022a; Elahi Shirvan et al., 2019; Lee et al., 2024), our findings showed that teacher appreciation, L2 enjoyment and IDLE affected L2 WTC in the moment. These findings imply that when teachers meet L2 students' psychological needs at the trait level or foster their L2 enjoyment at the state level, students are more likely to speak English in the moment.

Our findings also indicate that students' current participation in IDLE, particularly production-oriented IDLE, raises the likelihood of immediate L2 WTC. This immediate evidence shows that incorporating IDLE into L2 activities can facilitate more state L2 WTC in class or in everyday life situations. Unlike past studies with large sample sizes (N = 388; Lee & Sylvén, 2021; N = 1,265; Lee et al., 2024), trait-level IDLE was not linked to trait L2 WTC; however, their high correlation (r [mean IDLE, mean WTC] = .618) suggests that the low statistical power of the small sample (N = 16) might have caused a false negative. Another possible interpretation is that watching English-language Netflix or YouTube videos and interacting with other English users on social media may have a transient effect on L2 WTC, but no effect at the dispositional level. Past studies showing a positive relationship between IDLE frequency over six months and L2 WTC suggest a third possibility: Students might need to engage in IDLE over a longer period of time (e.g., six months) to affect their trait L2 WTC (Lee & Sylvén, 2021). Future studies can adjudicate these possibilities.

While demographic or trait-like factors mainly affected trait L2 WTC, state-like factors largely influenced state L2 WTC. These results imply that state-like/momentary affective or pedagogical support, whether in the classroom or in real-life situations (out-of-class and digitally), can immediately facilitate students' L2 WTC. These findings align with the view that trait L2 WTC is a person's overall disposition toward L2 communication, so it is more stable and less susceptible to change across contexts. By contrast, as state L2 WTC is a person's WTC in a specific situation, state L2 WTC is more local, so situation-specific attributes might change it. These results also support MacIntyre et al.'s (1998) framework, in which trait-like factors (e.g., age, language proficiency, and teacher appreciation) align with stable individual, social, and affective-cognitive contexts (Layers VI

and V), whereas motivational tendencies and situational antecedents (Layers IV and III) are linked to state-like factors (e.g., current participation in productive IDLE, current feeling of L2 enjoyment, and psychological well-being).

While past studies theorized a potential link between psychological well-being and L2 WTC (Dewaele et al., 2019), this is the first empirical study to show that students with a higher current state of psychological well-being can yield immediately higher L2 WTC. This result suggests further studies testing whether a teacher who enhances students' current psychological well-being immediately raises their L2 WTC. Surprisingly, both trait-like and state-like L2 anxiety were unrelated to L2 WTC at both the trait and state levels. Hence, EFL students with lower L2 anxiety may not necessarily become willing to communicate in English overall and in the moment. These results contradict the majority of previous research findings (showing that lower L2 anxiety correlated with higher L2 WTC; Botes et al., 2020; Dewaele, 2019; Jin & Lee, 2022; Lee et al., 2024). This study's high correlation at the trait-level of mean anxiety and mean L2 WTC (r = -.540) suggests that the low statistical power of the small sample (N = 16) might have caused a false negative, but the large ESM data (N = 1,120) showed high statistical power (> .99).

Interestingly, positive affective factors such as psychological well-being and L2 enjoyment are linked to L2 WTC at both the trait (out-of-class and digitally) and state levels. These findings support the positive psychology perspective in L2 teaching and learning: prioritize developing positive emotions and psychological attributes (e.g., enjoyment, motivation) over reducing negative ones (e.g., anxiety), to promote overall well-being (Dewaele et al., 2019; MacIntyre et al., 2019). Likewise, these results align with those of past studies showing that students with higher psychological well-being are often more autonomous, seek personal growth, are open to new experiences, or maintain positive relationships with others (Dewaele et al., 2019; Ryff, 1989). Future studies can examine the mechanisms by which psychological well-being or enjoyment affect L2 WTC. Notably, daily IDLEs measured via ESM and via the survey were similar (ESM: M = 4.86 hours, range = .94 to 8.88 hours; survey: 4.57 hours, range: .50 to 10.00 hours), ameliorating concerns over the accuracy of self-reported survey data (Arndt et al., 2023). Hence, recall bias did not alter these self-reported IDLE frequencies.

6. Implications

6.1. Theory and methodology

Our study has potential theoretical, methodological, and pedagogical implications. Our findings contribute to theory, specifically second language acquisition

theories regarding L2 WTC, informal language learning, and positive psychology. For instance, we found more trait- and state-L2 WTC antecedents, gained a better understanding of how IDLE, trait L2 WTC, and state L2 WTC interact, and revealed that enjoyment and psychological well-being, rather than anxiety, were related to trait- and state-L2 WTC. Students who studied English longer, had higher language proficiency, had higher pre-psychological well-being, had a higher standard deviation L2 WTC over 14 days, or had higher teacher appreciation showed higher L2 WTC outside of class. Students with higher language proficiency, higher pre-WTC digitally, or higher post-psychological well-being reported higher L2 WTC in digital settings. The ESM findings revealed that students with higher teacher appreciation, currently engaged in productive IDLE or both receptive and productive types of IDLE, currently experienced greater L2 enjoyment or currently experienced greater well-being had higher *L2 WTC now*. Of particular significance, psychological well-being was linked to trait and state L2 WTC only in non-academic settings (out-of-class, digital), which yields two theoretical insights. First, incorporating psychological well-being into the social and individual context (Layer VI) and affective-cognitive context (Layer V) of the pyramid model enhances our comprehension of L2 WTC. Secondly, academic (in-class) versus non-academic (out-of-class and digital) settings require separate L2 WTC pyramids. Hence, our study advances L2 WTC theory.

Methodologically, our study includes rigorous data across three contexts and advanced statistical analyses (Al-Hoorie & Vitta, 2019). Unlike past studies with only cross-sectional laboratory data (MacIntyre & Wang, 2021) or classroom studies (e.g., Dewaele & Dewaele, 2018; Lee & Liu, 2022), our real-time ESM data from participants in their natural real-life surroundings reduced respondents' recall biases, increased ecological validity, and rendered our findings more readily applicable to real-world situations. Furthermore, we applied advanced statistics (system of equations, multilevel cross-classification ordered logit) to address subtle, temporal research questions; avoid unwarranted assumptions; and increase the accuracy of our results.

6.2. Pedagogy

Our findings help teachers develop strategies for supporting students' out-of-class learning activities and emotional well-being, in order to improve their L2 WTC both at a particular moment and overall. As students with higher psychological well-being had higher *L2 WTC out-of-class, digitally,* and *now*, teachers who create and maintain supportive learning environments might help students become more autonomous and open-minded to engage in meaningful conversations with

others (Dewaele et al., 2019; Dewaele & Dewaele, 2019). Doing so might enhance students' mental health, positive outlook on life, immediate (state) L2 WTC, and trait L2 WTC in authentic situations.

Students with higher L2 enjoyment, particularly teacher appreciation, showed higher *L2 WTC out-of-class* and *now*. Thus, teachers can be caring, friendly, and supportive to build a strong teacher-student rapport (Chiu & Chow, 2011), which might improve L2 WTC outside of the classroom and at a given moment. Both trait-like and state-like L2 anxiety were unrelated to L2 WTC at both the trait and state levels. Hence, teachers can focus on cultivating positive emotions and attributes (e.g., enjoyment and motivation) to improve L2 WTC rather than reducing negative emotions (e.g., anxiety; Dewaele et al., 2019; MacIntyre et al., 2019). As students with higher pre-existing L2 WTC or standard deviation L2 WTC over 14 days showed higher *L2 WTC in-class, out-of-class,* or *digitally*, teachers can design and encourage activities that help students experience a variety of easy and difficult communicative situations (e.g., talking to friends in familiar settings vs. talking to strangers in unfamiliar settings). Such activities can help students improve their trait L2 WTC, especially outside the classroom (Lee & Hsieh, 2019). Students' current participation in IDLE, particularly production-oriented IDLE, increased the likelihood of *L2 WTC now*. Therefore, teachers who integrate IDLE into L2 activities might immediately boost state L2 WTC (Lee et al., 2022).

7. Limitations and implications for future research

This study's limitations include self-reported data, single region, limited contexts, and limited explanatory variables. Unlike one-time, retrospective surveys, ESM yields real-time data with greater accuracy about moods, thoughts, and behaviors in natural settings. As ESM is not widely used in L2 research, future researchers can use it to reduce potential recall bias and enhance the external validity of their findings. However, ESM data relies on self-reporting, which still remains subjective. Hence, future studies can capture objective data (e.g., with open-source *LangTrack* App, Arndt et al., 2023). Moreover, this study only examined EFL learners in one region, so future studies can include students from other regions and countries. Also, as this study only examined state L2 WTC at the global level, future studies can investigate state L2 WTC across three different settings (in-class, out-of-class, digital). Lastly, this study only examined a small set of explanatory variables, so future studies can include other L2 related variables (e.g., motivation and emotion constructs; Al-Hoorie, 2017, 2018; Derakhshan et al., 2021; Kruk et al., 2022).

8. Conclusion

Our research proposed and showed how EFL learners' demographics, L2 enjoyment, L2 anxiety, psychological well-being, and IDLE were associated with L2 WTC at the trait (in-class, out-of-class, and digital) and state (momentary) levels. Our survey data showed that older students, those with higher language proficiency, or those with higher pre-WTC digitally reported higher *L2 WTC in the classroom*. Among these student participants, those who had studied English for longer durations, had higher language proficiency, felt greater pre-psychological well-being, showed higher variation in L2 WTC, or felt that their teacher appreciated them more reported higher *L2 WTC out of the classroom*. Students with higher language proficiency, higher pre-WTC digitally, and higher post-psychological well-being reported higher *L2 WTC in digital settings*.

Our ESM data indicated that students who felt that their teacher appreciated them were currently engaging in productive IDLE, were currently experiencing more L2 enjoyment, or currently felt greater well-being had higher *L2 WTC at the moment*. Our findings contribute to second language acquisition theories such as L2 WTC, informal language learning, and positive psychology, as well as teachers' strategies for encouraging out-of-class learning activities and improving emotional well-being. These strategies can help EFL students improve their L2 WTC in general and in the present.

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References

Ahn, I., Chiu, M. M., & Patrick, H. (2021). Connecting teacher and student motivation: Student-perceived teacher need-supportive practices and student need satisfaction. *Contemporary Educational Psychology, 64*, 101950. https://doi.org/10.1016/j.cedpsych.2021.101950

Al-Hoorie, A. H. (2017). Sixty years of language motivation research: Looking back and looking forward. *SAGE Open*, *7*(1), 1-11. https://doi.org/10.1177/2158244017701976

Al-Hoorie, A. H. (2018). The L2 motivational self system: A meta-analysis. *Studies in Second Language Learning and Teaching*, *8*(4), 721-754. https://doi.org/10.14746/ssllt.2018.8.4.2

Al-Hoorie, A. H., & Vitta, J. P. (2019). The seven sins of L2 research: A review of 30 journals' statistical quality and their CiteScore, SJR, SNIP, JCR Impact Factors. *Language Teaching Research*, *23*(6), 727-744. https://doi.org/10.1177/1362168818767191

Arndt, H. L., Granfeldt, J., & Gullberg, M. (2023). The Lang-Track-App: Open-source tools for implementing the experience sampling method in second language acquisition research. *Language Learning*, *73*(3), 869-903. https://doi.org/10.1111/lang.12555

Bano, S., Cisheng, W., Khan, A. N., & Khan, N. A. (2019). WhatsApp use and student's psychological well-being: Role of social capital and social integration. *Children and Youth Services Review*, *103*, 200-208. https://doi.org/10.1016/j.childyouth.2019.06.002

Benjamini, Y., Krieger, A. M., & Yekutieli, D. (2006). Adaptive linear step-up procedures that control the false discovery rate. *Biometrika, 93*, 491-507.

Berscheid, E., & Reis, H. T. (1998). Attraction and close relationships. In D. T. Gilbert, S. T. Fiske, & G. L. McGraw-Hill (Eds.), *The handbook of social psychology* (4th ed.) (pp. 193-281). Oxford University Press.

Bertsekas, D. P. (2014). *Constrained optimization and Lagrange multiplier methods*. Academic.

Beyens, I., Pouwels, J. L., Driel, I. I. v., Keijsers, L., & Valkenburg, P. M. (2020). The effect of social media on well-being differs from adolescent to adolescent. *Scientific Reports*, *10*, 10763. https://doi.org/10.1038/s41598-020-67727-7

Botes, E., Dewaele, J.-M., & Greiff, S. (2020). The foreign language classroom anxiety scale and academic achievement: An overview of the prevailing literature and a meta-analysis. *Journal for the Psychology of Language Learning*, *2*, 26-56.

Botes, E., Dewaele, J.-M., & Greiff, S. (2021). The development and validation of the short form of the foreign language enjoyment scale. *Modern Language Journal*, *105*(4), 858-876. https://doi.org/10.1111/modl.12741

Botes, E., Dewaele, J.-M., & Greiff, S. (2022a). Taking stock: A meta-analysis of the effects of foreign language enjoyment. *Studies in Second Language Learning and Teaching*, *12*(2), 205-232. https://doi.org/10.14746/ssllt.2022.12.2.3

Botes, E., Dewaele, J.-M., & Greiff, S. (2022b). By the old gods and the new: The effect of the congruence and incongruence of foreign language classroom anxiety and enjoyment on self-perceived proficiency. *Modern Language Journal*, *106*(4), 784-797. https://doi.org/10.1111/modl.12807

Cao, Y., & Philp, J. (2006). Interactional context and willingness to communicate: A comparison of behavior in whole class, group and dyadic interaction. *System*, *34*(4), 480-493. https://doi.org/10.1016/j.system.2006.05.002

Chiu, M. M., & Chow, B. W.-Y. (2011). Classroom discipline across 41 countries: School, economic, and cultural differences. *Journal of Cross-Cultural Psychology*, *42*(3), 516-533.

Cinelli, C., & Hazlett, C. (2020). Making sense of sensitivity: Extending omitted variable bias. *Journal of the Royal Statistical Society: Series B (Statistical Methodology), 82*(1), 39-67.

Derakhshan, A., Dewaele, J.-M., & Noughabi, M. A. (2022). Modeling the contribution of resilience, well-being, and L2 grit to foreign language teaching enjoyment among Iranian English language teachers. *System*, *109*, 102890. https://doi.org/10.1016/j.system.2022.102890

Derakhshan, A., Kruk, M., Mehdizadeh, M., & Pawlak, M. (2021). Boredom in online classes in the Iranian EFL context: Sources and solutions. *System*, *101*, 102556. https://doi.org/10.1016/j.system.2021.102556

Dewaele, J.-M. (2019). The effect of classroom emotions, attitudes toward English, and teacher behavior on willingness to communicate among English foreign language learners. *Journal of Language and Social Psychology*, *38*(4), 523-535. https://doi.org/10.1177/0261927X19864996

Dewaele, J.-M., Chen, X., Padilla, A. M., & Lake, J. (2019). The flowering of positive psychology in foreign language teaching and acquisition research. *Frontiers in Psychology*, *10*, 467145. https://doi.org/10.3389/fpsyg.2019.02128

Dewaele, J.-M., & Dewaele, L. (2018). Learner-internal and learner-external predictors of willingness to communicate in the FL classroom. *Journal of the European Second Language Association*, *2*(1), 24-37. https://doi.org/10.22599/jesla.37

Dewaele, J.-M., & MacIntyre, P. D. (2014). The two faces of Janus? Anxiety and enjoyment in the foreign language classroom. *Studies in Second Language Learning and Teaching*, *4*(2), 237-274. https://doi.org/10.14746/ssllt.2014.4.2.5

Diener, E. (1984). Subjective well-being. *Psychological Bulletin*, *95*(3), 542-575. https://doi.org/10.1037/0033-2909.95.3.542

Diener, E., & Chan, M. Y. (2011). Happy people live longer: Subjective well-being contributes to health and longevity. *Applied Psychology: Health and Well-being*, *2*(1), 1-43. https://doi.org/10.1111/j.1758-0854.2010.01045.x

Diener, E., Wirtz, D., Tov, W., Kim-Prieto, C., Choi, D.-W., Oishi, S., & Biswas-Diener, R. (2010). New well-being measures: Short scales to assess flourishing and positive and negative feelings. *Social Indicators Research*, *97*, 143-156. https://doi.org/10.1007/s11205-009-9493-y

Ebadijalal, M., & Moradkhani, S. (2022). Understanding EFL teachers' wellbeing: An activity theoretic perspective. *Language Teaching Research*. https://doi.org/10.1177/13621688221125558

Elahi Shirvan, M, Khajavy, G. H., MacIntyre, P. D., & Taherian, T. (2019). A meta-analysis of L2 willingness to communicate and its three high-evidence correlates. *Journal of Psycholinguistic Research*, *48*, 1241-1267. https://doi.org/10.1007/s10936-019-09656-9

Ergün, A. L. P., & Dewaele, J.-M. (2021). Do well-being and resilience predict the Foreign Language Teaching Enjoyment of teachers of Italian? *System*, *99*, 102506. https://doi.org/10.1016/j.system.2021.102506

Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American Psychologist*, *56*(3), 218-226. https://doi.org/10.1037/0003-066X.56.3.218

Gregersen, T., Mercer, S., MacIntyre, P., Talbot, K., & Banga, C. A. (2023). Understanding language teacher wellbeing: An ESM study of daily stressors and uplifts. *Language Teaching Research*, *27*(4), 862-883. https://doi.org/10.1177/1362168820965897

Hiver, P., & Al-Hoorie, A. H. (2020). *Research methods for complexity theory in applied linguistics*. Multilingual Matters.

Horwitz, E. K., Horwitz, M. B., & Cope, J. (1986). Foreign language classroom anxiety. *Modern Language Journal 70*(2), 125-132. https://doi.org/10.1111/j.1540-4781.1986.tb05256.x

Hox, J. J., Moerbeek, M., & Van de Schoot, R. (2017). *Multilevel analysis*. Routledge.

Huo, J. (2022). The role of learners' psychological well-being and academic engagement on their grit. *Frontiers in Psychology*, *13*, 848325. https://doi.org/10.3389/fpsyg.2022.848325

Jin, J., Mercer, S., Babic, S., & Mairitsch, A. (2021). "You just appreciate every little kindness": Chinese language teachers' wellbeing in the UK. *System*, *96*, 102400. https://doi.org/10.1016/j.system.2020.102400z

Jin, S., & Lee, H. (2022). Willingness to communicate and its high-evidence factors: A meta-analytic structural equation modeling approach. *Journal of Language and Social Psychology*, *41*(6), 716-745. https://doi.org/10.1177/0261927X221092098

Joe, H.-K., Hiver, P., & Al-Hoorie, A. H. (2017). Classroom social climate, self-determined motivation, willingness to communicate, and achievement: A study of structural relationships in instructed second language settings. *Learning and Individual Differences*, *53*, 133-144. https://doi.org/10.1016/j.lindif.2016.11.005

Joreskog, K., & Sorbom, D. (2018). *LISREL 10.1*. Scientific Software International.

Kang, D.-M. (2014). The effects of study-abroad experiences on EFL learners' willingness to communicate, speaking abilities, and participation in classroom interaction. *System*, *42*, 319-332. https://doi.org/10.1016/j.system.2013.12.025

Kang, S.-J. (2005). Dynamic emergence of situational willingness to communicate in a second language. *System*, *33*, 277-292. https://doi.org/10.1016/j.system.2004.10.004

Kennedy, P. (2008). *Guide to econometrics*. Wiley Balckwell.

Khajavy, G. H., MacIntyre, P. D., & Barabadi, E. (2018). Role of the emotions and classroom environment in willingness to communicate: Applying doubly latent multilevel analysis in second language acquisition research. *Studies in Second Language Acquisition*, *40*, 605-624. https://doi.org/10.1017/S0272263117000304

Konstantopoulos, S. (2008). The power of the test in three-level cluster randomized designs. *Journal of Research on Educational Effectiveness, 1*, 66-88.

Konu, A., Alanen, E., Lintonen, T., & Rimpelä, M. (2002). Factor structure of the school well-being model. *Health Education Research*, *17*(6), 732-742. https://doi.org/10.1093/her/17.6.732

Kruk, M. (2021). Changes in self-perceived willingness to communicate during visits to *Second Life*: A case study. *The Language Learning Journal*, *49*(2), 240-250. https://doi.org/10.1080/09571736.2018.1554692

Kruk, M. (2022). Dynamicity of perceived willingness to communicate, motivation, boredom and anxiety in Second Life: The case of two advanced learners of English. *Computer Assisted Language Learning*, *35*(1-2), 190-216. https://doi.org/10.1080/09588221.2019.1677722

Kruk, M., & Pawlak, M. (2022). *Understanding emotions in English language learning in virtual worlds*. Routledge.

Kruk, M., Pawlak, M., Elahi Shirvan, M., & Shahnama, M. (2022). The emergence of boredom in an online language class: An ecological perspective. *System*, *107*, 102803. https://doi.org/10.1016/j.system.2022.102803

Lee, J. H. (2018). The effects of short-term study abroad on L2 anxiety, international posture, and L2 willingness to communicate. *Journal of Multilingual and Multicultural Development*, *39*(8), 703-714. https://doi.org/10.1080/01434632.2018.1435666

Lee, J. S., & Hsieh, J. C. (2019). Affective variables and willingness to communicate of EFL learners in in-class, out-of-class, and digital contexts. *System*, *82*, 63-73. https://doi.org/10.1016/j.system.2019.03.002

Lee, J. S., & Lee, K. (2020). Affective factors, virtual intercultural experiences, and L2 willingness to communicate in in-class, out-of-class, and digital settings. *Language Teaching Research*, *24*(6), 813-833. https://doi.org/10.1177/1362168819831408

Lee, J. S., Lee, K., & Hsieh, J. C. (2022). Understanding willingness to communicate in L2 between Korean and Taiwanese students. *Language Teaching Research*, *26*, 455-476. https://doi.org/10.1177/1362168819890825

Lee, J. S., & Liu, L. (2022). Dynamicity of EFL learners' willingness to communicate in an online class. *Journal of Multilingual and Multicultural Development*. https://doi.org/10.1080/01434632.2022.2039677

Lee, J. S., & Sylvén, L. K. (2021). The role of informal digital learning of English in Korean and Swedish EFL learners' communication behavior. *British Journal of Educational Technology*, *52*(3), 1279-1296. https://doi.org/10.1111/bjet.13082

Lee, J. S., Xie, Q., & Lee, K. (2024). Informal digital learning of English and L2 willingness to communicate: Roles of emotions, gender, and educational stage. *Journal of Multilingual and Multicultural Development*, *45*(2), 596-612. https://doi.org/10.1080/01434632.2021.1918699

Lee, J. S., Yeung, N. M., & Osburn, M. B. (2022). Foreign language enjoyment as a mediator between informal digital learning of English and willingness to communicate: A sample of Hong Kong EFL secondary students. *Journal of Multilingual and Multicultural Development*. https://doi.org/10.1080/01434632.2022.2112587

Li, C., Dewaele, J.-M., Pawlak, M., & Kruk, M. (2022). Classroom environment and willingness to communicate in English: The mediating role of emotions experienced by university students in China. *Language Teaching Research*. https://doi.org/10.1177/13621688221111623

Lin, Y.-T. (2019). Taiwanese EFL learners' willingness to communicate in English in the classroom: Impacts of personality, affect, motivation, and communication confidence. *The Asia Pacific Education Researcher*, *28*(2), 101-113. https://doi.org/10.1007/s40299-018-0417-y

Ljung, G., & Box, G. (1979). On a measure of lack of fit in time series models. *Biometrika, 66*, 265-270.

MacIntyre, P. D. (1999). Language anxiety: A review of the research for language teachers. In D. J. Young (Ed.), *Affect in foreign language and second language teaching: A practical guide to creating a low-anxiety classroom atmosphere* (pp. 24-45). McGraw-Hill.

MacIntyre, P. D., Baker, S. C., Clément, R., & Donovan, L. A. (2003). Sex and age effects on willingness to communicate, anxiety, perceived competence, and L2 motivation among junior high school French immersion students. *Language Learning*, *53*(S1), 137-166. https://doi.org/10.1111/1467-9922.00226

MacIntyre, P. D., Dörnyei, Z., Clément, R., & Noels, K. A. (1998). Conceptualizing willingness to communicate in a L2: A situational model of L2 confidence and affiliation. *Modern Language Journal*, *82*(4), 545-562. https://doi.org/10.1111/j.1540-4781.1998.tb05543.x

MacIntyre, P. D., Gregersen, T., & Mercer, S. (2016). *Positive psychology in SLA*. Multilingual Matters.

MacIntyre, P. D., Gregersen, T., & Mercer, S. (2019). Setting an agenda for positive psychology in SLA: Theory, practice, and research. *Modern Language Journal*, *103*(1), 262-274. https://doi.org/10.1111/modl.12544

MacIntyre, P. D., & Mercer, S. (2014). Introducing positive psychology to SLA. *Studies in Second Language Learning and Teaching*, *4*(2), 153-172. https://doi.org/10.14746/ssllt.2014.4.2.2

MacIntyre, P. D., & Wang, L. (2021). Willingness to communicate in the L2 about meaningful photos: Application of the pyramid model of WTC. *Language Teaching Research*, *25*(6), 878-898. https://doi.org/10.1177/13621688211004645

MacKinnon, D. P., Lockwood, C. M., & Williams, J. (2004). Confidence limits for the indirect effect: Distribution of the product and resampling methods. *Multivariate Behavioral Research, 39*, 99-128.

Martinez, B. A. F., Leotti, V. B., Nunes, L. N., Machado, G., & Corbellini, L. G. (2017). Odds ratio or prevalence ratio? *Frontiers in Veterinary Science, 4*(193), 1-8.

Mercer, S. (2021). An agenda for well-being in ELT: An ecological perspective. *ELT Journal*, *75*(1), 14-21. https://doi.org/10.1093/elt/ccaa062

Mercer, S., & Gregersen, T. (2023). Transformative positive psychology in the acquisition of additional languages. *Journal of Multilingual and Multicultural Development*. https://doi.org/10.1080/ 01434632.2023.2194869

Oxford, R. L. (2016). Powerfully positive: Searching for a model of language learner well-being. In D. Gabryś-Barker & D. Gałajda (Eds.), *Positive psychology perspectives on foreign language learning and teaching* (pp. 21-38). Springer.

Öz, H., Demirezen, M., & Pourfeiz, J. (2015). Willingness to communicate of EFL learners in Turkish context. *Learning and Individual Differences*, *37*, 269-275. https://doi.org/10.1016/j.lindif.2014.12.009

Pawlak, M., & Mystkowska-Wiertelak, A. (2015). Investigating the dynamic nature of L2 willingness to communicate. *System*, *50*, 1-9. https://doi.org/10.1016/j.system.2015.02.001

Pawlak, M., Mystkowska-Wiertelak, A., & Bielak, J. (2016). Investigating the nature of classroom willingness to communicate (WTC): A micro-perspective. *Language Teaching Research*, *20*(5), 654-671. https://doi.org/10.1177/1362168815609615

Peng, J.-E. (2012). Towards an ecological understanding of willingness to communicate in EFL classrooms in China. *System*, *40*, 203-213. https://doi.org/10.1016/j.system.2012.02.002

Rad, H. S., & Jafarpour, A. (2023). Effects of well-being, grit, emotion regulation. and resilience interventions on L2 learners' writing skills. *Reading & Writing Quarterly*, *39*(3), 228-247. https://doi.org/10.1080/10573569.2022.2096517

Reeve, J. (2005). *Understanding motivation and emotion* (5th ed). John Wiley and Sons.

Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, *55*(1), 68-78. https://doi.org/10.1037110003-066X.55.1.68

Ryff, C. D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. *Journal of Personality and Social Psychology*, *57*(6), 1069-1081. https://doi.org/10.1037/0022-3514.57.6.1069

Ryff, C. D., & Keyes, C. L. M. (1995). The structure of psychological well-being revisited. *Journal of Personality and Social Psychology*, *69*(4), 719-727. https://doi.org/10.1037/0022-3514.69.4.719

Sato, M., & Lam, C. D. (2021). Metacognitive instruction with young learners: A case of willingness to communicate, L2 use, and metacognition of oral communication. *Language Teaching Research*, *25*(6), 899-921. https://doi.org/10.1177/13621688211004639

Seligman, M. E. P. (2011). *Flourish: A visionary new understanding of happiness and well-being*. Atria Paperback.

Shamsi, E., & Bozorgian, H. (2021). A review of empirical studies of social media on language learners' willingness to communicate. *Education and Information Technologies*, *27*(4), 4473-4499. https://doi.org/10.1007/s10639-021-10792-w

Song, L., Luo, R., & Zhan, Q. (2022). Toward the role of teacher caring and teacher-student rapport in predicting English as a foreign language learners' willingness to communicate in second language. *Frontiers in Psychology*, *13*, 874522. https://doi.org/10.3389/fpsyg.2022.874522

Soyoof, A. (2022). Iranian EFL students' perception of willingness to communicate in an extramural digital context. *Interactive Learning Environments*, *31*(9), 5922-5939. https://doi.org/10.1080/10494820.2021.2024579

Sudina, E. (2023). Scale quality in second-language anxiety and WTC: A methodological synthesis. *Studies in Second Language Acquisition*, *45*(5), 1427-1455. https://doi.org/10.1017/S0272263122000560

Sundqvist, P., & Sylvén, L. K. (2016). *Extramural English in teaching and learning: From theory and research to practice*. Palgrave Macmillan.

Yashima, T. (2002). Willingness to communicate in a second language: The Japanese EFL context. *Modern Language Journal*, *86*(1), 54-66. https://doi.org/10.1111/1540-4781.00136

Zabihi, R., Ghominejad, S., & Ahmadian, M. J. (2021). Can willingness to communicate, communication in English anxiety, behavioural inhibition and behavioural action predict perceived L2 fluency? *Language Teaching Research*. https://doi.org/10.1177/13621688211044071

Zhang, J., Beckmann, N., & Beckmann, J. F. (2018). To talk or not to talk: A review of situational antecedents of willingness to communicate in the second language classroom. *System*, *72*, 226-239. https://doi.org/10.1016/j.system.2018.01.003

Zhang, J., Beckmann, N., & Beckmann, J. F. (2019). One situation doesn't fit all: Variability and stability of state willingness to communicate in a Chinese college English classroom. *Language Teaching Research*, *26*(3), 504-529. https://doi.org/10.1177/1362168819891330

Zhang, J., Beckmann, N., & Beckmann, J. F. (2020). More than meets the ear: Individual differences in trait and state willingness to communicate as predictors of language learning performance in a Chinese EFL context. *Language Teaching Research*, *27*(3), 593-620. https://doi.org/10.1177/1362168820951931

Zhou, L., Xi, Y., & Locktman, K. (2020). The relationship between second language competence and willingness to communicate: The moderating effect of foreign language anxiety. *Journal of Multilingual and Multicultural Development, 44*(2), 129-143. https://doi.org/10.1080/01434632.2020.1801697

APPENDIX A

Ancillary analyses

Table A1 Correlations, variances, and covariances of student variables in the lower left, diagonal, and upper right matrices

	Student variables	1	2	3	4	5	6	7	8	9	10	11
1	Post-WTC in-class	0.33	0.18	0.25	0.74	0.08	0.68	0.05	0.20	-0.07	-0.14	-0.15
2	Post-WTC out-of-class	0.37	0.68	0.50	0.10	-0.19	0.88	0.18	0.12	0.03	-0.01	0.15
3	Post-WTC digitally	0.49	0.69	0.79	0.34	-0.21	0.81	0.13	0.36	0.02	0.00	0.13
4	Age	0.52	0.05	0.15	6.06	1.03	1.25	0.34	0.35	-0.39	-0.59	-0.32
5	Studying English duration	0.13	-0.22	-0.23	0.40	1.11	0.00	-0.21	-0.05	-0.12	-0.26	-0.34
6	Language proficiency	0.76	0.69	0.59	0.33	0.00	2.38	-0.07	0.22	-0.18	-0.15	-0.27
7	Pre-well-being	0.12	0.32	0.21	0.20	-0.29	-0.07	0.47	0.09	0.04	-0.14	0.25
8	Pre-WTC digitally	0.54	0.22	0.62	0.22	-0.07	0.22	0.20	0.42	0.00	-0.01	0.00
9	SD WTC	-0.40	0.11	0.08	-0.49	-0.34	-0.36	0.19	-0.01	0.10	-0.03	0.08
10	Post-teacher appreciates me	-0.40	-0.02	-0.01	-0.41	-0.41	-0.16	-0.34	-0.01	-0.17	0.35	0.08
11	Post-well-being	-0.42	0.28	0.23	-0.21	-0.52	-0.28	0.58	-0.01	0.41	0.21	0.39

Table A2 Correlations, variances, and covariances of student in time variables in the lower left, diagonal, and upper right matrices

	Student variables	1	2	3	4	5	6
1	WTC now	1.45	0.06	0.08	0.23	0.96	0.95
2	Pre-teacher appreciates me	0.08	0.45	0.05	0.04	0.17	0.11
3	IDLE productive now	0.12	0.14	0.26	-0.06	0.01	0.03
4	IDLE both now	0.24	0.07	-0.14	0.63	0.17	0.09
5	Enjoy now	0.70	0.22	0.03	0.18	1.28	1.01
6	Well-being now	0.72	0.15	0.06	0.11	0.82	1.21