



Examining metacognitive strategy use in L1 and L2 task-situated writing: effects, transferability, and cross-language facilitation

Wandong Xu^{1,2} · Xinhua Zhu²

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Abstract

Despite the widely recognized importance of metacognition in language learning, relatively few empirical studies have investigated the role of metacognitive strategies with a cross-linguistic perspective. Drawing on the mixed-method design combining questionnaire and interview data, this study systematically investigated the effects, the transfer potential, and the cross-language facilitation of metacognitive strategies between L1 and L2 contexts. Structural equation modelling (SEM) and multigroup analysis results revealed that metacognitive strategies afforded a more prominent predictive role in English (L2) writing than in Chinese (L1) writing; such strategy use transferred between the two writing contexts, which kept invariant between lower- and higher- L2 proficiency groups and between English and non-English major groups; and there was a cross-language facilitation effect of L1 writing metacognitive strategies on L2 writing performance via the mediation of L2 writing metacognitive strategies. Complementary to the quantitative results, the qualitative interview data was analyzed to provide deep insights into the participating students' metacognitive strategy use in the two task-situated writing. Findings are extensively discussed to offer theoretical and pedagogical implications in this domain.

Keywords Metacognitive strategies · Transfer · Chinese (L1) writing · English (L2) writing · SEM

Introduction

Metacognition was initially proposed by Flavell (1976) as “one’s knowledge concerning one’s cognitive processes and products or anything related to them” (p.232). He proposed three components that subsumed the metacognition construct: metacognitive knowledge,

✉ Xinhua Zhu
xinhua.zhu@polyu.edu.hk

¹ School of Foreign Languages, Anhui Agricultural University, Anhui, China

² Department of Chinese and Bilingual Studies, Faculty of Humanities, The Hong Kong Polytechnic University, Hong Kong S.A.R, China

metacognitive experiences, and metacognitive strategies (Flavell, 1979), which allow students to observe and control their thoughts, behaviors, and emotions to enhance learning. It originates from cognitive and educational psychology and has been applied to language learning and teaching by Wenden (1987) since the 1980s. While researchers may conceptualize and operationalize this construct differently, there is a broad consistency regarding its importance in learning success (Veenman et al., 2006). Of note, the acquisition of writing poses a higher demand on learners' self-initiated, self-sustained, and self-regulated learning practices (Forbes & Fisher, 2020). Examining the role of metacognition in the writing process and outcomes offers valuable insights into writer autonomy, which is gaining increasing importance in modern language education (Lee & Mak, 2018; Qin & Zhang, 2019; Teng & Zhang, 2016).

Writing is a strategic course in which the writer processes and manages different types of knowledge and resources purposively and iteratively to produce a desired text (Abdel Latif, 2021). The problem-solving nature of writing heightens the influence of metacognitive skills in enabling the writer to plan, monitor, and evaluate thoughts and actions involved in the writing process. Research on language learning strategies typically acknowledges its position by successively including metacognitive strategies as a distinct subcategory of strategy taxonomies (Oxford, 1990; O'Malley & Chamot, 1990; Rubin, 1981), strategic competence as an integral part of communicative language ability (Bachman & Palmer, 2010), and metacognitive regulation as a dimension of self-regulated process (Dörnyei, 2005; Teng & Zhang, 2016). Theoretically, the role of metacognition has also been situated within well-established writing models to varying degrees. Metacognition affords a good lens for researchers to investigate how writers approach and address learning tasks autonomously in relation to the quality of produced written texts. However, research on metacognitive strategy use in L1 and L2 writing is still cursory. The existing research has reported discrete fragments of metacognitive strategies under the framework of language learning strategy, while there is a lack of empirical investigations focusing on such strategy use in improving L1 and L2 writing task performance with its various but correlated types.

Bilingual programs have experienced a significant rise around the globe. Cummins' linguistic interdependence hypothesis (LIH) and common underlying proficiency (CUP) preclude the L1-L2 transfer of literacy-related skills (1979, 1981). It is reasonable to assume that bilingual learners can draw on metacognitive skills that they have acquired in L1 writing to exercise management and regulation of their cognitive processing and behavior when completing L2 writing and vice versa. Research on metacognitive strategy use has been conducted in either the L1 or L2 context, while the potential of L1-L2 interactions of such strategy use within bilingual students has been less explored. To address this gap, this study compares L1 and L2 writing metacognitive strategies among Chinese EFL learners to better illuminate their metacognitive strategy profiles and effectiveness from a cross-linguistic perspective, thereby informing the theoretical discussions of L1 and L2 relations.

Writing, whether in L1 or L2, is one of the most challenging language skills for learners to master. Chinese EFL learners have often been observed to exhibit a more passive approach to writing, partly stemming from their prior experiences with exam-oriented and teacher-centred language instruction. Teachers are used to a product-oriented approach of delivering vocabulary, grammar and structure knowledge in writing classes instead of cultivating students' execution and regulation of the composing process (Lee & Wong, 2014; Shi et al., 2019; Yang & Gao, 2013). Thus, the results of this study can be discussed extensively

to provide valuable information about cultivating metacognitively competent writers and enhancing Chinese EFL learners' self-autonomy in this domain. In sum, the present study is conducted to bridge the above empirical and practical needs. Furthermore, individual characteristics (i.e., the participants' L2 proficiency level and academic major background) that may play a role in reported strategy utilization (Teng & Huang, 2019; Teng & Qin, 2024) are also considered in this study to provide a better understanding of the relationship between L1 and L2 writing metacognitive strategies.

Literature review

The extant literature is reviewed and discussed extensively to develop theoretical and empirical insights into metacognitive strategies and their role in writing with a cross-linguistic perspective. We first discuss empirical evidence regarding what metacognitive strategies have been found to influence language task performance in which way by consulting with language learning strategy research. Then we narrow down to several influential writing process models and identify how the construct of metacognition is contextualized within each model. Finally, we analyze the potential interaction of metacognitive strategies across L1 and L2 writing contexts by referring to Cummins' LIH and CUP and the existing L1-L2 comparison studies.

Metacognitive strategies in language learning strategy research

Consulting language learning strategy literature is valuable for research on writing metacognitive strategies. The bulk of language learning strategy literature has long been focused on strategy classification. From Rubin's (1981) initial effort of compiling a list of strategies directly and indirectly related to language learning performance to Oxford's (1990) standardized strategy inventory for language learning, metacognitive strategies have been successively necessitated as an important subcategory. In the domain of writing, researchers have identified specific strategies in line with writers' metacognitive control, including self-initiating, orientation, planning, monitoring, re-reading, evaluating, and revising (Arndt, 1987; Bai et al., 2014; Qin & Zhang, 2019; Teng et al., 2021; Wenden, 1991; Zhao & Liao, 2021). When relating to writing performance, Chien (2012) found qualitative differences between high- and low-achieving student writers in the employment of planning and revising strategies throughout the writing process. High-achieving student writers devoted more efforts to devising general plans and specific goal-formation steps to address the task requirements and rethinking and re-editing the written texts at both discoursal and lexical levels than their low-achieving peers. Qin and Zhang (2019) quantitatively corroborated such differences between the two writer groups in their questionnaire-based study. High-achieving student writers differed significantly in the usage frequency of three subcategories of metacognitive strategies of planning, monitoring and evaluating.

It should also be noted that metacognitive strategies occupy a hierarchical position in these strategy taxonomies that coordinate and regulate other types of strategies, thereby enhancing writers' cognitive engagement and composing efficiency (Anderson, 2005). Without metacognitive strategies, learners possibly lose the opportunity to "plan their learning, monitor their progress, or review their accomplishments and future learning direc-

tions” (O’Malley & Chamot, 1990, p.8). Given its essential role in language learning and use, researchers have already raised theoretical attempts to incorporate the ability to use metacognitive strategies as an integral part of language ability. According to Bachman and Palmer’s (2010) framework, strategic competence, a constituent component of communicative language ability, involves “higher-order metacognitive strategies that provide a management function in language use, as well as in other cognitive activities (p.48).” Their conceptualization opened a new avenue for research on language learners’ strategy use and pioneered a strategic competence approach in this field.

Dörnyei (2005) later raised a revitalization proposal for language learning strategy research by aligning it with a more robust and inclusive construct of self-regulation. As Zimmermann (2000) defines, self-regulation refers to the individual process of directing, organizing, and adapting self-generated thoughts, emotions, and behaviors cyclically to achieve determined learning goals. It encompasses multiple aspects, including cognition, metacognition, motivation, behavior, and environment, all managed systematically to enhance the ultimate attainment (Schunk & Greene, 2018). Being a more dynamic notion than language learning strategy, self-regulation captures the proactive nature of learners in their own language acquisition (Dörnyei, 2005). In this way, strategy researchers favouring self-regulation would no longer be confined to relying solely on internally developed theories and difficulties in conceptualizing and classifying strategies as mere products of learners’ thoughts and actions (Roes et al., 2018). It provides a relatively stable outsider perspective of exploring strategic behaviors specific to language learning and use. Self-regulated learners rely on a variety of metacognitive strategies to control and regulate cognition, motivation, behavior, and environment in the learning process (Zimmerman, 2013). Metacognitive regulation forms a core part of the self-regulated writing process compared with other dimensions of self-regulation (Teng & Zhang, 2016), thus offering another motive for empirical investigations on metacognitive strategies.

The role of metacognition in writing process models

Writing is an essential tool for expressing and exchanging thoughts, introducing and describing events, and presenting and transmitting information (Flower & Hayes, 1981). Students who cannot write nicely are disadvantaged in extending learning development and gaining future employment (Harris et al., 2019). Adequate writing skills are not simply attributed to linguistic processing but also to metacognitive knowledge and regulation (McCormick, 2003) since writing is a constructive process that requires deliberate and analytical control. The value of metacognition in writing attainments has long been acknowledged in theoretical attempts to model the composing process (Dimmit & McCormick, 2012; Harris et al., 2019). As these writing models depict, metacognition seems to be ubiquitous throughout the entire composing process, during which students plan, monitor, and evaluate their cognitive, behavioral, and emotional efforts (Flower & Hayes, 1981; Hayes, 1996; Kellogg, 1996; Scardamalia & Bereiter, 1987; Zimmerman & Reisemberg, 1997). To better understand how metacognition influences the development of writing expertise, it is necessary to review and delineate these influential writing models that have evolved during the past few decades with a focus on metacognitive control.

In their groundwork model of writing, Flower and Hayes (1981) describe metacognitive involvement in writers’ composing in the monitor arranging and managing the sequence

and iteration of basic writing subprocesses explicitly as well as in the planning and reviewing subprocesses. In Bereiter and Scardamalia's models of writing (1987), metacognitive activities are defined as an integral part of writing development, progressing from simple knowledge telling in novice writers to advanced knowledge transforming in expert writers. Novice writers employ an elementary metacognitive mechanism by testing the appropriateness of information retrieved from memory and monitoring their mental representation of the writing task. In contrast, expert writers rely more heavily on metacognitive mechanisms by engaging in reflective thinking about the interaction between content and rhetorical problem spaces and monitoring problem analysis and goal setting. Kellogg's (1996) writing model assigns a salience to working memory and acknowledges metacognitive engagement by specifying the central executive, which regulates the activation and execution of all writing subprocesses and designating planning as anticipating content and monitoring as inspection and evaluation of the produced texts. Zimmerman and Reisemberg (1997) attribute metacognitive regulation to manipulating the triadic influences from personal endeavor and external environment in their model. In a recent model attempt, Hacker and associates (2009, 2018) reconceptualized writing as applied metacognition and demonstrated that metacognitive dynamics operate across all stages of writing processes. The above-specified writing models have led us to examine how writers operationalize their metacognitive regulation in the writing process and its connection to final writing performance.

Relationship between L1 and L2 writing metacognitive strategies

According to Cummins' (1979) LIH, "the development of competence in a second language is partially a function of the type of competence already developed in L1 at the time when intensive exposure to L2 begins" (p.222). The cognitive/academic language proficiency (CALP) that supports the development of L1 and L2 literacy skills is interdependent through the same central processing system of CUP (Cummins, 2000). Thus, it allows for transferring concepts, skills, and strategies between L1 and L2 (Cummins, 2016). Cummins' LIH has been tested for the relationship between L1 and L2 writing skills at the macro level of general proficiency and at a variety of micro levels that may play a part in writing competence. Pae (2018) observed the intertwined relationship between L1 and L2 writing skills in tasks of both low and high cognitive complexities. Zhu et al. (2021) found the cross-language facilitation effect of L1 discourse synthesis skills on L2 integrated writing performance, thus indicating that secondary bilingual students could transfer discourse synthesis skills already acquired in L1 to enhance L2 writing performance. In addition to varied linguistic measures, previous studies also lent empirical support for Cummins' LIH by extending the CUP from a psychological perspective, including learners' current self-beliefs (Xu et al., 2023) and future images (Zhu et al., 2022) of writing competence. L2 writers possessed the distinct advantage of utilizing both their L1 and L2 resources synchronously for a strategic purpose while writing (Cumming, 2001). It is reasonable to assume that metacognitive strategies under investigation in this study could potentially transfer between L1 and L2 task-situated writing.

It is noteworthy that the cross-linguistic transfer is not invariant. There is growing attention to the factors moderating the relationship between L1 and L2 skills. As an "individual-level phenomenon," the learner exercises discretion in reusing and reshaping what is acquired in the source language to enhance the performance in the target language (Jarvis &

Pavlenko, 2008; Larsen-Freeman, 2013). Taking the linguistic threshold hypothesis (LTH) as an example, learners' L2 proficiency is a possible moderator that changes the strength of the relationship between L1 and L2 skills. The cross-linguistic transfer effect may differ across L2 proficiency levels and be short-circuited below a certain linguistic threshold (Cummins, 1980). In addition, researchers have also identified a host of other individual factors that are relevant to the cross-linguistic relationship, such as L1 proficiency, gender, grade, and language acquisition order. There is mixed evidence for the moderating effects of these individual factors (Baker et al., 2012; Edele & Stanat, 2016; Grant et al., 2011). The L1-L2 connection degree was determined by the learners' L1 proficiency levels in Edele and Stanat's (2016) study and varied between male and female bilinguals in the study by Grant et al. (2011). However, Baker and his associates (2012) found no L1-L2 transfer during the early stage of learning, which kept invariant across Grades 1–3. Learners' academic major is a possible factor for the variations of cross-linguistic transfer because it makes intuitive sense that English majors and non-English majors, who have variant exposure to the target language and different instructional environments in tertiary education, possibly differ in how they use and transfer knowledge and skills between L1 and L2 writing. Yet, studies on the moderating effects of individual factors on cross-linguistic transfer are scant.

Regarding the continuing interest in metacognition from theoretical and empirical perspectives and the lack of a cross-linguistic approach in extant literature, this study examines and compares Chinese EFL learners' metacognitive strategy use in L1 and L2 writing. The participants' L2 proficiency and disciplinary major are also taken into investigation to afford profound insights into the complexity embedded in the L1-L2 transfer mechanism. More specifically, this study aims to address the following research questions by combining the writing task, questionnaire and interview datasets in L1 and L2 contexts:

- (1) To what extent do students' metacognitive strategies predict their L1 and L2 writing performance? Do the effects keep invariant across L1 and L2 writing contexts?
- (2) What is the relationship between L1 and L2 writing metacognitive strategies? How do L2 proficiency and academic major moderate the relationship between L1 and L2 writing metacognitive strategies?

Methods

Participants and setting

502 second-year undergraduate students from two medium-ranking universities in mainland China were recruited in this study. Among the participant sample, 129 were male, and 373 were female. The participants' ages spanned from 18 to 22 ($M=19.46$, $SD=0.75$). The two disciplinary major groups of participants (i.e., 244 were English majors and 258 were non-English majors) maintained a balanced size. These students were diverse in their English proficiency levels according to their self-reported gaokao English scores, which ranged from 43 to 145 ($M=115.70$, $SD=14.71$). They were required to undertake parallel L1 and L2 writing tasks and post-task metacognitive strategy questionnaires in this study. Another sample of 20 participants (i.e., 10 English majors and 10 non-English majors of differ-

ent L2 proficiency levels) was recruited to participate in the stimulated-recall interview to report their metacognitive processes in writing extensively with the recorded videos of task completion replayed as stimuli. Writing has been a crucial part of the participants' previous Chinese and English instructions since primary school. Before data collection, all the students filled in the consent form to indicate their voluntary participation.

Instruments

Before the main study, all the participants were required to complete a background form, which elicited their self-reports of demographical information including age and gender and educational background including academic major, gaokao English test scores, and language learning experience about years of English learning.

Two argumentative writing tasks, i.e., one for Chinese (L1) and the other for English (L2), were designed and used in this study (see Appendices A and B). The argumentative writing tasks were selected in this study because it was a vital writing genre commonly used in the participants' real-life writing practices and assessments. In the two writing tasks, the participants were required to present and argue for their opinions on the given debatable topic. They were prompted to articulate their views on early education in the Chinese writing task and online education in the English one. The task prompt offered the time limit and evaluative criteria as a reminder for the participants to complete the task on time and pay particular attention to those writing aspects during their task completion processes. The topics selected for the writing tasks were closely associated with the participants under investigation, with the perspectives of their teachers and target students into consideration. The participants were provided with a total of 45 minutes to finish the writing task at hand. The text length for the Chinese writing task was more than 600 words, and that for the English writing task was more than 200 words.

The writing metacognitive strategy questionnaire was validated as a robust instrument for L1 and L2 task-situated writing contexts in Xu's study (2024). It consists of 33 items measuring students' metacognitive strategy use in terms of a 6-point Likert scale of agreement (see Appendix C). Five inter-correlated subcategories of metacognitive strategies are clustered under a single common factor of metacognitive regulation. The task interpreting strategy subcategory includes 6 items measuring writers' interpretation and assessment of the writing task. Planning strategies comprise 7 items assessing writers' prior thinking and preparation for task completion. Non-linguistic monitoring strategies encompassed 6 items indicative of writers' regulation of non-linguistic aspects along with writing-related activities such as emotions and time. The linguistic monitoring subcategory contains 5 items pertaining to writers' online oversight of the retrieval and use of linguistic resources. The remaining 9 items formed the last evaluating subcategory, which occurs when writers review and reexamine their written products and experience.

The scoring rubric was based on a 5-band holistic writing rubric that weighted writing quality equally along with four main components, i.e., task achievement, content relevance and sufficiency, organization, and language use (see Appendix D). The maximum score for the writing task was 25 marks, with five marks for each band. Participants' written texts were assessed by two groups of raters, with one group comprised of two raters for L1 and L2 writing respectively. After standard training, norming, and pilot rating sessions, the two

groups of raters completed the scoring of all L1 and L2 written texts and reached acceptable inter-rater reliability coefficients, i.e., 0.867 and 0.879.

Data collection

The participants took part in this study voluntarily by filling out a consent form and a background form before administering the writing tasks and questionnaires. Their gaokao English test (NMET) scores were collected as a reliable measure of their English (L2) proficiency. The participants were required to complete Chinese and English writing tasks using their laptops in class. Immediately after each writing task, these participants would receive a QR code from their instructor. They could scan the QR code to access the online questionnaire corresponding to the writing task, which elicited their responses about their metacognitive strategy use in the prior writing process. A counterbalanced design was adopted to avoid the effects of order, with half of the participants completing the Chinese writing task and its questionnaire and the other half undertaking the English writing task and its questionnaire at first. After one week, they were assigned the remaining writing task and questionnaire. Writing tasks and questionnaires were administered in class. Their instructors were assigned to help invigilate the whole procedure to ensure that all the steps were conducted in the same manner as planned. Students could press the hands-up button on the online meeting software or type their questions in the chat box anytime during the data collection procedure. The first author stood by online to address any questions from the participating students immediately. Another sample of 20 students was invited to take the post-task stimulated-recall interview to answer the following open questions about the effects and transfer potential of metacognitive strategies:

- (1) What do you think of these metacognitive strategies?
- (2) What strategies influence your Chinese/English writing performance, and what doesn't?
- (3) Let's compare the metacognitive strategies you used in Chinese and English writing. Are they similar or different?

Data analysis

All the data were typed into Excel files for further analyses in the IBM SPSS and AMOS programs. Preliminary analyses, including descriptive statistics, collinearity diagnostics, and bivariate correlations, were run in SPSS ver. 26. The SEM analysis was then performed in AMOS ver.24 to test the simultaneous relationship among target variables. As shown in Fig. 1, a structural model was proposed based on the literature reviewed above. Average ratings from item responses subsumed the five subcategories of metacognitive strategies served as indicators for the latent variables of L1 and L2 writing metacognitive strategies. As metacognitive strategy use has been found to be an essential factor influencing writing performance (Hosseinpour & Kazemi, 2022; Qin & Zhang, 2019; Zhao & Liao, 2021), a single-headed arrow indicative of a causal relationship was drawn from L1 writing metacognitive strategies to L1 writing performance and from L2 writing metacognitive strategies to L2 writing performance. L1 metacognitive strategies and writing performance were reasonably assumed to impact their L2 counterparts for the possible L1-L2 transfer. The

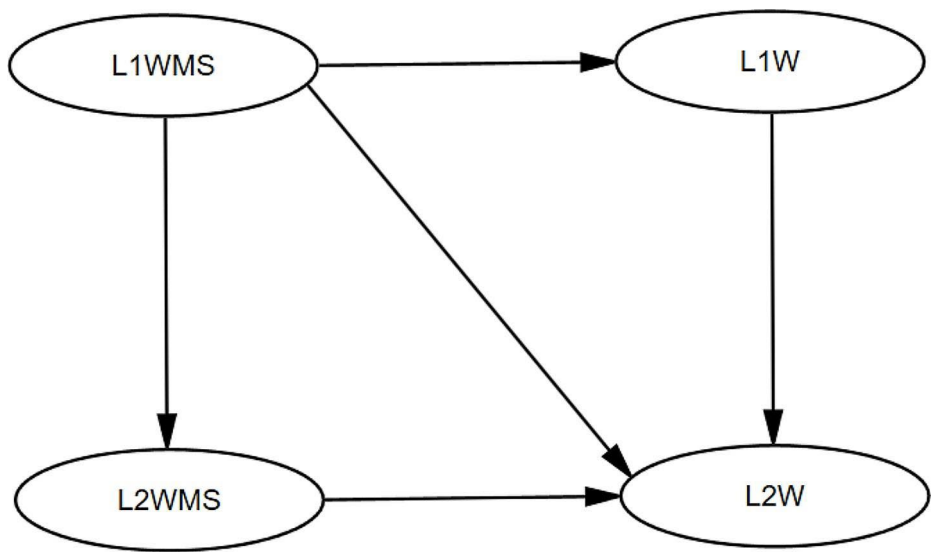


Fig. 1 The hypothesized metacognitive-strategies-on-writing model

indirect effect of L1 metacognitive strategies on L2 writing performance mediated by L2 metacognitive strategies was also hypothesized and tested for the cross-language facilitation found in previous studies (Xu et al., 2023; Zhu et al., 2021, 2022). Adequate model fit was checked with reference to the following criteria: $\chi^2/df \leq 5$, $p > 0.05$, the comparative fit index (CFI), the goodness-of-fit index (GFI), and the Tucker-Lewis index (TLI) ≥ 0.90 , the root mean residual (RMR) and the root mean square error of approximation (RMSEA) ≤ 0.10 (Phakiti, 2018).

The moderation effects of L2 proficiency and academic major on the cross-linguistic transfer of metacognitive strategies were finally examined via multigroup SEM analyses. The L2 proficiency level was operationally divided into higher and lower proficiency groups ($n=245$ and 257) by using the median split of the participants' self-reported gaokao English scores following Walsh et al. (2008) and Pae (2018). The participants were also divided into two groups according to their academic major, i.e., English-major and non-English-major groups ($n=244$ and 258). As Pae (2013) recommended, the multigroup analysis is typically used to test the moderating effect based on the framework of the chi-square difference test, which statistically compares the difference in chi-square values between the baseline and the constraint models. More specifically, the hypothesized model was first evaluated for each group. The constraint model was then developed with the equality constraint imposed on the path leading from L1 to L2 writing metacognitive strategies to make it equal across the groups under comparison. After that, the constraint model was compared with the baseline one by virtue of a chi-square difference test indicating the influence of added equality constraint on model fit (Kline, 2016). A statistically significant chi-square difference would evince the non-invariance of the L1-L2 transfer of metacognitive regulation across the two L2 proficiency groups and the two major groups. The moderation effect was further examined by comparing path coefficients between the higher- and lower-L2 proficiency groups and the English- and non-English major groups.

All the interviews were recorded and transcribed verbatim by one author of this study and another doctoral student of applied linguistics. The transcription work made the author deeply engage in these qualitative data and build a general understanding of the participants' metacognitive strategy use in the two writing contexts. The doctoral student double-checked the interview transcripts for accuracy. The interview data were coded by the two coders line by line and then re-analyzed to explore the effects of metacognitive strategies and similarities and differences of such strategy use between L1 and L2 writing contexts (Creswell, 2014). For example, interview responses containing words like “helpful” were identified and coded under the category of strategy effects, and those containing words like “same” were identified and coded under the category of the relationship between L1 and L2 writing metacognitive strategies. Interview extracts were also interpreted, organized, and translated as illustrative examples to complement quantitative results.

Results

Descriptive statistics, collinearity statistics, and correlation results

Table 1 presents descriptive statistics of the five MS factors and writing scores in L1 and L2 contexts among the 502 participants. As is shown in Table 1, mean scores of the five subcategories of metacognitive strategies ranged from 4.45 to 5.05 in L1 writing and from 4.29 to 4.82 in L2 writing. Among the five types of metacognitive strategies, participants interpreted the task requirements the most while they made relatively less planning before composing, which remained the same in both writing contexts. In addition, average L1 and L2 writing scores fell in the medium band, i.e., 13.31 and 13.43 respectively. Most participants in this study achieved an above-average level of performance in both Chinese and English writing tasks. Skewness and kurtosis values of these variables were less than ± 3 , indicating the satisfaction of normal distribution for inferential analyses.

Collinearity diagnostics among the different types of L1 and L2 metacognitive strategies were tested. According to the collinearity statistics presented in Table 2, the tolerance values of the metacognitive strategy variables exceeded the cutoff value of 0.2 and the Variance

Table 1 Descriptive statistics of metacognitive strategy factors and writing scores ($n=502$)

Variables		Min	Max	Mean	SD	Skewness	Kurtosis
Chinese (L1) writing metacognitive strategies	L1TI (6 items)	2.83	6.00	5.05	0.69	-0.431	-0.334
	L1P (7 items)	2.29	6.00	4.45	0.79	0.139	-0.303
	L1NLM (6 items)	2.67	6.00	4.85	0.69	-0.150	-0.228
	L1LM (5 items)	2.00	6.00	4.55	0.79	0.032	-0.256
	L1E (9 items)	1.44	6.00	4.79	0.73	-0.226	0.222
English(L2) writing metacognitive strategies	L2TI (6 items)	2.83	6.00	4.82	0.71	-0.377	0.019
	L2P (7 items)	1.00	6.00	4.29	0.84	-0.303	0.457
	L2NLM (6 items)	2.67	6.00	4.70	0.73	-0.057	-0.380
	L2LM (5 items)	1.80	6.00	4.35	0.83	-0.075	-0.203
	L2E (9 items)	1.00	6.00	4.60	0.81	-0.38	0.505
Chinese (L1) writing scores		5.83	21.50	13.31	1.96	0.554	1.806
English (L2) writing scores		5.00	22.33	13.43	2.72	0.403	1.035

Notes. TI: task interpreting; P: planning; NLM: non-linguistic monitoring; LM: linguistic monitoring; E: evaluating

Table 2 Coefficients of stepwise multiple linear regression

Model	Unstd coefficients		Std coefficients		Sig.	Collinearity statistics	
	Unstd. B	Std. error	Std.Beta	t		Tolerance	VIF
(Constant)	0.736	0.167		4.403	0.000		
L1P	0.241	0.038	0.277	6.300	0.000	0.415	2.410
L1NLM	0.151	0.049	0.151	3.107	0.002	0.339	2.951
L1LM	0.094	0.042	0.107	2.220	0.027	0.343	2.915
L1E	0.168	0.050	0.177	3.360	0.001	0.291	3.437
L2TI	0.367	0.039	0.379	9.347	0.000	0.490	2.042
L2P	-0.082	0.038	-0.099	-2.131	0.034	0.375	2.666
L2NLM	0.042	0.045	0.044	0.929	0.353	0.362	2.759
L2LM	-0.021	0.042	-0.026	-0.512	0.609	0.319	3.132
L2E	-0.053	0.045	-0.062	-1.188	0.235	0.293	3.412

a. Dependent variable: L1WTI

Table 3 Bivariate correlations between variables ($n=502$)

Strategy factors	Task Interpreting	Planning	Non-linguistic monitoring	Linguistic monitoring	Evaluating
L1-L2 pair	0.576***	0.521***	0.457***	0.488***	0.513***
Chinese (L1) writing scores	0.231***	0.166***	0.267***	0.187***	0.313***
English (L2) writing scores	0.422***	0.434***	0.311***	0.412***	0.418***

Notes. *** denotes $p < 0.001$

Inflation Factor (VIF) value fell within the acceptable threshold of less than 5, indicating the absence of multicollinearity of these writing metacognitive strategy variables (Hair et al., 2006). Thus, the multicollinearity issue will not impact the size of bivariate correlations between L1-L2 pairs of metacognitive strategies and the contributive effects of metacognitive strategies on writing performance.

Correlation results between these variables are presented in Table 3. Following Cohen's (1992) scale, small, medium, and large effects are operationally defined as r larger than 0.10, 0.30, and 0.50. It can be shown that almost all the L1-L2 pairs of metacognitive strategies shared a strong and positive correlation. Simply put, students who had a higher usage of the subcategory of metacognitive strategies in L1 writing tended to apply these strategies more frequently in L2 writing and vice versa. The five subcategories of metacognitive strategies were weakly but positively correlated with L1 writing scores ($r=0.231, 0.166, 0.267, 0.187$, and $0.313, p < 0.001$), while all of them reached an above-medium level of correlation with L2 writing scores ($r=0.422, 0.434, 0.311, 0.412$, and $0.418, p < 0.001$).

SEM results

With the presence of multiple measurement errors, the SEM technique helps to compare the strength of relationships among target variables directly and accurately. The multicollinearity assumption among the four latent variables in the SEM model is satisfied since their correlation coefficients did not exceed the threshold of 0.7 (Byrne, 2016; Booth et al., 1994). The proposed model fits the whole dataset well, as demonstrated by the following indices: $\chi^2(38)=307.155$, $\chi^2/df=4.523$, RMSEA=0.084, RMR=0.074, CFI=0.957, GFI=0.916,

TLI=0.941. Figure 2 presents the hypothesized model with standardized parameter estimates of all paths. All the hypothesized paths were significantly different from zero except the path from L1 writing metacognitive strategies to L2 writing performance. SEM results indicated that L1 and L2 writing performance were directly and positively influenced by corresponding metacognitive strategies ($\beta=0.32$, $p<0.001$ in the L1 context; $\beta=0.41$, $p<0.001$ in the L2 context). L1 writing metacognitive strategies constituted a significant predictor of L2 writing metacognitive strategies ($\beta=0.62$, $p<0.001$). Similarly, L1 writing performance was found to predict L2 writing performance significantly and positively ($\beta=0.29$, $p<0.001$). Although L1 writing metacognitive strategies had no direct effects on L2 writing performance ($p=0.205$), the standardized indirect effect of L1 writing metacognitive strategies on L2 writing via the mediation of L2 writing metacognitive strategies was significantly positive ($\beta=0.255$, Bootstrap CIs [0.177, 0.343], $p<0.001$).

Multigroup SEM results

Two multigroup SEM analyses were employed to examine the moderation effect of individual characteristics, i.e., L2 proficiency and academic major, on the L1-L2 transfer of metacognitive strategies. Prior to conducting multigroup SEM analysis, the model fit to the dataset from each subgroup was examined respectively. As evidenced by the indices in Table 4, the hypothesized model showed an acceptable fit to the four different subsets of data. Next, a cross-group equality constraint was imposed on the path leading from L1 to L2 writing metacognitive strategies to have the invariance test of L1-L2 transfer of metacognitive regulation across the two L2 proficiency groups and the two academic major groups. By statistically comparing the constraint model with the baseline model, two chi-square difference ($\Delta\chi^2$) values of 0.278 and 1.596 were obtained, which were insignificant at the 0.05 alpha level ($p=0.598$ and 0.206). By inference, the participants' L2 proficiency and academic major failed to exert significant moderating effects on the L1-L2 transfer of

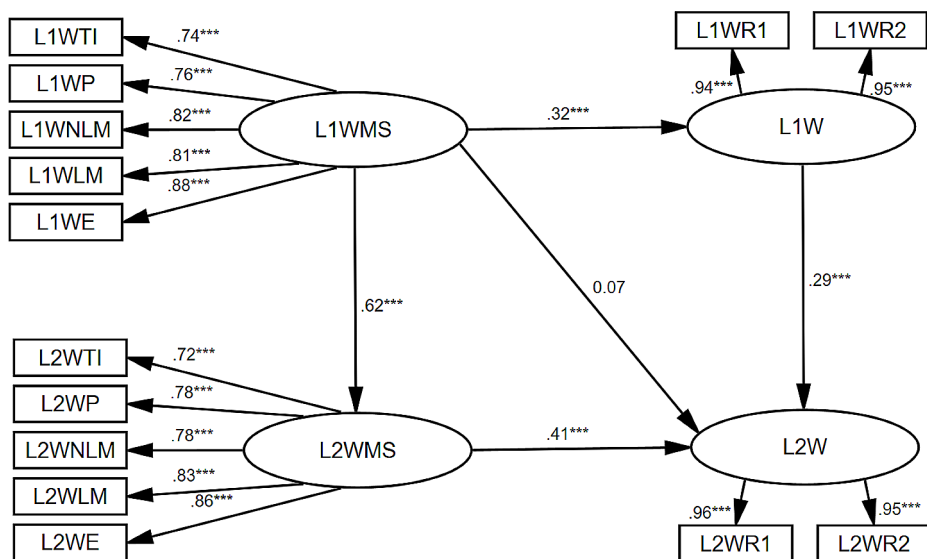


Fig. 2 The metacognitive-strategies-on-writing model with standardized estimates

Table 4 Fit indices of the metacognitive-strategies-on-writing model for each group

Model	χ^2/df	p	RMSEA	RMR	CFI	GFI	TLI
Lower L2 proficiency	3.296	0.000	0.095	0.082	0.945	0.894	0.925
Higher L2 proficiency	2.349	0.000	0.074	0.055	0.964	0.905	0.951
English major	1.590	0.000	0.049	0.044	0.981	0.939	0.974
Non-English major	2.975	0.000	0.088	0.075	0.962	0.900	0.948

metacognitive regulation. However, a close look at the path parameters suggests that such transfer was slightly stronger for the higher L2 proficiency group ($\beta_{\text{higher}}=0.655, p<0.001$) than for the lower L2 proficiency group ($\beta_{\text{lower}}=0.605, p<0.001$) and for the English major group ($\beta_{\text{English}}=0.682, p<0.001$) than for the non-English major group ($\beta_{\text{Non-English}}=0.600, p<0.001$).

Interview results

We focused on the participants' interview responses of interest and relevance to how metacognitive strategy use influenced writing performance and interacted between L1 and L2 writing contexts to provide complementary information for the quantitative results of this study.

Although the participating students scored differently in the writing tasks, they unanimously reported the positive effects of metacognitive strategy use on the writing process and outcomes, which was the same in L1 and L2 contexts. Taking Participant 17 in Chinese writing as an example, she noted, "Reading the task prompt carefully is very helpful, especially those evaluative criteria, serving as mental cues reminding me of these aspects during the writing process, thus guiding me fulfil the task requirements effectively". Participant 8 had a similar experience in English writing and said, "These conscious strategies have an impact. I approach the English writing task with greater focus and dedication". The use of metacognitive strategies even assumes a more important role in L2 writing for reconciling the insufficiency of linguistic knowledge than in L1 writing. For instance, when comparing L1 and L2 writing processes, Participant 19 confessed that "I only need to turn my thoughts into words and sentences during L1 writing, while L2 writing is a fine-tailored process in which I attend more to language use and continuously tell myself, use advanced words, change the sentence type, and check the grammatical errors. Purposively managing the retrieval of limited linguistic knowledge, the text quality (of L2 writing) is enhanced".

Corresponding to the statistically significant relationship between L1 and L2 writing metacognitive strategies, interview results from most participants, despite their disciplinary major and L2 proficiency, revealed a generally similar pattern of strategy use during both writing processes. For instance, when asked "What are the similarities and differences between metacognitive strategies used in Chinese and English writing tasks?", Participant 6 answered: "I follow a similar procedure for both Chinese and English writing tasks, creating an outline, being attentive while writing, and continuously revising and modifying sentences". Additionally, the participants may use L1 to devise content plans for L1 and L2 writing, as Participant 19 reported, "As Chinese is my mother tongue, I approach every writing task similarly by thinking ahead in this language, outlining my main arguments and subpoints and considering how to support them". The participants also recalled their L2 linguistic resource in L1 planning to compensate for the lack of L1 writing experience.

Participant 10 commented: “I haven’t written in Chinese since entering the university, so I almost forget how to compose a Chinese text. When completing the Chinese writing task, I think about English linking words such as “first of all” and “secondly” and write “Shouxian” and “Qici” in Chinese accordingly”.

Discussion

In line with previous studies (Soto et al., 2023; Teng et al., 2022; Zhao & Liao, 2021), a strong relationship exists between learners’ metacognitive strategy use and writing performance in L1 and L2. Learners who execute more metacognitive control in their writing processes scored relatively higher in their final written texts than their counterparts lacking the use of metacognitive strategies, regardless of which language involved. It supports Anderson’s (2005) claim that successful language learners have a more expansive repertoire of strategies at their disposal to accomplish their task of learning a language effectively. Student writers who exhibit higher frequency levels of metacognitive strategy use tend to sustain or increase their cognitive engagement, critical thinking, effort and persistence during the composing process, which in turn leads to better performance (Teng & Yue, 2022; Wolters, 1999; Zimmerman & Risemberg, 1997). Further examining the path parameters simultaneously, we find that metacognitive strategies had a relatively greater predictive effect on L2 writing than L1 writing. Thus, the strength of the impact of metacognitive regulation on actual writing performance is influenced by the L1/L2 context to some degree. The role of metacognitive regulation becomes more prominent when writing in an L2, where learners may encounter more cognitively, emotionally, and socially demanding challenges than writing in L1 (Kormos, 2012; Xu et al., 2023). Learners may need more active and effective regulation of cognition, affect, and behavior to achieve their writing goals when completing a writing task of higher complexity (Zimmerman & Schunk, 2011). Against the larger insufficiency of linguistic knowledge and the heavier constraints imposed on cognitive resources (Schoonen et al., 2011), they are more compelled to rely on effective metacognitive skills to achieve successful performance in L2 writing. Metacognitive strategies related to interpreting task requirements, constructing and executing plans, engaging in real-time monitoring, and evaluating participation in the writing process and quality of written texts altogether demonstrate a compensatory role in relieving the information load in the working memory system and addressing encountered difficulties (Teng & Qin, 2024).

The estimated structural model also evidenced the associations between L1 and L2 writing metacognitive strategies. L1 writing metacognitive strategies significantly and substantially influenced L2 writing metacognitive strategies and then exerted a cross-language facilitation effect on L2 writing performance. As Cumming (2001) posits, L2 writers possess the distinct advantage of utilizing both their L1 and L2 resources concurrently for strategic purposes when writing. It is reasonable to claim that metacognitive regulation is transferable between L1 and L2 writing, thus partly supporting Cummins’ LIH, which is consistent with the results of previous studies (Guo & Huang, 2020; Pae, 2018; Xu et al., 2023; Zhu et al., 2021). Of note, the cross-linguistic comparison in this study also expands the CUP shared by L1 and L2 literacy skills to learners’ deliberate control over their thoughts, actions and emotions in writing. It is empirically supported that the CUP covers not only linguistic and psychological elements but also metacognitive ones.

The two rounds of multigroup SEM analysis failed to identify the significant moderation effects of individual L2 proficiency and academic major on the relationship between L1 and L2 writing metacognitive strategies. It diverges from Pae's (2018) results, which empirically supported the LTH that the efficient L1-L2 transfer of writing skills was more likely to occur for higher L2 proficiency learners than their lower L2 proficiency peers. Such inconsistency is possibly attributed to the different participant samples. In Pae's (2018) study, the bilingual participants under investigation were Korean high-school EFL learners, while this study recruited college EFL learners from mainland China. Differences may appear between the two bilingual populations in their understanding and use of metacognitive knowledge and skills in writing due to the interplay of individual, educational, and cultural dimensions. The heterogeneity in the participant sample leads to inconsistent results concerning the L1-L2 transfer of metacognitive regulation between higher and lower L2 proficiency groups. Besides, learners are expected to differ in their development of metacognitive skills in the writing domain and the ability to transfer what they have developed between L1 and L2 contexts due to different disciplinary teaching and learning environments (Johnson et al., 2012). However, the relationship between L1 and L2 writing metacognitive strategies does not hinge on the two academic major groups in this study. The pessimistic picture of writing instruction for Chinese students is a possible explanation for this unexpected result. Similar to Jiang et al. (2023), it is found that writing instructions in China have not yet met the demand for the writing development of university students. Instead of experiencing effective writing pedagogies in classrooms or other tutoring institutions, the participants under investigation were more likely to develop writing skills via self-learning practices. Limited teaching resources and learning approaches potentially constrain the mastery of effective regulation and uniformly cause an unmaturing level of metacognitive skills for student writers of different disciplines. Therefore, regardless of their disciplinary majors, learners struggle with composing high-quality texts and transferring their acquired skills across language contexts after years of language education.

Conclusions and implications

This study represents an innovative inquiry into Chinese EFL learners' metacognitive strategy use in task-situated writing with a cross-linguistic perspective. The findings have several theoretical and pedagogical implications. The training of metacognitive strategies is recommended as a pedagogical tool in writing classrooms, considering the predictive effects of metacognitive strategies on L1 and L2 writing performance and the malleability of metacognition. Some pedagogical suggestions can be integrated into the metacognitive strategy training to enhance students' awareness and regulation of their writing processes, thereby improving their writing competence and incurring a prosperity of writer autonomy. In line with the subcategories of metacognitive strategies in this study, explicit guidance is needed to help students form an accurate task representation, generate logical pre-plans, execute effective monitoring linguistically and non-linguistically, and have meaningful evaluations. The training should be embedded in the writing classroom as learners sit in writing tasks and other writing-related activities instead of being decontextualized. Practical guidance appears to be more effective than vague explanations in delivering metacognitive skills. Manipulating the task difficulty in terms of genres and topics can also enhance students'

understanding of metacognitive strategies in a sustainable way (Negretti & McGrath, 2018; Ong, 2014). Besides, the strong associations between L1 and L2 writing metacognitive strategies partly support Cummins' (1979) LIH and CUP from a metacognitive perspective. Given the L1-L2 transfer of metacognitive regulation, it is evident to recommend cross-language collaborations such as joint talks and curriculum co-design between L1 and L2 writing educators and practitioners to promote the effective use of these strategies in writing and better address the obstacles faced by students in their way to proficient and independent writers. Moreover, the cross-language effect further directs our attention to acknowledging the importance of L1 writing metacognitive skills in shaping L2 writing development. L2 proficiency and academic major were not found to significantly moderate the L1-L2 transfer of metacognitive strategies, and teachers should devote balanced efforts to cultivate the cross-linguistic transfer abilities of these different groups of students, bridging the possible gap (Pae, 2018).

Limitations and suggestions for future research

Nonetheless, the results of this study should be interpreted cautiously due to the following limitations. Firstly, data were collected from somewhat homogeneous participants regarding their age, learning experience, and educational settings despite their heterogeneous disciplinary backgrounds and L2 proficiency levels. Future research is advised to replicate the results with learners from diverse educational and cultural backgrounds, further enhancing the result generalizability. Secondly, questionnaire items in this study were more likely to measure the quantity of strategy use, possibly drawing a partial portrayal of students' metacognitive skills. How often the participants employ metacognitive strategies does not mean how well they do. In this regard, future research is warranted to spare more efforts to evaluate the quality of such strategy use. Thirdly, a single measure of writing task may risk not fully capturing students' writing performance. It is advisable to incorporate a range of writing tasks with different levels of complexity to better assess the participants in writing. Monitoring measures, including students' self-assessment of their written works, can also be adopted in future research to promote metacognitive regulation and autonomy in learning to write. Additionally, task characteristics such as writing genres and topics tied to students' metacognitive strategy use are not taken into the research design. These task characteristics may impact how writers perform metacognitive regulation in writing. Therefore, we expect future research to include narrative and expository genres and familiar and unfamiliar topics to offer more insightful information about the dynamic L1-L2 transfer mechanism. Finally, the cross-sectional research design in this study cannot identify the changing pattern and developmental route of learners' metacognitive skills. A longitudinal design is recommended for future research.

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Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

Informed consent statement Informed consent was obtained from all human subjects involved in this study.

Institutional review board statement The study involving human participants was reviewed and approved by the Departmental Research Committee of The Hong Kong Polytechnic University.

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References

- Abdel Latif, M. M. M. (2021). Remodeling writers' composing processes: Implications for writing assessment. *Assessing Writing*, 50, 100547. <https://doi.org/10.1016/j.asw.2021.100547>.
- Anderson, N. J. (2005). L2 learning strategies. In E. Hinkel (Ed.), *Handbook of research in second language teaching and learning* (pp. 757–771). Lawrence Erlbaum.
- Arndt, V. (1987). Six writers in search of texts: A protocol-based study of L1 and L2 writing. *ELT Journal*, 41, 257–267. <https://doi.org/10.1093/elt/41.4.257>.
- Bachman, L. F., & Palmer, A. S. (2010). *Language assessment in practice*. Oxford University Press.
- Bai, B., Hu, G. W., & Gu, P. Y. (2014). The relationship between writing strategies and English proficiency in Singapore primary schools. *The Asia-Pacific Education Researcher*, 23, 355–365. <https://doi.org/10.1007/s40299-013-0110-0>.
- Baker, D. L., Park, Y., & Baker, S. K. (2012). The reading performance of English learners in grades 1–3: The role of initial status and growth on reading fluency in Spanish and English. *Reading and Writing*, 25, 251–281. <https://doi.org/10.1007/s11145-010-9261-z>.
- Booth, G. D., Niccolucci, M. J., & Schuster, E. G. (1994). Identifying proxy sets in multiple linear regression: An aid to better coefficient interpretation. <https://archive.org/details/identifyingproxy470boot/page/n1/mode/2up>.
- Byrne, B. M. (2016). *Structural equation modeling with Amos: Basic concepts, applications, and programming* (3rd ed.). Routledge.
- Chien, S. C. (2012). Students' use of writing strategies and their English writing achievements in Taiwan. *Asai Pacific Journal of Education*, 32(1), 93–112. <https://doi.org/10.1080/02188791.2012.655240>.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112(1), 155–159. <https://doi.org/10.1037/0033-2909.112.1.155>.
- Creswell, J. W. (2014). *Research design: Qualitative, quantitative, and mixed method approaches* (4th edition). SAGE publications.
- Cumming, A. (2001). Learning to write in a second language: Two decades of research. *International Journal of English Studies*, 1(2), 1–23. <https://revistas.um.es/ijes/article/view/48331>.

- Cummins, J. (1979). Linguistic interdependence and the educational development of bilingual children. *Review of Educational Research*, 49(2), 222–251. <https://doi.org/10.3102/00346543049002222>.
- Cummins, J. (1980). The cross-lingual dimensions of language proficiency: Implications for bilingual education and the optimal age issue. *TESOL Quarterly*, 14(2), 175–187. <https://doi.org/10.2307/3586312>.
- Cummins, J. (2000). *Language, power, and pedagogy: Bilingual children in the crossfire*. Multilingual Matters.
- Cummins, J. (2016). Reflections on Cummins (1980), the cross-lingual dimensions of language proficiency: Implications for bilingual education and the optimal age issue. *TESOL Quarterly*, 50(4), 940–944. <https://doi.org/10.1002/tesq.339>.
- Dimmitt, C., & McCormick, C. B. (2012). Metacognition in Education. In K. R. Harris, S. Graham, & T. Urdan (Eds.), *APA educational psychology handbook* (pp. 157–187). American Psychological Association.
- Dörnyei, Z. (2005). *The psychology of language learner individual differences in second language acquisition*. Lawrence Erlbaum Associates.
- Edele, A., & Stanat, P. (2016). The role of first-language listening comprehension in second-language reading comprehension. *Journal of Educational Psychology*, 108(2), 163–180. <https://doi.org/10.1037/edu0000060>.
- Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. Resnick (Ed.), *The nature of intelligence* (pp. 231–235). Lawrence Erlbaum Associate.
- Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist*, 34(10), 906–911.
- Flower, L., & Hayes, J. R. (1981). A cognitive process theory of writing. *College Composition and Communication*, 32(4), 365–387.
- Forbes, K., & Fisher, L. (2020). Strategy development and cross-linguistic transfer in foreign and first language writing. *Applied Linguistics Review*, 11(2), 311–339. <https://doi.org/10.1515/applirev-2018-0008>.
- Grant, A., Gottardo, A., & Geva, E. (2011). Reading in English as a first or second language: The case of Grade 3 Spanish, Portuguese, and English speakers. *Learning Disabilities Research & Practice*, 26, 67–83. <https://doi.org/10.1111/j.1540-5826.2011.00327.x>.
- Guo, X., & Huang, L. S. (2020). Are L1 and L2 strategies transferable? An exploration of the L1 and L2 writing strategies of Chinese graduate students. *The Language Learning Journal*, 48(6), 715–737. <https://doi.org/10.1080/09571736.2018.1435710>.
- Hacker, D. J. (2018). A metacognitive model of writing: An update from a developmental perspective. *Educational Psychologist*, 53, 220–237. <https://doi.org/10.1080/00461520.2018.1480373>.
- Hacker, D. J., Keener, M. C., & Kircher, J. C. (2009). Writing is applied metacognition. In D. J. Hacker, J. Dunlosky, & A. C. Graesser (Eds.), *Handbook of metacognition in education* (pp. 154–171). Routledge.
- Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2006). & Tatham, R. L. *Multivariate data analysis*. Pearson University Press.
- Harris, K. R., Ray, A., Graham, S., & Houston, J. (2019). Answering the challenge: SRSD instruction for close reading of text to write to persuade with 4th and 5th Grade students experiencing writing difficulties. *Reading and Writing*, 32, 1459–1482. <https://doi.org/10.1007/s11145-018-9910-1>.
- Hayes, J. R. (1996). A new framework for understanding cognition and affect in writing. In C. M. Levy, & S. Ransdell (Eds.), *The science of writing: Theories, methods, individual differences, and applications* (pp. 1–27). Lawrence Erlbaum.
- Hosseinpur, R. M., & Kazemi, Z. (2022). Composing strategies employed by high-and low-performing Iranian EFL students in essay writing classes. *Assessing Writing*, 51, 100601. <https://doi.org/10.1016/j.asw.2021.100601>.
- Jarvis, S., & Pavlenko, A. (2008). *Cross-linguistic influence in language and cognition*. Routledge.
- Jiang, L., Yu, S., Zhou, N., & Xu, Y. (2023). English writing instruction in Chinese students' experience: A survey study. *RELJ Journal*, 54(1), 37–54. <https://doi.org/10.1177/0033688220980227>.
- Johnson, M. D., Mercado, L., & Acevedo, A. (2012). The effect of planning sub-processes on L2 writing fluency, grammatical complexity, and lexical complexity. *Journal of Second Language Writing*, 21, 264–282. <https://doi.org/10.1016/j.jslw.2012.05.011>.
- Kellogg, R. T. (1996). A model of working memory in writing. In M. C. Levy, & S. E. Ransdell (Eds.), *The science of writing: Theories, methods, individual differences and applications* (pp. 57–71). Laurence Erlbaum Associates.
- Kline, R. B. (2016). *Principles and practice of structural equation modelling* (4th ed.). Guilford.
- Kormos, J. (2012). The role of individual differences in L2 writing. *Journal of Second Language Writing*, 21, 390–403. <https://doi.org/10.1016/j.jslw.2012.09.003>.
- Larsen-Freeman, D. (2013). Transfer of learning transformed. *Language Learning*, 63, 107–129. <https://doi.org/10.1111/j.1467-9922.2012.00740.x>.

- Lee, I., & Wong, K. (2014). Bringing innovation to EFL writing: The case of a primary school in Hong Kong. *The Asia-Pacific Education Researcher*, 23, 159–163. <https://doi.org/10.1007/s40299-013-0149-y>.
- McCormick, C. B. (2003). Metacognition and learning. In W. M. Reynolds, & G. E. Miller (Eds.), *Handbook of psychology* (pp. 79–102). Wiley.
- Negretti, R., & McGrath, L. (2018). Scaffolding genre knowledge and metacognition: Insights from an L2 doctoral research writing course. *Journal of Second Language Writing*, 40, 12–31. <https://doi.org/10.1016/j.jslw.2017.12.002>.
- O'Malley, J. M., & Chamot, A. U. (1990). *Learning strategies in second language acquisition*. Cambridge University Press.
- Ong, J. (2014). How do planning time and task conditions affect metacognitive process of L2 writers? *Journal of Second Language Writing*, 23, 17–30. <https://doi.org/10.1016/j.jslw.2013.10.002>.
- Oxford, R. L. (1990). *Language learning strategies: What every teacher should know*. Newbury House.
- Pae, T. I. (2013). Skill-based L2 anxieties revisited: Their intra-relations and the inter-relations with general foreign language anxiety. *Applied Linguistics*, 34(2), 232–252. <https://doi.org/10.1093/applin/ams041>.
- Pae, T. I. (2018). Effects of task type and L2 proficiency on the relationship between L1 and L2 in reading and writing: An SEM approach. *Studies in Second Language Acquisition*, 40(1), 63–90. <https://doi.org/10.1017/S0272263116000462>.
- Phakiti, A. (2018). Confirmatory factor analysis and structural equation modelling. In A. Phakiti, De P. Costa, L. Plonsky, & S. Starfield (Eds.), *The Palgrave handbook of applied linguistics research methodology* (pp. 459–500). The Palgrave Macmillan.
- Qin, L., & Zhang, L. J. (2019). English as a foreign language writers' metacognitive strategy knowledge of writing and their writing performance in multimedia environments. *Journal of Writing Research*, 11(2), 393–413. <https://doi.org/10.17239/jowr-2019.11.02.06>.
- Rubin, J. (1981). Study of cognitive processes in second language learning. *Applied Linguistics*, 11, 117–131. <https://doi.org/10.1093/applin/11.2.117>.
- Scardamalia, M., & Bereiter, C. (1987). Knowledge telling and knowledge transforming in written composition. In S. Rosenberg (Ed.), *Advances in applied psycholinguistics: Reading, writing, and language learning* (pp. 142–175). Cambridge University Press.
- Schoonen, R., van Gelderen, A., Stoel, R. D., Hulstijn, J., & de Glopper, K. (2011). Modelling the development of L1 and EFL writing proficiency of secondary school students. *Language Learning*, 61(1), 31–79. <https://doi.org/10.1111/j.1467-9922.2010.00590.x>.
- Schunk, D. H., & Greene, J. A. (2018). *Handbook of self-regulation of learning and performance* (2nd edition). Routledge.
- Shi, L., Baker, A., & Chen, H. (2019). Chinese EFL teachers' cognition about the effectiveness of genre pedagogy: A case study. *RELC Journal*, 50(2), 314–332. <https://doi.org/10.1177/00336882177165>.
- Soto, C., Gutierrez de Blume, A. P., Rebollo, V., Rodriguez, F., Palma, D., & Gutiérrez, F. (2023). Metacognitive monitoring skills of reading comprehension and writing between proficient and poor readers. *Metacognition and Learning*, 18(1), 113–134. <https://doi.org/10.1007/s11409-022-09317-8>.
- Teng, F., & Huang, J. (2019). Predictive effects of writing strategies for self-regulated learning on secondary school learners' EFL writing proficiency. *TESOL Quarterly*, 53(1), 232–247. <https://doi.org/10.1002/tesq.462>.
- Teng, M. F., & Qin, C. (2024). Assessing metacognitive writing strategies and the predictive effects on multimedia writing. *Asia Pacific Journal of Education*, 1–24. <https://doi.org/10.1080/02188791.2024.2325132>.
- Teng, M. F., & Yue, M. (2023). Metacognitive writing strategies, critical thinking skills and academic writing performance: A structural equation modeling approach. *Metacognition and Learning*, 18(1), 237–260. <https://doi.org/10.1007/s11409-022-09328-5>.
- Teng, L. S., & Zhang, L. J. (2016). A questionnaire-based validation of multidimensional models of self-regulated learning strategies. *The Modern Language Journal*, 100(3), 674–701. <https://doi.org/10.1111/modl.12339>.
- Teng, M. F., Qin, C., & Wang, C. (2021). Validation of metacognitive academic writing strategies and the predictive effects on academic writing performance in a foreign language context. *Metacognition and Learning*, 1–24. <https://doi.org/10.1007/s11409-021-09278-4>.
- Teng, M. F., Wang, C., & Zhang, L. J. (2022). Assessing self-regulatory writing strategies and their predictive effects on young EFL learners' writing performance. *Assessing Writing*, 51, 100573. <https://doi.org/10.1016/j.asw.2021.100573>.
- Veenman, M. V., Van Hout-Wolters, B. H., & Afflerbach, P. (2006). Metacognition and learning: Conceptual and methodological considerations. *Metacognition and Learning*, 1(1), 3–14. <https://doi.org/10.1007/s11409-006-6893-0>.

- Walsh, G., Evanschitzky, H., & Wunderlich, M. (2008). Identification and analysis of moderator variables. *European Journal of Marketing*, 42, 977–1004. <https://www.emerald.com/insight/content/doi/10.1108/03090560810891109/full/pdf>.
- Wenden, A. (1987). Metacognition: An expanded view on the cognitive abilities of L2 learners. *Language Learning*, 37(4), 573–597. <https://doi.org/10.1111/j.1467-1770.1987.tb00585.x>.
- Wenden, A. L. (1991). *Learner strategies for learner autonomy*. Printice-Hall International.
- Xu, W. (2024). *Metacognitive strategy use in Chinese (L1) and English (L2) writing: A within-subject comparison* [Unpublished doctoral dissertation, The Hong Kong Polytechnic University].
- Xu, W., Zhao, P., Yao, Y., Pang, W., & Zhu, X. (2023). Effects of self-efficacy on integrated writing performance: A cross-linguistic perspective. *System*, 115, 103065. <https://doi.org/10.1016/j.system.2023.103065>.
- Yang, L., & Gao, S. (2013). Beliefs and practices of Chinese university teachers in EFL writing instruction. *Language Culture and Curriculum*, 26(2), 128–145. <https://doi.org/10.1080/07908318.2013.794817>.
- Zhao, C. G., & Liao, L. (2021). Metacognitive strategy use in L2 writing assessment. *System*, 98, 102472. <https://doi.org/10.1016/j.system.2021.102472>.
- Zhu, X., Li, G. Y., Cheong, C. M., Yu, G., & Liao, X. (2021). Secondary school students' discourse synthesis performance on Chinese (L1) and English (L2) integrated writing assessments. *Reading and Writing*, 34, 49–78. <https://doi.org/10.1007/s11145-020-10065-x>.
- Zhu, X., Guan, Y., & Yao, Y. (2022). Transfer of ideal L1 and L2 writing selves and their impacts on L2 writing enjoyment and integrated writing performance. *Assessing Writing*, 54, 100674. <https://doi.org/10.1016/j.asw.2022.100674>.
- Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–40). Academic.
- Zimmerman, B. J. (2013). From cognitive modeling to self-regulation: A social cognitive career path. *Educational Psychologists*, 48, 135–147. <https://doi.org/10.1080/00461520.2013.794676>.
- Zimmerman, B. J., & Risemberg, R. (1997). Becoming a self-regulated writer: A social cognitive perspective. *Contemporary Educational Psychology*, 22, 73–101. <https://doi.org/10.1006/ceps.1997.0919>.
- Zimmerman, B. J., & Schunk, D. H. (2011). *Handbook of self-regulation of learning and performance*. Routledge.

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