Exploring Chinese Learners' of English Response to Negative Language Transfer Feedback: An Evaluation of a Writing Assistant Tool

by

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Abstract

Previous research has enhanced our understanding of feedback from peers, teachers, and software as well as the widely reported negative language transfer phenomenon. However, the impact of an automated writing assistant tool that specifically provides negative language transfer feedback on Chinese learners' writing remains unexplored. The present study employs a writing assistant tool capable of detecting NLT for studying student reactions to this feedback. Eighteen Chinese learners of English participated in the study. They completed two English writing tasks, one with the NLT tool and another without it. Their metalinguistic knowledge was measured using three metalinguistic tests at different times. The results indicated that participants' performance on the Morpho-Orthographic Choice Task improved following NLT tool use. This was not the case when using current support tools. Additionally, an interaction between the tools and pre-/post-test was observed in the Wug's Test, where participants experienced significantly larger learning gains when they used the NLT tool than when they did not. Participants' perceptions were determined using interviews and questionnaires, which revealed a positive attitude towards the tool's usefulness and ease of use. These findings suggest that the use of the NLT tool may improve learners' morphological knowledge and help them overcome negative language transfer. The positive attitudes of participants towards the tool also indicate the NLT tool is helpful and easy to use. Integrating the NLT tool in educational settings has the potential to alleviate teachers' workload and foster self-reflection skills for independent learning among students.

Preface

The study was approved by a Research Ethics Board at the University of Alberta (Pro00082188). Participants voluntarily attended this study and signed consent forms after being informed about study procedures. No personally identifying data was stored. No additional potential risks were involved in the study and no conflict of interest needed to be disclosed.

Portions of the research conducted for this thesis are part of an international research collaboration. The setup of eye-tracking devices and affect measurement equipment was conducted by Minghao Cai. Robyn Tang reviewed writing prompts found in appendix A and conducted the first four interviews. Xiaoyang Jia reviewed the Chinese version of the interview protocol in appendix B and coded the interview collaboratively with me. A team of undergraduate students in CMPUT 401 and Leticia developed and tested the NLT tool I evaluated. Prof. Carrie Demmans Epp reviewed all material used in this study. I carried out other work including instrument development, data collection, analysis, and interpretation, reporting, and the literature review.

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Acronyms

L1

First language

L2

Second language

NLT

Negative language transfer

GG

Google Docs grammar checker condition

NT

Negative language transfer tool condition

EFL

English as a foreign language

ESL

English as a second language

ELL

English language learner

SVO

Subject verb object

SLA

Second language acquisition

AI

Artificial intelligence

Glossary

Negative language transfer

Negative language transfer is a second language acquisition phenomenon in which learners incorrectly reuse rules from one language when communicating in another language.

Chinese negative transfer

Negative language transfer from Chinese

First Language

A language a person learns first and can use fluently, also known as mother tongue or native language.

Second Language

A language a person learns after the first language or mother tongue.

Target Language

Language that a learner is trying to acquire, typically as a second or foreign language.

English as a foreign language

Study of English by non-native speakers in a non-English-speaking environment where English is not the official or main language.

English as a second language

Study of English by non-native speakers in an English-speaking environment where English is an official or main language.

English language learner

A person who is in the process of learning the English language.

Second language acquisition

The process of learning a new language after the acquisition of the first language is complete.

Chapter 1

Introduction

Globalization has made the world more interconnected, and English has been used widely as a common language for communication across cultures and borders (Cenoz & Jessner, 2000). Learning English offers many benefits. For example, people are learning English to have access to information on the Internet because over 56% of online content is in English (*Usage Statistics and Market Share of Content Languages for Websites*, 2023). Additionally, English has become a tool for post-graduate students to access a range of academic programs. The proportion of public school students in the United States who are learning English as a second language (ESL) has been growing (*COE - English Learners in Public Schools*, 2019). Many industries demand specific competence levels in English, such as business English proficiency or professional knowledge of legal English. Professionals who excel in the language can enhance their competitiveness in the global market.

Developing robust English writing skills offers numerous benefits. It enables individuals to communicate their ideas and thoughts with others effectively, both domestically and internationally. As highlighted by Saputro (2013), writing serves as an important medium of communication that allows learners to articulate their thoughts and connect with people worldwide. Moreover, strong English writing skills are essential for academic success, particularly when it comes to writing essays, research papers, and dissertations. Writing helps stimulate critical and deeper thinking by encouraging students to focus and organize their ideas while providing more time for introspection and consideration (Irmscher, 1979).

Writing is a vital component of learning English as a foreign language (EFL). It is a collection of separate skills, including word spelling, sentence structure, grammar, and organization. Accurate grammar and writing structure in written communication are essential for effective interaction with others. Learning English typically involves four skills: reading, writing, listening, and speaking. The International English Language Testing System (IELTS) exams are intended to comprehensively assess language proficiency. Among these skills, writing is the most challenging skill for EFL learners in both

general training and academic tests. The average score in writing is the lowest among all test components according to the 2021 IELTS test-taker performance report (*Test Taker Performance*, 2021).

According to the British Council (*English in Numbers*, 2016), China has an estimated 400 million English language learners. Furthermore, the English language learning market in China is projected to grow at a compound annual rate exceeding 21% from 2020 to 2025 (Research and Markets, 2022). Chinese students are facing challenges in mastering English skills. It is partly due to their lack of usage knowledge of English because English is an examination-oriented subject in China instead of application-oriented. In response to this focus of the educational system, many students' learning goals are to pass English exams rather than develop English proficiency (Liao, 2019). The fact is that Chinese students' IELTS scores are below world average level and the writing score is the lowest of the four skills (*Test Taker Performance*, 2021).

The "writing to learn" theory suggests that the act of writing can help individuals to better understand and retain information (Rivard, 1994). According to this theory, writing promotes learning by encouraging individuals to actively engage with the material and organize their thoughts in a structured way. Additionally, writing can help learners expand vocabulary, improve grammar, develop habits and skills in pronunciation, speaking, and reading, which promotes second language acquisition (SLA).

The "learning to write" theory refers to the idea that writing is a skill that is developed through practice and feedback. This theory emphasizes the significance of providing students with opportunities to write regularly, receive feedback from teachers and peers, and revise their work accordingly (Perl, 1979). Thus, the acquisition of language also promotes writing skills through regular practice and feedback.

During second language writing, learners may consciously or unconsciously apply the rules of their native language when encountering knowledge gaps, such as unfamiliar grammatical structures in their second language. For example, they might use the sentence order from their first language (L1) when composing complex sentences in their second language (L2). This phenomenon is called language transfer.

Language transfer refers to the influence of a learners' L1 or prior linguistic knowledge on their L2. This phenomenon is characterized by learners thinking of new languages (L2) in terms of the structure of their L1s (Lado, 1957). Language transfer can be positive or negative (Chan, 2004). Positive language transfer promotes second language acquisition when learners recognize common features shared by both languages. These similarities make it easier for learners to understand the new language. Negative language transfer (NLT) impedes language learning when learners apply sentence

structure or grammar rules from their native language that do not exist in the new language, which introduces errors.

Negative language transfer is a common challenge faced by EFL learners and is not limited to Chinese speakers. The larger the difference between two languages, the greater the potential negative impact (Timina, 2013). The specific difficulties faced by Chinese speakers can be influenced by factors such as differences in the grammar, pronunciation, and writing systems of English and Chinese (Dai-hong & Cui-qiong, 2018; Ma & Tan, 2013; Shi, 2015). Negative language transfer from Chinese often affects syntax and grammar in English, including active and passive voice use and the use of singular and plural nouns. This process hinders the learner's proficiency in the second language (Brogan & Son, 2015). Researchers proposed that helping students to reduce negative language transfer errors can effectively improve their English writing (Bai & Qin, 2018). This may be especially beneficial for Chinese learners of English given the distance between Chinese and English and statistics released by the Ministry of Education (MOE) of China (2021) that show the number of college students in mainland China has exceeded 18 million.

Researchers have recognized the impacts of Chinese negative transfer on English acquisition and offered suggestions to help students mitigate these effects (e.g., Liao, 2019; Lu, 2019). Lu (2019) suggested that both English teachers and students should pay more attention to Chinese negative transfer by comparing grammar across the two languages. Liao (2019) and Timina (2013) proposed that teachers should provide error correction or design error correction assignments to provide in-class practice. Feng (2005) and Zhou (2020) advised students to increase their exposure to English input and practice English more frequently to alleviate negative language transfer. In addition, Guo (2014a) highlighted that differences in cultural backgrounds has a great impact on Chinese students' English skills, suggesting English teachers should help them adapt to the English thinking style and provide them with contextual information. However, it remains unclear whether these suggestions or measures are effective in practice.

Writing feedback can be an effective way to improve learners' writing accuracy and English learning. Meta-analyses (e.g., Lim & Renandya, 2020; Lv et al., 2021) have shown that writing feedback can support learners in correcting errors and improving their quality of writing. Chang et al. (2021a) reported that students who received corrective feedback had greater learning gains compared to those in the control group. Writing feedback can be categorized into direct corrective feedback and indirect corrective feedback. Direct corrective feedback such as error correction is more effective than indirect corrective feedback in improving writing accuracy (Reynolds & Kao, 2021). However, indirect corrective

feedback is more likely to help mitigate negative transfer by drawing learner attention to knowledge gaps. Because indirect corrective feedback such as metalinguistic explanations can promote learners' extensive engagement with English knowledge. Learners need to notice and comprehend feedback with their current knowledge first before correcting errors by themselves using their new understanding, which completes a full cycle of the language acquisition process (LaLande, 1982).

Metalinguistic explanation involves giving metalinguistic clues about the cause of errors, which can help learners develop their metalinguistic knowledge (Bitchener, 2008). Previous studies have offered metalinguistic information by means of error codes indicating the type of error (e.g., Robb et al., 1986) or by numbering errors with a brief metalinguistic explanation for each error (e.g., Sheen, 2007). More specifically, localized metalinguistic feedback circles or highlighted errors that are accompanied by metalinguistic explanations without corrections. Thus, metalinguistic explanations can be integrated as indirect corrective feedback to enhance L2 metalinguistic awareness without error corrections.

Teacher-provided feedback has been acknowledged as an effective way of assisting second language learners. However, teacher feedback has some drawbacks: providing feedback is a time-consuming task, written commentary might lack accuracy, and students do not receive real-time feedback (Cumming, 1985; Huang et al., 2020). Automated writing feedback provided through technologies could play a supporting role in second language acquisition.

With the advancement of science and technology, more and more writing activities are performed on computers. This trend is particularly noticeable among current learners regardless of their background. A recent report by The Wall Street Journal reveals that 85% of elementary school students (grades 3-5) in the United States are satisfied with computer-based writing tasks, and approximately 80% find computer-based testing easy to perform (Porter, 2015).

A variety of writing assistant tools are available to help learners improve their writing and English skills in a classroom setting. Writing assistant tools include online monolingual and bilingual dictionaries, grammar checkers, and Artificial Intelligence (AI) writing assistants like Grammarly. Second language learners have widely used these tools to receive feedback and support their academic writing (Lew, 2016; Yoon, 2016). While these tools previously provided single functions, they now offer more comprehensive assistance. For example, many tools can provide in-depth error reports for analyzing writing or suggest synonyms based on contextual features, some even generate content like ChatGPT does. Learners are accustomed to using online tools like these and spend an average of 15% of their writing time using online tools (Gánem-Gutiérrez & Gilmore, 2021).

These tools mainly address the specific usage of words or grammar by providing error corrections. No research has evaluated any tool for its ability to help language learners overcome negative language transfer. The lack of such tools may be due to the absence of data that can be used to develop negative language transfer detectors. In addition, developing a language learning tool specifically for Chinese English learners may contradict the universality and scalability that commercial companies typically pursue. Faced with a lack of writing assistant tools that target negative language transfer, my goal is to help learners better understand the differences in usage between their native language and the L2 and enhance their metalinguistic awareness of their L2 in order to reduce negative language transfer effects. Helping learners notice errors related to negative transfer will contribute to reducing the number of similar errors in their writing.

The Negative Language Transfer Tool was developed to provide NLT feedback. The provided NLT feedback consists of metalinguistic explanations of learners' errors along with a set of constative example sentences in both languages, one sentence in Chinese and another in English, to help learners think of the cause of errors, make them more aware of rule divergence between Chinese and English, and improve their English metalinguistic knowledge. This feedback should help reduce Chinese negative transfer effects. We evaluate the tool to see whether this is the case.

This study employs a mixed-methods approach that combines tests with a questionnaire and interviews. I hope to contribute to the field of second language acquisition and the development of effective writing support tools to help learners overcome negative language transfer.

Language transfer is a well-recognized phenomenon that impedes learners' second language acquisition. Negative language transfer is a common challenge faced by multilingual learners and is not limited to Chinese speakers. When writing in English, Chinese learners of English make mistakes that are caused by the patterns and rules of their native language. However, there is not yet an effective way to help them overcome this negative impact. This study aims to explore the effectiveness of automatically providing feedback on errors grounded in the learners' native language in order to increase their awareness of differences between Chinese and English grammar, thereby improving their English proficiency.

This thesis is organized as follows. Chapter 2 introduces the theoretical foundation for understanding the language transfer phenomenon and second language acquisition. Chapter 3 reviews research on negative language transfer and current measures to avoid negative language transfer as well as presenting the research questions I aim to answer. In Chapter 4, I describe the research methods, including research design, participants, instruments, study procedures, and data analysis

procedures. Chapter 5 presents the results that address the posed research questions. In Chapter 6, I discuss possible explanations for these findings, as well as limitations, implications, and future research directions. Finally, Chapter 7 concludes this thesis by summarizing the work and contributions.

Chapter 2

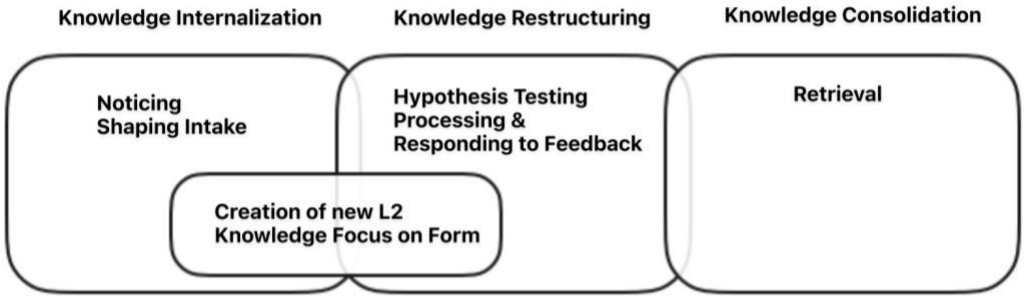
Theoretical Framework

Second language acquisition (SLA) is a sub-discipline of applied linguistics. It draws on multidisciplinary theoretical and empirical perspectives to focus on how people acquire a second language and why not everyone does so successfully (Gass et al., 2020; Robbins, 1995).

Housen & Pierrard (2005) proposed that L2 development involves three main sequential macro-processes as Figure 1 presents: knowledge internalization, modification, and consolidation. Knowledge internalization is the first stage of acquisition, when learners establish connections between form and meaning by noticing and processing selected inputs. The second stage is knowledge modification, during which learners develop and refine their knowledge through exposure to additional input and feedback.

Figure 1

Language Acquisition Process



Many studies have shown that adult learners encounter more challenges when learning a second language compared to young learners. Consequently, adults tend to rely on structures and meanings from their first language while learning a second language (Albert & Obler, 1978; Larsen-Freeman & Long, 2014). In the process of acquiring a new language, learners develop an interlanguage.

Interlanguage is characterized by combining features from the learner's native language and the new language, and it has unique features that arise from the learner's efforts to understand and produce the new language (Selinker, 1972). Interlanguage is a language system used by second or foreign-language learners who are learning a new language. It is influenced by the learner's native language, the new language being learned, and their own cognitive and linguistic abilities. Interlanguage is closely related with language transfer, as learners gradually establish their own language system through interlanguage. This language system includes elements transferred from their first language.

2.1 Language Transfer

Language transfer refers to the influence that one of the learner's languages has on another. Learners often use their L1 rules and patterns when writing in an L2 (Selinker, 1969). For example, the particle "的" is commonly used in expressions to indicate possession in Chinese, and Chinese learners of English may incorrectly use "的" to represent the possessive case. Therefore, the knowledge and habits of a learner's first language can have an impact on their second language use. This phenomenon is known as language transfer. It is also referred to as cross-linguistic transfer.

2.1.1 Language Transfer Theories

Two frameworks are prominent in a modern understanding of language transfer (Genesee et al., 2006): the interdependence hypothesis (Cummins, 1979) and the contrastive analysis hypothesis (Connor, 1996).

With regards to linguistic interdependence, a main claim is that L1 and L2 acquisition are mutually dependent and both contribute to and draw from the same common underlying proficiency (Cummins, 1991). In other words, development of the L1 can affect and facilitate the development of the L2 (Cummins, 1979). Recent research evidence supports that language transfer is bidirectional; the L2 can also lead to cross-language transfer to the L1 (Kaushanskaya & Marian, 2007). For example, Knoph (2013) found that treating bilingual aphasic patients' weaker L2 English could lead to cross-language transfer to their L1 Arabic when no intervention was conducted for their L1. This transfer may be due to a shared conceptual system for the two languages. This leads to a theory of explanation for the phenomenon of language transfer.

Research on bilingual representation examines how the brain stores and expresses semantic forms, glyphs, phonetics, and semantics. In the past, the independent representation model suggested that linguistic forms and semantic systems of the two languages were represented separately (Ku et al., 1996). However, more recent studies support the common representation mode, that the semantic representations of the two languages are mutually shared (Ding et al., 2003). This is consistent with the linguistic interdependence hypothesis proposed by Cummins (1979).

Apart from the interdependence model, contrastive analysis theory uses detailed linguistic analysis to identify structural (i.e., grammatical) similarities as well as differences between two languages (e.g., Connor, 1996; Robbins, 1995). This approach predicts when and how language transfer may occur. According to this framework, L2 acquisition is accelerated by language structural similarities such as syntax and semantics while impeded by structural differences (Melby-Lervåg & Lervåg, 2011). Structural similarities might lead to an easier acquisition of an L2 because learners can recognize common features for both languages. This appears in Chinese learners' ability to understand English compound word formation. Conversely, structural differences can lead to errors in the L2 due to incorrect inferences from the L1. Therefore, learning an L2 that is close to the L1 and shares more structural features with the learner's L1 (e.g., English and Spanish) should be easier than learning a distant one (e.g., English and Chinese).

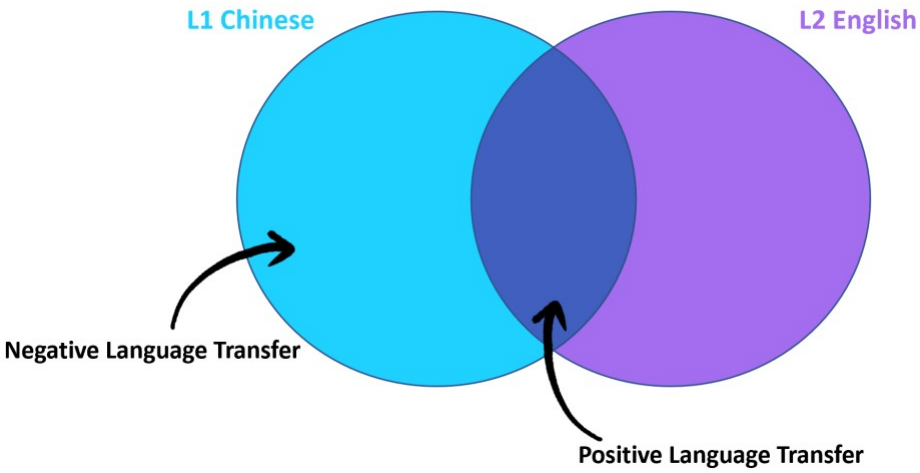
Theoretically, understanding cross language transfer can help researchers to comprehend the effects of language transfer on language acquisition and how learning a new language differs from learning a first language. Practically, this knowledge can aid researchers in designing effective educational interventions to facilitate second language acquisition in practice.

Figure 2 illustrates the interaction between L1 (Chinese) and L2 (English) and where language transfer occurs. When L2 learners encounter difficulties in the L2, they tend to transfer the morphological and syntactical patterns they are accustomed to from their L1 to the L2. This type of transfer can help learners to produce correct outputs (positive transfer). Positive transfer occurs when the rules of the L1 and L2 are consistent. For example, Chinese rhyme awareness facilitates the development of English phonemic awareness (Keung & Ho, 2009). Additionally, Chinese learners of English may transfer their knowledge of grammar structures from Chinese to English. Both Chinese and English share a subject-verb-object (SVO) sentence structure (Ahmed, 2013). Chinese learners of English may transfer their knowledge of this SVO structure to English and correctly produce sentences such as "I eat a banana" or "He watched a movie". Another example is that Chinese and English share some

common words with similar sounds and the same meanings, such as sofa (沙发, Shāfā), tofu (豆腐, Dòufu), and pizza (披萨, Pīsà). These words can help Chinese learners expand vocabulary and understand texts more easily. Overall, these structural similarities can lead to positive language transfer, helping learners understand and produce English sentences more accurately.

Figure 2

Language Transfer



2.1.2 Negative Language Transfer

Negative language transfer occurs when the rules of both languages do not match and the L1 obstructs the acquisition of the L2 (Brown, 2000; Guiberson, 2013; Nicoladis, 2002), thus hindering learner proficiency in the second language (Brogan & Son, 2015). Negative language transfer is likely to occur when learners do not fully pay attention or they lack knowledge to produce correct outputs. Learners may subconsciously apply the L1 rules to the L2 without realizing the differences between the rules, leading to errors. This type of error is related to negative language transfer, and it is one of the most common causes of learner errors in second language acquisition (Bardovi-Harlig & Sprouse, 2017). Additionally, Connor (1996) suggested that a common rhetorical error made by English language learners (ELLs) is when they try to translate a phrase from their native language into their target language, which can contribute to these types of errors.

Grammar covers a wide range of language rules, such as morphology (word formation), phonology (sound system), semantics (meanings of words), and syntax (the study of how words are combined to form sentences). For example, the sentence "I like apple" contains a grammatical error that is typically made by Chinese speakers when learning English. Chinese does not indicate singular or plural by transforming the noun whereas English does. This sentence is missing an article, which is likely influenced by the fact that Chinese does not use articles to introduce singular nouns. Alternatively, this sentence would be grammatically correct if “apple” were transformed to its plural form “apples”.

As might be expected, negative language transfer can cause interference with the development of L2 writing. Many studies have explored structural differences between languages, such as English and Russian (Aleeva, 2012), English and Malaysian (Tse & Yau, 2014), and English and Chinese (Timina, 2013). These studies showed that the differences interfere with English learning and negatively impact learners’ writing. Moreover, research on the interference of the L1 on L2 acquisition have shown that greater differences between L1 and L2 structures result in more significant learning difficulties (Timina, 2013). Dipolog (2016) emphasized the importance of addressing Chinese negative transfer and suggested that teachers assist Chinese students by using appropriate teaching strategies. However, he did not specify which strategies are effective or recommended for use.

In addition, some researchers (e.g., M. Guo et al., 2014a) have suggested that the differences in cultural backgrounds can also affect Chinese students' English learning, especially their thinking mode. They need to use and adapt to an English thinking mode and reasoning process; they must try to avoid thinking in Chinese as much as possible. This thinking mode transition is especially challenging for Chinese learners of English because of the substantial cultural differences and their lack of exposure to English contexts. These differences in culture and thinking mode also negatively impact learners’ writing.

2.1.3 Negative Language Transfer from Chinese to English

Although positive language transfer has been observed between alphabetic languages, there are fewer studies investigating cross-language transfer between non-alphabetic and alphabetic languages, such as Chinese and English (M. Yang et al., 2017). Liu (2011) found that when students' Chinese proficiency was far superior to their English proficiency, they tended to subconsciously rely on their Chinese when facing difficulties in English, which benefited English acquisition. She found that 67.43% of students believed that Chinese was helpful to college English writing, despite the potential for negative transfer to occur.

Chinese and English differ in various aspects, such as structure (Dai-hong & Cui-qiong, 2018), grammar (morphology, phonology, semantics) (Shi, 2015), culture (Eastern and Western culture), ways of thinking, and spelling (Ma & Tan, 2013). The influence of Chinese can be observed in almost every aspect of English usage (e.g., grammar, pronunciation, and writing system) (Dipolog-Ubanan, 2016; Shi, 2015). As a result, negative transfer from Chinese is common in English writing and learning, with these differences reflected in learners' writing products.

Because of the knowledge gap and the different structures between L1 and L2, Chinese students often rely on memorizing fixed sentences and patterns when learning English. While this approach may improve their English performance in the short term, the backwash effect (i.e., the effect of testing on teaching and learning practices) can lead to thinking solidification as well as making it difficult for learners to distinguish the specific differences or meanings of these sentences (Liao, 2019). Timina (2013) reported that student writers' compositions are largely influenced by the features of the Chinese rhetorical style like compositional structure, repetition, and lack of personal anecdotes or opinions. It is a common phenomenon for beginners or intermediate students to compose essays by thinking in Chinese, which results in word-for-word translations. The less proficient they are in a second language, the more likely they tend to translate rather than thinking in that second language (Faerch & Kasper, 1983). This strategy is consistent with reports that Chinese students are negatively influenced by Chinese grammar, lexical features, and orthographic features (e.g., Keung & Ho, 2009; Shi, 2015; Timina, 2013).

The associated impact of Chinese on English language learning may explain why Chinese negative transfer has captured the attention of many researchers. These researchers have investigated the impact of Chinese negative transfer on English writing and learning among students. This transfer can take different forms, such as semantic transfer, which involves taking cultural or conceptual meaning from Chinese to English. It leads to difficulties in vocabulary comprehension (Odlin, 1989). Orthographic transfer refers to the influence of the writing system from Chinese to English, including spelling rules, punctuation, and capitalization (M. Wang et al., 2009). Phonological transfer refers to a learner transferring the sound patterns and pronunciation rules from Chinese to English, leading to errors in pronunciation or stress patterns (Khvtisiashvili, 2018). Grammatical transfer, also known as syntactic transfer, refers to sentence structures and grammar rules that are transferred from Chinese to English leading to grammatically incorrect sentences (Chan, 2004). For Chinese learners of English, one of the main challenges is to acquire grammatical features that are not present in their native language

but essential for English. They must also learn to adapt the mapping between the semantic and pragmatic features and the syntactic and lexical resources of English.

The above-mentioned grammatical transfer produces significant negative effects on English writing and is common among Chinese learners of English. Negative transfer of grammar rules is an important type of Chinese negative transfer because of the significant differences in grammar and syntax between Chinese and English (Fa, 2010; Shi, 2015). While the basic SVO (subject-verb-object) sentence is closely matched in both languages, there are many differences in grammar rules, including those surrounding article use, verb tense, subject-verb agreement, active and passive voice, word order, preposition use, plural and singular nouns, implied subject (loss of subject), conjunction use, and sentence structure. Many researchers and teachers have reported evidence of Chinese grammatical transfer. For instance, Timina (2013), Shi (2015), and Dipolog (2016) have reported that various types of student errors were related to Chinese grammatical transfer including verb tense and word use (word form and uncountable/countable nouns) errors. Errors related to sentence structure were found by Timina (2013) Shi (2015) reported that Chinese students made conjunction mistakes that related to Chinese negative transfer. Dipolog (2016) found that Chinese students commonly made errors with articles and determiners, and they violated subject-verb agreement rules. Common grammatical differences between Chinese and English, as well as where the negative transfer of Chinese occurs are discussed below.

2.1.3.1 Articles.

Articles, such as a(n) and the, are the most commonly used words in English, and yet their usage is complex. Part of the complexity can be attributed to the fact that the English article system does not consist of one-to-one form and meaning relationships. This complexity poses a number of challenges for L2 learners of English (Andersen, 1984). It is well known that the Chinese language does not have functional equivalents of the English definite and indefinite articles, leading to difficulties for Chinese learners in correctly using the article system in English. For example, these learners tend to omit the article where native speakers of English would use one. For example, Chinese learners may say “Middle East” instead of “the Middle East”.

2.1.3.2 Verb Tense.

The concept of the time of an action is expressed by time adverbs or context in Chinese. There is no tense marking in Chinese, the same verb form is used in the past tense, present tense, and future tense. Time is expressed in individual words, such as tomorrow, and verbs do not need to change according to tense, which is different from English. Meanwhile, different verb tenses and verb forms

were used in English. For example, Table 1 presents a typical case about negative transfer for verb tense as it would appear with the verb “work” at different times. Chinese has no verb tense; Chinese learners use the same “work” in different tenses according to their Chinese experience.

Table 1

Verb Tense in Chinese and English

Tense	Chinese Use	English Use
Past	I work yesterday	I worked yesterday
Present	I work now	I am working now
Future	I work tomorrow	I will work tomorrow or I am going to work tomorrow

2.1.3.3 Subject-verb Agreement.

Unlike English, Chinese does not have subject-verb agreement. This means that verbs in Chinese do not change based on the personal pronoun used. In contrast, English regular verbs must be suffixed with "s" or "es" when used in the present third person singular form. Table 2 provides examples of how subject-verb agreement is used in Chinese and English.

Table 2

Subject-verb Agreement Use in Chinese and English

Pronoun	Chinese Use	English Use
First person singular	I like apples	I like apples
Third person singular	He like apples	He likes apples

Chinese learners often use the original form “like” in the second sentence to create “He like apples” because there is no distinct verb form for the third person singular in Chinese.

2.1.3.4 Active & passive voice.

The English passive voice is commonly constructed using “be” + past participle, and there are some other passive particle variants such as “get”, “feel”, and “look”. In Chinese, typical passive markers include “被”, “让”, and “为”. However, compared to English, Chinese uses less passive voice and more active voice. Therefore, Chinese tends to omit the English passive markers. For instance, instead of saying “the room needs to be clean.” Chinese speakers may say “The room needs to clean.” Chinese learners omit the “被” resulting in Chinese negative language transfer. Similarly, in Chinese expressions like “晒太阳” (being in the sun), the word for “被” (passive marker) is often omitted. They actually mean “被太阳晒”. Overall, it seems that Chinese learners tend to use active voice more frequently than passive voice due to their expression habits, which affects their use of passive voice. For example, Chinese speakers may say “Drinking tea is popular all over the world.” instead of “Tea is drunk widely all over the world.” While both sentences are correct in English, there tends to be a preference for using the active voice.

Chinese speakers tend to use the first sentence more often as it aligns with Chinese expression forms. The problem of word order in sentences is also reflected in the passive voice, where “My car by a thief was stolen” follows Chinese word order instead of “My car was stolen by a thief.” which contributes to a form of negative transfer.

2.1.3.5 Word Order.

Chinese and English have different word orders for declarative and interrogative sentences. In Chinese, declarative and interrogative sentences have almost identical word order. The interrogative sentence starts with a declarative sentence and ends with one interrogative. This means that Chinese speakers can convert statements into yes/no questions by simply adding one interrogative at the end of the declarative sentence. However, word order is different in English; every single word needs to be shifted back one position when forming an interrogative sentence, because an interrogative is needed at the beginning of the sentence. Consider the declarative sentence “你喜欢香蕉” (You like bananas) as an example. To change it to a question, Chinese speakers add one interrogative word “吗” to the end in sentence, which creates “你喜欢香蕉吗？”(Do you like bananas?). However, in English, “you,” “like,” and “bananas” need to be shifted back one position and “Do” needs to be added at the beginning of the sentence.

The placement of time words in a sentence is also different. In English, time expressions are typically placed at the beginning of a sentence or right after the subject. However, in Chinese, time expressions are usually positioned before the verb or action. Consider the sentence “他昨天去了超市” (He went to the supermarket yesterday) as an example, Chinese learners may use Chinese word orders to express it, which creates “He yesterday went to the supermarket”.

The situation is the same for the placement of location information in a sentence. When describing where things happened (e.g., at work or on the bus), Chinese speakers usually use a phrase beginning with “在”. This phrase needs to come after the word indicating time (if there is one) and before the verb. In contrast, English places location information after the verb. For instance, Chinese learners may mistakenly say “I yesterday at home watched movies” to “我昨天在家看电影” (I watched movies at home yesterday).

2.1.3.6 Prepositions.

Prepositions, such as on, at, to, of, and in, are used far more frequently in English than in Chinese (Z. Lin, 2017). While there are a total of 286 prepositions in English, Chinese only has about 30 prepositions (W. Wang, 2003). As a result of this difference, Chinese students are used to placing an object directly after an intransitive verb in their English writing, and they may use incorrect prepositions after verbs or before nouns. For example, they might use “on the morning” in the morning”. Additionally, errors can occur when learners are unable to match multiple parts of speech correctly. For example, “go to school” and “go to work” are correct phrases but “go to home” is incorrect because home is being used as an adverb here and does not require the preposition “to.”

2.1.3.7 Plural and Singular Nouns.

When transforming from singular and plural, nouns often need to have “s” or “es” appended to indicate plural. However, Chinese nouns do not have a similar rule. Chinese uses measure words (e.g., “个”, “本” “只”), quantity words (e.g., “许多”, “很多”), or context to indicate plurality - there is no need to transform the noun itself. Consider the number of cats (“猫”) as an example:

“我有一只猫” (I have a cat)

“我有五只猫” (I have five cats)

“我有一百只猫” (I have a hundred cats)

In English “cat” should be pluralized to “cats” when referring to more than one. However, in Chinese, there is need to no change the noun “猫”.

2.1.3.8 Implied subject or loss of subject.

In Chinese, the subject is often omitted when it can be inferred from the context. For example, instead of saying “如果你有时间，就来和我玩” (when you have time, come to visit me.), a Chinese speaker may simply say “有空就来玩” (When have time, come to visit me.), which omits the subject.

2.1.3.9 Misuse of Conjunction.

Chinese use two conjunctions to express logical progression relationships or transition relationships, such as “因为…，所以…” (because…, so…) and “即使…，还…”(though…, still…). In contrast, English only uses one conjunction word. As a result, Chinese learners may mistakenly say “Because the box is very heavy, so I can not move.” The correct and common way to express this sentence in English is “I can’t move the box because it’s very heavy”.

2.1.3.10 Sentence Structures.

Chinese and English have different structures. When expressing that languages are hard to learn for adults, Chinese speakers may say, “adults are hard to learn languages” based on the structure in Chinese “成人很难学会语言”. In English, the correct expression is “it’s hard for adults to learn languages”.

One fact that may affect this is the fact that Chinese characters are indistinguishable in terms of part of speech (Lu, 2019). Xia (2015) reports that Chinese English learners make 4.5 times more part-of-speech errors than their counterparts from other countries. Sheen (2018) suggested that Chinese learners may struggle with understanding the parts of speech in English due to the distinct relationship between nouns and verbs. Unlike in Chinese, where verbs can be grouped with nouns, English places them in separate categories. This difference could lead to difficulties grasping this concept for Chinese learners. Chinese nominalism has a profound and widespread impact on Chinese students, which also contributes to Chinese negative transfer.

Most rule-based negative transfer errors are treatable (e.g. article and subject-verb agreement), which means they can be addressed through explicit instructions or sufficient awareness of rules (Ferris, 1999). Therefore, learners’ attention to feedback may be potentially helpful in mitigating Chinese negative transfer. Learners can be made aware of the linguistic gap in form and meaning by processing

feedback information deeply. Consequently, their metalinguistic knowledge is improved, which reduces negative language transfer. This feedback can be explicit or implicit as is the case when noticing occurs.

2.2 Noticing

Noticing plays a key role in converting input to intake during second language acquisition (Schmidt, 1994). It is claimed that consciousness, which is a prerequisite for noticing, enables learners to develop knowledge of the L2 (Tomlin & Villa, 1994).

Schmidt (1990) defined noticing as the conscious registration of a structure's surface features. He acknowledged that noticing items can also lead to metalinguistic awareness (i.e., noticing plus metalinguistic understanding). Loew (1997) conducted a study on 28 Spanish L2 learners who completed a problem-solving task (a crossword puzzle) while using think-aloud protocols. The results showed that learners noticed structures and demonstrated rule formation and hypothesis testing as they developed metalinguistic awareness about the noticed structures. Leow (2000) also found a positive correlation between the learners' levels of awareness and performance on post-task recognition and written production tests. These studies provide evidence that learning is more effective when it occurs with awareness, supporting Schmidt's theory of noticing.

Noticing can take place at any time during the input and output process, allowing learners to become aware of the gaps in their interlanguages (Swain, 2000). This noticing involves recognizing features of the second language and identifying differences between their interlanguage and the second language form, which can help language acquisition (Schmidt, 1990). Take the incorrect sentence "he like apple" and correct one "he likes apples" as an example. Chinese learners may notice the correct word form of "likes" and "apples" in this sentence and compare them with their writing "like" and "apple". They may then realize that "like" is replaced by "likes" and "apple" is replaced by "apples", helping them to understand the differences in grammar rules between the two languages. Such comparison of the correct with incorrect output can support learner noticing, which is the result of the learner's deep processing of the information from the feedback they received. Therefore, learners can more clearly understand different grammar rules, potentially reducing negative language transfer. Attention to language form is likely to be necessary for intake (Ellis, 2005). But the extent of explicit noticing required for intake has been debated (Cross, 2002; Truscott, 1998).

These findings suggest the potential benefits of having learners pay attention to the metalinguistic clues associated with their errors as support to correct their metalinguistic knowledge.

2.3 Indirect Corrective Feedback

Corrective feedback is defined as “the feedback that learners receive on the linguistic errors they make in their oral or written production in a second language” (Sheen & Ellis, 2011). Corrective feedback can influence noticing and shape intake by helping learners to notice the gap between their own production and the target language (Doughty & Williams, 1998; Swain, 1998). Corrective feedback can help students improve writing accuracy (Saadi & Saadat, 2015; Sia & Cheung, 2017).

Corrective feedback can be divided into direct corrective feedback and indirect corrective feedback. Direct corrective feedback is used to make explicit corrections to writers’ text (by writing in the correct grammatical form), whereas indirect corrective feedback indicates where writers made a mistake by marking, highlighting, or underlining an ungrammatical construction but not offering an immediate correction (Robb et al., 1986). Indirect corrective feedback can be provided with or without location. When providing feedback without indicating location, learners have to first locate the errors before being able to attend to them. Corrective feedback with location shows the location of errors by highlighting, underlining, circling, or otherwise drawing attention to errors. As the errors are located, learners need only attend to the errors. Learners have to draw on their own linguistic resources and thus this form of feedback is likely to be most effective if learners have already partially acquired knowledge of the features being corrected.

Metalinguistic corrective feedback provides metalinguistic clues about an error, but it does not provide a direct correction. In previous studies, metalinguistic corrective feedback used error codes indicating the type of error a learner had made as a form of explanation (e.g., Robb et al., 1986) or numbered errors and provided a brief metalinguistic explanation for each error (e.g., Sheen, 2007). Metalinguistic coded corrective feedback varies according to whether an error is located in the text or not. Located metalinguistic coded corrective feedback specifically locates the errors by writing the codes above the errors (e.g., ‘v.t.’ for verb tense) or by writing the codes in the margin (e.g., ‘sp.’ for spelling) and highlighting or circling them in the text. The second type of metalinguistic feedback locates the errors and provides brief metalinguistic explanations about them, which is the type of feedback this study is going to provide. As the name suggests, metalinguistic corrective feedback can be seen as developing metalinguistic knowledge about a linguistic structure. Therefore, indirect corrective feedback can provide specially designed input to facilitate attention for metalinguistic understanding, which may help avoid Chinese negative transfer.

2.4 Arguments for and Against Providing Feedback

What is the most effective way to provide feedback to learners? is a central question for second language acquisition (SLA). For more than a decade, second language writing teachers and researchers have discussed the value of error correction or written corrective feedback in L2 writing instruction. Although many studies, including large-scale meta-analyses have been performed, many have produced contradictory results (Russell & Spada, 2006; Truscott, 2007). Kang and Han (2015) examined 21 studies and concluded that "written corrective feedback can improve the grammatical accuracy of student writing". But Truscott (2020) argued that their findings offer no basis. Some researchers (e.g., Truscott, 2007) have claimed that written corrective feedback is a "clear and dramatic failure". Truscott claimed that grammar correction has no place in writing courses and should be eliminated; he argued that error correction overlooks SLA insights about the gradual and complex process of acquiring the forms and structures of a second language. He delineated a range of practical problems concerning the capability and willingness of teachers to give error corrections. In addition, he discussed students' readiness to receive such correction (Truscott, 1996). Yet others have pointed out that written corrective feedback can improve writing precision in limited contexts (Ferris, 2006).

Others have explained how indirect corrective feedback works for supporting language acquisition. Lalande (1982) suggested that indirect corrective feedback (e.g. metalinguistic codes such as v.t. for verb tense) is beneficial because it permits "guided learning" and "problem solving". This prompts learners to self-correct their errors by editing their texts. Ferris (2002) also suggested that indirect corrective feedback is more suitable for more advanced learners, whereas direct corrective feedback (providing error correction) may be more advantageous for learners with lower proficiency levels. This is because indirect corrective feedback encourages deeper processing by students and requires them to apply metalinguistic explanations to their own errors.

2.5 Theoretical Framework Summary

In this chapter, I first reviewed literature related to the language acquisition process. Learners may develop an interlanguage system when learning a second language. The learner's interlanguage is influenced by language transfer that occurs as learners try to make sense of the new language using existing knowledge from their native language. Learners transfer grammar or pronunciation of their native language to the new language. When this knowledge is not shared by the L1 and L2, negative

language transfer occurs, which results in errors or misunderstandings. Negative transfer from Chinese to English is common because of many dissimilarities between the two languages. These dissimilarities include differences in grammar, pronunciation, and writing systems. It is possible to provide feedback that contains metalinguistic explanations to support correct metalinguistic knowledge by promoting the noticing process, thus helping Chinese learners of English mitigate negative language transfer.

Chapter 3

Related work

In this chapter, I introduce what role English writing plays in English learning and how negative transfer from Chinese knowledge affects English writing and learning. Then, I describe how technology-assisted tools can be used with indirect corrective feedback to help learners overcome negative language transfer.

3.1 English Writing

Good writing needs to show a naturally logical progression of thought and should be easy to read for the intended audience. Achieving this requires the ability to use language in a comprehensive manner (Harris, 2004). English writing and English learning are closely related. Good writing poses a challenge to the writer's language use including vocabulary, grammar, variety of sentences, content consistency, and rhetorical skills. Many learners learn about the language to achieve their writing goals.

Writing is often considered the last skill that L2 learners acquire from the learning-to-write perspective (Hyland, 2011). This is because effective teaching of L2 writing requires advanced L2 development. Understanding why writing is challenging for language learners can inform the development of learning strategies. Some researchers have proposed four main areas of writing: writing process, writing product, writing context, and teaching of writing (Archibald & Jeffery, 2000). The product of writing relates to text analysis and error analysis, while the teaching of writing involves learning strategies and development of language proficiency.

3.1.1 Learning to Write

Students can develop writing skills through various methods, such as learning grammar rules, receiving guidance from a teacher, and reading books or articles. They can focus on producing written text or correcting errors, as well as observing and analyzing the writing of others. Genre-based writing

can be an effective learning approach for students (Lin et al., 2017). For example, learners may prepare for writing task 2 of the IELTS exam by practicing academic and persuasive writing. They may prepare for writing task 1 by summarizing and explaining information from a graph, table, or chart.

In addition, learners often employ writing strategies to support their writing. For instance, they create outlines and organize paragraphs in terms of structure, particularly when composing lengthy or complex texts. Outlines help them identify key points, facts, and ideas to include in their papers, providing a clear roadmap for their writing.

Writing and reading are two skills that are closely and tightly linked (Ghorbani et al., 2013), where extensive reading often helps learners become better writers. Consistent with this, reading is a popular way to enhance writing skills. With the abundance of reading materials available, learners can acquire more words, sentence structures, and phrases to express their thoughts (Habibi & Sarjit Singh, 2015). Additionally, expanding vocabulary is another strategy for improving English proficiency thereby improving writing skills.

Some learners use grammar checkers to increase their writing accuracy by reducing grammatical errors. Writing with as few errors as possible is a fundamental requirement of writing, which also demonstrates the learner's solid grammar knowledge. Grammar checking tools can help learners identify common grammar mistakes and make necessary corrections.

In addition to grammar checkers and other tools, learners often rely on translation to produce content when learning to write in a second language. They tend to think in their native language and translate from their native language to the target language. For example, Mandarin Chinese speakers may directly translate each word into its English equivalent when writing in English. This approach may result in Chinglish - an ungrammatical mixture of Chinese and English that foreign teachers may find unintelligible (Timina, 2013). This approach can also lead to negative transfer from Chinese to English.

3.2 Chinese Negative Transfer

To prevent negative language transfer from Chinese, current measures and approaches include enhancing learners' fundamental English skills, increasing English input, paying attention to grammatical differences between Chinese and English, using contrastive analysis, and providing corrective feedback.

Shi (2015) proposed enhancing learners' fundamental skills such as listening, speaking, reading, writing, and translation. Shi thought better mastery of these skills could reduce the likelihood of negative language transfer occurring. However, Lu (2019) found that English teachers focused on

improving students' examination performance instead of addressing fundamental skill development because English is an examination-oriented subject.

Researchers have suggested increasing English input as a measure to alleviate negative transfer effects (Feng, 2005; Ma & Tan, 2013; Zhou, 2020). They suggested students should be encouraged to read extensively and watch English movies or other media as only with enough correct input can learners produce correct output. However, without linguistic guidance, the effectiveness of these practices in reducing negative transfer is limited. Some studies have reported that even after living in an English-speaking country for many years, L2 learners still exhibit negative language transfer. Swan (1985) and Skutnabb-Kangas (1976) found that L2 learners' production remains grammatically inaccurate after many years of exposure to the target language. This could be attributed to a lack of opportunities for learners to notice the linguistic features of the language and practice them.

Other researchers have emphasized the importance of noticing or paying attention in overcoming negative language transfer. Timina (2013) suggested that students noticing this phenomenon is the key, teachers should make students aware of their most common errors caused by differences between L1 and L2, and encourage them to continue paying attention to the major structural differences between their native language and English. She suggested providing a handout in the form of a list of negative transfer errors with examples for students to check their essays against. Lu (2019) found English teachers have not paid sufficient attention to helping students address this issue in practice. Liu (2011) also found that none of the students had an effective method for dealing with Chinese negative transfer, and suggested that it is important to be aware of transfer so that students can then reduce or avoid negative transfer.

Many researchers have suggested contrastive analysis of differences between Chinese and English is an effective strategy to address negative language transfer (M. Guo et al., 2014a; He & Niao, 2015; S. Lin & Wen, 2013; Shi, 2015; Zhou, 2020). Teachers can use contrastive analysis methods to make students aware of the existence of negative language transfer and how negative transfer affects their English writing and learning. Comparing grammar rules between Chinese and English can help students realize and understand the differences and similarities between the two languages. Studies by Chen (2006) and Tan (2006) have shown that contrastive analysis can help students learn pronunciation, grammar, and vocabulary differences between Chinese and English. Lu (2019) suggested that English teachers should use contrastive analysis to explain differences in grammar, thinking mode, and culture between English and Chinese in order to help students be aware of NLT. She believed that only after

students improve their awareness of the differences between Chinese and English can they adjust their sentence structure to a more native expression form.

Contrastive analysis is effective not only in the Chinese context but also across other languages that share common features with Chinese and that are distinct from English, such as Malay. For example, both Chinese and Malay use noun classifiers to indicate the number of nouns, lack inflection, and do not use articles (Wong, 2012). In the study conducted by Fatin (2018), negative language transfer from Malay to English resulted in preposition misuse and subject-verb agreement errors. He compared the grammatical differences between Malay and English, and he attributed these errors to differences in grammatical rules between Malay and English. He found that students wrote their drafts in Malay and applied the Malay grammar rules and sentence patterns in their English writing. It may be helpful to compare the grammar of both languages to make students aware of the common and different features in order to help them overcome negative transfer.

Researchers recommend providing feedback such as error corrections or explanations. Lu (2019) suggested that teachers should identify and analyze errors related to negative transfer that students are likely to make in their writing, help them correct the errors, and provide guidance on proper usage. Liao (2019) and Timina (2013) highlighted that teachers should offer corrective feedback and guide students to understand grammar to help students be aware of the correct meanings and forms. Additionally, teachers can design error correction activities in the classroom to focus students on correcting such errors.

Overall, to help students overcome negative language transfer, previous researchers have recommended enhancing fundamental skills and increasing learners' exposure to English. They emphasized the importance of recognizing and noticing Chinese negative transfer for both teachers and students and recommended using comparative analysis in English teaching. They also recommended providing corrective feedback. However, none of the researchers conducted empirical research to investigate whether the above approaches, such as contrastive analysis or corrective feedback, are effective in practical English teaching. Although researchers (e.g., Dipolog-Ubanan, 2016; Shi, 2015) explored various types of errors caused by Chinese negative transfer on English writing; this information has not been used to enhance feedback.

There is currently no effective method for Chinese students to monitor and manage negative language transfer (Liu, 2011). Previous research has not assessed a tool that can promote learner noticing, make them aware of negative language transfer in order to help them avoid it by increasing

their metalinguistic knowledge. Consequently, it remains a challenge for students, educators, and researchers to deal effectively with the effects of negative transfer.

Like prior work that has only studied the presence or process of negative language transfer, Wanderley's work contributed automated methods for detecting Chinese transfer (Farias Wanderley & Demmans Epp, 2021). She evaluated the performance of different models in identifying errors related to Chinese negative transfer, which provided a foundation for this study. The NLT tool was developed using her models (Farias Wanderley & Demmans Epp, 2021; Wanderley, 2021).

3.3 Feedback

Regardless of the methods used to improve writing skills, many learners can make progress by receiving, understanding, and digesting feedback. This aligns with the role of feedback in facilitating learning (Lipnevich & Panadero, 2021). Direct corrective feedback, such as error correction, is considered to be an effective way to help students improve their writing. Writing feedback consists of a series of suggestions and explanations to improve the quality of writing. These may include grammar or spelling corrections, sentence structure improvements, organization suggestions, idea development tips, and coherence suggestions.

3.3.1 The Importance of Writing Feedback

Feedback plays an important role in learner writing development because it prompts learners to improve their performance and better align their performance with expectations (Van der Kleij et al., 2015). Writing feedback is beneficial to learners in many ways because effective writing feedback not only marks grammatical errors but also instructs learners how to apply feedback when revising their work, which facilitates the development of their language proficiency (Chandler, 2003; Price et al., 2010; Williams & Beam, 2019). Moreover, quality feedback promotes learner reflection by providing explanations and examples. It contributes to learners' engagement with writing activities and boosts their positive attitudes towards language learning (Storch & Wigglesworth, 2010).

3.3.2 The Effectiveness of Writing Feedback

Many researchers have reported the effectiveness of writing feedback in the development of L2 learners' writing accuracy. For instance, Mansourizadeh & Abdullah (2014) found that writing feedback supports correcting errors and improving the quality of writing in subsequent drafts, with a 28.85%

margin of improvement following written feedback. Kang and Han (2015) analyzed 21 empirical studies and concluded that corrective feedback had a moderate effect size on improving grammatical accuracy among L2 learners. Similarly, Chang et al. (2021a) discovered that students who received corrective feedback had greater learning gains than those in the control group. Guo et al. (2022) found that ESL students corrected 85% of Grammarly-flagged usages after receiving corrective feedback, leading to significant decreases in their error scores. Therefore, writing feedback is an effective approach for improving learners' writing accuracy.

3.3.3 The Source of Writing Feedback

Writing feedback may be provided by teachers (corrections or comments) either orally or in written form, by peer reviewers, or by software (Hyland & Hyland, 2006). It was more effective for writing development compared to oral feedback (Biber et al., 2011) because it is more traceable and easier to document than the oral delivery format (Banaruee et al., 2018).

Feedback from different sources has affected L1-English learners and L2-English learners differently. Peer feedback promoted mature immigrant ELLs' learning since learners were comfortable asking their peers for clarification and were more willing to seek assistance from them. They also had a pro-technology bias, and they were less likely to question automated feedback (Liaqat et al., 2021). L1 English writers benefited more from teacher feedback than peer feedback or programmatically-generated feedback. In contrast, L2 English writers showed the opposite trend with much larger gains seen when they engaged with feedback from their peers or software (Dipolog-Ubanan, 2016).

In terms of the level of detail in feedback, research has shown that providing simple feedback was as effective as using categorical markers to code feedback content in English writing (Ferris & Roberts, 2001). For example, highlighting all kinds of errors in yellow helps students as much as using different colors based on the variety of errors.

3.3.4 Direct vs. Indirect Corrective Feedback

Reynolds & Kao (2021) claimed that direct corrective feedback is more effective than indirect corrective feedback in helping with writing accuracy, especially for EFL students (Lee et al., 2015). Bitchener & Knoch (2010) suggested that there is no difference in effect on student writing accuracy between direct error correction and oral metalinguistic explanation, and direct error correction with written metalinguistic explanation. However, other researchers (Bitchener & Knoch, 2010; Ferris, 2006)

have recognized the benefits of indirect corrective feedback. For instance, learners who receive indirect corrective feedback are encouraged to reflect on their mistakes and self-correct them, which can rectify incorrect knowledge or enhance existing knowledge (Bitchener & Ferris, 2011). This approach is more likely to lead to long-term improvements in accuracy. Additionally, Storch & Wigglesworth (2010) found that learners who received indirect corrective feedback were more engaged than those who received direct corrective feedback. According to Ferris (2002), learners had to identify the nature of the error and attempt to provide the correct form using their understanding of grammar and word meanings. This process allowed them to offer suggestions and counter-suggestions while deepening their engagement with the feedback. Ferris (2002) found direct error correction resulted in more correct revisions than indirect error feedback. However, students who received indirect corrective feedback reduced their error frequency ratios significantly more than those who received direct corrective feedback over the course of the semester.

Researchers found that providing direct corrective feedback did not affect learners' explicit and implicit knowledge of the target structure (the English indefinite article). However, metalinguistic explanations helped develop their explicit knowledge of the target structure (Shintani & Ellis, 2013). In addition, Amrhein & Nassaji (2010) found that students preferred direct correction that requires less effort on their part, indicating a willingness to transfer error correction responsibility to teachers or other tools. This preference could hinder language learning.

Regarding students' preferences on how instructors provide written corrective feedback, Chandler (2003) found that students preferred direct correction, whereas most other studies (Hong, 2004; Komura, 1999; Rennie, 2000) showed that learners preferred indirect corrective feedback with codes or labels. Ji (2015) conducted a survey of Chinese students' need for instructor error feedback. She found that all students expected some kind of error correction. Of those surveyed, 28% favored direct correction while 79.2% preferred indirect correction. Within the latter group, 12.9% expected instructors to underline errors, and 66.3% expected both underline errors and error codes in combination. Besides, teachers and L2 writing researchers also have favored the use of indirect corrective feedback as it emphasizes self-correction by students (Ashwell, 2000; Ferris & Roberts, 2001; Polio et al., 1998).

Indirect corrective feedback also has some drawbacks. Zamel (1985) argued that peer feedback may not be effective because students might struggle to identify and correct errors without assistance, which also applies to indirect corrective feedback. However, indirect corrective feedback helps learners become independent self-editors by providing them an opportunity to self-correct as suggested by

Hendrickson (1980), especially when they were given some metalinguistic explanations. Direct corrections often lack metalinguistic information, which should have helped language acquisition.

3.3.5 Metalinguistic Explanation Feedback

Researchers (Bitchener, 2008; Sheen, 2007) have shown that metalinguistic explanation (ME) can support language learning. In previous studies, metalinguistic explanation has been provided through error codes indicating the type of error (Robb et al., 1986) or by numbering errors and providing a brief metalinguistic explanation for each type of error (Sheen, 2007). In both cases, it is necessary to identify and correct errors in individual learners' written work. In addition to explanation, comparing incorrect utterances with the correct ones can also help learners acquire accurate language structures for L2 learning (Tomasello & Herron, 1989). Lu (2019) suggested that practical English teaching should use comparative analysis to help students differentiate between Chinese and English. Stefanou and Revesz's study (2015) found that combining direct written corrective feedback with metalinguistic feedback was more effective than using only one of these two types of feedback. Therefore, providing feedback that combines metalinguistic explanation with a comparison of utterances could potentially benefit Chinese learners of English and support them in reducing Chinese negative transfer.

Recent studies have compared traditional teacher feedback with peer feedback, exploring the effectiveness of each (e.g., Mao & Crosthwaite, 2019; Pourdana & Asghari, 2021). However, no research has yet explored using a writing assistant tool to provide metalinguistic clues and examples as indirect corrective feedback to promote learners' thinking of the cause of errors in individual learners' writing. This approach may correct or enhance their metalinguistic awareness thereby helping them prevent negative language transfer.

3.4 Computer-Mediated Language Learning

Although traditional teacher feedback on students' writing is an effective way of assisting second language acquisition, it has limitations. Teachers cannot provide immediate and practical feedback due to their heavy teaching load (Huang et al., 2020). They spend a substantial amount of time responding to errors in student writing (Lee, 2007), mostly provided through written commentary. However, previous studies have suggested that ESL teachers make similar types of comments and these comments are arbitrary, lack precision, and are difficult for students to understand (Cumming, 1985; Zamel, 1985). In some contexts, error correction provided by teachers can also pose a challenge as it

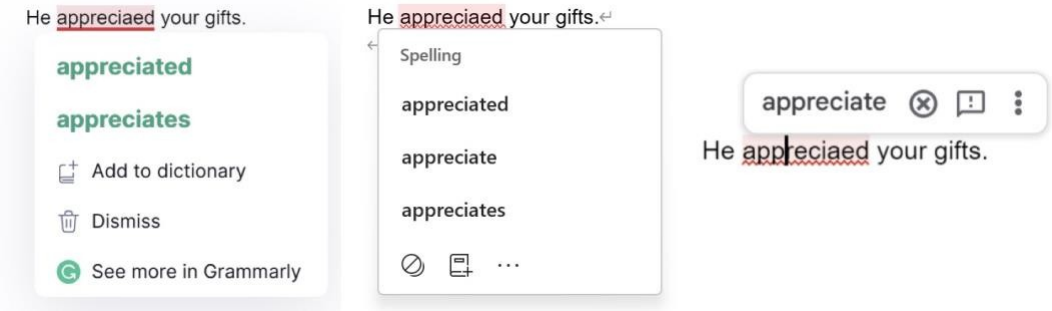
should focus on providing formative explanations to improve students' writing instead of primarily being used as a measurement tool for determining writing scores (Lee & Coniam, 2013).

Therefore, technology-assisted language learning can play an important role in the writing process in ESL classrooms. Automated writing feedback programs can provide opportunities for immediate and accurate feedback, reducing teacher workload, and unlocking student learning potential (Nova, 2018). Many studies have shown that computer-mediated tools aid students with second language acquisition (Genaro, 2013; Ghufron & Rosyida, 2018; Huang et al., 2020; Lee & Kim, 2013; Nova, 2018; Stevenson & Phakiti, 2014). The use of computer-mediated tools allows students to receive feedback anytime and anywhere. This reduces space and time constraints while creating more learning opportunities for students to help them achieve their learning goals (Ghufron & Rosyida, 2018).

Writing assistant tools are commonly used in technology-assisted language learning to help improve the quality of learners' writing. Basic writing assistant tools provide grammatical error correction and spell checking. Dedicated software like Grammarly is among these tools. In other cases, these support functions are integrated into word-processing software such as Microsoft Word and Google Docs. These tools can detect various errors (including grammatical, punctuation, and spelling errors) and provide sentence suggestions. These writing assistant tools provide corrective written feedback by drawing lines under errors as prompts. When writers click on the marked words, corrective suggestions appear in a small pop-up window. If writers choose to accept the suggested corrections by clicking on them, the error words in the text will be replaced. Figure 3 shows how these tools prompt users.

Figure 3

Screenshot of Suggestions from Grammarly, Microsoft Word, and Google Docs (from left to right)



The availability of AI-based writing assistant tools has increased with the rise of artificial intelligence (Nazari et al., 2021). These advanced writing assistant tools employ machine learning to provide suggestions including grammar and spell checking, and they perform automatic operations such as composition suggestions, auto-completion of content, and tone detection. They can produce writing based on some user-entered keywords and themes as is the case with tools like Rytr, Typsewise, and ChatGPT. ChatGPT (2022) uses a large language model to generate human-like text. While it was not specifically designed as a writing assistant tool, it can be used for such purposes because it supports functions such as sentence paraphrasing, email generation, and poem or story writing.

Several studies have introduced writing assistant tools in English learning to provide students with a learning opportunity to improve their grammatical accuracy (e.g., Genaro, 2013; Hartshorn et al., 2010). For instance, Grammarly is a common writing assistant tool. It uses technology to provide automated feedback on grammar and spelling. Students can use this tool to improve their grammatical accuracy and improve writing quality (Genaro, 2013). In a survey, Grammarly was found to be useful and easy to use in helping students avoid grammatical mistakes (Cavaleri & Dianati, 2016). Additionally, Chang et al. (2021a) found that students who used Grammarly significantly outperformed those who were not using Grammarly on their post-test writing performance.

However, grammar checker tools tend to prioritize error corrections over supporting user learning. They often lack explanations for suggested corrections and do not encourage learners to engage in self-reflection, which could hinder the learning process. Although feedback from correction tools can improve the quality of the texts produced by L2-English learners, there is limited evidence that the effects of such feedback lead to more general improvements in learners' writing proficiency (Amrhein & Nassaji, 2010; Ekiert & Gennaro, 2021; Shintani & Ellis, 2013). Mubarak (2013) found that correction had minimal impact on the overall accuracy of English article use. According to Shintani & Ellis (2013), direct error correction did not improve accurate use of English articles, while metalinguistic feedback produced immediate effects. Furthermore, some aspects of language use were negatively affected by correction. Ekiert & Gennaro (2021) discovered that while the group receiving correction improved on targeted uses, the control group showed greater improvement. Apart from the targeted uses addressed by corrections, the correction groups scored consistently lower than the control group on other uses of English articles.

Researchers have studied how technology-assisted language learning can help students improve their writing skills (e.g., Chang et al., 2021a; Guzmán Gámez et al., 2019). However, none of them have explored the use of technology-assisted tools to help students overcome negative transfer

from Chinese. As a result, feedback provided by Grammarly and similar tools may not meet the learning needs of learners with English as an additional language. This inspired the integration of metalinguistic explanations with computer-mediated writing assistant tools to better support these learners.

3.5 Research Goals

This study aims to investigate learner errors in the context of negative transfer, and their response to it. This study provides NLT feedback that incorporates metalinguistic information to help learners improve their metalinguistic knowledge, and it assesses whether this kind of feedback can be effective as a countermeasure to assist learners' L2 writing and acquisition. Therefore, this study seeks to gain deeper insight into the impact of negative language transfer from Chinese to English in learner writing and the effect of the NLT tool on learners' metalinguistic knowledge by answering the following research questions:

1. In what ways does Chinese affect participants' English writing?
2. What strategies do participants use to reduce or avoid Chinese negative transfer?
3. What effect, if any, does the NLT tool have on improving metalinguistic knowledge in Chinese learners of English?
4. What are the participant's perceptions of the usefulness and ease of use of the NLT tool when writing essays in English?

As suggested by the above literature, these questions will provide insight into areas that have yet to be addressed. Chinese negative transfer is inevitable, and it can not be addressed unless learners pay enough attention and clearly understand the source of the transfer. While traditional teacher feedback is effective in improving English accuracy, few teachers aim to strengthen learner metalinguistic knowledge and help them overcome negative transfer. Many technology-based tools have been used to enhance writing accuracy and language acquisition without addressing this phenomenon of language learning. This means the use of a tool for providing this type of feedback could be useful if it is effective.

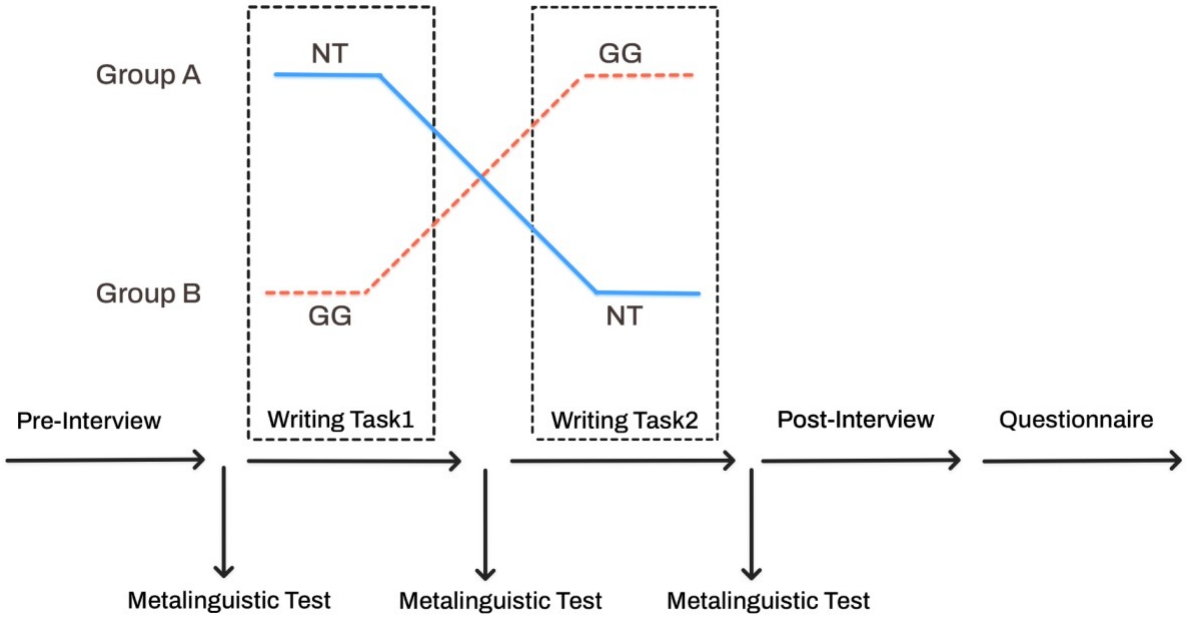
Chapter 4

Methods

I used a mixed-methods approach (Creswell & Creswell, 2017) where complementary qualitative and quantitative methods were combined. To elicit participants' perceptions, I conducted Individual pre- and post-interviews as well as administered questionnaires. I measured participants' metalinguistic knowledge through their performance on writing tasks and tests. Figure 4 shows the overall study process, which used a within-subjects design that counterbalanced the two conditions: the Negative Transfer Tool (NT) and Google Docs (GG).

Figure 4

Study Process: Our Within-Subjects Cross-Over Design



4.1 Participants

This study recruited 18 participants. All participants spoke Mandarin or Cantonese as their first language, and they were able to read the screen without glasses or while wearing contacts.

Participants were recruited through social media postings, Chinese student associations, and student newsletters at the University of Alberta. Some early participants had lived in Canada since childhood and their English writing proficiency appeared to be too high. Therefore, the recruitment process was adjusted in order to identify participants whose Chinese should be stronger than their English. I shared the recruitment information with institutions that assist new immigrants in finding employment or in learning English, as their clients are more aligned with the target participants for this study.

The 18 participants' ages ranged from 20 to 47 (M = 27.1, SD = 7.32). Among them, there were 14 (77.8%) females and 4 (22.2%) males. Their educational backgrounds varied from high school to Ph.D., with 7 (38.9%) participants having completed high school, and 5 (27.8%) participants holding university degrees.

All participants spoke Mandarin, 3 participants (P4, P5, P9) also spoke Cantonese, 1 (P18) spoke the Shandong dialect, and 1 participant (P4) also spoke Taiwanese (Hokkien). In addition, 3 participants (P1, P2, P3) also spoke Japanese.

The distribution of participants' English learning time ranged from 10 to 24 years (M = 16.2, SD = 4.55). Additionally, the participants have lived in English-speaking countries for a period ranging from less than 1 year to 12 years (M = 4.10, SD = 3.63). Fourteen participants have taken the IELTS test with scores ranging from 5.5 to 7.5 (M = 6.6, SD = 0.7), while 1 participant had taken the College English Test 6 (CET-6), and 1 participant had taken the Test of English as a Foreign Language (TOEFL) with a score of 100, and another had taken a high school English placement test. See Table 3 for full demographic information.

Participants were assigned a numeric identifier. This identifier (e.g., P1) is used to indicate which participant a quote originated from.

The study was approved by a Research Ethics Board at the University of Alberta (Pro00082188). Participants voluntarily attended this study and signed consent forms after being informed about study procedures. Each participant received a $15 Amazon gift card as an honorarium following participation.

Table 3

Demographics of Participants

ID	Group	Age	Gender	Education Level	Other Languages Spoken	Chinese Dialects	How many years English learned	Number of years living in an English-speaking environment	English test	Test scores
P1	B	32	Female	University degree	Japanese	Mandarin	15	1	IELTS	7
P2	B	20	Female	High school or Secondary school	English, a bit of Japanese	Mandarin	11	10	A high school English placement test for taking an ESL class	do not remember, but they did put me in an ESL class
P3	A	22	Female	University degree	Japanese, English	Mandarin	10	Less than 1	IELTS	7.5
P4	A	22	Female	High school or Secondary school		Mandarin, Cantonese	15	12		
P5	A	22	Female	High school or Secondary school		Mandarin, Cantonese	12	4	IELTS	6
P6	AA	31	Female	Master of Education		Mandarin	24	8	IELTS	7
P7	A	29	Female	University degree	Taiwanese	Mandarin	23	Less than 1	IELTS	7
P8	A	23	Male	college	English	Mandarin	11	5	IELTS	6.5
P9	A	22	Female	High school or Secondary school		Mandarin, Cantonese	18	7	IELTS	8

P10	A	47	Female	University degree	English	Mandarin	20	3	IELTS	5.5
P11	A	20	Female	High school or Secondary school		Mandarin	14	1	IELTS	6.5
P12	B	22	Female	High school or Secondary school	English	Mandarin	14	4	IELTS	6.5
P13	B	41	Female	PhD degree	English	Mandarin	10	Less than 1	CET-6	pass
P14	B	23	Female	University degree	English	Mandarin	20	5	IELTS	7.5
P15	B	30	Male	MSc degree	English	Mandarin	16	Less than 1	TOEFL	100
P16	B	28	Male	High school or Secondary school	English	Mandarin	23	8	IELTS	6
P17	B	28	Female	MSc degree		Mandarin	18	Less than 1	IELTS	5.5
P18	B	25	Male	MSc degree	English	Mandarin, Shandong	18	3	IELTS	6

Note. A - NLT tool used first; B - Google Docs used first

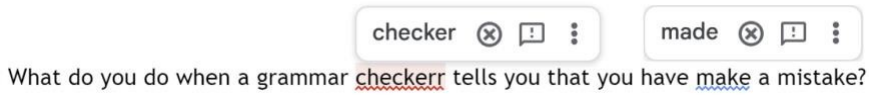
4.2 Instruments

4.2.1 Google Docs Spelling and Grammar Suggestions

Google Docs offers spelling and grammar check features for multiple languages including English. When writers make mistakes while writing with this feature turned on, they receive corrections for spelling or grammar errors. More specifically, misspelled words are underlined in red while grammar errors are underlined in blue. After clicking these markers, Google Docs displays the necessary corrections to writers. Writers can either accept the suggestions by clicking on the prompts or ignore them by clicking on the close icon (See Figure 5).

Figure 5

A *Screenshot* of Spelling and Grammar Suggestions in Google Docs

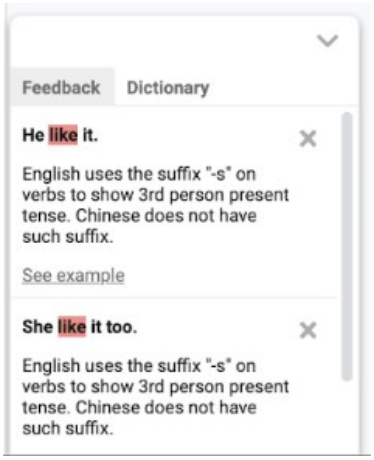


4.2.2 Negative Language Transfer Writing Tool

As part of this study, the Negative Language Transfer Writing Tool (NLT tool), a Chrome extension, was developed. This extension helps native Chinese language speakers learn English by providing feedback on grammatical errors. It appears as a small window in the bottom left corner of the screen while users write in Google Docs. The extension communicates with the LanguageTool API to detect grammatical errors and send this information to the negative language transfer detection model API (Farias Wanderley & Demmans Epp, 2021). The API passes information to models to determine if any errors were related to negative language transfer. If any of the errors identified are deemed to be related to negative language transfer, learning resources that explain the error's connection to this phenomenon are provided (Figure 6). Additionally, there is a clickable "example" button that shows a set of example sentences. This example includes one grammatically correct sentence and one incorrect sentence affected by Chinese language. Users can compare the difference between these two sentences to understand the cause of errors and related grammatical knowledge.

Figure 6

A Screenshot of *the* NLT Tool Window Showing Feedback



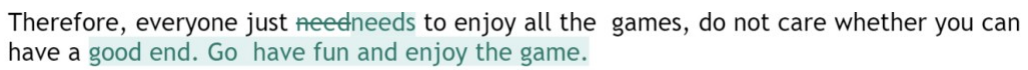
4.2.3 Google Docs Logs

Google Docs has an activity log that tracks user editing history, including the number of edits and when changes happened. This log records changes such as additions, deletions, and replacements made by users. When a user adds new content, the newly added part is highlighted in green. Deleted

content is marked with strikethrough formatting, and replacement text appears next to the original word in green. This makes it easy for me to identify changes made by participants. For example, in Figure 7, “needs” was highlighted in green and the original word “need” was annotated with strikethrough formatting, which means the participant replaced “need” with “needs.”

Figure 7

A Screenshot of Annotation in Google Docs Log Activities



4.2.4 Negative Language Transfer Writing Tool Logs

As participants write in English on a Google Docs file with the NLT tool turned on, the tool automatically logs information in the background. This includes errors detected, feedback provided, and whether the errors were related to negative language transfer. More specifically, the user_ids log contains the sentence id, user id, and creation time (Table 4). Language_tool_errors log records information about normal grammar errors, including sentence id, sentence, grammar rule, error description, and type of the error (Table 5). Errors related to negative language transfer are recorded in the Negative_language_transfer_errors log, including sentence id, sentence, and the feedback message the tool provided (Table 6). These records support the analysis of user interactions with the extension.

Table 4

A Sample Record from User_id Log

Sentence ID	User ID	Creation time
9214	108125229327830525270	2022-10-01 23:19:56

Table 5

A Sample Record from Language_Tool_Errors Log

Sentence ID	Sentence	Grammar Rule	Description	Type
9213	Therefore, everyone just enjoy every game, do not care whether you can have a	HE_VERB_AGR	Agreement error: Non-third person/past tense verb with 'he/she/it' or a pronoun	grammar

Table 6

A Sample Record from Negative_Language_Transfer_Errors Log

Sentence ID	Sentence	Message
9214	Therefore, everyone just enjoy every game, do not care whether you can have a	English uses the suffix "-s" on verbs to show 3rd person present tense. Chinese does not have such suffixes.

4.2.5 Eye Tracking

In this study, participants' eye gaze information was tracked using Pupil Core eye-tracking glasses (Kassner et al., 2014). These glasses have three cameras: two of the cameras for filming participants' eyes, and the one outward-facing RGB camera for capturing the real world. Pre-printed markers were used to support the tracking of participants' areas of interest (AOI) and head positions.

Calibration of the eye tracker is necessary in order to collect data correctly. Researchers helped participants put on and adjust the eye tracker to ensure stability throughout the study and the precise detection of pupils by cameras. The screen displays a red dot wrapped by a circle from the middle to the four corners in turn. Participants were asked to focus their eyes on the red dot until the color turned from red to green.

During the study, the eye-tracking system recorded participants' pupil and gaze information, as well as raw video of their eyes and the real world. The data collected by the eye tracking device includes the eyes video, real-world video, gaze, pupil, blink, fixation, head movement, and AOI. Analysis of the data collected from eye-tracking glasses will be conducted in future research.

4.2.6 Affect Measurement

Electrodermal activity (EDA) data were collected using an Empatica E4 wristband. The Empatica E4 is a wearable wristband designed to monitor physiological signals such as heart rate, electrodermal activity, interbeat intervals and temperature (Temperature, 2020). The raw data was streamed in real-time via Bluetooth connection with a laptop. Electrodermal activity (EDA) data and eye-tracking data were synchronized using software at the time of collection. Data collected from the wristband will be analyzed in future work.

4.2.7 Writing Tasks

The International English Language Testing System (IELTS) is an international standardized test designed to assess the English language proficiency for non-native English speakers. It is widely accepted by 140 countries and is the most popular test for higher education (*Why Accept IELTS Scores?*, 2023). IELTS is aimed to provide unbiased and fair assessment of test takers' English language skills, including speaking, listening, reading, and writing, with high reliability and validity (*Ensuring Quality and Fairness*, 2023). Writing task 2 is a component of the writing test, where testers are required to complete an essay in a formal style of at least 250 words within 40 minutes.

I adapted the writing prompts from the past five years of the IELTS Writing Task 2. Participants were given 10 - 15 minutes to write at least 120 words.

I collected writing prompts and grouped them into appropriate themes, including education, technology, community development, movies, work, success, health, food, travel, friends, games, celebrity, history, personal character, and investment. Each theme had two or three prompts. In order to reduce ambiguity and bias, all writing prompts were iteratively reviewed by Robyn Tang (research assistant - linguistics), Carrie Demmans Epp (native English speaker), and me. We revised some wording and removed some similar prompts after discussion. Our goal was to maximize diversity among themes while keeping a manageable number of prompts. After this process, we selected 41 writing prompts that covered 15 themes, which can be found in Appendix A.

4.2.8 Metalinguistic Knowledge Measurement

How to measure learners' English proficiency before and after intervention is key. There are various measures that can assess writing development, mainly focusing on linguistic aspects such as fluency, accuracy, and complexity (Bulté & Housen, 2012; Verspoor et al., 2012). However, many factors such as genre knowledge (Tardy, 2012) and goal setting (Cumming, 2012) may affect the quality of writing. Therefore, researchers must consider these additional factors when evaluating writing development. For example, research often uses timed writing as a measure of writing ability, but this may not accurately reflect participant language proficiency because different genres and time constraints can affect performances in writing. As a result, I used metalinguistic knowledge to assess learners' English proficiency instead of assessing writing development.

I combined four instruments to assess participants' metalinguistic knowledge: the Morpho-Orthographic Choice Task, Carlisle's Morphological Structure Test, the Wug's Test, and the Bee Grass Test. Each of these instruments focuses on different aspects of linguistic knowledge. These tests were used to measure changes in participants' metalinguistic knowledge following their use of the NLT tool. In the end, three versions of the metalinguistic test were created and administered through separate Google Forms. Each Google Form combined a subset of the four tests. Instructions were given in English and Chinese. To ensure the consistency in difficulty levels across the three versions, pilot studies were conducted (see Appendix F). The metalinguistic tests were adjusted by swapping the same type of questions until the mean and standard deviation was similar among the three tests.

Below, I will detail the test information and describe the process for combining these tests into a set of instruments for measuring changes in participant knowledge over time.

4.2.8.1 Morpho-Orthographic Choice Task.

This measures learners' knowledge of English spelling rules and the criteria for how words change when suffixes are added. It asks learners to select the correctly spelled word from a pair of words (e.g., complition and completion).

I created three test forms by choosing one item from every three items in the test. For example, items 1, 4, and 7 were assigned to test form 1, items 2, 5, and 8 were assigned to test form 2, and items 3, 6, and 9 were assigned to test form 3. I repeated this process until an equal number of items from the original test had been allocated to each test form. Each correct answer was worth 1 point for a maximum score of 11 on this sub-test.

4.2.8.2 Carlisle's Morphological Structure Test.

The original version was an oral task that asked participants to modify the form of a word to fill in a complete sentence (Carlisle, 2000). For example, if the word "engine" was provided, learners should fill in the blank in the sentence "My brother is an ____." with "engineer".

I modified this test so that instead of reading the sentence and answering it orally, participants were given the test and asked to type in the appropriate form of the word to complete each sentence as previous research had done (Demmans Epp & Phirangee, 2019). The scoring method was modified: a correct response earned 2 points and a response with a spelling error earned 1 point. Again, I divided the original instrument into three sub-forms by assigning every third item to a test form as I did with the Morpho-Orthographic Choice task. The maximum score for this sub-test was 18 points.

4.2.8.3 Wug's Test.

The Wug's Test is a picture book designed to assess the learners' understanding of English morphology using fictitious nouns, verbs, and adjectives. For example, "This is a wug. Now there is another one. There are two of them. There are two ____''. In this example, the correct response is "wugs''.

I divided the original instrument into three test forms by the category of questions, such as plural or compound words, to ensure an equal number of each question type for each form. Each question was accompanied by a cartoon that I illustrated. Each correct answer earned 1 point. There were four opening-answer questions that required participants to describe the semantics of each part of compound words. A full explanation earned 1 point while partial explanations earned 0.5 points. The maximum score for this sub-test was 13 points.

4.2.8.4 Bee Grass Test.

This test is composed of fourteen questions and is based on Elbro and Arnbak's (1996) and Fowler and Liberman's (1995) research. Participants were presented with two options to choose from for each question, which asked them to identify the correct compound form for a given word. For example, they had to decide whether "grass bee" or "bee grass" was a better name for a bee that lives in the grass. Similarly, they had to determine whether "bee grass" or "grass bee" was more appropriate for describing grass where many bees like to hide. I modified the administration format from oral to written multiple-choice questions, with each correct answer earning 1 point. The maximum score for this sub-test was 4 points.

4.2.8.5 Scoring.

An assessment guideline was developed to evaluate participant responses to the metalinguistic tests. The guideline was developed by Carrie and me. We discussed inconclusive answers to ensure consistency in scoring, especially for the open-ended questions in the Wug's Test.

To make it easier to score and analyze errors, I developed a scoring system in Google Sheets. The automated scoring system was combined with manual scoring by the research team to score all metalinguistic tests.

The metalinguistic tests were administered using Google Forms, and all responses were exported to Google Sheets. Before scoring, data preprocessing was conducted first by converting responses to lowercase and stripping spaces at the beginning and end of words. I first performed automated scoring, followed by the manual scoring of open-ended questions. The research team reviewed and discussed all incorrect answers until agreement was reached.

4.2.9 Interviews

Prior to the interviews, I developed a pre-interview and post-interview protocol based on the interview guide used by Demmans Epp (2016). The questions were designed to obtain information about the background and perception of the participants, which would help me interpret the results of the quantitative analysis. The final interview protocol was improved using the feedback and suggestions from interview pilots (refer to Appendix F). Appendix B contains both the Chinese and English versions of the interview protocols.

4.2.9.1 Pre-interview.

The pre-interview was developed to gather information regarding participants' language learning experiences, their writing assistant tool usage experience, and how they perceived the impact of Chinese on their English writing. It consists of three parts with a total of twelve questions.

The interview started with questions about their language learning experience, which allowed me to gain an understanding of their motivation for learning a foreign language and what their language learning experience has been.

The second part of the interview collected information about participants' experience of using writing assistant tools. It helped discover which writing assistant tools they have used as well as how these tools assisted them in English writing. Furthermore, participants provided their feedback on the

suggestions offered by these tools and expressed their thoughts on features that could be improved or benefits they received from using them.

The third part of the interview focused on the participant's perception of their native language. This helped me gain insight into the participants' understanding and awareness of how Chinese influences their English writing.

4.2.9.2 Post-interview.

The questions in the post-interview provided insight into the usefulness and ease of use of the NLT tool. By asking questions in the post-interview, information about participants' attitudes and intent regarding the subsequent use of the NLT tool was collected. The post-interview protocol consisted of two parts and nine questions.

In the first part of the interview, participants were asked about their perceptions of the NLT tool. These questions aimed to elicit the participants' perceptions of the feedback provided by the NLT tool. Participants answered questions about the knowledge that they learned from the feedback and their thoughts on its explanations and examples. Additionally, participants were asked about the ease of use of the NLT tool. Questions covered the user interface and the interaction design of the NLT tool. Other questions elicited suggestions for additional features or improvements to the NLT tool.

The second part of the questionnaire asked participants about the impact of Chinese on English writing and their attitudes towards these impacts. Participants were also asked how NLT tool use affected their English writing.

In the interview, the order of the questions was not fixed, allowing respondents to express their opinions and suggestions in a natural and conversational manner. This approach encouraged the collection of additional information (Mann, 2011). The interviewer's training is important because they can influence the quality of the outcome (Bowling, 2005). To ensure a smooth interview process, several pilot interviews were conducted before the formal interview to familiarize the researcher with the interview procedures.

I developed the interview protocol in English then translated it into Chinese using Google Translate and my Chinese language experience. All language versions were reviewed to ensure reliability. The English version was reviewed by English native speaker Carrie. The Chinese version was revised and confirmed by a native Chinese speaker Xiaoyang Jia. In the end, both the Chinese and English versions were formed.

The interviewee could select either language according to his or her preference. Interviews were conducted face-to-face in the office and recorded. Each interview lasted approximately 8 to 15 minutes.

4.2.10 Questionnaire

The questionnaire consisted of four main sections that elicited information about participant perceptions of the NLT tool, their English learning experiences, native language, and demographics. The full questionnaire can be found in Appendix C.

I used a five-point Likert scale to collect information regarding participants' perceptions of using the NLT tool (1 - Strongly agree; 2 - Agree; 3 - Neither agree nor disagree; 4 - Disagree; 5 - Strongly Disagree).

Checkboxes were used to determine which aspects of English writing participants would like to improve the most. Eight options were provided based on common errors made by EFL Chinese learners (Dipolog-Ubanan, 2016), including argumentation, grammar, punctuation, spelling, word use, verb use, text structure, and singular versus plural usage of nouns.

The second part collected information about participants' English-language background and proficiency. Participants were asked to report how long they have been studying English and how long they have lived in an English-language environment. Participants also provided their scores on standardized English tests if they had taken such tests.

The third part gathered data about the participants' language backgrounds. They were asked to indicate any other languages they speak besides Chinese and what dialects of Chinese they speak.

Last, demographic information, including gender, year of birth, and education level, were collected.

4.3 Procedures

My colleague Robyn and I underwent training and conducted multiple pilot studies before the official study. This helped us become familiar with device setup and software environments, interview protocols, and the entire study process. Additionally, I developed a procedure checklist and instructions to follow during the study (refer to Appendix D).

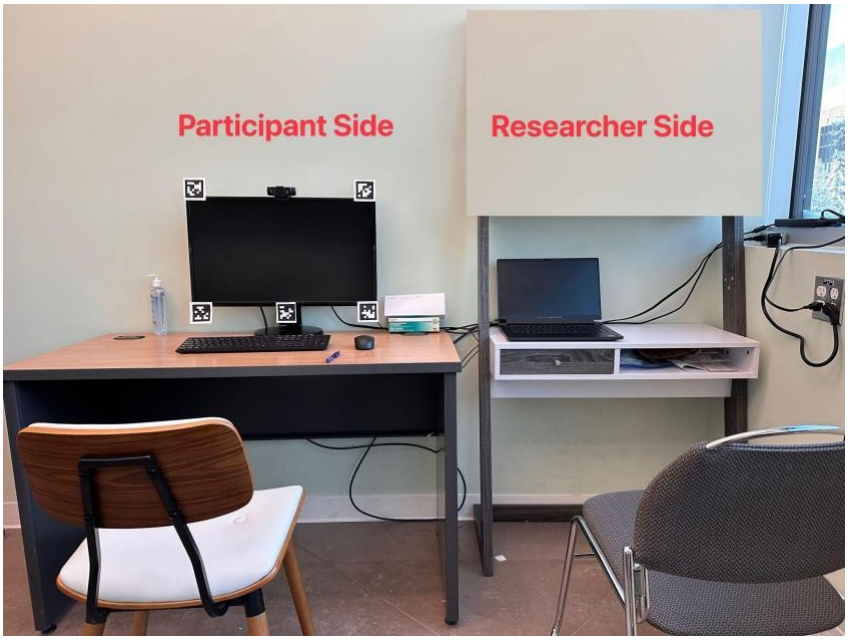
The study has two conditions: the NLT tool (NT) and Google Docs Grammar Checker (GG). Participants were randomly split into two groups. Group A consisted of 9 participants who underwent NT first, followed by GG. Group B also had 9 participants. Group B started with GG and then underwent NT. This counterbalanced design can help address potential carryover effects that learning English knowledge from metalinguistic tests and writing in English may have on the performance of

metalinguistic knowledge (Johnson, 2010).

The experiment was conducted in an office with a laptop and monitor at the University of Alberta Computing Science Centre. Figure 8 shows the setup of the study room. Participants sat on the left side facing the external monitor while researchers sat on the right side facing the laptop. Researchers moved windows that participants needed to read to the external monitor. Interviews were recorded using an audio recorder.

Figure 8

Study Room Setup



Informed consent forms were reviewed and signed by participants before starting the study. My colleague Robyn and I explained the overall process of the study and asked participants which language they would prefer to use in interviews. Participants were asked to choose two writing topics from a list, and then selected two specific writing prompts related to those topics (refer to Appendix A for full writing prompts). For each writing prompt, researchers created a Google Doc containing the prompt.

The pre-interview was conducted first, then participants wore an E4 wristband on their arms and wore eye-tracking glasses. Researchers conducted a calibration procedure in order to collect data from these sensors. Participants completed the first metalinguistic knowledge test, followed by writing their first English essay in Google Docs, and then they completed the second metalinguistic knowledge test. Subsequently, participants wrote the second English essay and completed the third metalinguistic

knowledge test before undergoing the post-interview after removing the wristband and eye-tracking glasses. Finally, participants completed the questionnaire at the end of the study.

The study took participants between 78 and 95 minutes to complete. Robyn and I interviewed the first four participants, while I conducted interviews with the remaining participants.

4.4 Data Analysis

4.4.1 Quantitative Analysis

Statistical analysis of the metalinguistic test data was conducted using SPSS 26.0. Descriptive statistics were analyzed first, including minimum, maximum, mean, and standard deviation. All necessary assumptions were checked before performing statistical tests. The Shapiro-Wilk Test, distribution plots, and Q-Q plots were used to check for normality to determine whether parametric or non-parametric tests should be used.

According to the study design, participants were divided into two conditions: NT and GG. When participants were in the NT condition, they used the NLT tool and received feedback from both the NLT tool and Google Docs spelling and grammar checker. Meanwhile, participants in the GG condition only used Google Docs and received feedback from its spelling and grammar checker when they were in this condition.

To examine whether there was a main effect of tool or test administration, as well as interactions between them. I used a two-way repeated measures ANOVA when the data were normally distributed and the Friedman test if the normality assumption was violated. The within-subjects factors were the tools participants used (NT or GG) and test type (pre-test or post-test). The dependent variables were the scores on the metalinguistic test and subtests.

In order to characterize participants' learning from feedback they received while performing two writing tasks, learning gains were calculated. Learning gain is a measure of the change in performance a participant showed over time. Specifically, I calculated NT learning gains and GG learning gains to assess changes in metalinguistic knowledge (Colt et al., 2011). T-tests or the alternative non-parametric Wilcoxon signed-rank test were used to examine if the difference between learning gains was significant. These statistical tests helped determine whether the participants' metalinguistic knowledge changed.

4.4.2 Qualitative Analysis

A thematic analysis was conducted. The themes that emerged during analysis were used to better understand the quantitative results and obtain insight into the underlying reasons behind the participants' beliefs and behaviors. The analysis focused on developing a clear understanding of participants' experiences and identifying the challenges participants encountered with regard to using the NLT tool in English writing.

The interviews for the study were audio-recorded and transcribed before analysis. The analysis of the interview was conducted in the original language that participants spoke during the interview. Seventeen participants used Mandarin in the interviews, and 1 participant used a mix of Mandarin, Cantonese, and English. Transcriptions of Chinese interviews were translated into English using Google Translate and my Chinese experience. This translation approach was considered reasonable since the most essential step in the translation process is that the translator needs to comprehend the culture and the experience of participants. Having lived in China and grown up in a similar context, I was able to reduce potential threats to the validity of the data (Choi et al., 2012).

I used both deductive and inductive approaches to analyze the interview data (Braun & Clarke, 2006). First, initial codes were developed based on the research goals of examining participants' experience with using the NLT tool, including knowledge learned from feedback, strategies when writing in English, the impact from Chinese, and satisfaction with the NLT tool. Additional codes and sub-codes were developed through an iterative and open coding process. The coding results were reviewed by a native Chinese speaker Xiaoyang, who was a part of the coding team.

The codebook and coding results were shared among the coding team members through a secure cloud platform. In code review meetings, we went over the codes and discussed issues until we reached agreement regarding any areas of ambiguity or conflicts that arose among team members. Additionally, for each participant, I extracted an individual's responses to feedback and their preference for when they respond to feedback.

Through the iterative coding process consisting of a blend of deductive and inductive approaches, we identified a range of themes.

The participant's identifier (e.g., P1) was used to indicate which participant a quote originated from. Where quotes were used, I provided the original transcription and its English translation if the interviewee used Chinese.

Chapter 5

Results

This study explored the effects of negative language transfer from Chinese on participants' English writing and examined the effectiveness of automatically provisioned NLT feedback in ESL essay writing using metalinguistic tests. This study also used interviews with a questionnaire to ascertain the participants' learning experience. I have presented the analyses of these data according to the research questions that they answer.

5.1 Research Question 1: In what ways does Chinese affect participants' English writing?

Seventeen participants (94.4%) indicated that they were aware that their knowledge of Chinese affects their English writing, while one participant thought there was little influence.

Some participants reported positive impacts from Chinese. They said that different languages allowed them to perceive situations from different perspectives.

> 不同的文化中会以不同的方式思考问题，这反映在语言中。因此，能够从不同的角度看待同一个问题，将使我能够写更多的东西。
>
> Different cultures have different ways of thinking, and this is reflected in writings. Therefore, being able to look at the same issue from different perspectives will enable me to write more. (P4)

The participants stated that thinking in Chinese aided them in determining the subject matter and generating ideas for writing.

我觉得起码我们中文的思维方式可以先把点总结出来，可能第一点第二点第三点是什么。

I think at least our Chinese way of thinking can summarize the points first, maybe what is the first point, the second point, and the third point. (P14)

Participants said many aspects of English writing were affected by negative language transfer (see Table 7). Among them, the top three aspects of their English writing that were considered to be influenced by Chinese were word use (50.0%), grammar (50.0%), and sentence structure (38.9%).

Table 7

Which Part of English Writing Is Influenced by Chinese?

Aspects of English that were influenced	**Percentage of participants**
Word use	50.0%
Grammar	50.0%
Word order	27.8%
Verb tense	11.1%
Noun singular and plural	11.1%
Article	11.1%
Conjunction	11.1%
Sentence structure	38.9%
Expression	27.8%
Writing methods and logic development	22.2%
Tone	11.1%
Word spelling	5.6%
Rhyme	5.6%

Almost all participants (17/18) reported thinking in Chinese while writing in English. Some participants thought in Chinese throughout the essay.

我可能在写的时候还是有一种中文的脑袋在思考。

I may still have a Chinese head thinking when I write (P7)

While others mentioned thinking in Chinese for certain words, phrases, or sentences. As a result, participants were required to translate their ideas from Chinese to English during the writing process. Some participants reported that they translated ideas into English in their minds and wrote them down, while others preferred to write down their thoughts in Chinese and then translated them into English using a translation tool.

写作的时候用英文写，其实脑子里面想的是中文的意思，我在进行一个很快的中翻英。

What I think in my mind is the meaning of Chinese, and I'm doing a quick translation from Chinese to English. (P15)

我写的所有东西都是基于中文翻译出来的。

Everything I write is based on Chinese translation. (P18)

Some participants reported that the process of translating Chinese into English took more time than thinking directly in English because thinking in Chinese was "习惯性的思路" (habitual thinking) (P14), and they thought "用英文的话很难想的比较的深" (It is difficult to think deeply in English) (P11).

这些我觉得对非母语者来说是比较困难，但是对母语者来说，它不需要有多高的学历，这是他天生从小在这生长起来，他就这么说话，所以对他们来说自然而然的东西。

I think these are quite difficult for non-native speakers. But for native speakers, they don't need to have much higher education. This is the natural thing for them because

they were born and raised here. That's just how he talks, so it comes naturally to them. (P18)

They especially felt that they had to think in Chinese when they were expected or required to think critically, and they believed that most people tend to think in their native language.

Sentence structures, rhyme, modal particles, word spelling, writing methods, and logic development were also reported by participants as being affected by Chinese. Participants reported that their expression of sentences in English writing was affected by Chinese: some sentences in Chinese omitted the subject, while this was not typical in English. Some participants reported using modal particles at the end of sentences in Chinese to convey their mood or attitude, but they expressed uncertainty about how to achieve the same effect in English because English did not use modal particles for such purposes. P3 provided an illustrative example.

比方说我想有人迟到了，我说你怎么这么晚呀，但我没有真的很生气，这个呀字就表现出我就抱怨一下，但如果说英文的话，就 why are you so late？ 这就有点 strong 的感觉。

Let's say someone is late and I said “你怎么这么晚呀” (why are you so late) but I'm not really angry. The word "呀" shows that I'm just complaining a bit. But I say it in English, it is “why are you so late?” This feels a bit stronger. (P3)

我在广东话中听起来很温柔，我用同样的方式说话，我说英语可能听起来很粗鲁。

I sound very gentle in Cantonese, but when I speak the same way in English, I may come across as rude. (P4)

Participants reported struggling with spelling and expressed difficulty in mastering it because English is the language of spelling, which is different from Chinese. When reading aloud, native English speakers may be able to correctly spell the words they were pronouncing but participants could not.

Participants also mentioned the writing approaches and logical development between sentences were affected by Chinese. Some participants said that Chinese writing contains more

foreshadowing than English. The article then proceeds to present the main points of the argument. In contrast, English writing may initially introduce the main points before delving into further details.

> 中文说的重点说了很多，可能重点在后面，然后英语习惯是把重点你要说的直接就拉出来放在前面，然后你在后面再解释我为什么要有这几个重点。
>
> Chinese may put points on the back, and English custom is to put the points you want to say in front, and then you explain why I have these points. (P10)

In addition, participants reported that English writing was more specific, precise, and logically coherent, whereas Chinese writing may contain more leaps in thinking.

> 中文的思考方式跟英语的思考方式非常不同，英语的话更直接，就不能去那种跳跃性的思维方式，但是中文的话可能就会，英语就好像需要一条一条的写就不能跳，就一条一条的比较连贯。
>
> The way of thinking in Chinese is very different from that in English. English is more direct, and you cannot use a jumping thinking style. But Chinese may allow it. English writing is relatively linear, with a one-to-one correspondence between arguments and explanations. (P11)

Participants expressed their desire to learn the local culture in its native language, which motivated them to learn a foreign language. But they said it was difficult to find precise English equivalents for Chinese words because the words in the two languages did not always have one-to-one correspondence.

Participants reported that the vast differences between Chinese and English made learning English more difficult.

> 比如说我之前的母语是法语的话，可能会学英语的话就更简单，因为它两者有很多相似的地方，但是学中文和英文它就有很大的不同。

> For example, if my native language is French, it might be easier to learn English because there are many similarities between the two. But Chinese and English are very different. (P2)

Grammar was the most reported as being affected by NLT - 50% of participants cited it during the interview. The differences between Chinese and English grammar had an impact on participants' English writing. While some participants used "grammar" broadly to describe this influence. Others specifically mentioned how singular and plural forms, tense, and word order impacted their writing.

Noun singular and plural This was highlighted by certain participants who were bothered by the inconsistency of English rules for modifying singular and plural nouns. Some nouns needed to append “s” or “es” when changing from singular to plural, while other nouns dropped a letter and then appended “s” or “es”. “没有统一的规则，令人困惑。” (No uniform rules, it's confusing.) (P7) In contrast, Chinese nouns do not have a distinction between singular and plural forms, nor does it differentiate between countable and uncountable nouns. P2 used "tree" as an example.

> 中文就是树，然后很多树，然后这样的不一样，然后我会有有时候不知道怎么加，就说你要加 s 或者是 ss 或者 es 或者你要加另外一个单词，然后才能再加 es 然后你可能要拿掉一两个字母，然后再加什么 s，会有一点搞不清。
>
> In Chinese, it is “tree”, then many “tree”. Sometimes I don’t know how to append suffixes. Sometimes it appends “s”, “trees”. Sometimes it appends “ss” to “treess” or appends “es” to “treees”, and sometimes you might have to take off one or two letters and append “s” or “es”. It's confusing. (P2)

Verb tense Participants reported that Chinese and English have different rules for changing verb tenses. English verbs change their form in the past tense and different verbs are transformed in different ways. But Chinese verbs do not require such changes. Instead, auxiliary words are used to indicate tense in Chinese. This discrepancy highlights another area where negative language transfer can occur between the languages.

因为中文里面没有这种需要把词语拿走，然后再加一个新的词语去 make a past tense.

There is no such need to take away the word and then add a new word to make a past tense in Chinese. There is no need to change the verb in Chinese. (P2)

Participants additionally expressed their confusion regarding the English language's past tense and past participle.

到底是过去分词还是什么分词还是过去式？比如说 read，read，read，三个字都一样，可是它念的确实不一样的，或者是在它有时候变化是这个样子，只要加 ed，有时候又不用，没有一个规则。

Is it the past participle or the past tense? For example, “read”, “read”, “read”. All three words are spelled the same but pronounced differently. Is it the past participle or the past tense? Sometimes verbs need to append “ed”. Sometimes they’re not necessary. The rules are not uniform. (P7)

Word order Participants reported that some expressions such as time, locations, and phrases have reversed order in Chinese and English, often leading to confusion. Since they were thinking in Chinese, the order of English sentences retained the Chinese order, resulting in different sentence structures, also known as Chinglish.

在英文的表达里，它可能会觉得将前面的就是中文里前面表达的意思要放在句子的后面去表达，然后在句子结构上就很大的不同。

In English expressions, it may feel necessary to place the meaning expressed earlier in Chinese at the end of the sentence, resulting in a significant difference in sentence structure. (P5)

Besides, participants said that in English, modifiers were placed after the object, whereas Chinese modifiers were placed before the object.

Articles Participant said that there were no articles or similar grammatical structure in Chinese, but they had to add an article before a noun to indicate whether the noun was specific or general in English.

> 要不要加 the 冠词或是不用加，这个会是一个蛮大的困扰。
>
> To add or not to add the article “the”, this can be quite a big confusion. (P7)

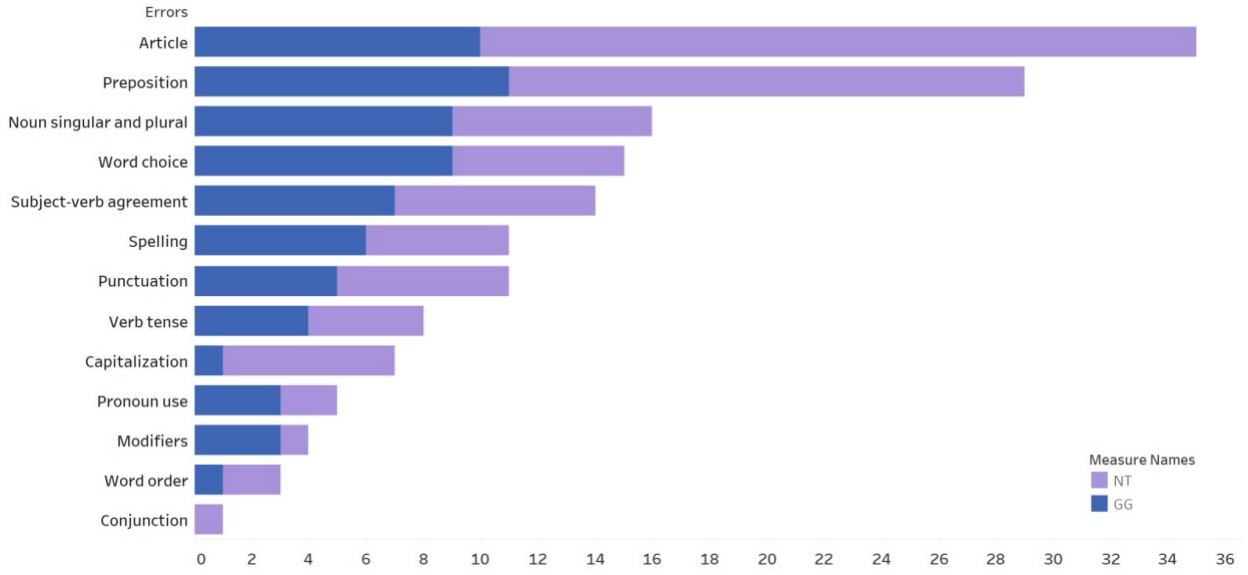
Conjunctions Participants stated the differences in some conjunction usages between Chinese and English. “Because” was used to express causality. Unlike English conjunctions, Chinese uses “because” and “so” simultaneously to construct a sentence and explain the relationship. The clauses succeeding "because" furnished the reason while those following "so" presented the outcomes.

> 英文有英文的连接词，但是因为我们中文没有那些，不是那样用连接词的，你如果按中文那样敲的话就有问题。
>
> English has English conjunctions, but we don't have those in Chinese. We don't use conjunctions like that. If you use them the same way as in Chinese, it may cause confusion or errors. (P15)

While preposition misuse was among the top three errors observed, none of the participants reported that their preposition usage had been affected by Chinese. Of the 159 errors identified in participants’ writing, preposition-related errors accounted for 18% of the observed errors. The other prominent errors (i.e., noun singular and plural errors at 10.1% and article use errors at 22%) had been identified by participants. Figure 9 shows the types and counts of grammatical errors in both essays.

Figure 9

Total Errors in Participant Writing by Condition



The Google Docs log captured 55 participant corrections, which accounted for 34.6% of all errors made. The top three types of corrections addressed preposition (25.5%), article (20.0%), and noun number (singular vs plural; 20.0%) errors. Figure 10 shows the grammatical error types and counts for NT or GG conditions in both essays.

While participants made many grammatical errors, some believed that the errors were not due to a lack of knowledge but rather to carelessness.

可能我知道但是我没注意到这点。

I may have known, but I didn't pay attention to this point. (P7)

自己写的时候可能不注意。

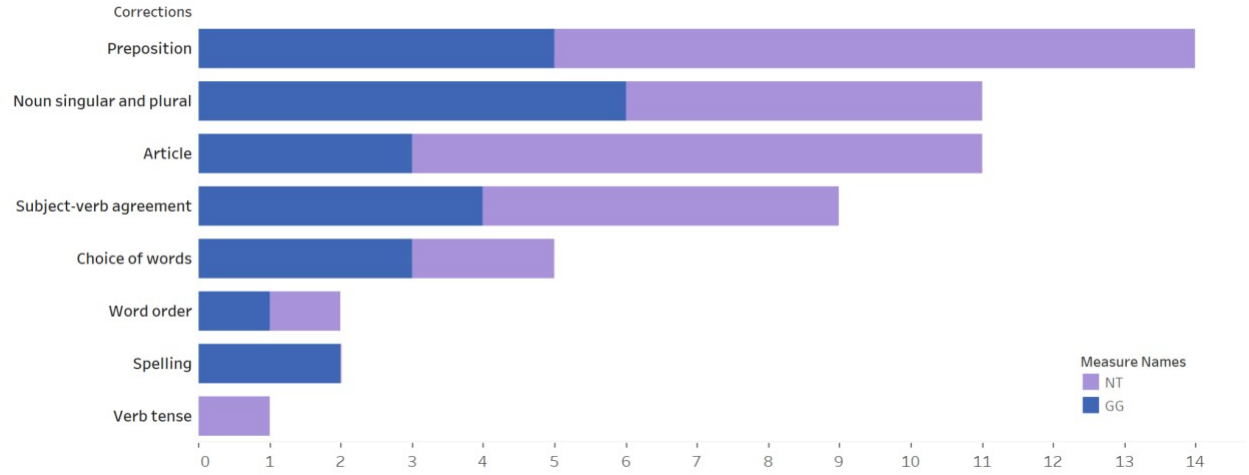
I may not pay attention when I write. (P15)

比较基础的那种语法错误，有时候会无意识的就用错。

Basic syntax errors are sometimes used unconsciously. (P9)

Figure 10

Corrections in Participant Writing by Condition

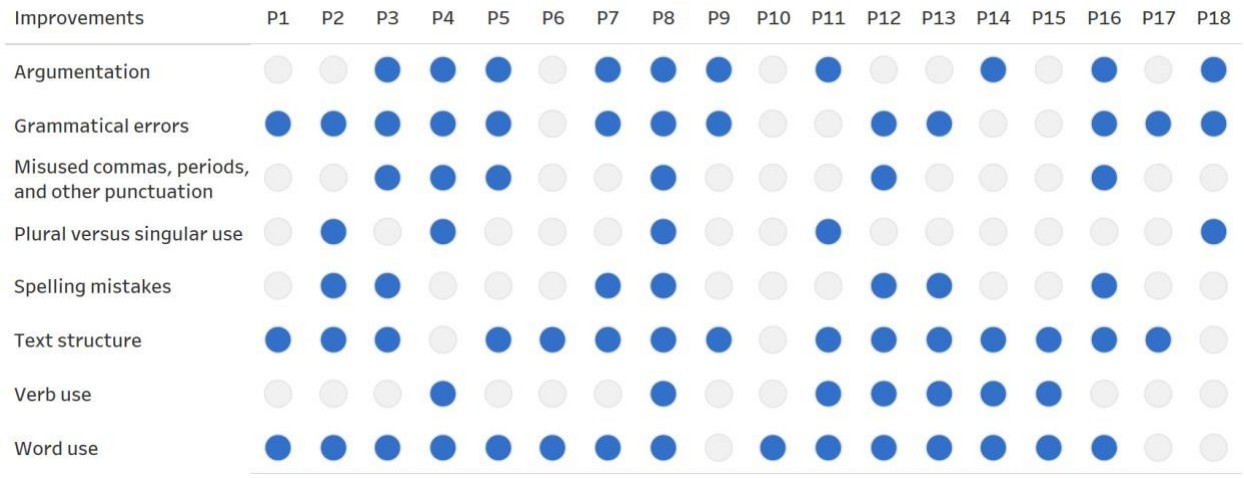


Across both conditions (NT, GG), participants most frequently corrected preposition (29.0%, 20.8%), noun singular and plural form (16.1%, 25.0%), articles (12.5%, 25.8%), and subject-verb agreement (16.1%, 16.7%) errors. Spelling corrections were only observed in the GG condition while verb tense corrections only occurred in the NT condition.

The questionnaire results revealed that the aspects of English writing participants most wanted to improve were those affected by Chinese. This finding was consistent with their interview responses, the errors made in essays, and the corrections they made. According to the interview, 50% of participants reported that Chinese affected their grammar, with articles and prepositions being their most common errors. Figure 11 shows which aspects of English participants wanted to improve. Word use (83.3%), text structure (83.3%), and grammatical errors (72.2%) emerged as the top three priorities for improvement.

Figure 11

Participants' Most Wanted Improvements in English Writing



5.2 Research Question 2: What strategies do participants use to reduce or avoid Chinese negative transfer?

Of the 18 participants, 13 (72.2%) reported that they consciously avoided Chinese negative transfer, while 4 participants did not make an effort to avoid this effect. One participant was unsure whether she avoided it or not.

Participants employed various approaches to reduce or avoid Chinese negative transfer. Table 8 shows the strategies used by participants. It shows that the three most common strategies were thinking directly in English (27.8%), paying attention to grammatical differences (22.2%), and referring to and imitating expressions from example sentences (22.2%). Only one participant (5.6%) used writing assistant tools to reduce Chinese negative transfer.

Table 8

Strategies Used by Participants to Avoid Effects from Chinese

Strategies	Proportion of participants
Think in English directly	27.8%
Pay attention to grammatical differences	22.2%
Refer to and imitate the expressions of the example sentences	22.2%
Use writing assistant tools	5.6%
Native English speakers to revise and provide advice	5.6%
Practice in English writing	5.6%
Speak with English speakers.	5.6%
Learn new English words	5.6%

The most common preventative strategies used by participants was to think in English directly though it was challenging.

> 我在自己尽量我感觉还是用英语来思考，比如说写的时候就有点难。
>
> I try to think in English as much as possible, but it's a bit difficult when I'm writing. (P1)

> 在想的时候不要用中文去想，尽量思考时候就直接用英文的方向去思考，听起来很难，我觉得一开始很难，可是我就是慢慢变成一个习惯。
>
> When thinking, do not think in Chinese. Instead, try to think in the direction of English directly when thinking. It sounds difficult, and I think it was difficult at first, but I gradually developed it as a habit. (P7)

However, some participants thought it was too challenging or “完全不能” (completely unable) as P14 commented.

我现在觉得是用英语合适的表达自己用中文想表达的比较深的一些观点是最难的，用中文就很流畅，用英语的话就不行。

I now feel that it is most difficult to express some deep thoughts in English that I want to express in Chinese. I am very fluent in Chinese, but not in English. (P11)

我肯定是做不到用英文直接来书写。

I am definitely not able to write directly in English. (P15)

One participant used writing assistant tools to mitigate negative language transfer from Chinese.

利用工具就是 Grammarly 或者是 Google translate 去尝试着去看可以怎么去修改。

Using tools such as Grammarly or Google Translate to try and see how to modify it. (P5)

Some participants paid more attention to the differences in grammar.

经常要相当于脑子里面自己提醒一下自己一样。

It often feels like reminding myself in my mind. (P8)

只能自己稍微注意一下。

I can only pay a little attention to myself. (P13)

While others referred to and imitated the expressions of the example sentences.

看一些 sample lab report，然后看别人是怎么去表达这些数据。

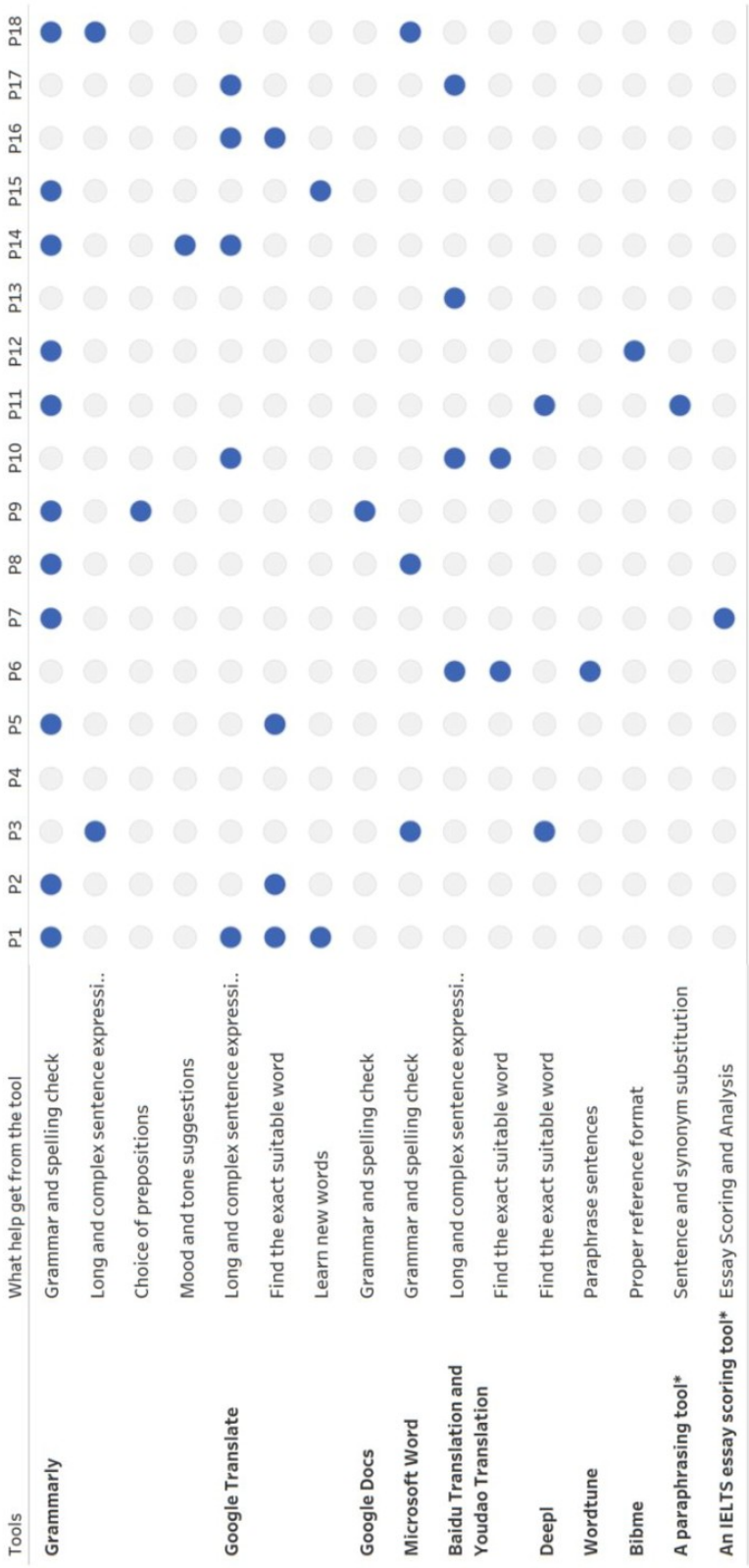
Look at some sample lab reports and see how others express this data. (P5)

找一些例比较地道的例句去模仿。

Find some authentic example sentences to imitate. (P11)

Figure 12

Writing Assistant Tool Used by the Participants and Helps They Get



Note. Participants did not remember the name of the tool.

Figure 12 shows that participants primarily used two types of writing assistant tools: grammar and spell checkers and translation tools. Grammar and spell checkers offered direct corrective feedback (error corrections). Grammarly, Microsoft Word, and Google Docs were among the tools reported. Translation tools, such as Google Translate, Baidu Translate, Youdao Translate, and DeepL, were commonly used by participants to translate paragraphs, sentences, and words. Additionally, some participants reported using other tools like Wordtune for paraphrasing sentences, Bibme for proper reference formatting, an IELTS essay scoring tool for grading and analyzing essays, and a paraphrasing tool for rewriting sentences with different sentence structures.

Participants found the writing assistant tools very helpful for their English writing. For example, participants said the grammar and spell checkers were very efficient for improving their grammar accuracy: 11 participants (61.1%) reported they would first consider whether the grammar suggestion was correct or appropriate before accepting or rejecting it, while 7 participants (38.9%) said they would directly accept suggestions.

Participants stated that grammar checkers allowed them not to have to worry about grammar and saved them time from checking grammar by themselves, enabling them to type quickly.

> 就相当于是给我自己上了一个保险的那种感觉，你让它检查过之后，你就会觉得说应该是没有什么大问题。
>
> It's like giving myself a sense of insurance. After you have it checked, you will feel that there should be no major problems. (P9)

Participants noted that these tools can help them avoid low-level grammatical errors when writing essays. Moreover, by simply following the highlights, they were able to swiftly identify any errors and rectify them with the mere click of a button.

> 你觉得对你就点一下更正，如果觉得不对你就不点让它忽略。
>
> If you think it’s correct, just click to correct it. If you think it’s wrong, don’t click to ignore it. (P18)

Additionally, some participants said the grammar checker provided a user-friendly interface and was easy to use.

Participants stated translation tools were useful because translation tools can help them express long and complex sentences, and they learned new words from translations.

However, the writing assistant tools had some negative effects on English essays. Some participants (3/18) reported they were less likely to notice grammar mistakes because they applied all suggestions and corrections without taking time to memorize or think deeply about them. Additionally, they reported becoming somewhat dependent on these tools after prolonged use.

我写的时候就没有太过于去在意单复数，但是我写完之后它就会去纠正。

I don't pay too much attention to singular and plural forms when I write, but it will help correct errors after I finish writing. (P5)

Some participants said they would not consciously correct errors, and they would not memorize errors or related grammar knowledge.

因为它纠正的话，我就不会有意识的自己去改。

Because if it (tool) corrected it (error), I would not consciously correct it by myself. (P11)

我就下意识的去应用它，但是我自己不会去把它背下来之类的。

I apply it subconsciously, but I don't memorize it. (P9)

Some participants reported a decline in their grammar level.

我现在的语法错误其实感觉比我高中的时候用手写的语法错误要更多。

I actually feel like I make more grammatical errors now than I made in high school when I wrote by hand. (P11)

Moreover, none of these writing assistant tools were specifically designed to address errors related with negative language transfer. Some participants reported that the tools they used did not focus on Chinese negative language transfer related errors.

它好像可能也没有照顾到你们所侧重的那个点，哪些是中文的思考表达所造成的错误。

It may not seem to take into account the point you are focusing on, which is the errors caused by Chinese thinking and expression. (P11)

Overall, participants used a variety of methods to reduce Chinese negative transfer, but only one participant used writing assistant tools to prevent negative transfer from Chinese. While all participants had used writing assistant tools, they did not use these tools for this purpose.

5.3 Research Question 3: What effect, if any, does the NLT tool have on improving metalinguistic knowledge in Chinese learners of English?

The scores for the full metalinguistic tests were first examined (Table 9). Inspection of Q-Q plots showed that the data were normally distributed. A two-way repeated measures ANOVA revealed no significant main effect of tools on participant metalinguistic test scores ($F(1,17) = .01$, $p = .918$, $\eta_p^2 = .001$), no significant effect of the post-test and pre-test ($F(1,17) = .04$, $p = .837$, $\eta_p^2 = .003$), and no interaction between tool and test ($F(1,17) = .35$, $p = .871$, $\eta_p^2 = .002$).

Table 9

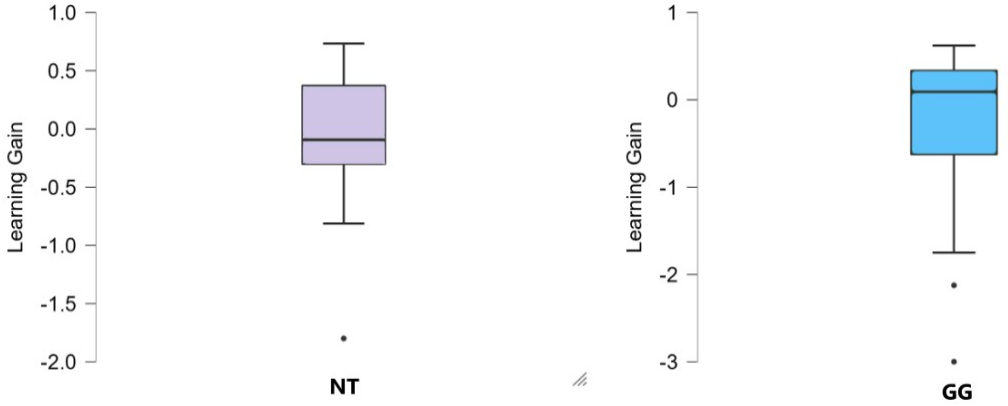
Full Metalinguistic Test Results of Participants

	Mean	Std. Deviation	Min	Max
NT Pre	38.14	3.66	28.5	44
NT Post	38.11	4.47	31.5	45
GG Pre	37.94	4.47	28	45
GG Post	38.19	3.76	28.5	43

The distribution plots (Figure 13) and Shapiro-Wilk tests indicated that both the NT learning gains (W = 0.89, p = .039) and the GG learning gains (W = 0.81, p = .002) were not normally distributed. The Wilcoxon signed rank test showed that no significant differences in learning gains were found across tools (Z = -0.50, p = .616, r = .12).

Figure 13

NT Learning Gains and GG Learning Gains for Full Metalinguistic Test



Sub-tests A detailed analysis was conducted to examine the changes for each of the four subtests, as each subtest assessed a different aspect of morphological knowledge compared to the full metalinguistic test. From the above analysis of the total score, it was unclear if there was any variation in participants' performance concerning a specific type of metalinguistic knowledge. Hence, it was necessary to analyze the sub-tests. Moreover, a combination of sub-tests with increasing scores and sub-tests with decreasing scores may result in no change or a small change in the overall score. Consequently, this variability could result in incorrect conclusions if, for example, an increase in a participant's scores on two subtests was offset by a decrease on the other two subtests.

A statistical analysis was conducted to examine the changes for each of the four subtests. The descriptive statistics of participant performance on each of these subtests are presented in Table 10.

Table 10

The Descriptive Statistics for the Metalinguistic Knowledge Subtests as M (SD)

Subtest	NT Pre	NT Post	GG Pre	GG Post
Morpho-Orthographic Choice Task	10.17 (1.04)	10.67 (0.49)	10.00 (1.24)	10.11 (1.13)
Carlisle's Morphological Structure Test	14.28 (2.72)	13.61 (3.62)	13.94 (3.80)	14.22 (2.71)
Wug's Test	9.92 (1.19)	10.33 (1.32)	10.44 (1.17)	10.08 (1.14)
Bee Grass Test	3.78 (0.65)	3.50 (0.70)	3.56 (0.71)	3.78 (0.65)

All sub-test scores and learning gains were examined. Below, I will provide details for those where significant differences were observed.

Morpho-Orthographic Choice Task The results of the two-way repeated measures ANOVA revealed that there was no significant main effect of pre-test and post-test on participant Morpho-Orthographic Choice Task scores ($F(1,17) = 2.96$, $p = .102$, $\eta_p^2 = .15$) and there was no significant interaction between tools and post/pre-tests ($F(1,17) = .54$, $p = .474$, $\eta_p^2 = .03$). There was a significant difference found for tools ($F(1,17) = 4.48$, $p = .049$, $\eta_p^2 = .21$), indicating that using the NLT tool had a main positive effect on participants' metalinguistic knowledge: participant's score was higher following the NLT tool use.

The results indicated that the NLT tool positively influenced participants' performance in the Morpho-Orthographic Choice Task. Participants in GG performed similarly in the post-test ($M = 10.11$, $SD = 1.13$) and pre-test ($M = 10.00$, $SD = 1.24$). However, participants in NT showed improvement in the post-test ($M = 10.67$, $SD = 0.49$) compared to their pre-test scores ($M = 10.17$, $SD = 1.04$), as shown in Figure 14.

Figure 14

Scores of Morpho-Orthographic Choice Task for Participants in NT and GG

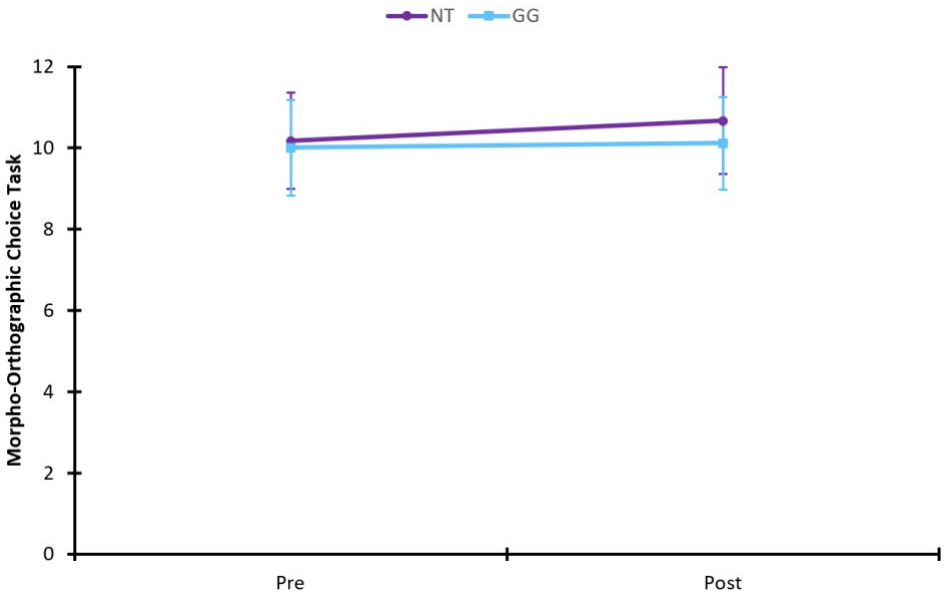
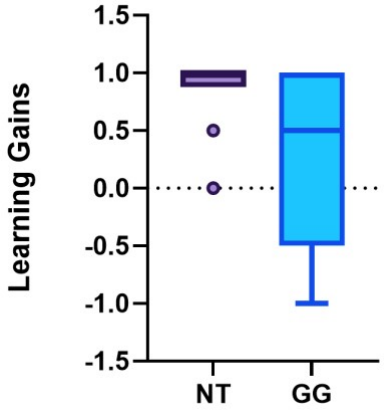


Figure 15 shows the NT learning gains (M = 0.85, SD = .34) and GG learning gains (M = 0.31, SD = .81) for Morpho-Orthographic Choice Task. As distribution plots and Shapiro-Wilk tests indicated that neither the NT learning gains (W = 0.53, p < .001) nor GG learning gains (W = 0.80, p = .022) were normally distributed, the Wilcoxon signed-rank test was used. It revealed there was no statistically significant difference in learning gains between participants based on the tool being used (Z = -0.96, p = 0.336, r = 0.23).

Figure 15

A boxplot of Morpho-Orthographic Choice Task learning gains

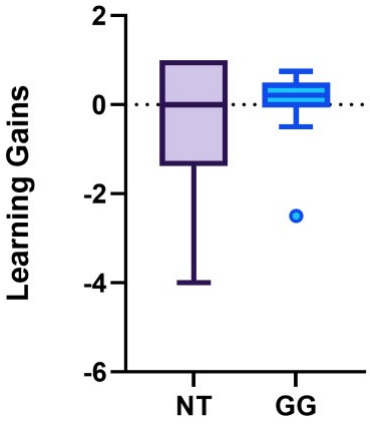


Carlisle's Morphological Structure Test A two-way repeated measures ANOVA showed no main effect of tools on participants' scores for Carlisle's Morphological Structure Test ($F(1,17) = .10$, $p = .753$, $\eta_p^2 = .01$). The difference between pre-test and post-test was not significant ($F(1,17) = .20$, $p = .660$, $\eta_p^2 = .01$). There was no interaction between tools and post/pre-tests ($F(1,17) = .55$, $p = .470$, $\eta_p^2 = .03$).

Figure 16 shows the NT learning gains ($M = -0.43$, $SD = 1.51$) and GG learning gains ($M = 0.03$, $SD = .81$) for Carlisle's Morphological Structure Test. A *t*-test revealed that the difference between NT learning gains and GG learning gains was not significant ($t(12) = -1.28$, $p = .233$, $d = -.35$, 95%CI [-1.85, .50]).

Figure 16

A Boxplot of Carlisle's Morphological Structure Test Learning Gains



Wug's Test A two-way repeated measures ANOVA was conducted, and the results indicated no significant main effects of the tools on participant Wug's Test scores ($F(1,17) = .46$, $p = .506$, $\eta_p^2 = .02$). No significant difference was found when comparing post-test and pre-test for both tools ($F(1,17) = 0.01$, $p = .895$, $\eta_p^2 = .001$). No significant interaction was found between tools and pre/post-tests ($F(1,17) = 2.19$, $p = .157$, $\eta_p^2 = .11$).

Figure 17 shows that participants' scores following the NLT tool use and following Google Docs use crossed from pre-test to post-test. Although this cross was not a significant interaction, the high variability in participant performance could prevent the detection of an interaction.

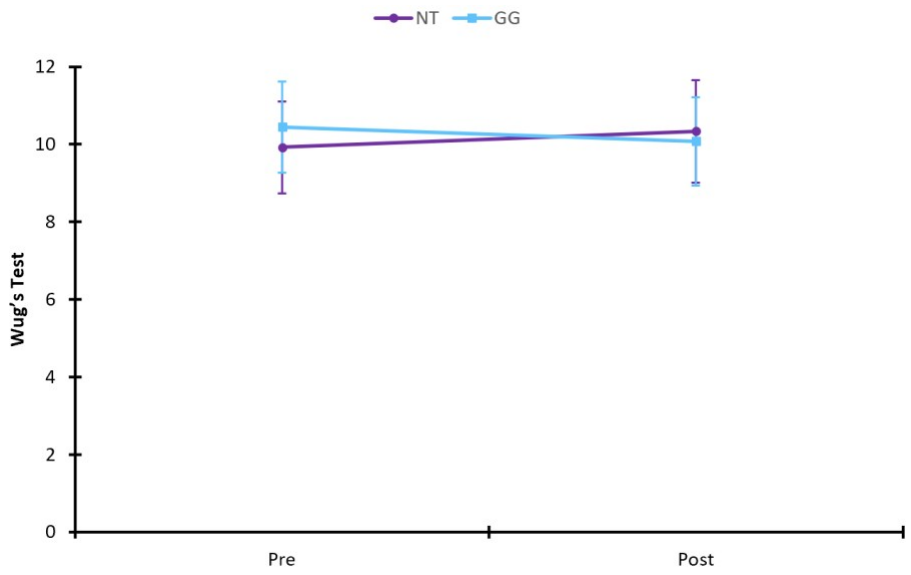
The results of the tests indicated that participants performed better on the pre-test ($M = 10.44$, $SD = 1.17$) compared to their post-test ($M = 10.08$, $SD = 1.14$) when using Google Docs. In contrast, when

using the NLT tool, participants performed better on the post-test (M = 10.33, SD = 1.32) than the pre-test (M = 9.92, SD = 1.19).

Moreover, a comparison of pre-test scores showed that participants exhibited potentially better performance before using Google Docs than before using the NLT tool. However, this was reversed in the post-test.

Figure 17

Scores of Wug's Test for Participants in NT and GG. Error bars represent SD



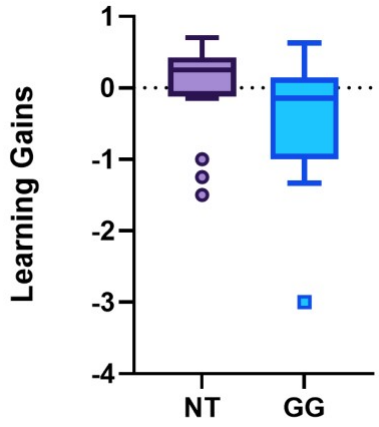
Note. Despite the crossing of the two lines, this interaction was not significant due to the relatively large standard deviation.

The distribution plots (Figure 18) and Shapiro-Wilk tests indicated that both NT learning gains (W = 0.79, p < .001) and GG learning gains (W = 0.85, p = .008) were not normally distributed. The Wilcoxon signed-rank test was used, and it revealed that the difference between NT learning gains (Mdn = *0.25*) and GG learning gains (Mdn = *-0.15*) was not significant (Z = -1.90, p = .058, r = .45) with a medium observed effect.

Figure 18 shows the NT learning gains (M = 0.21, SD = 0.63) and GG learning gains (M = -0.41, SD = 0.85) for Wug's Test where NT learning gains had a slight improvement while GG learning gains decreased with a negative median value. These findings suggest that the NLT tool may have a positive impact on language learning, whereas Google Docs did not.

Figure 18

A Boxplot of Wug's Test Learning Gains



Bee Grass Test Since the normality assumption was not satisfied according to the distribution plot, the Friedman test was used. It revealed that there was no statistically significant difference between the pre-test and post-test for both tools ($\chi^2(3) = 5.61$, $p = .132$ $W = .31$). Since there was no overlap between the participants who had NT learning gains and participants who had GG learning gains, further statistical analysis could not be conducted.

Overall, the effectiveness of the NLT tool was found in the results of the Morpho-Orthographic Choice Task and Wug's Test. The Morpho-Orthographic Choice Task assessed English spelling rules and how words changed when suffixes are appended. Upon analyzing the writing errors made by participants, it was revealed that noun singular and plural errors accounted for 20% of all writing errors. Specifically, when using the NLT tool, these errors made up 16.1% of all errors, while they accounted for 25% of all errors when using Google grammar checker. Therefore, singular and plural noun errors were among the most common mistakes made by participants. These findings were corroborated by the participants in the interviews when they talked about being influenced by Chinese. They attributed their difficulties with word spelling and irregular rules for changing singular and plural nouns to the influence of Chinese.

As for the knowledge that participants acquired, most participants (83.3%) reported that they learned some grammar from the feedback, such as singular and plural nouns, word spelling, and prepositions. Table 11 shows the knowledge that participants learned through the feedback. These findings suggest that the NLT tool was effective in improving metalinguistic awareness in certain areas, contributing to the overall improvement in participants' language proficiency.

Table 11

What Participants Learned from the Feedback on Their Writing

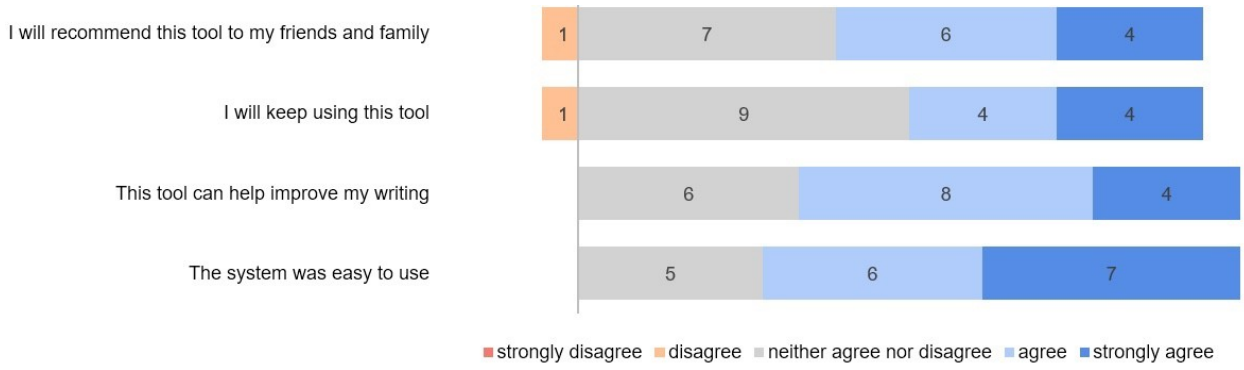
Aspects of English learned from feedback	Proportion of participants
Noun singular and plural	27.8%
Preposition	27.8%
Spelling	22.2%
Article	22.2%
Punctuation	16.7%
Subject-verb agreement	11.1%
Verb tense	5.6%

5.4 Research Question 4: What are the participant's perceptions of the usefulness and ease of use of the NLT tool when writing essays in English?

Figure 19 shows the participants' responses to questionnaire items about their attitudes towards using the NLT tool.

Figure 19

Participants' Attitudes towards Using the NLT tool



Usefulness The majority of participants (67%) showed positive attitudes towards using the NLT tool. One participant thought that the NLT tool was very fast in providing grammar feedback, sometimes even faster than Google Docs:

> 非常快，一出了错立马可能就出来出现了，这个软件的我感觉比那个文档的还快一些。
>
> Very fast, as soon as an error occurs, it may immediately appear. I feel that this software is even faster than Google Docs. (P1)

Participants also stated that the NLT tool's informative explanations and contrastive sentence examples were helpful, which encouraged them to self-examine their writing.

> 这很好啊，就是会提示我自己哪边有错的地方，我就会去进行检查。然后它同时也会给我一些正确的表述方式提醒我。
>
> That's great, it will prompt me where I made mistakes so that I can go and check. Then it will also remind me of some correct ways of expression. (P17)

The tool provided contrastive sentences that made it easy to understand grammar differences. These merits indicated that the NLT tool was helpful, convenient and fast. Moreover, some participants (33.3%) thought that the feedback from the NLT tool would make them pay more attention to grammar and avoid making similar errors in the future.

> 它也会给我一些正确的表述方式提醒我。在这个过程我自己也能会以后在写相同的东西的时候就会注意到这个问题。如何写作倒是没有写到，但是具体的像在英语使英语的使用方法。它是会给我一些帮助，比如说我自己的可能单词的词性是用的不对，然后单复数的问题，冠词的问题，后边如果我再遇到相同的这个词的一个词性和单复数的使用的时候，我就会知道正确的是什么样的。

> It will also give me some correct expressions to remind me. In the process, I will also pay more attention to this problem later when writing the same thing in the future. It doesn't help with how to write, but it does provide some assistance in specific areas such as English usage. For example, I may use the wrong part of speech of the word, then the problem of singular and plural forms or articles. If I encounter a part of speech of the same word and the singular and plural usage later on, I will know what the correct is like. (P17)

Participants also pointed out the disadvantages of using the NLT tool in English writing. Participants listed several negative comments about the tool. Specifically, they noted that while the NLT tool checked grammar rules, it did not offer suggestions on sentence structure, synonyms, translation or identifying logical errors between sentences. Participants believed that grammatical errors were only a small part of what affects writing, and they would like a writing assistant tool with greater functionality. Participants suggested adding several features to the NLT tool, such as suggestions for sentence structure, detecting repeated words and patterns, translation, automatic capitalization, and spacing insertion, as well as spell check.

In addition, participants reported that the NLT tool provided less feedback on grammar errors compared to other grammar checkers, which left them dissatisfied with the amount of feedback they received from the NLT tool, as they felt it did not address all their writing concerns.

> 其实我自己知道有很多就是错误，但是好像那个工具最后就指出了一个错误。
>
> I actually know that there are many errors, but it seems that the tool (the NLT tool) only pointed out one error at the end. (P2)

Ease of use Figure 19 indicates that many participants (67%) had a positive attitude towards the ease of use of the NLT tool. They mentioned that the NLT tool extracted the entire sentence containing the error into the feedback window, allowing them to quickly focus on the context of errors and make corrections. Moreover, participants noted that using the NLT tool was similar to other writing assistant tools they had used before, making it easy to start using.

Participants also suggested improvements to the NLT tool in terms of its ease of use. Several participants suggested enlarging the NLT tool's interface windows, as they sometimes found it difficult to notice the feedback displayed in the current fixed-size window. Some participants found the NLT

feedback was difficult to navigate, especially when there was a lot of feedback in the window. When they made multiple writing errors, the NLT tool provided several pieces of feedback. However, as they continued writing, the content displayed in the NLT tool's small window remained fixed at the first piece of feedback. Consequently, participants had to manually drag the progress bar each time to view feedback for their latest error. In other words, participants' writing errors were not synchronized with the feedback displayed by the NLT tool.

Participants suggested that the NLT tool should highlight the error word in the text; they believed that highlighting the error in-text would allow them to better understand the context of the paragraph. The NLT tool currently displays the entire sentence where the error occurred in the NLT tools' window, without highlighting which specific word was used incorrectly in the essay. They also recommended enlarging the "example" button, because they initially did not notice the NLT tool provides example sentences.

Chapter 6

Discussion

6.1 Research Question 1: In what ways does Chinese affect participants' English writing?

Many participants in the study used a strategy where they wrote English translations based on the thinking and reasoning process they used when speaking in Chinese. They believed that thinking in Chinese was natural and made it easier for them to think deeply. While participants were aware of the interference of their first language (Chinese) knowledge on their English writing, they tended to translate from thinking in Chinese to English when they wrote in English. This is corroborated by previous studies (Dipolog-Ubanan, 2016). When writing in a foreign language whose linguistic properties and structures differed from their first language, learners tended to rely on the structures from their L1 and transfer them to the L2.

In the present study, it was found that Chinese negative transfer had a significant impact on various aspects of English writing. The top three areas most influenced were word use (50.0%), grammar (50.0%), and sentence structure (38.9%).

Participants reported many aspects of English writing were negatively affected by Chinese, one of them was semantic transfer. They reported that Chinese words and English words were not fully matched, which can result in inaccurate word use after translation. Translating between the two languages may result in nuanced differences, particularly for contemporary jargon, classical literature, and proverbs. Previous studies indicated that Chinese negative transfer affected word use, leading to misuse of verbs and lexical redundancy (Shi, 2015). However, it remained unclear whether the limited usage of English language was due to inadequate English proficiency or negative transfer from Chinese, as a lack of English vocabulary knowledge among learners may also contribute to this issue. Semantic transfer was a type of Chinese negative transfer that involved word meaning and comprehension (Wu,

2004; Zhai, 2009). This transfer was caused by Chinese words and English words not always having a direct match - one Chinese word could have several corresponding English words.

Participants reported that finding precise English words can be challenging. Yang (2009) pointed out that the negative transfer of vocabulary was mostly reflected in the collocation and choice of words. The same verb can be used with different nouns in different contexts when writing in Chinese, which affects learner verb choice. For instance, Chinese words corresponding to the verb "look" (看) can be used as in "look at the bottle" (看这个瓶子), "look at the movie" (看这部电影), and "look at the book" (看这本书). The same verb (看) was used with different nouns because these actions were related to the use of eyes so no distinction was made in Chinese. But in English, specific verbs are paired with certain nouns to form fixed collocations. The correct forms in English are "look at the bottle", "watch the movie", and "read the book." Similarly, Chinese speakers of English may say "open the light" (开灯) following the pattern of "open the door" (开门) when they meant to turn on a light.

Aside from the misuse of fixed collocations, lexical redundancy was another common error in word use that was affected by Chinese. Lexical redundancy occurs when Chinese learners did not fully understand the meaning of English words and used multiple words to express a single English word, resulting in a wordy or redundant English expression (Ye, 2019). For example, the meaning of "exit" in Chinese is represented through a phrase composed of two words "出口". Consequently, Chinese learners tended to use "exit door" rather than "exit" to refer to a way out of buildings, which leads to redundancy. Some participants used writing assistant tools to learn new vocabulary, which can aid in their comprehension of proper lexical use. Research has shown that technology-assisted L2 vocabulary learning can be more advantageous than traditional methods (Hao et al., 2021). Learners can easily access more learning materials such as the latest sentence examples from writing assistant tools. In addition to expanding vocabulary, some writing assistant tools were used to identify and address grammatical errors in their writing.

Chinese learners may experience negative language transfer due to the differences in grammar between Chinese and English. This was also reported in the interview by some participants. Negative grammatical transfer was found in various areas, such as noun singular and plural usage, verb tense, and verb form, as well as article use. In the interview, participants reported that nouns singular and plural were negatively affected by Chinese. Selinker (1992) suggested that errors were related to structural

differences because Chinese does not distinguish between singular and plural noun forms. Noun singular-plural deformation is a common difficulty faced by English learners in English writing, particularly for Chinese English learners (Lu, 2019). One of the most common errors in English writing is the confusion between singular and plural noun forms. The analysis of errors made by participants in their writing revealed that 20% of all errors were related to this issue. This finding was further supported by participants during interviews, who attributed their mistakes to Chinese language influence. They noted that the irregularity of the rules for changing singular and plural nouns posed a challenge, resulting in errors. Although the participants were aware of these irregular rules, they were unable to fully master the complex morphological rules and apply these rules in their English writing. In English, to indicate nouns changing from singular to plural, the appropriate plural suffix should be used. For example, some nouns append the suffix “s”, while others append “es” or “ies”. Certain nouns drop one of the letters that follow and then append “s” or “es” to transform from singular to plural. When Chinese learners of English were unfamiliar with these rules, they tended to apply a rule from their native language. But Chinese nouns do not distinguish between singular and plural or countable and uncountable forms, which can lead to mistakes. This grammatical error negatively affected writing consistency and impeded the acquisition of English skills.

Additionally, context sensitivity can contribute to the commission of errors such as noun singular versus plural, verb tense and form, and subject-verb agreement because they were contingent on the specific context in which words were used (Wing & Baddeley, 1980). For instance, the context may indicate the number of objects or entities being referred to, and the appropriate singular or plural form of the noun and verb tense will be determined accordingly. However, in other cases, the context may not be clear, which may further contribute to errors when L2 learners are unfamiliar with the conventions and expectations of written English, such as differentiating between specific elements, like “among” or “between” (Lee et al., 2020).

Participants also pointed out that negative language transfer affected word spelling. They struggled with spelling because English requires learners to be able to spell words when they read them out. But Chinese learners do not possess a similar ability because Chinese word pronunciation and spelling are independent of each other. Google Docs has a spell-check feature that detects errors such as “appreciata”. But the NLT tool did not offer this function. This may explain why spelling corrections were only made when participants were using Google Docs if the participants focused on the NLT feedback and did not rely on or use Google Docs feedback to correct spelling errors. This illustrates the need for a more comprehensive tool to address various aspects of language use.

Although participants made many grammatical errors in their writing, which accounted for 64.8% of the total number of errors. Some participants attributed their mistakes to lack of attention or carelessness rather than a deficiency in knowledge. Despite acknowledging this issue, they continued to make basic grammatical errors. This finding suggests that their English metalinguistic awareness was vague and unclear regarding certain aspects of grammar; they were aware that differences exist but did not fully understand how they differ. Take the singular versus plural items from the Wug's Test as an example. While participants understood that there were some rules to follow when changing a word using morphological rules, they had not fully mastered the rules and struggled to apply these rules in writing. As participants pointed out, a lack of uniformity in the rules caused confusion. To address this issue, it was necessary to improve their metalinguistic awareness and teach them about the grammar related to negative language transfer. Previous studies suggested that considerable differences in the structures of Chinese and English caused grammatical and lexical errors (Timina, 2013); thus, filling this knowledge gap is important.

The most common writing errors were related to word choice and grammar, specifically articles, prepositions, and noun number (singular versus plural). These errors in writing were consistent with participant interview responses about which aspects of English writing were impacted by Chinese. According to the contrastive analysis theory, structural differences may cause errors in the L2 as a result of erroneous inferences from the L1 (Connor, 1996). It was found that 159 errors were made in the participants' two English texts. Of these, 55 (33.6%) were corrected by participants, which indicated that a small percentage of errors were corrected with the help of tools. This low percentage could be attributed to time constraints, as they were asked to write as much as possible within a limited timeframe, leaving little opportunity for review or editing.

It was interesting to note that prepositions were the second most common mistake in writing and the top correction participants made, yet they did not mention preposition usage in their interviews. There were several factors that may contribute to this finding. For instance, Chinese negatively impacted various aspects of English usage. Learners tended to focus more on grammar rules that are consistent, rather than those that are not. Prepositions can be challenging for English learners because their use in a particular context may not always follow predictable or consistent rules (O'Dowd, 1998). This idiosyncratic nature of preposition use can make it difficult for learners to master their usage, particularly in contexts where multiple prepositions could be used interchangeably. In addition, Chinese learners may rely on writing assistant tools like grammar checkers to identify and correct errors with prepositions.

The most common areas participants desired to improve were word use (83.3%), text structure (83.3%), and grammatical errors (72.2%). These aligned with the parts that participants answered in interviews as being most affected by Chinese. Similarly, participants' responses to aspects of writing that were affected by Chinese are consistent with those of previous studies. Dipolog-Ubanan (2016) reported that the most common errors were word choice, spelling, tense, article and subject-verb agreement. These findings suggested that Chinese had a negative impact on participants' English proficiency, and they expressed a desire to improve it.

6.2 Research Question 2: What strategies do participants use to reduce or avoid Chinese negative transfer?

There were some participants who did not attempt to avoid Chinese transfer - they believed Chinese was their native language and they had been learning Chinese for more than 20 years. They thought the advantages of thinking in Chinese outweighed the disadvantages, which was consistent with findings from previous studies. Liu (2011) found that participants admitted that their grammar was negatively affected, thinking in Chinese led to more grammatical errors. Despite this, they believed that the idea of the essay remained unaffected and considered it to be the most important aspect of their writing. Therefore, these participants preferred to continue thinking in Chinese while writing in English, despite the potential language transfer issues.

Most participants (72.2%) made a conscious effort to avoid negative transfer from Chinese by using a variety of approaches, but they were unable to effectively prevent negative Chinese transfer. This was in line with previous studies (Liu, 2011), which have shown the challenges faced by students when it comes to effectively handling errors associated with negative transfer. One of the most common preventative strategies (27.8%) taken by participants was to think in English directly, but some found it too challenging or were "完全不能" (completely unable) (P14) as reported in results. Additionally, thinking in Chinese contributed to transfer from Chinese to English. For example, participants reported that they tended to use Chinese conjunctions instead of English ones when thinking in Chinese. This was where the transfer occurred since it was difficult to convert Chinese conjunctions into their English ones after translation.

It was found that 22.2% of participants actively paid attention to grammatical differences as a means of avoiding Chinese negative transfer. For example, they constantly reminded themselves of

grammar differences in their minds while writing. Their behaviors supported that the process of language learning requires noticing structures (Gass, 1988). Ideally, their attention should be raised when a knowledge gap occurs. The timing of feedback was important for drawing learners' attention (Shintani, 2016). I agree that synchronous feedback has been shown to be more effective than asynchronous feedback because synchronous feedback provided learners with input when they needed it, enabling them to notice knowledge gaps (Swain, 1995). Consequently, writing accuracy was improved through error corrections, echoing the findings from previous studies that error correction was effective in improving writing accuracy (Chang et al., 2021a; Ghufron & Rosyida, 2018; ONeill & Russell, 2019). However, it remained unclear whether the corrections were consolidated into participants' L2 knowledge.

The use of writing assistant tools was one potential approach for providing error correction to participants in an effort to attract their attention. Grammar and spell-checker tools were primarily used by participants to check their grammar and spelling, and 2 participants used them to learn new words and expand their vocabulary. A previous study also found that most writers felt at ease when using writing assistant tools that supported grammar checking, including spell checkers, as they provided a safety measure for writing (Dale & Viethen, 2021). However, a meta-analysis pointed out that automated feedback was more effective in improving vocabulary and may be less effective in improving grammar in writing (Ngo et al., 2022).

While participants commonly used writing assistant tools, these tools did not focus on addressing errors related to negative language transfer. It is likely that participants' English proficiency and metalinguistic knowledge related to language transfer were not improved or corrected. Both Google Docs and the NLT tool provided corrective feedback. Google Docs provided error corrections in terms of grammar and spelling corrections with colored underlining. However, it did not provide an opportunity for the entire process of language acquisition - internalization, modification, and consolidation (Housen & Pierrard, 2005). While direct corrective feedback allowed learners to recognize the erroneous form, and make immediate revisions (Shintani, 2016), noticing only occurred when learners corrected errors by themselves and interacted with feedback deeply. Direct correction provided by traditional writing assistant tools might not be sufficient for capturing participants' attention. In fact, 38.9% of participants reported that they accepted suggestions and corrected errors directly and subconsciously without thinking or self-reflection. A previous study has shown that written feedback required extra time for deep processing, and often needed to be read multiple times to help students revise their work (Hepplestone & Chikwa, 2014). However, learners did not allocate this additional time to check feedback

content or think deeply about the error, which would have supported their learning. Moreover, participants reported they would not remember related grammar knowledge. Instead, they relied on these correction tools that allowed them to pay less attention to grammar in English writing. Essentially, their behavior was equivalent to giving permission to the tool to fix errors on their behalf, without actively engaging with form and meaning and self-modification which are all needed to support language learning. This reliance on writing assistant tools was a major disadvantage because these tools were not designed to encourage skill learning and independence; instead, learners might depend on them excessively, which could impede their growth (Napolitano & Stent, 2009).

When combined with metalinguistic understanding, noticing can lead to the development of metalinguistic awareness (Schmidt, 1994). Some participants stated that their grammatical knowledge had declined compared to when they wrote by hand in high school. As learners became more dependent on technology, they were less aware of errors as they had become accustomed to rectifying errors with grammar checkers. This ultimately resulted in a regression in skills when students relied solely on tools instead of putting in their own effort (Boughaba et al., 2022).

The NLT tool was designed to draw learners' attention by providing metalinguistic clues and highlighting errors in sentences. Unlike other grammatical tools that offer direct corrections, such as Google Docs. The use of the NLT tool required learners to actively engage with the learning material. It was able to grab learners' attention, which is necessary for language acquisition (Gass, 1988). Participants must first notice the metalinguistic explanations and comprehend them with their existing knowledge. This process entails self-learning and self-reflection. They can then rectify errors on their own using their newfound understanding of related grammar knowledge. This entire process, as encouraged by the new tool, aligned better with the macro-processes of language acquisition.

Moreover, the NLT tool's feedback contained a set of contrastive sentences that enable comparison of Chinese and English grammar. Many researchers (e.g., M. Guo et al., 2014b; He & Niao, 2015; Shi, 2015) have suggested using contrastive analysis to highlight the differences between these two languages and help students improve their attention to grammar. Thus, by incorporating this metalinguistic information into their knowledge, participants can apply the related knowledge to correct their grammatical errors. As some participants noted, they will pay closer attention to grammar in order to avoid making similar mistakes in the future.

Overall, participants used a variety of methods to reduce Chinese negative transfer, but only one of them used writing assistant tools for this purpose. Despite the fact that all participants have been using writing assistant tools, these tools did not identify the potential relationship between grammatical

errors and the native language of learners, and they did not provide related causes of errors. Google Docs merely offered corrections without any explanation, while Grammarly provided corrections and brief explanations indicating the type of error without the cause of errors or how different it was from learners' L1 grammar. Consequently, none of these writing assistant tools allowed learners to reflect on the cause of errors related to their L1 as effectively as the NLT tool did. As a result, participants were unaware that negative language transfer could be reduced or avoided with the help of writing assistant tools.

Previous studies have shown that learners required error correction feedback (Evans et al., 2010). Negative language transfer-related feedback was also necessary. Although almost all participants acknowledged that Chinese influenced their writing and most participants (72.2%) consciously took measures to reduce these effects, learners were unable to effectively address negative language transfer from Chinese on their own. This was consistent with a previous study's finding that students struggled to effectively deal with errors related to negative language transfer even when motivated to do so (Liu, 2011).

6.3 Research Question 3: What effect, if any, does the NLT tool have on improving metalinguistic knowledge in Chinese learners of English?

NLT feedback has been shown to be effective through participants' improved results on the Morpho-Orthographic Choice Task and Wug's Test. According to language acquisition theory (Schmidt, 1990), learners realized knowledge gaps through feedback review and subsequently applied their new understanding of knowledge to improve their post-test scores.

Both the Wug's Test and the Morpho-Orthographic Choice Task involved noun morphing rules, but the Wug's Test was more challenging as it focused on productive (active) vocabulary while the Morpho-Orthographic Choice Task assessed receptive (recognized or passive) vocabulary. In general, learners acquire receptive vocabulary before they can produce it, as receptive knowledge is logically necessary for the production of vocabulary (Lee & Muncie, 2006). The Wug's Test presented a higher level of difficulty than the Morpho-Orthographic Choice Task, as it required learners to type the entire word rather than choose the correct spelling from two options. This distinction emphasized the effectiveness of the NLT tool, as it helped learners improve their performance in both receptive and

productive tasks, thereby demonstrating the tool's potential for helping learners to overcome negative language transfer.

The Wug's Test evaluated whether participants have the ability to extend morphological rules to new cases (Berko, 1958). As an example, consider the difference in forming singular and plural forms of nouns, which was a challenge for Chinese learners of English (Dipolog-Ubanan, 2016). Chinese learners of English often make mistakes when forming plurals because, unlike English, Chinese nouns do not require such transformation - number is communicated through other mechanisms such as quantifiers or context. If participants fully comprehended and grasped the rules governing noun transformation from singular to plural forms, they could extend this knowledge of morphological rules to new words that they have not encountered before. However, they may make mistakes if they simply memorize the plural spelling of certain nouns since the Wug's Test used made-up (pseudo or nonce) words specifically designed for testing one's understanding of morphological rules.

There were also some meaningful findings from the perspective of learning gains in the Wug's Test. Specifically, when comparing the learning gains in the NT condition and the GG condition. The NT learning gains (Mdn = 0.25) were almost measurably larger than GG learning gains, with an observed medium effect. A power analysis for a two-tailed Wilcoxon signed-rank test indicated that the observed power is 0.27, making that assessment under-powered. I would have needed 79 participants for the study to be adequately powered (.80). In the absence of a priori effect sizes, it was not possible to know how many participants would be needed.

Participants' learning gain in the Wug's Test indicated they learned through the NLT feedback, their learning gains when using the NLT tool were 40% larger than their learning gains when they did not use the NLT tool. This finding was aligned with previous research, which has shown that writing feedback can support correcting errors and improving writing quality in subsequent drafts. In one case, the margin of improvement following written feedback was 28.85% (Mansourizadeh & Abdullah, 2014). After reviewing the interview responses, the results revealed that noun number (singular vs. plural) was focused on by participants, which may explain their improved scores on the Wug's Test since it specifically assessed pluralization. Participants were attentive to the NLT feedback and recognized the knowledge gap between their writing and correct usage. They took time to review and understand related metalinguistic knowledge before applying this new knowledge to correct errors. As a consequence, the success of correcting errors by participants means they were able to correct errors themselves with their understanding of English grammar.

Overall, the metalinguistic tests were used to measure participants' metalinguistic knowledge, and the above findings showed their morphological awareness improved. Thus, it can be concluded that the NLT tool enhanced Chinese learners' metalinguistic skills in English.

It is important to consider that the lack of significant improvement in the overall metalinguistic test and other sub-tests does not necessarily imply the NLT feedback was ineffective or there was no improvement in metalinguistic awareness. There are several possible explanations for the lack of measurable score changes in the other metalinguistic tests. Some participants received less feedback. It may be because they (e.g., P5) had a high level of English proficiency and made fewer mistakes in writing as they had lived in an English-speaking environment (e.g., Canada) for a long time. Based on informal observations during the data collection process, Google Docs, as a mature commercial product, seemed to detect and prompt feedback faster than the NLT tool in most cases. Some participants immediately reacted to mistakes before the NLT tool displayed any prompts. They regarded the errors as regular errors and corrected them by accepting direct correction instead of paying attention to metalinguistic information and being self-reflective. This may have led to underestimating the effectiveness of NLT feedback. Additionally, the writing genre was limited to persuasive writing. Unlike narrative writing, there were not as many tense changes, which may have limited the potential for receiving NLT feedback. The effectiveness of feedback was influenced by the genre of the task (Kang & Han, 2015), which could negatively affect the evaluation of the NLT tool.

In addition, the gap between participant use and comprehension of NLT feedback also has impacts on the effectiveness of feedback. Zhao (2010) suggested that learners' understanding of feedback should be considered at least as important as learners' use of feedback in terms of how feedback mediates EFL writing development. Previous studies indicated that students integrated more teacher feedback than peer feedback in their redrafts (74% against 46%). However, they understood a larger proportion of peer feedback than teacher feedback (83% versus 58%) (Zhao, 2010). Other research also reported that learners preferred peer feedback over teacher feedback, and they were less likely to question automated feedback (Liaqat et al., 2021). These suggest it is possible that participants may have mechanically modified their writing according to the NLT or Google Docs feedback without processing the feedback deeply. As it was a time-limited writing task, they did not have access to external resources such as teachers or the Internet, which might have contributed to this issue. Additionally, some participants struggled with correcting errors due to a lack of ability in applying their new metalinguistic knowledge. In this case, participants were aware of the knowledge gap, but they were unable to correct errors.

In addition, the NLT feedback shares a disadvantage with other indirect corrective feedback. Participants needed to comprehend explanations based on their existing knowledge (Ferris & Roberts, 2001). A lack of essential grammar knowledge can limit their understanding of the feedback provided. The above factors may contribute to underestimating the potential benefits of using the NLT tool.

6.4 Research Question 4: What are the participant's perceptions of the usefulness and ease of use of the NLT tool when writing essays in English?

Understanding participants' perceptions is important for effective feedback since if they do not perceive the corrective nature of feedback or if their perception differs from feedback intentions, they may not benefit from it (Amrhein & Nassaji, 2010). Results of participants' responses indicated they appreciated receiving informative grammar feedback quickly through prompts and contrastive sentence examples. As a result of using the NLT tool, they paid more attention to grammar and developed certain aspects of their grammar awareness in writing tasks. The NLT feedback helped participants more accurately understand the differences between Chinese and English grammar rules, leading to increased focus on similar grammar in their subsequent writing. Overall, they felt the NLT tool was helpful in learning English.

However, some participants desired more feedback targeting sentence structure, including suggestions for alternative sentence patterns and synonyms. Additionally, they suggested the NLT tool should offer spell checking and non-NLT-related feedback to further improve its effectiveness and cater to a wider range of learners' needs because these basic functions are essential for English writing.

Participants thought the NLT tool was easy to use because the NLT tool provided a user-friendly interface and usage similar to the writing assistant tools that they were already familiar with. Participants also expressed a desire for the NLT tool to highlight errors in their essays so errors can be located more easily. The NLT tool was designed to be able to highlight errors in-text, but this feature did not work since Google Docs changed the API between when it was developed and when the study was conducted. The "example" button could also be made larger for easier interaction and the display window could be adjusted to allow for customization instead of having a fixed size.

The results indicated that participants recognized the perceived usefulness and perceived ease of use when using the NLT tool in essay writing. According to the Technology Acceptance Model (Davis,

1989), perceived usefulness and ease of use can explain students' attitude towards technology usage and their intention to use it. Therefore, these two key factors determine whether students will adopt and use a new technology. The results indicated the NLT tool has the potential to become a widely accepted and effective tool for overcoming negative language transfer in writing for Chinese learners of English.

6.5 Cultural Bias

Participants' attitudes were generally positive. Nevertheless, cultural bias may affect the attitudes of Chinese English students toward the NLT tool. For example, Chinese learners, having grown up in a collectivist culture may emphasize group harmony and cooperation. Thus, they may be less inclined to express negative opinions (Zha et al., 2006). This bias could potentially lead to the positive attitude observed towards using the NLT tool. Moreover, the Chinese education system placed a strong emphasis on examination performance, which may result in favorable attitudes towards the NLT tool because it may help students pass English exams or improve their test scores. The Chinese government has implemented proposed technology-related policies in schools through "Education information: 10 years development plan (2011–2020)", promoting the integration of technology into teaching and learning across subjects, including English (Li & Ni, 2011). Research has suggested that Chinese EFL learners and teachers generally hold a positive attitude towards technology use (e.g., Chang et al., 2021b; Huang et al., 2019). This technology trust may also contribute to their positive attitude towards the NLT tool. Additionally , Liaqat et al. (2021) found that immigrant ELLs may have a pro-technology bias across home cultures, suggesting that participants' attitude towards the NLT tool could be influenced by their technological orientation.

It is important to acknowledge the cultural bias inherent in the NLT tool itself. The tool reflected the perspectives and conventions of English-speaking cultures when identifying errors related to negative language transfer in English writing by Chinese learners. This can result in the tool inaccurately labeling language use that was acceptable or natural in Chinese culture as "incorrect" or "strange" from the perspective of English-speaking cultures. For example, the tool may identify certain grammar structures or vocabulary choices that are common in Chinese but not in English as errors. Consequently, the tool reinforced the notion that English was the only "correct" or "proper" way of expressing ideas while other cultural perspectives (e.g., Chinglish) were not valued or considered. This bias highlighted

the importance of taking into account diverse cultural perspectives when developing and using language support tools to ensure a more inclusive understanding of language learning.

6.6 Limitations

This study adopted a cross-over design, which offered some advantages, such as requiring fewer study participants and allowing participants to serve as their own controls. However, this design can also result in a carry-over effect from the previous intervention to the subsequent intervention potentially altering results (Heesen, 2020). For instance, participants in group A (who first used the NLT tool and then Google Docs) learned subject-verb agreement from the NLT feedback during their first writing task. As a result, they paid more attention to similar usage and scored higher on the second metalinguistic knowledge test. But it was less likely to observe similar score improvements from the second to the third metalinguistic test when they used Google Docs. Similarly, participants in Group B (who first used Google docs then the NLT tool) may have learned some knowledge like spelling from the first writing task, which had impacts on the evaluation of the NLT tool. Participants' knowledge was measured before the study, midway through the study, and at the end of study, which could partly account for the carry-over effects by measuring learning for each tool. However, this assumes that ceiling effects were not present. Including a washout period between two the use of the tools could reduce the carry-over effect, but estimating how long it takes to forget knowledge participants learned may be a challenge.

Some measures could be taken to minimize the impact of participants' varying English proficiency on evaluation results. For instance, during recruitment, participants could be split into two groups based on their disclosed English proficiency. Alternatively, an initial English proficiency test could be conducted before the study begins. Participants would then be grouped according to their test results, ensuring a balanced distribution of different proficiency levels across the two groups.

The Hawthorne Effect may also influence the results. Knowing their work is under study, participants might improve their writing or make extra efforts to correct their errors. This increased focus and effort could enhance their performance, irrespective of whether they used the NLT tool or Google Docs Grammar Checker. The Hawthorne Effect tends to diminish over time as participants become accustomed to being observed. Therefore, extending the duration of the study to a term may help reduce this effect.

This study only focused on the short-term acquisition of metalinguistic awareness and did not intend to measure long-term effects. In this study, awareness retention or decay were not considered (D

et al., 2009; Willingham & Dumas, 1997), which is common for early analyses of educational technologies. Later studies can investigate long-term effects of using the NLT tool and other writing assistant tools to better understand their impact on Chinese learners' English language development over time. For example, participants could use the NLT tool for a term, and researchers could examine how long it takes for them to start making changes to particular types of errors.

Metalinguistic knowledge in this study was assessed through a combination of four metalinguistic tests, but these tests did not cover all aspects of metalinguistic knowledge. For instance, prepositions and articles are two major areas of learning that were observed, but the tests did not include questions specifically addressing these areas, resulting in potential misunderstandings. Preposition knowledge might be measured by a guided cloze test where the participants could be asked to fill in gaps with appropriate prepositions of place, time, and direction (Saravanan, 2015). Regarding article knowledge measurement, while there was no test specifically designed to measure article usage, some subtests (e.g., The Boston Diagnostic Aphasia Examination) included questions about articles. Future research should consider incorporating a more comprehensive assessment of metalinguistic knowledge by including tests over a broader range of linguistic features, such as prepositions and articles, to better understand the impact of writing support tools like the NLT tool on learners' overall language proficiency.

All errors and corrections in this study were recorded by a combination of the Google Docs log and the NLT tool log. However, not every mistake or correction was recorded as some participants rectified an error promptly either through feedback or self-correction before any tools could capture the change. While keylogging is capable of recording all changes, it was not considered appropriate for this study. Firstly, this invasive technology would capture every keystroke made by learners which may make some learners uncomfortable and cause trust issues due to potential privacy violations. Additionally, keylogging captures more data than necessary for the study. It may provide too much noise or irrelevant information that is not useful for analysis (Leijten & Van Waes, 2013).

In addition to the above, the current study did not differentiate between self-corrections and corrections based on feedback from a specific tool. The attention data collected through the eye tracker will later be used to determine how learners processed corrections.

Notwithstanding these limitations, the results of this study addressed the research questions and expanded our understanding of language transfer from Chinese to English. This study also shed light on how technology affects Chinese learners' English writing, and it provided insight into grammatical transfer in the context of different types of automated feedback.

6.7 Implications

Despite the limitations, the findings contribute valuable information to the field of second language acquisition and have implications for the development of effective writing support tools to help learners overcome negative language transfer.

The results of this study provide evidence that using a tool like the NLT tool can improve learners' metalinguistic awareness and help them overcome negative language transfer. This study has important educational implications. Metalinguistic clues can enable learners to have a better understanding of the grammatical distinction between their L1 and L2, which is conducive to second language acquisition. This study's findings revealed that the NLT tool had a positive impact on participants' morphological knowledge, which supports the contrastive analysis theory that noticing and understanding are essential to language acquisition (Schmidt, 1994). In addition, eye-tracking data could be further analyzed to determine the relationship between participants' attention and feedback, providing additional insights into the learning process.

The study suggests that metalinguistic feedback provided by writing assistant tools can contribute to English writing pedagogy. Most instructors provide feedback on essays and require multiple drafts but few of them give grammatical feedback on all assignments. Giving feedback on all assignments is time-consuming and may not even be beneficial in the long term (Robb et al., 1986; Truscott, 1996). Moreover, few instructors offer feedback that focuses on errors related to students' native language. Incorporating the NLT tool into classes is a practical approach for EFL students in developing writing skills. As a result, students could receive immediate feedback without waiting for teachers' response while teachers would be able to reduce their workloads.

Understanding indirect corrective feedback that contains metalinguistic information requires a certain level of grammar knowledge, so students in middle and senior grades are more likely to benefit from such feedback. Ferris (2002) suggested that it is more beneficial to respond to recurrent patterns of errors in a focused manner, particularly rule-governed grammar such as articles and subject–verb agreement, than to respond to all errors. Teachers could use the statistical results of errors in the NLT tool to determine the extent to which students are negatively affected by Chinese, and to decide whether to provide additional instruction to strengthen students' weak grammar knowledge.

In addition to metalinguistic explanations, the NLT tool offers other unique advantages over traditional grammar checkers. The NLT tool uses contrastive sentences to illustrate the grammar differences, making the difference more intuitive for learners. Some supplementary teaching practices

can be incorporated to make the NLT feedback more effective. For example, teachers could remind students to review their past errors and feedback according to error history, as a way to convert short-term acquisition into long-term acquisition. In addition, Dowden et al. (2013) recommended that teachers and students should work together in order to resolve misunderstandings or miscommunications in the process of giving feedback. The present study also suggested that teachers should support students in developing self-reflection skills when correcting basic grammatical errors, as students need to understand the metalinguistic information within the context of their existing knowledge. Students should be taught how to effectively respond to NLT feedback and how to interpret metalinguistic information so they can make full use of NLT feedback. According to the Common European Framework of Reference (CEFR), intermediate (B1-B2) or advanced (C1 to C2) learners, who can comprehend the main ideas in a complex text and who have a certain level of grammatical understanding, might benefit more from using the NLT tool. In contrast, beginners (A1 to A2) who only understand and use common everyday expressions and phrases may not have enough knowledge of English to use this type of feedback.

Writing assistant tools that provide indirect corrective feedback such as the NLT tool could allow learners to be less dependent on traditional grammar checkers. The NLT tool promotes learners' self-reflection ability and supports them to become independent EFL writers. Participants have expressed their concerns about relying too much on the use of grammar checkers, using the NLT tool alleviates this worry. By using the NLT tool, learners can correct or enhance their English metalinguistic awareness, prevent grammatical errors related to negative transfer, and improve their English writing accuracy. Ultimately, they can write better English essays independently in the future, without having to rely on correction features.

6.8 Future Directions

Many studies have demonstrated that individual student differences have a significant impact on the learning process. Students' past English learning experiences and their personality influence how they respond to feedback. In addition, speaking different Chinese dialects, as well as mastery of other languages by students may affect how they experience language transfer. Therefore, exploring the influence of students' demographic characteristics and past English learning experiences on language transfer is a potential direction for future research. Due to the sample size and the scope of the study, this study did not conduct systematic analysis of student characteristics and language transfer. However,

with a larger sample size, educational data mining techniques such as classification, clustering, regression, and association rule analysis could help uncover the effects of student characteristics on language transfer.

Research has been conducted on the impact of specific Chinese dialects on language transfer, such as the Sichuan dialect (Ma & Tan, 2013) and the Wenzhou dialect (Huang, 2017). Among the various dialects, Cantonese is the most widely spoken, with about 120 million native speakers worldwide according to a 2019 survey (Tone, 2021). Therefore, an interesting direction for future research would be to examine the differential effects of Cantonese and Mandarin on English language acquisition and assess the efficacy of the NLT tool in mitigating negative transfer from Cantonese. This approach would provide valuable insights into unique challenges faced by Cantonese speakers when learning English and inform the development of targeted NLT tools to address these specific issues.

Beyond the variation in dialects, expanding the scope of this study to include oral English represents another potential research direction. Most Chinese students generally exhibit stronger English writing and reading skills than speaking skills. Participants In the current study reported that the impact of negative language transfer in writing may be less because they used similar sentence patterns in academic writing (e.g., lab reports), experienced relatively lower variation in tense (Caplan, 2019), and focused on topics closely related to their study and research. In contrast, oral English involves more spontaneous and dynamic language use, where speakers are expected to respond quickly during a conversation. Learners are more likely to encounter challenges with elements such as tense and inflection (Wong et al., 2021).

While certain types of errors (e.g., spelling, punctuation) may not be exposed through speech alone, learners are more prone to make errors related to subject-verb agreement, prepositions, and articles. These errors are likely more frequent in spoken English than in written English. Oral English also allows researchers to collect data on negative language transfer pronunciation, as Chinese learners may struggle with certain aspects of English pronunciation due to differences between the two languages. For example, Chinese has no consonant clusters and word pronunciation typically ends with vowels. Moreover, both writing and speaking are two types of language input suggested by researchers (Swain, 1985), and if participants can successfully circumvent negative language transfer while speaking in English, it would better demonstrate their ability to overcome negative language transfer.

However, tracking and analyzing data from spoken language can be challenging. To address this, Ortega-Llebaria and Calantoni (2014) conducted research on L2 English intonation using Praat which

allows for the analysis of different acoustic features of the speech. Using similar methods can help gain valuable insights into how negative language transfer appears in spoken English.

One recommendation for future research is to record the screen as participants write in English. This approach would record every error, correction, and reaction that occurs in the writing process, allowing researchers to analyze errors and participant behaviors with higher granularity. Errors could be categorized based on how they were corrected: errors corrected immediately without using feedback, errors corrected during learners' reviews without using feedback, errors corrected using NLT feedback, and errors corrected through Google Docs feedback.

In subsequent studies, attention analysis could be conducted. Attention data collected through eye-tracking glasses can be used to investigate the connection between attention and feedback. This data can be integrated with self-report engagement measures (Fredricks et al., 2005). A major challenge in educational technology integration is to engage students with diverse affective characteristics, motivations, beliefs, self-concepts, and emotions. To address this, affective data collected using the E4 wristband could be combined with questionnaire data (Pekrun et al., 2011) to measure participant emotions during study. This multi-faceted approach would provide a more nuanced understanding of how learners interact with feedback and help develop more effective NLT tools that cater to a wider range of student needs.

Chapter 7

Conclusion

Language transfer is a phenomenon where learners apply features and patterns from their first language (L1) to their second language (L2) when they encounter knowledge gaps. Such transfer can be beneficial to L2 writing development when the L1 and L2 share common structures or usage. However, due to differences between the two languages, such transfer can also lead to errors and impede L2 learning.

The structural differences between Chinese and English contribute to the prevalence of negative language transfer from Chinese to English. While previous research has examined various types of errors associated with negative language transfer and learners' perceptions, it has yet to adequately address how to overcome this negative effect.

This study employs a mixed-methods design aimed at investigating the impact of Chinese negative transfer on English writing among Chinese learners of English and their responses to writing support tools. This study evaluated the effectiveness of the NLT tool in improving learners' metalinguistic knowledge and examined participants' perceptions of using the NLT tool.

The results of this study indicate that all participants thought in Chinese while writing in English. Almost every aspect of English writing was affected by negative language transfer. The findings reveal that the most common errors were related to word use, sentence structure, and grammar. Grammatical errors included word order, verb tense and form, use of articles, singular and plural noun forms, and conjunction usage.

To mitigate negative language transfer, participants used various strategies. Some participants paid more attention by consciously reminding themselves of grammar rules, which supports the importance of notice in language learning. All learners used writing assistant tools, but only a few utilized them specifically to address negative language transfer. Participants mainly used two types of writing assistant tools: grammar and spelling checkers for checking accuracy, and translation tools for assistance with long and complex sentences.

None of these available tools focused on helping learners distinguish between Chinese and English grammar through metalinguistic information. Although grammar checkers provided error correction, they did not identify or relate errors to learners' native language like the NLT tool did. The NLT tool was specifically developed to offer indirect corrective feedback through metalinguistic explanations and a set of contrastive example sentences that highlight differences in grammar rules between Chinese and English. This approach prompts learners to consider the cause of errors and apply their newfound knowledge to rectify or prevent similar errors.

This study evaluated the effectiveness of the NLT tool in improving learners' metalinguistic knowledge. The results showed the NLT tool had a positive effect on the Morpho-Orthographic Choice Task score. Participants experienced significantly larger learning gains when using the NLT tool than when they did not. These findings suggest that the NLT tool drew learners' attention, prompting them to deeply process the feedback so that they understood it in the context of their existing knowledge. As a result, they acquired knowledge by self-reflection and applied this knowledge to correct errors. Specifically, participants learned new grammar or gained fresh insights into grammar concepts such as singular and plural nouns, articles, and prepositions.

In terms of perceptions of the NLT tool use, participants demonstrated strong perceived positive attitudes. They recognized that the NLT tool offers a user-friendly interface and helps them improve grammar knowledge while enhancing writing accuracy.

Overall, this study addressed the research gap in evaluating the effectiveness of a writing support tool in helping learners overcome negative language transfer and sheds light on how learners respond to such tools. This study also revealed how learners have used writing assistant tools and the impact of negative language transfer from Chinese on English learning.

Implementing a tool like the NLT tool in second language teaching has some implications. On the one hand, teachers can save time by not having to provide extensive corrections and instead focus on helping students understand the feedback provided by the tool when correcting basic grammatical errors. On the other hand, this approach encourages students to develop self-reflective skills and become independent language learners. Learning grammar through feedback from such tools also boosts students' confidence in their ability to self-correct. As a result, the NLT tool has the potential to change the way Chinese learners of English tackle negative language transfer, leading to more effective language learning experiences.

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Appendix A

Writing Prompts

Topic lists

Education

Technology

Community development

Movie

Work

Success

Health

Food

Travel

Friends

Games

Celebrity

History

Personal character

Government/company investment

Instruction*: You should write between 150 to 200 words. You should aim to finish writing in under 15 minutes.*

Education

Many people choose to attend or not to attend college or university for many different reasons. Why do you think people attend college or university? Use specific reasons and examples to support your answer.

Do you agree or disagree with the following statement? Grades (marks) encourage students to learn. Use specific reasons and examples to support your opinion.

Some students choose to attend schools or universities outside their home countries. Why do you think some students study abroad? Use specific reasons and details to explain your answer.

Technology

Do you agree or disagree with the following statement? Current technology allows students to learn more information and learn it faster. Use specific reasons and examples to support your answer.

Do you agree or disagree with the following statement? Modern technology is creating a single world culture. Use specific reasons and examples to support your opinion.

Do you agree or disagree with the following statement? Technology has made the world a better place to live. Use specific reasons and examples to support your opinion.

Community development

Should a city try to preserve its old, historic buildings or destroy them and replace them with new, modern buildings? Use specific reasons and examples to support your opinion.

A company has announced that it wishes to build a large factory near your home. Discuss the advantages and disadvantages of this new influence on the area where you live. Do you support or oppose the factory? Explain your position.

Some people think that human needs for farmland, housing, and industry are more important than saving land for endangered animals. Do you agree or disagree with this point of view? Why or why not? Use specific reasons and examples to support your answer.

Movie

Do you think movies are popular around the world? Use reasons and specific examples to support your answer.

Some movies are serious, designed to make the audience think. Other movies are designed primarily to amuse or entertain. Which type of movie do you prefer? Use specific reasons and examples to support your answer.

Do you agree or disagree with the following statement? Reading fiction (such as novels and short stories) is more enjoyable than watching movies. Use specific reasons and examples to explain your position.

Work

Some people prefer to own a business. Others prefer to work for an employer. Would you rather work for someone else or own a business? Use specific reasons to explain your choice.

Some people work because they need money to live. What are some other reasons that people work? Discuss one or more of these reasons. Use specific examples and details to support your answer.

Success

Do you agree or disagree with the following statement? Only people who earn a lot of money are successful. Use specific reasons and examples to support your answer.

In your opinion, what is the most important characteristic (for example, honesty, intelligence, a sense of humor) that a person can have to be successful in life? Use specific reasons and examples from your experience to explain your answer.

What is a very important skill a person should learn in order to be successful in the world today? Choose one skill and use specific reasons and examples to support your choice.

Health

In general, people are living longer now. Discuss the causes of this phenomenon. Use specific reasons and details to develop your essay.

People do many different things to stay healthy. What do you do for good health? Use specific reasons and examples to support your answer.

Food

Some people prefer to eat at food stands or restaurants. Other people prefer to prepare and eat food at home. Which do you prefer? Use specific reasons and examples to support your answer.

In many countries, traditional foods are being replaced by fast food. This has a negative impact on families, individuals and society. To what extent do you agree or disagree? Give reasons for your answer using your own ideas and experience.

Nowadays, food has become easier to prepare. Has this change improved the way people live? Give reasons for your answer using your own ideas and experience.

Travel

Do you agree or disagree with the following statement? The best way to travel is in a group led by a tour guide. Use specific reasons and examples to support your answer.

Many people visit museums when they travel to new places. Why do you think people visit museums? Use specific reasons and examples to support your answer.

You have the opportunity to visit a foreign country for two weeks. Which country would you like to visit? Use specific reasons and details to explain your choice.

Friends

Do you agree or disagree with the following statement? A person should never make an important decision alone. Use specific reasons and examples to support your answer.

It is sometimes said that borrowing money from a friend can harm or damage the friendship. Do you agree? Why or why not? Use reasons and specific examples to explain your answer.

Some people choose friends who are different from themselves. Others choose friends who are similar to themselves. Which kind of friend do you prefer for yourself? Why?

Games

Do you agree or disagree with the following statement? Playing games teaches us about life. Use specific reasons and examples to support your answer.

Do you agree or disagree with the following statement? Playing a game is fun only when you win. Use specific reasons and examples to support your answer.

Celebrity

Some famous athletes and entertainers earn millions of dollars every year. Do you think these people deserve such high salaries? Use specific reasons and examples to support your opinion.

Your city has decided to build a statue or monument to honor a famous person in your country. Who would you choose? Use reasons and specific examples to support your choice.

If you could meet a famous entertainer or athlete, who would that be, and why? Use specific reasons and examples to support your choice.

History

If you could go back to some time and place in the past, when and where would you go? Why? Use specific reasons and details to support your choice.

The twentieth century saw great change. In your opinion, what is one change that should be remembered about the twentieth century? Use specific reasons and details to explain your choice.

Personal character

What are some of the qualities of a good parent? Use specific details and examples to explain your answer.

What are some important qualities of a good supervisor (boss)? Use specific details and examples to explain why these qualities are important.

Neighbors are the people who live near us. In your opinion, what are the qualities of a good neighbor? Use specific details and examples in your answer.

Government/company investment

A company is going to give some money either to support the arts or to protect the environment. Which do you think the company should choose? Use specific reasons and examples to support your answer.

Some people think that governments should spend as much money as possible on developing or buying computer technology. Other people disagree and think that this money should be spent on more basic needs. Which one of these opinions do you agree with? Use specific reasons and details to support your answer.

Your school has received a gift of money. What do you think is the best way for your school to spend this money? Use specific reasons and details to support your choice.

Appendix B

Interview Protocol

Pre-Evaluation Interview

Language learning:

1. What has learning new languages been like for you?
2. What helped you the most with learning English? Why?
3. When you have to write something in English, what process do you use? (strategy)

Writing assistant tools:

4. What writing assistant tools have you used? (PC/Mobile App/Browser extensions/Grammarly)?
5. How did you use these tools (ask for each tool, top 3 listed, or best and worst)?
6. How did they help you?
7. How did they frustrate you?
8. What would your ideal writing assistant tool do?

Native language

9. How do you think your first language affects your English writing?
10. Which part of your English writing do you think is most affected by [participant's native language]?
11. How do you avoid your native language affecting your English writing? (What do you do?) (Example)
12. What do you do when a grammar checker tells you that you have made a mistake?

Post-Evaluation Interview

Negative Language Transfer tool:

1. How did you feel about receiving feedback from the tool?
2. What did you learn about how you write while you were using this tool?
3. Was there something that you wanted the tool to do and couldn't? (Ask them to describe it)
4. What would you like to see added to this technology to make learning easier for you?
5. What frustrated you about this tool?

Native language

6. How do you think your first language affected your English writing?
7. Which part of your English writing do you think was most affected by your first language?
8. How do you think this tool influenced your writing?
9. What would your ideal writing assistant tool do?

Chinese Version

评估前访谈

英语学习经历

1. 学习新语言对你来说是什么样子的?
2. 当你学习英语时，你觉得什么对你帮助最大？为什么?
3. 当你要用英语写东西时，你会采用什么步骤/策略?

写作工具

4. 你使用过哪些写作辅助工具？(电脑/手机应用/浏览器扩展/Grammarly)?

5. 你是如何使用这些工具的（问每一个工具，列出前三名，或最好和最差的）？
6. 它们是如何帮助你的(设计，功能)?
7. 它们是如何让你沮丧的？他们的那些地方你还不满意
8. 你理想中的写作助手工具会做什么?

母语

9. 你认为你的第一语言对你的英语写作有什么影响?
10. 你认为你的英语写作的哪一部分受[参与者的母语]的影响最大?
11. 你如何避免你的母语影响你的英语写作？(你是怎么做的？)(举例)
12. 当语法检查告诉你你犯了一个错误时，你会怎么做?

评估后访谈

负面语言迁移工具

1. 你如何看待从该工具接收反馈?
2. 在使用这个工具时，你学到了什么关于你如何写作?
3. 是否有一些你想做而做不到的事情？(请描述一下)
4. 你希望看到将哪些内容添加到此技术中，以使你更轻松地学习?
5. 这个工具的什么地方让你感到沮丧?

母语

6. 你认为你的第一语言是如何影响你的英语写作的?

7. 你认为你的第一语言对你英语写作的哪部分影响最大?
8. 你认为这个工具如何影响你的写作?
9. 你理想中的写作助手工具会做什么?

Appendix C

Questionnaire

This questionnaire was designed for participants in the negative language transfer experiment and was used for the research.

1. Participant ID *

General Questions

2. Please indicate how much you agree with each statement *Mark only one per row.*

	Strongly agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
The system was easy to use					
This tool can help improve my writing.					
I will keep using this tool.					
I will recommend this tool to my friends and family					

3. Which part of your writing do you want to improve the most? * *Check all that apply.*

- Grammatical errors
- Misused commas, periods, and other punctuation.
- Verb use
- Plural versus singular use
- Spelling mistakes
- Word use
- Text structure
- Argumentation

English Experience

4. Approximately how many years have you been learning English? *

Dropdown options range from less than 1 year to 27 years.

5. How many years have you lived in an English-language environment? *

Dropdown options range from less than 1 year to 27 years.

6. Have you ever taken an English test? * *Mark only one oval.*

Yes *Skip to question 7*

No *Skip to question 9*

English Test

7. What test did you use to meet your English language requirements? * *Mark only one oval.*

IELTS

TOEFL

iBT

Other:

8. What was your test score? *

Language

9. What other languages besides Chinese do you speak?

10. Which dialects of Chinese do you speak? *Check all that apply.*

Mandarin

Cantonese

Other: _____

Age

11. Year of Birth * *Mark only one oval.*

Dropdown options ranges from 1990 to 2005

Gender

12. What is your gender? *Mark only one oval.*

- Female
- Male
- Non-binary
- Prefer not to say

- Other:

Academic Information

13. What is the highest level of education you have completed? *Mark only one oval.*

- High school or Secondary school
- University degree
- MSc degree
- PhD degree
- Other:

Appendix D

Checklist in Study

Date: Researcher:

Participant ID: Group:

Language for interview:

Steps	Time (mins)	Notes
• Introduction	3	Overall process of the experiment the estimated time - 90 mins Ask participants whether they want to use Chinese or English?
• Acknowledgment signature (consent)	2	2 consent files
• Pre-interview	10	Use recorder
• Participants pick two writing questions on two topics	5	Create two docs

• Devices setup and calibration
  • Wear, adjust and calibrate eye tracker
  • Wear wristband
  • Start recording
  • Pupil Capture
  • E4 Streaming Server
	7	• *Anaconda Prompt: activate py38*
		• *cd C:\For_NLT_CaseStudy*
		• Make sure pupil detection confidence is consistently above 80%
		• Set project code and participant ID in Pupil Capture
		• EDA electrodes should line up between middle and ring fingers

• LabRecorder.exe		• *>>activate py38* *>>cd C:\For_NLT_CaseStudy* *>>python e4streaming.py*
• First metalinguistic knowledge test	7	
• First writing task	15	• Group A - with the NLT tool • Group B - without the NLT tool Use timer, emphasize time
• Second metalinguistic knowledge test	7	
• Second writing task	15	• Group A - without the NLT tool • Group B - with the NLT tool Use timer
• Devices removal	7	
• Third metalinguistic knowledge test	2	
• Post-interview	8	Use recorder
• Questionnaire	4	
• Pay and sign the payment form (thank them)	4	

Appendix E

Sensors Used in Study

Note. Empatica E4 wristband

Note. Eye-tracking glasses Pupil Core

Appendix F

Pilot

Metalinguistic calibration

I conducted a calibration study for the initial version of the metalinguistic knowledge tests in order to ensure consistent difficulty across versions.

Eight university students participated in the pilot study. Each participant completed three versions of the four metalinguistic tests. (Morpho-Orthographic Choice Task, Carlisle's Morphological Structure Test, Wug's Test, and Bee Grass Test). Descriptive statistical analyses were conducted, including minimum, maximum, mean, and standard deviation.

Due to the fact that participants' metalinguistic knowledge had not changed significantly in a short period of time, I expected that the performance of the three versions would be consistent for each participant if the difficulty between versions was roughly the same.

The assessment guidelines were also updated, more correct answer options were added, some half-correct answers were added, and the placements of answers were adjusted according to the same sequence order in tests to make the order of questions and answers consistent.

Table 1 shows the descriptive statistics of the metalinguistic tests before the pilot. The results revealed that the third version had lower means than the first and second versions for the Morpho-Orthographic Choice Task. For Carlisle's Morphological Structure Test, the mean of the second version was lower than the first and third versions. For Wug's Test, the mean of the first version was lower than the second and third versions. For the Bee Grass Test, the mean of the three versions was not significantly different.

Table 1

Descriptive Statistics Result of metalinguistic Tests Before the Calibration

	Morpho-Orthographic Choice Task			Carlisle's Morphological Structure Test			Wug's Test			Bee Grass Test		
	Version 1	Version 2	Version 3	Version 1	Version 2	Version 3	Version 1	Version 2	Version 3	Version 1	Version 2	Version 3
MIN	10	10	9	0	0	0	4	4	4	3	4	4
MAX	11	11	11	18	18	18	10	13	13	4	4	4
MEAN	10.9	10.9	10.4	13.3	14.6	15.3	7.5	10	10.4	3.9	4	4
SD	0.4	0.4	0.7	5.7	6.5	6.2	2.4	3	2.8	0.4	0	0

The question assignment to test versions was adjusted according to the result of the pilot. The principle of adjustment is that the types of questions traded between versions should remain the same, i.e., plural questions were replaced by plural questions and possessive questions were replaced by possessive questions within a subtest. More specifically, we identified the question with a high error frequency (relatively hard) in the version with a low mean score, swapped it with the question with a low error frequency (relatively easy) in the version with a high mean score, and reran the descriptive statistics analysis. We repeated this process until the mean and standard deviation scores of the different versions were close. Table 2 shows the descriptive statistics of metalinguistic tests after the calibration.

Table 2

Descriptive Statistics Result of Metalinguistic Tests After Calibration

	Morpho-Orthographic Choice Task			Carlisle's Morphological Structure Test			Wug's Test			Bee Grass Test		
	Version 1	Version 2	Version 3	Version 1	Version 2	Version 3	Version 1	Version 2	Version 3	Version 1	Version 2	Version 3
MIN	10.0	10.0	9.0	14.0	16.0	16.0	9.0	9.0	9.5	3.0	4.0	4.0
MAX	11.0	11.0	11.0	18.0	18.0	18.0	12.0	12.5	13.0	4.0	4.0	4.0
MEAN	10.6	10.9	10.6	16.6	16.9	17.4	10.4	10.7	10.8	3.9	4.0	4.0
SD	0.5	0.4	0.7	1.4	1.1	0.9	1.5	1.3	1.1	0.4	0.0	0.0

The assessment guidelines were also updated, more correct answer options were added, some half-correct answers were added, and the placement of answers were adjusted according to the same sequence order in tests to make the order of questions and answers consistent.

After balancing the items across subtests using the descriptive statistics, I applied a one-way repeated measures ANOVA to check whether there were differences among metalinguistic tests. The results revealed that there was no statistically significant difference in the mean scores for each of the Morpho-Orthographic Choice Task ($F(2,12) = .46$, $p = .64$, $\eta_p^2 = .07$), Carlisle's Morphological Structure Test ($F(2,12) = .96$, $p = .41$, $\eta_p^2 = .14$), Wug's Test ($F(2,12) = .18$, $p = .84$, $\eta_p^2 = .03$), and Bee Grass Test ($F(2,12) = .46$, $p = .40$, $\eta_p^2 = .14$), which suggests that the three tests have the same difficulty level. There also was no significant difference in the overall score across test versions ($F(1,7) = .98$, $p = .36$, $\eta_p^2 = .12$).

Pilot Interviews

Four university students participated in the pilot interviews. Two of the interviews were conducted in person, and the other two were conducted online. Pre-interviews and post-interviews were conducted consecutively according to the interview protocol with no experiments in between. The details are explained below, and pseudonyms are used to identify participants.

The first pilot was conducted with Lane. Since Lane is a native English speaker, the interview process did not include questions about the impact of native language on English writing. Lane indicated that she had not used any writing assistant tools. People actually use at least some support features, such as automatic spelling correction, automatic grammar checking, or auto-completion. The fact that

Lane was unaware that these tools are used to assist her was illustrated by her response when I mentioned that Google Docs included a spelling checker by default. Lane expressed its perceived disadvantage like the feedback was provided slowly - she found that she often received feedback from tools after she had already found the error by herself. As a result, the interview questions were revised to add more guidance, and I will prompt the participant if they are unaware of the features of writing assistant tools or do not know what to say.

The second pilot was conducted with Miao, a native Chinese learner of English whose background is more similar to those of the intended participants. This interview was conducted in Mandarin. The main feedback I received during the interview was that the descriptions in the interview questions were too broad and abstract, making it difficult to provide answers. Most changes in the interview protocol were related to adding more examples to help interviewees when they are having difficulty responding. In addition, I am able to conduct the interview in Chinese if the participants prefer it, as this will allow them to express themselves more clearly and explicitly.

The third participant is Robert, a native Chinese English learner. The interview practice process was relatively smooth. The participant noted that the native language section of the pre- and post-interviews contained the same questions. I kept this structure because it could help highlight changes in learner perspectives that are due to their experiences using the negative language transfer tool. There were no further changes made after the interview with the fourth participant Tory because the interview went well.

The final interview protocol was improved using the feedback and suggestions from the interview pilots. To reduce ambiguity, some words were modified to make question expressions easier for participants to comprehend and more consistent with the meaning of what we intended to ask. The length of the questions was adjusted by adding or deleting words so as to ensure that the sentences were concise and complete. The English version was reviewed by a researcher who has experience in interview protocol development, and the Chinese version was reviewed by Xiaoyang, a Chinese editor who majored in editing and publishing and has work experience in the book industry.

Appendix G

NLT Feedback in the Study

Sentences with negative language transfer error and the feedback provided by the NLT tool

ID	Sentences written by participants	Feedback provided by the NLT tool
1	There are some city choose to	Chinese does not differentiate between singular or plural verb forms. English uses different verb forms for singular or plural subjects.
2	One of the must go places has to be Hokkaido.	Some English words use hyphens to connect two words, Chinese doesn't
3	For example, in one research program, every team member has their own specific task and they need to make a plan in advance, then need plan the meeting to summarize and integrate their results	Chinese does not have infinite form. In English, when the verb is in the base form (e.g. to be, to go) the word "to" comes before the verb to show that the verb is in infinitive form.
4	Therefore, everyone just need to enjoy all the games, do not care whether you can have a good end	English uses the suffix "-s" on verbs to show 3rd person present tense. Chinese does not have such suffix.
5	Therefore, everyone just enjoy every game, do not care whether you can have a	English uses the suffix "-s" on verbs to show 3rd person present tense. Chinese does not have such suffix.
6	Have fun and enjoy game.	Chinese does not have articles. English uses articles before nouns.
7	As we known, most of people are working for a company, and some people are working for their own business.	Chinese may include or exclude the missing verb. In English, the verb must be used.