Global and Local Cognitive Processing in Paraphrasing and Translation: A Comparative Study Using Eye-Tracking and Retrospective Protocols

Tianyi Han and Dechao Li
The Hong Kong Polytechnic University

Xingcheng Ma
Southeast University

Intralingual translation is an essential linguistic mediation that facilitates the interpretation of meaning, and paraphrasing is a typical case in point. While paraphrasing exercise has found wide application from translation training to language learning, little attention has been paid to its cognitive processes in texts with different textual and sentential features. Considering its resemblance to interlingual translation, we conducted a comparative study to investigate the text- and sentence-level cognitive processes during translation and paraphrasing using eye-tracking and retrospective protocols. Sixteen student translators were invited to perform translation (English-Chinese) and paraphrasing (in English) tasks. The experimental texts were selected in different genres and included sentences with different difficulty levels. Their eye movements were recorded as indicators of cognitive load and attention shift pattern, and retrospective interviews were conducted to uncover their mental processing more explicitly. The results showed that (1) At the textual level, English-Chinese (E-C) translation and English paraphrasing induced comparable overall cognitive load during the comprehension process and showed a similar pattern of attention shift, whereas, in target text production, English paraphrasing elicited an increased cognitive load which may result from an additional burden of the second language (L2) production as well as a lack of subliminal semantic bilingual priming; (2) The effect of genre on the text-level cognitive load differed significantly between E-C translation and English paraphrasing, indicating a genre-specific strategy which is more salient in translation;(3) In the sentence level, sentence difficulty affected the cognitive load during both tasks especially E-C translation, and (4) the effect of sentence difficulty on two tasks was also modulated by the text genre. This interaction effect is possibly due to a shallow processing strategy in paraphrasing difficult sentences, which is more applicable in tourism texts. These findings provided preliminary evidence for the shared ground and differences in cognitive processes between translation and paraphrasing. Meanwhile, they revealed the vital role of several influential factors such as text genre, sentence difficulty, and language proficiency.

Keywords： paraphrasing, cognitive processing, global and local analysis, eye-tracking

Introduction

Translation can be perceived as a representative process of linguistic mediation, during which the content of the meaning is reformulated into different forms to facilitate communication (Whyatt, 2017). Jabokson (1959) classifies translation into three types: interlingual, intralingual, and intersemiotic. Intralingual translation, also known as rewording or paraphrasing, has a widespread practice in daily life, such as updating aging texts and reproducing specialized texts in plain language for nonexpert communication (Whyatt, 2017). However, this type of translation has received peripheral status in translation studies (Zethsen, 2009). Not many studies have been carried out on it, especially from a cognitive perspective. Consequently, much uncertainty still exists on the cognitive processing of intra-lingual translation and how it overlaps with or differs from interlingual translation. Besides, it is also unclear whether these translation processes are conditioned by potential factors like text genre and sentence difficulty.

This study adopted a comparative approach between interlingual translation and intralingual paraphrasing in light of these research gaps. We explored the global and local cognitive processing of translation and paraphrasing and investigated the modulation effects of text genre and sentence difficulty. The

Tianyi Han and Dechao Li, Department of Chinese and Bilingual Studies, The Hong Kong Polytechnic University, Hong Kong, China; Xingcheng Ma, School of Foreign Languages, Southeast University, Nanjing, China.

The work reported in this paper was supported by a General Research Fund (GRF) grant (Project No. PolyU 15600419) from the Research Grants Council of Hong Kong for Dechao LI and partially supported by the Social Science Funding of Jiangsu Province (No.21YYC006), Jiangsu *Shuangchuang* Talent Program (No. JSSCBS20210101), and the Fundamental Research Funds for the Central Universities (No. 2242021R40017) for Xingcheng Ma.

Correspondence concerning this article should be addressed to Dechao Li, Department of Chinese and Bilingual Studies, The Hong Kong Polytechnic University, Hong Kong, 999077, China. E-mail: dechao.li@polyu. edu.hk

global analysis examined participants' text-level cognitive load and attention shift patterns between the source text (ST) and the target text (TT). In the local analysis, we narrowed our focus to the cognitive load in specific experimental sentences. Eye-tracking data were collected and further interpreted with retrospective interviews to reveal the underlining mental processing. These attempts are expected to deepen our understanding of the similarities and differences in cognitive processing between translation and paraphrasing and hopefully provide pedagogical insights into applying paraphrasing exercises in translation training.

Inter- and intra-Lingual Translation: Translation and Paraphrasing

Interlingual and intralingual translation are two typical examples of language mediation (Whyatt, 2017). According to Jabokson (1959), interlingual translation refers to a reformulation of the linguistic signs using another language. This practice has caught much attention of translation scholars (Whyatt, 2017; Zethsen, 2009). Intralingual translation, identified as an alternative way of expressing the message using different forms of the same language, has been a more peripheral area in translation studies (Jabokson, 1959; Zethsen, 2009). Despite its inferior research status, it has a widespread applications such as audio description, rewriting, and localization (Whyatt, 2017). One example of intralingual translation is paraphrasing. The term "paraphrasing" can be understood from different angles (Vila et al., 2014), such as a strategy adopted in translation and interpreting (Li, 2015; Zethsen, 2009) or an activity that uses different ways of expression to achieve a resemble equivalence of meaning (Barzilay, 2003; Bhagat & Hovy, 2013). To compare with interlingual translation, we follow Bhagat & Hovy's (2013) definition and consider paraphrasing as a process of rewording or rephrasing the original message within one language based on the skopos of the new text (Campbell, 1998). This process usually involves successful conceptual comprehension of an original text (Uemlianin, 2000) and appropriate reconstruction of a new text within a certain degree of flexibility to avoid copying verbatim (Hirvela & Du, 2013; Zethsen, 2009).

Similarities and Differences Between Translation and Paraphrasing

Previous studies have introduced a family resemblance between translation and paraphrasing as well as some unique characteristics of their own (Whyatt, 2017; Zethsen, 2009). In terms of the similarities, translation and paraphrasing generally share similar processes and adopt transferable strategies. First, both tasks involve the processes of decoding meaning from the original text and mapping the meaning using different linguistic forms, during which similar mental operations are required, such as planning, self-monitoring, and self-revision (Whyatt et al., 2016; Whyatt & Naranowicz, 2020). This metacognitive resemblance further leads to similar processing stages observed in the performance, including orientation, drafting, and revision (Jakobsen, 2002; Whyatt et al., 2016). Besides, the production of both tasks is characterized by comparable linguistic and cognitive constraints, for instance, lexical retrieval problems and limited working memory capacity (Kruger, 2012; Whyatt et al., 2016). Consequently, the strategies adopted in paraphrasing are often shared with translation, such as omission, objective addition, and stylistic simplification (Whyatt et al., 2017; Zethsen, 2009).

Notwithstanding the procedural and conceptual similarities, Whyatt et al. (2016) point out that the essential difference between translation and paraphrasing lies in the number of languages involved. Specifically, translation with a switch between different languages leads to additional bilingual processing costs, mainly due to code-switching and cognitive control of the activation of two languages (Green, 1998; Whyatt et al., 2017). By comparison, paraphrasing, which only requires monolingual processing, is expected to cause less cognitive load. Apart from the difference in the number of activated languages, Kruger (2012) also captures their unique characteristics concerning linguistic constraints. The author argues that although both tasks are ST-constrained derived activities, the former involves a more prominent component of free and unconscious language production. In contrast, the latter tends to be more restricted by the existing ST and more conscious of cognitive processes like lexical selection and structural reformulation. This distinction indicates that paraphrasing is also a complicated meta-linguistic task and is not necessarily less demanding than translation (Whyatt et al., 2017). These differences directly affect the processing effort during translation and paraphrasing tasks.

Empirical Cognitive Explorations Through a Comparative Approach

To reveal the overlaps and divergences between translation and paraphrasing, researchers have conducted several empirical studies comparing two tasks from a cognitive perspective, thanks to the burgeoning technologies of eye-tracking and key-logging. Whyatt et al. (2016) combined eye-tracking, key-logging, and screen-capture software to compare the processing effort and cognitive rhythm in English-Polish translation and Polish

paraphrasing tasks performed by professional translators. The results preliminarily confirmed an overall higher processing effort in translation with longer task time, lower processing speed, and denser fixations in ST, but with a comparable behavior pattern of text production and problem-solving pauses among both tasks. This study provides supporting evidence on the shared ground and uniqueness between translation and paraphrasing and, meanwhile, sheds light on the effectiveness of this comparative approach. Subsequent studies have further made tentative explorations on several aspects of the cognitive processing of translation and paraphrasing, including the decision-making process, mental operations, the use of stylistic simplification and explicitation strategies, and the effect of translation expertise (Kajzer-Wietrzny, 2019; Whyatt et al., 2017; Whyatt & Naranowicz, 2020). These attempts contribute to uncovering the extent to which translation and paraphrasing resemble and differ from each other. However, one notable limitation of these studies lies in the limited types of languages investigated, mainly Indo-European languages. This limitation calls for a need to explore the cognitive processing between translation and paraphrasing from various other language combinations, and one example could be Chinese and English.

Paraphrasing Exercise in the Development of Language Competence

Given the shared ground between translation and paraphrasing, paraphrasing exercise has been adopted in the translation and interpreting training to enhance students' sub-skills of 'analyzing, synthesizing, and evaluating the original text' (Cheung, 2016; Choy & Lee, 2012). As mentioned above, paraphrasing has been recognized as an effective strategy, especially when no appropriate equivalence is available in the target language and an explicit explanation of the intended meaning is required (Li, 2015). For example, Cheung (2016) examined the effectiveness of paraphrasing exercises in trainees' interpreting performance and confirmed a remarkable correlation between the progressive training of paraphrasing and the improvement of students' interpreting expertise. Critically, this pedagogical value of paraphrasing seems to also exist in translation training, as studies have discovered a possible transfer of sub-skills between two tasks such as planning, self-monitoring, and meaning reformulation (Whyatt, 2018; Whyatt & Naranowicz, 2020). However, paraphrasing is seldom incorporated into the translation training nowadays, at least in the curricula in Hong Kong-based universities, probably due to an under-explored relation between translation and paraphrasing (Yan et al., 2018). Therefore, more studies on a comparative investigation of translation and paraphrasing are required to enrich our knowledge and offer theoretical guidance for the pedagogical application of paraphrasing practice in translation training.

Potential Factors Modulating the Cognitive Processing of Translation and Paraphrasing

Previous research has started to investigate possible influential factors in the processing of translation and paraphrasing, for example, the effect of translation expertise (Kajzer-Wietrzny, 2019; Whyatt, 2018; Whyatt & Naranowicz, 2020). However, other factors may also modulate cognitive processing but have been far underestimated. The current study takes a step further by examining two types of text-related factors: sentence difficulty and text genre.

Effect of Sentence Difficulty in Translation and Paraphrasing

Sentence difficulty has been acknowledged as one of the critical external factors leading to comprehension problems during translation (see Hatzidaki, 2007). Translation problems can arise when the sentence structure is too complicated to be recognized successfully on the first reading (Mishra et al., 2013). It can also occur when the intended meaning of a sentence goes beyond its literal interpretation, which requires an additional need to make an inference (Jensen, 2012). These two dimensions, namely syntactic complexity and semantic non-literalness, were both included to reflect sentence difficulty in this study.

Syntactic complexity is one of the properties closely correlated with sentence translation difficulty (Liu et al., 2019; Mishra et al., 2013). A complex syntactic structure in a sentence induces a complicated relationship among linguistic elements and therefore requires extra processing effort (Givón & Shibatani, 2009; Hatzidaki, 2007). For example, relative clauses in English-Chinese translation and interpreting are considered to display high syntactic complexity, evidenced by a more frequent rereading pattern and an increased cognitive burden during the comprehension phase (Ma, 2021; Ma et al., 2022; Tsai, 2015).

Semantic non-literalness is also expected to be a contributor to sentence translation difficulty, and one representative can be metaphorical expressions (Hatzidaki, 2007). The metaphor refers to expressions whose meaning needs to be interpreted through a mapping between two distinct yet linked concepts (Gibbs Jr & Colston, 2012). Clark & Lucy (1975) proposed the Three-stage Model to demonstrate the complicated mental operations involved in the interpretation of the metaphorical expression, which consists of an initial interpretation of the literal meaning, an examination for plausibility based on the context, and a re-interpretation of the intended meaning when problems are

detected. The conflicts that emerged during the examination impede people's comprehension and induce a highly demanding cognitive load. Studies have widely confirmed the effect of metaphorical expressions on cognitive loads using different methods such as think-aloud protocols, key-logging, and eye-tracking (Sjørup, 2008; Sjørup, 2013; Tirkkonen-Condit, 2002).

To the best of our knowledge, empirical studies on cognitive processing in translation mainly focus on a global analysis of the overall textual difficulty (Cui & Zheng, 2021; Hvelplund, 2011; Liu et al., 2019). Local analysis of specific sentence-level processing difficulty, a popular research focus in interpreting studies, has not received much attention from translation scholars (Gile, 2008; Liang et al., 2017; Ma, 2021). Besides, paraphrasing has been introduced as an effective strategy to cope with the translation of difficult sentences by using a simpler equivalent for a complex structure or explaining the implicit meaning of the original segment (Li, 2015). However, there has been no empirical evidence that the mental processing of a single sentence is largely overlapped between translation and paraphrasing.

Effect of Text Genre in Translation and Paraphrasing

Izquierdo (2000) regards genre as a categorization of texts according to their primary function and intended purpose. To achieve a specific function, texts of a particular genre tend to be characterized by certain language styles, structures, and content features (Hvelplund & Dragsted, 2018; Munday, 2016). For example, an informative text type such as a news report aims at representing information about specific events. Accordingly, the language used to transmit the message is always logical or referential, and the content needs to be explicit and clear. By contrast, a tourism promotional text categorized as the operative text type attempts to achieve particular effects on the target reader (to attract potential tourists for a trip). Therefore, this type of text is featured by dialogic languages and appellative-focused content (Munday, 2016). Concerning the translation practice, text genre is one of the critical determinants in the decision-making process and the adoption of translation methods (Biel, 2018; Munday, 2016). Montalt et al. (2008) further argue that genre consolidates the translator's textual and communicative sub-competencies by training their ability to recognize, analyze, and produce texts appropriately according to diverse sociolinguistic situations (Kelly, 2005). In paraphrasing, several product-oriented studies have also reported that source text genre can shape paraphrasing type and behaviors (Deléger & Zweigenbaum, 2008; Kim et al., 2015). Nevertheless, little is known about how genre influences the paraphrasing process from a cognitive perspective and whether this effect shows unique characteristics compared to the translation process.

The Current Study

This study adopts a comparative approach to explore the cognitive processes during translation and paraphrasing, combining both a text-level global analysis and a sentence-level local analysis. It further investigates the modulating effect of sentence difficulty and text genre during processing. We use the eye-tracking data triangulated with participants' retrospective protocols to answer the following research questions:

RQ1: What are the similarities and differences between. English-Chinese translation (E-C translation) and English paraphrasing in the text-level cognitive processing?

1a. Whether and to what extent does E-C translation differ. from English paraphrasing in terms of the cognitive load and attention shifts?

1b. Whether and in what way does source text genre affect. the participants' cognitive load and attention shift pattern during translation and paraphrasing? Besides, are these effects, if any, comparable between translation and paraphrasing?

RQ2: What is the effect of sentence difficulty on the. sentence-level cognitive load during translation and paraphrasing

2a. What are the similarities and differences between E-C. translation and English paraphrasing when coping with sentences of different difficulty?

2b. How does source text genre affect the sentence-level cognitive load during translation and paraphrasing? Are these effects, if any, comparable between translation and paraphrasing?

Methodology

The current study belongs to a larger research project on a process- and product-oriented investigation on translation and paraphrasing using eye-tracking, key-logging, and retrospective protocols. As here we restrict our focus to cognitive processing, the methodology in this article only includes eye-tracking and retrospective protocols.

Cognitive Investigation Using Eye-Tracking and Retrospective Protocols

In recent years, eye-tracking and retrospective protocols have

received increasing attention in the process-oriented research in translation studies, both of which offer a window into the cognitive processes hiding behind the external behavior (Ferreira, 2014; Ma, 2021). Based on the eye-mind hypothesis (Just & Carpenter, 1980), researchers can use eye-tracking metrics to reveal the real-time processing effort and the allocation of attention (Hvelplund, 2014). This method has been widely adopted in combination with the retrospective protocol, an explicit verbalization of the translation process, to achieve data triangulation (Cui & Zheng, 2021; Ferreira, 2014; Schmaltz, 2018). In this study, three eye-tracking metrics were calculated: average fixation duration (AFD), average fixation counts (AFC), and attention shifts (AS). The former two metrics indicate the cognitive load during processing, generally with a longer AFD and more AFC in a more cognitive demanding process. The latter one shows how many times participants switch their attention between the source text (ST) and the target text (TT), which reflects the allocation of cognitive resources during a task (Hvelplund, 2011).

Participants

Sixteen participants' data were selected for the present analysis. The participants, including thirteen females and three males aged 22 to 28 (M = 23.81, SD = 1.55), were Mandarin-English bilingual speakers with Mandarin as their dominant language and English as their first foreign language. They were postgraduate students majoring in translation and interpreting at universities in Hong Kong and had been trained in translation skills for at least 12 consecutive weeks. Based on the background questionnaires, only those who had obtained a TEM-8 (Test for English Majors-Band 8) [1] certificate or scored at least 6.5 on the IELTS (International English Language Testing System) exam were selected to ensure their upper-intermediate or advanced proficiency level in English. The participants were confirmed to acquire the blind typing skill and have a normal or corrected-to-normal vision. Each was paid HKD 200 for their participation.

Design and Materials

Each participant was required to perform an E-C translation task and an English paraphrasing task. There were three within-subject independent variables in the experiment design: our primary focus of task mode (translation vs. paraphrasing), together with text genre (news text vs. tourism text) and sentence difficulty (critical sentence vs. control sentence) as two modulating factors.

The experiment contained four English STs, including two news reports and two tourism promotional paragraphs. All the texts were selected from official online websites [2] and were controlled in length ranging from 155 to 165 words. Several key textual features were matched by changing low-frequency words and revising some syntactic structures without altering the original meaning (see Table 1). We minimized our artificial revisions to enhance ecological validity. Four PhD students in Translation Studies were invited to give feedback on the coherence of the manipulated texts and evaluate the translation difficulty of each text as well as each sentence through a 5-point Likert Scale questionnaire. The ratings on the texts confirmed an equal level of textual difficulty among all texts (Appendix A).

Furthermore, we selected three critical sentences with a higher-level difficulty and three control sentences as a baseline in each genre based on the ratings of sentence difficulty, resulting in 12 experimental sentences (see Appendix B). Critical sentences were the ones that contained either complex relative clauses or metaphorical expressions and, more importantly, showed a significantly higher degree of translation difficulty compared to control sentences (t = 4.874, p = .001).

Table 1

Summary of the Textual Information of Four Source Texts

	Text 1	Text 2	Text 3	Text 4
Genre	News	News	Tourism	Tourism
Word count	165	158	155	157
Percent of complex words	13.94%	20.25 %	12.90 %	17.83%
Flesch Kincaid Reading Ease	48.2	48.2	46.3	42
Flesch Kincaid Grade Level	11.7	10.9	13.2	13.9
Automated Readability Index	13.4	12.1	14.6	13.9

Note. Flesch Kincaid Reading Ease uses a score between 1 to 100 to reflect the readability of a text based on several core measurements such as word length and sentence length. A more difficult text receives a lower score. The score can be further converted into the Flesch Kincaid Grade Level, implying the approximate grade level needed for a successful understanding. The Automated Readability Index provides another assessment of the required grade level in America to understand a text. This assessment highlights the importance of the character length in words and sentences.

[1] TEM8 is widely used in China to evaluate the overall English proficiency of undergraduates majoring in English.

[2] The news reports were selected from the Financial Times (Chinese) Website (http://www.FTChinese.com), and the tourism promotional texts were selected from the TripAdvisor Website (https://en.tripadvisor.com.hk/).

Each task included two texts of the same genre (either news or tourism) in the experiment. Task order and the genre type in two tasks were counterbalanced among participants using the Latin Square Design.

Procedure

We used *Tobii Studio 3.4.8* to program the experiment and *Tobii TX300* to record the eye movement data with a frequency of 300 HZ. In addition, *Translog II* was adopted to record participants' eye-tracking and key-logging activities. Before the experiment, participants were asked to sign a consent form and read instructions on the whole procedure. Then they went through a warm-up practice to get familiar with the calibration and task requirements. At the beginning of the experimental task, they passed a 9-point calibration and then read detailed instructions on this task. The instruction specified the desired function of the output text based on the text genre in this task. For news texts, participants were required to provide the readers with complete information about a news report. For tourism texts, they were asked to produce an appropriate text in a travel brochure to attract potential visitors. Next, they went through another 5-point calibration under a stricter validation. By pressing a recording button, they started the translation/paraphrasing task on the computer. They were assigned the task with a randomly selected text genre. If the translation task included two news texts, the tourism texts would be accordingly presented in the paraphrasing task. The source text was displayed in the top window during the task, and participants typed their output at the bottom. They were not allowed to shake their bodies drastically or access external resources such as electronic dictionaries and the Internet. A list of low-frequency words was provided beforehand to avoid extra comprehension difficulty of unfamiliar words. After finishing the first task, participants had a five-minute break and then moved on to the second one. Retrospective interviews were carried out after both tasks were completed, during which participants watched fast-forwarding video recordings of their translation and paraphrasing processes. They were encouraged to pause it at any time and explain reasons for observed behaviors that might indicate processing difficulties. Meanwhile, the experimenter also asked questions to elicit participants' perception of task difficulty, their self-evaluation of the performance, and explanations of strategies. There was no time limit for each task, and the whole experiment took approximately two hours.

Data Processing and Statistical Analysis

In terms of the eye-tracking data, we first checked the gaze sample, which indicates the quality of the eye data. All the data files reached the baseline of 84%. For each participant, abnormal fixations of fewer than 60ms were discarded, and adjacent fixations of less than 75ms were merged. To conduct a global analysis, we considered each ST and TT region as an Area of Interest (AOI). Furthermore, we set each experimental sentence in ST as an AOI to perform local analysis. All the AOIs were created manually based on the visual assessment of each participant's fixation distribution. This laborious work can ensure the accuracy of fixation data despite individual variants of calibration deviation. Participants' AFD and AFC in an AOI were indicators of cognitive load in the fixated area. The former was exported directly from the Tobii studio, and the latter was calculated by dividing the total fixation counts by the number of words involved in ST. Besides, the number of AS between ST and TT was an indicator of the global attention shift pattern. It was calculated based on the visit count data between ST and TT and further rechecked thoroughly.

Data of three indicators were collected for statistical analysis in R.4.1.1(R Core Team, 2019). We first evaluated the data distribution in each data set using *qqnorm* and *plot* packages (Courtney & Chang, 2018) and removed the outliers accordingly. Then we used the linear mixed-effect (LME) model to analyze the remaining data via the *lme4* package (Bates et al., 2015), adopting the maximal random effect structure justified by the data through a forward model comparison approach. Random slopes for interaction predictors with a significant value lower than .20 were considered to improve the model fit significantly and included in the final model (Matuschek et al., 2017).

All the recordings of the interview were transcribed and double-checked manually. These data were used to complement the eye movement results for discussion and were not included in the statistical analysis.

Results

Global Analysis of Cognitive Processing in Translation and Paraphrasing

The global analysis focused on the text-level cognitive loads (indicated by AFD and AFC) and the attention shift pattern between ST and TT (indicated by AS). First, we looked at the average task time for each task summarized in Table 2. There seems to exist a potential modulating effect of text genre on two tasks, indicated by a longer task time spent on news texts in the translation task but the opposite in the paraphrasing task. This hypothesis needs to be further verified by inferential statistics.

Table 2

Average Task Time for Translation and Paraphrasing in Different Genres

	Genre	
Task	News	Tourism
E-C Translation	1314.19	950.88
English Paraphrasing	1166.94	1202.25

Cognitive Load in Translation and Paraphrasing Tasks

To analyze AFD and AFC, we built two LME models for ST and TT regions separately for each variable, including Mode (Paraphrasing vs. Translation) and Genre (News vs. Tourism) as interacting predictors and Participant and Text as random intercepts. We scaled all the predictors using *scale* package (Becker et al., 1988) and applied inverse transformation and log transformation to the AFD and AFC data respectively for the Linear Mixed-effect Model analysis.

In terms of the AFD, three out of 64 data points were discarded as outliers in the ST region (4.69% of all data). Table 3 presents the results of the final model. No significant difference was found in the two tasks, showing that the AFD was comparable between translation and paraphrasing in the ST region irrespective of text genre (Figure 1).

Table 3

Results of the LME Model for Average Fixation Duration in ST

	Estimate	Std. Error	df	t value	Pr(>|t|)
cMode	0.049	0.036	10.722	1.376	0.197
cGenre	0.033	0.043	5.159	0.753	0.484
cMode:cGenre	0.135	0.126	13.944	1.073	0.302

Note. Model: lmer (TransResults~ cMode*cGenre + (cMode + cGenre + 1|Subject) + (1|Text)

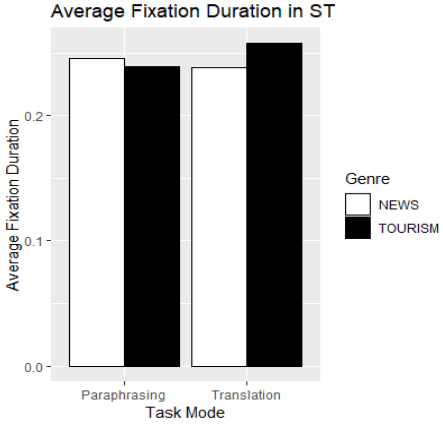

Figure 1. AFD in ST during translation and paraphrasing in different genres.

Two outlier data were removed in the TT region (3.13% of all data), and the results were presented in Table 4. We found a significant main effect of task mode, with a longer AFD in the English paraphrasing task than in the E-C translation task (t = −4.44, p = .002). The text genre did not significantly influence the AFD in the TT region.

Table 4

Results of the LME Model for Average Fixation Duration in TT

	Estimate	Std.Error	df	t value	Pr(>|t|)
cMode	-0.250	0.056	9.214	-4.441	0.002 **
cGenre	0.012	0.055	8.606	0.226	0.826
cMode:cGenre	0.211	0.128	14.249	1.652	0.120

Note. Model:lmer (TransResults~cMode*cGenre + (cMode + cGenre + 1|Subject) + (1|Text)

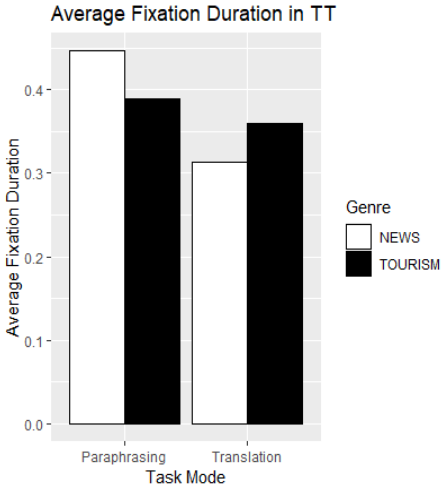

Figure 2. AFD in TT during translation and paraphrasing in different genres.

As for AFC, we considered one data point as the outlier in the ST region and discarded it before analysis (1.56% of all data). Similar to the AFD, the AFC did not show significant differences among different task modes and text genres (Table 5, Figure 3).

Table 5

Results of the LME Model for Average Fixation Count in ST

	Estimate	Std. Error	df	t value	Pr(>|t|)
cMode	-0.032	0.048	8.708	-0.663	0.524
cGenre	-0.024	0.068	5.417	-0.358	0.734
cMode:cGenre	-0.039	0.062	13.870	-0.636	0.535

Note. Model: lmer (TransResults~ cMode*cGenre + (cMode + cGenre + 1|Subject) + (1|Text)

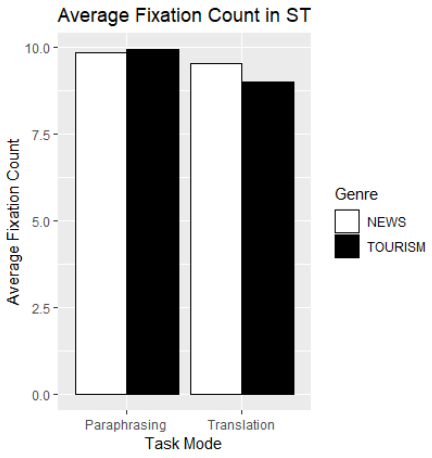

Figure 3. AFC in ST during translation and paraphrasing in different genres.

In the TT region, three outliers were deleted (4.69% of all data), and Table 6 presented the results of the final model. We observed a significant interaction effect between task mode and text genre (t = − 2.32, p = .037, see Table 6). Figure 3 demonstrates that the AFC in news texts was distinctly larger than that in tourism texts during the E-C translation task (t = − 2.55, p = .025). By contrast, the difference between news and tourism texts did not reach significance in the English paraphrasing task (t = 1.027, p = .33).

Table 6

Results of the LME Model for Average Fixation Count in TT

	Estimate	Std.Error	df	t value	Pr(>|t|)
cMode	0.084	0.049	11.727	1.703	0.115
cGenre	-0.033	0.072	4.672	-0.451	0.672
cMode:cGenre	-0.153	0.066	13.667	-2.316	0.037 *

Note. Model: lmer (TransResults~ cMode*cGenre + (cMode + cGenre + 1|Subject) + (1|Text)

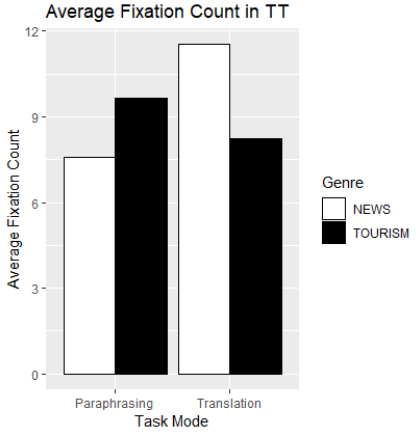

Figure 4. AFC in TT during translation and paraphrasing in different genres.

The Attention Shift Pattern in Translation and Paraphrasing Tasks

The number of AS between ST and TT was also analyzed to reveal the attention shift pattern during translation and paraphrasing tasks (Figure 5). One out of 64 data points was removed as an outlier (1.56% of all data). Log transformation was applied to the AS data, and the results were presented in Table 7. Again, the differences across task modes and text genres were insignificant (Figure 5).

Table 7

Results of the LME Model for Attention Shifts Between ST and TT

	Estimate	Std.Error	df	t value	Pr(>|t|)
cMode	-0.063	0.040	7.658	-1.597	0.151
cGenre	-0.028	0.059	4.205	-0.483	0.653
cMode:cGenre	-0.019	0.051	13.602	-0.374	0.715

Note. Model: lmer (TransResults~ cMode*cGenre + (cMode + cGenre + 1|Subject) + (1|Text)

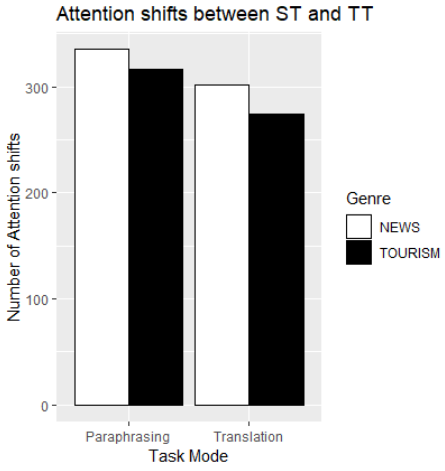

Figure 5. AS between ST and TT during translation and paraphrasing in different genres.

Local Analysis of Cognitive Processing in Translation and Paraphrasing Tasks

Then we turned to the local analysis of the cognitive loads of experimental sentences, indicated by AFD and AFC at the sentence level. Two LMM models were built for AFD and AFC respectively, with Mode (Paraphrasing vs. Translation), Genre (News vs. Tourism), and Sentence Difficulty (Control vs. Critical) as interpreting predictors, together with random intercepts by Participant and Sentence Item. The predictors were all contrast-coded (Davis, 2010), and we applied log transformation on both the AFD and AFC data for the analysis.

In terms of AFD, one data point was deleted as an outlier (0.52% of all data), and the results were presented in Table 6. We found a marginally significant effect on sentence condition, suggesting that the AFD tends to be longer in critical sentences than in control sentences (t = 2.024, p = .077). Besides, the interaction between task mode and sentence condition was marginally significant (t = 1.708, p = .090). Further analysis showed that critical sentences require a significantly longer AFD than control sentences in the E-C translation task (t = 2.321, p = .047). However, this difference failed to reach significance in English paraphrasing task (t = 1.646, p = .138) (Figure 6). There was also a marginal significance in the three-way interaction of task mode, sentence condition, and text genre (t = 2.028, p = .053). Figure 7 demonstrates that the AFD in control sentences among different conditions were similar. Interestingly, the modulation effect of text genre differs between the two tasks regarding critical sentences. Specifically, paraphrasing critical sentences from an English tourism text resulted in a considerably shorter AFD than those from an English news text (t = − 4.89, p < .001). In contrast, in the E-C translation task, the AFD was similar between different genres (t = − 1.109, p = .300).

Table 8

Results of LME Model for Average Fixation Duration on Experimental Sentences

	Estimate	Std. Error	df	t value	Pr(>|t|)
cMode	0.053	0.034	15.812	1.549	0.141
cGenre	-0.130	0.153	8.340	-0.853	0.417
cSentence-Condition	0.308	0.152	8.193	2.024	0.077
cMode: cGenre	0.279	0.166	14.017	1.680	0.115
cMode: cSentence-Condition	0.090	0.052	147.196	1.708	0.090
cGenre: cSentence-Condition	-0.422	0.302	8.002	-1.396	0.200
cMode:cGenre: cSentence-Condition	0.252	0.124	24.933	2.028	0.053

Note. Model: lmer (TransResults~ cMode*cGenre*cSentenceCondition + (cGenre + cSentenceCondition+ 1|Subject) + (1|SentenceItem)

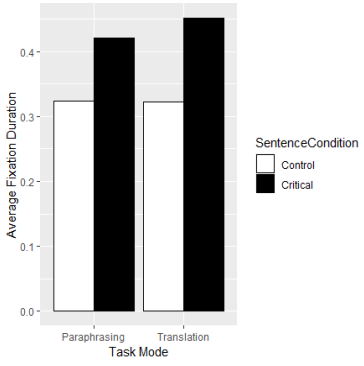

Figure 6. AFD in critical and control sentences during translation and paraphrasing.

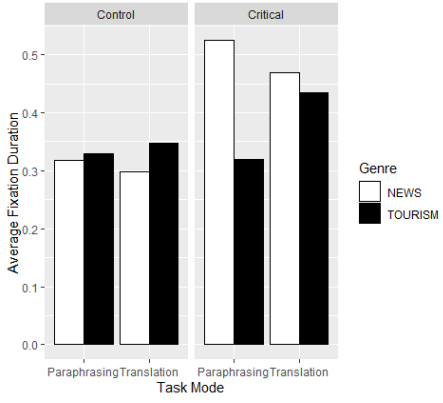

Figure 7. AFD in critical and control sentences during translation and paraphrasing in different genres.

We deleted three outlier data points (1.57% of all the data) about AFC. Table 7 shows a significant main effect of sentence condition, with significantly more AFC overall in critical sentences than in the control sentences (t = 3.293, p = .011) (Figure 7).

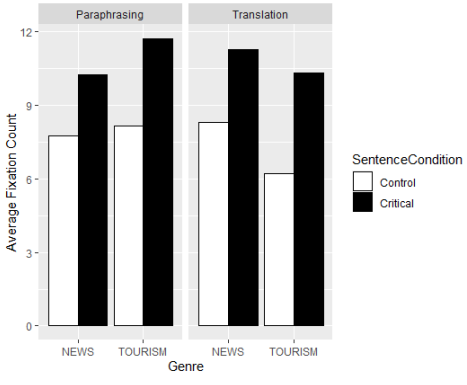

Figure 8. AFC in critical and control sentences during translation and paraphrasing in different genres.

Table 9

Results of LME Model for Average Fixation Count on Experimental Sentences

	Estimate	Std. Error	df	t value	Pr(>|t|)
cMode	-0.038	0.054	11.399	-0.692	0.503
cGenre	-0.024	0.078	15.951	-0.304	0.765
cSentence-Condition	0.196	0.059	7.992	3.293	0.011*
cMode: cGenre	-0.079	0.061	13.916	-1.306	0.213
cMode: cSentence-Condition	0.027	0.020	144.604	1.379	0.170
cGenre: cSentence-Condition	0.028	0.060	7.992	0.477	0.646
cMode:cGenre: cSentence-Condition	0.009	0.020	144.620	0.445	0.657

Note. Model: lmer (TransResults~ cMode*cGenre*cSentenceConditi-on + (cMode + cGenre + 1|Subject) + (1|SentenceItem)

Discussion

This study investigates the text- and sentence-level cognitive processing between translation and paraphrasing. Our interest lies in whether the processing effort required in two types of language mediation varies among different text genre types and sentence difficulty levels. The findings preliminarily give insights into the similarities and differences between translation and paraphrasing with the effect of two examined factors. Here we discuss the theoretical implications of these findings for the global and local cognitive processing in translation and paraphrasing and the pedagogical application of paraphrasing in translation training.

Global Cognitive Processing in Translation and Paraphrasing

The first two research questions focus on the cognitive processing between translation and paraphrasing at the textual level. To address them, we compared the overall cognitive load in ST and TT regions and the attention shift pattern in two tasks. The results confirmed an overall similar cognitive load in ST comprehension, supported by similar fixation duration and fixation counts in the ST region during translation and paraphrasing. Besides, the attention shift pattern indicated by the frequency of attention switch between ST and TT is also comparable between the two tasks. As all the texts have been controlled in the number of words, this result implies that participants have a close length of individual attention units (the units that occur between each attention shift) on average, suggesting a similar way of allocating cognitive resources in translation and paraphrasing tasks (Hvelplund, 2011). These findings align with the argument that translation and paraphrasing share certain conceptual operations, such as decoding the ST meaning for comprehension and managing cognitive resources in ST reading and TT production (Whyatt et al., 2016; Whyatt & Naranowicz, 2020; Zethsen, 2009). The implications of these findings in pedagogical practice will be further discussed in later.

However, the results revealed some interesting differences between translation and paraphrasing in the TT region. One observation is that English paraphrasing induces an overall higher cognitive load in TT than E-C translation. This result contradicts the previous findings that translation is more cognitively demanding compared to paraphrasing (Whyatt et al., 2016; Whyatt et al., 2017). One crucial difference between previous research and the current study is that Whyatt's team mainly focused on paraphrasing in one's first language (L1), whereas we examined paraphrasing in one's second language (L2). It is reasonable to consider L1 as a language with higher proficiency than L2 in most cases. Therefore, a possible explanation could be that language proficiency may also play a vital role in modulating the cognitive load during translation and paraphrasing tasks. On the one hand, the lower cognitive load in L1 paraphrasing in previous studies and the E-C translation (L2-L1 translation) in the current study may benefit from the comprehension and production advantage in L1 (e.g., Kelly, 2005). According to the Revised Hierarchical Model (RHM, Kroll & Stewart, 1994), the L1 lexicon is thought to be interconnected more firmly and has stronger links to conceptual representations. This feature facilitates the accessing to the meaning and the selection of lexical words. By contrast, text comprehension and production in one's second language (L2) tend to be less privileged (Jankowiak & Lehka-Paul, 2022), usually with a longer time for comprehension and more constant monitoring and modification of syntactic structures and lexical choices in the production. This difference between L1 and L2 may account for the relatively higher cognitive load in English (L2) production, with significantly denser fixations in the TT region during the English paraphrasing. Whyatt et al. (2016) ascribed the higher cognitive load in L2-L1 translation than in L1 paraphrasing to additional bilingual processing costs. Concerning the language proficiency difference in their study, we may propose that the incomparable cognitive loads can also

result from a comprehension disadvantage in L2 during translation. This account seems persuasive in explaining the observed denser fixations in ST. On the other hand, RHM also proposes that the access to semantic representations in the L2-L1 direction can be fast and automatic (Kroll & Stewart, 1994). Indeed, previous studies have confirmed a bilingual priming effect, which argues that recognizing a word can facilitate the activation of its translation equivalence unconsciously (Altarriba, 1992; Chen & Ng, 1989; Schoonbaert et al., 2009). It is likely that in the E-C translation task, the automatic activation of the translation equivalence in Chinese during ST comprehension helps to offset the processing cost of lexical selection in TT production, leading to a lower cognitive load.

Another observation is a profound modulation effect of genre on cognitive loads. The results reported a larger number of AFC when translating news text compared to tourism text. However, this difference disappeared in the paraphrasing task. We come up with one tentative account that this may be due to a genre-specific strategy adopted more frequently in translation. Participants may tend to have higher standards for the faithfulness of the content information in news text, which requires more fixations to monitor the TT production. Besides, as news texts are released by official authorities in most cases, participants probably need to devote more fixations to modifying sentences, making them appropriate in a formal style. These genre-specific operations seem to be lost in the paraphrasing task, which may result from the lack of good practice in paraphrasing. As discussed earlier, paraphrasing has not been included in the teaching curricula yet. As a result, participants tend to be less aware of the genre-specific features during the production of a paraphrasing task.

Local Cognitive Processing in Translation and Paraphrasing

The last two research questions step further into the cognitive processing between the translation and paraphrasing tasks at the sentence level. We compared the sentential cognitive load in two tasks under the effect of text genre and sentence difficulty. As expected, sentences with high-level difficulty induce an overall higher cognitive load, which was confirmed by both a tendency for a longer AFD and significantly more AFC in processing critical sentences.

The results further revealed that text genre and sentence difficulty influence cognitive loads. Interestingly, we found a reduced difficulty effect in paraphrasing compared to translation in terms of the AFD. Unlike the comparable cognitive load at the textual level and in control sentences, the cognitive load in critical sentences is relatively lower in paraphrasing translation. This observation implies that the mental processing between paraphrasing and translation is not entirely identical, especially when dealing with cognitively demanding items like sentences with complex structures or metaphorical meanings. We infer that the observed lower processing effort may benefit from a strategy of shallow processing only applicable to the paraphrasing task. As pointed out by Barrón-Cedeño et al. (2013), paraphrasing can be accomplished by either surface modifications like substituting synonyms or more in-depth level transformations related to semantic-based reorganizations (Whyatt et al., 2016). The degree of changes largely depends on the task itself and the specific objectives (Vila et al., 2014; Whyatt et al., 2016). Notably, people may not necessarily need to understand the ST meaning accurately if they rely on surface modifications or shallow processing in paraphrasing. Indeed, during the interview, several participants pointed out that they failed to fully understand the meaning of several complex sentences when paraphrasing the texts. Under these circumstances, they only replaced some words and phrases with alternative expressions to keep the meaning unchanged.

In addition, critical sentences in the tourism text tend to induce lower cognitive loads than those in the news text during paraphrasing. Our tentative explanation for this phenomenon is that the adoption of the shallow processing strategy may be restricted only to specific text genres. As discussed previously in the paper, the content is the main focus of communication in informative texts like news reports. Therefore, an accurate understanding of the text's meaning is essential for this text type, which may partially restrict the application of the shallow processing strategy. By contrast, operative texts like tourism promotional texts mainly aim at their appellative function and, therefore, may pay less attention to the accuracy of the text meaning. As a result, the shallow processing strategy tends to be more applicable in paraphrasing critical sentences in tourism texts, which explains the integrated modulation effect of both text genre and sentence difficulty between translation and paraphrasing.

Pedagogical Implications of the Application of Paraphrasing Practice

It is inspiring to observe several similar patterns in the cognitive processing of translation and paraphrasing, suggesting the potential pedagogical value of paraphrasing practice. One crucial observation is that both the textual cognitive load in ST and the sentential cognitive load in control sentences are comparable between translation and paraphrasing, irrespective of text genre. This result indicates that the comprehension process in translation and paraphrasing tends to be similar. The idea echoes Uemlianin's (2000) argument that "paraphrase is an

essential part and perhaps the whole of certain conceptual comprehension". Therefore, one may use paraphrasing practice as a tool to sharpen the comprehension skills in the training. Critically, during this process, translation trainers need to control the difficulty of materials to prevent the students from using shallow processing as a ruse. Moreover, the ability to extract the essential meaning of given information accurately can also be directly adopted in the translation and interpreting practice to offset the cognitive loads caused by difficulties in comprehension (Li, 2015).

Another important finding is a similar attention shift pattern in translation and paraphrasing, indicating a similar way of allocating cognitive resources. Good management of cognitive resources is vital in translation and interpreting (Gile, 1995; Hvelplund, 2011), and Gile (1995) further claims that this skill is developed through practice. Thus, incorporating paraphrasing into students' daily training can also be expected to consolidate students' cognitive management ability.

Conclusion

The current study investigated the global and local cognitive processing in interlingual translation and intralingual paraphrasing using eye-tracking and retrospective protocols. We found several shared grounds between intra- and inter-lingual transfer, such as a comparable cognitive load in ST comprehension and a similar attention shift pattern. Differences also exist, mainly shown by a lower cognitive load in TT production in the E-C translation due to an L1 production advantage and an automatic semantic bilingual priming. Besides, text genre and sentence difficulty play a vital role in manipulating cognitive processing. Genre-specific features may lead to different cognitive demands at the textual level. Meanwhile, it may also be combined with sentence difficulty to affect the adoption of the specific paraphrasing strategy. Those similarities and difficulties found in this study are expected to reveal the vital role of several influential factors such as text genre, sentence difficulty, and target language on the one hand and give insights into the pedagogical application of the transferable skills and shared mental operations between translation and paraphrasing on the other hand.

There are also some limitations in this study. The most important one is that the number of experimental sentences appropriate for the local analysis is too limited. Meanwhile, some experimental sentences are not separated by filler sentences. This phenomenon is likely to induce an unexpected spill-over effect in eye-tracking experiments. These potential problems may possibly account for the observed marginal but not significant differences in the local analysis. Therefore, future studies need to strike a better balance between the control of influential variables in experimental materials and the ecological validity of the empirical research. Moreover, the eye-tracking data in ST and TT regions is expected to be further divided by different sub-processes such as orientation, drafting, and revising to reveal a more detailed description of the cognitive processing between translation and paraphrasing.

References

Altarriba, J. (1992). The representation of translation equivalents in bilingual memory. *Advances in Psychology*, *83*, 157–174. https://doi.org/10.1016/S0166-4115(08)61493-4

Barrón-Cedeño, A., Vila, M., Martí, M. A., & Rosso, P. (2013). Plagiarism meets paraphrasing: Insights for the next generation in automatic plagiarism detection. *Computational Linguistics*, *39*(4), 917–947. https://doi.org/10.1162/COLI_a_00153

Barzilay, R. (2003). *Information fusion for multidocument summarization: Paraphrasing and generation*. New York: Columbia University.

Bates, D., Mächler, M., Bolker, B. M., & Walker, S. C. (2015). Fitting linear mixed-effects models using lme4. *Journal of Statistical Software, 67*(1), 1–51. https://doi.org/10.18637/jss.v067.i01

Becker, R. A., Chambers, J. M., & Wilks, A. R. (1988). *The news language*. California :Wadsworth & Brooks/Cole.

Bhagat, R., & Hovy, E. (2013). What is a paraphrase? *Computational Linguistic—Association for Computational Linguistics*, *39*(3), 463–472. https://doi.org/10.1162/COLI a 00166

Biel, Ł. (2018). Genre analysis and translation. In K. Malmkjœr (Ed.), *The Routledge handbook of translation studies and linguistics* (pp. 151–164). London : Routledge. https://doi.org/10.4324/9781315692845-11

Campbell, C. (1998). *Teaching second-language writing: Interacting with text* (1st ed.). Boston: Heinle & Heinle.

Chen, H.-C., & Ng, M. L. (1989). Semantic facilitation and translation priming effects in Chinese-English bilinguals. *Memory & Cognition*, *17*(4), 454–462.

Cheung, A. K. F. (2016). Paraphrasing exercises and training for Chinese to English consecutive interpreting. *International Journal of Interpretation and Translation*, *14*(1), 1–18. https://doi.org/10.1075/forum.14.1.01che

Choy, S. C., & Lee, M. Y. (2012). Effects of teaching paraphrasing skills to students learning summary writing in ESL. *Journal of Teaching and Learning*, *8*(2), 77–89. https://doi.org/10.22329/jtl.v8i2.3145

Clark, H. H., & Lucy, P. (1975). Understanding what is meant from what is said: A study in conversationally conveyed

requests. *Journal of Verbal Learning and Verbal Behavior, 14*(1), 56–72. https://doi.org/10.1016/S0022-5371(75)80006-5

Courtney, M. G. R., & Chang, K. C. (2018). Dealing with non-normality: An introduction and step-by-step guide using R. *Teaching Statistics*, *40*(2), 51–59. https://doi.org/10.1111/test.12154

Cui, Y., & Zheng, B. (2021). Effect of perceived translation difficulty on the allocation of cognitive resources between translating and consultation: An eye-tracking and screen-recording study. In C. Wang & B. Zheng (Eds.), *Empirical studies of translation and interpreting: The post-structuralist approach* (pp. 51–73). New York: Routlegde.

Davis, M. J. (2010). Contrast coding in multiple regression analysis: Strengths, weaknesses, and utility of popular coding structures. *Journal of Data Science, 8*(1), 61–73. https://doi.org/10.6339/jds.2010.08(1).563

Deléger, L., & Zweigenbaum, P. (2008). Paraphrase acquisition from comparable medical corpora of specialized and lay texts. *AMIA Annual Symposium Proceedings*, 146–150.

Ferreira, A. (2014). Analyzing recursiveness patterns and retrospective protocols of professional translators in L1 and L2 translation tasks. *Translation and Interpreting Studies*, *9*(1), 109–127. https://doi.org/10.1075/tis.9.1.06fer

Gibbs Jr, R. W., & Colston, H. L. (2012). *Interpreting figurative meaning*. Cambridge : Cambridge University Press.

Gile, D. (1995). *Basic concepts and models for interpreter and translator training*. Amsterdam: John Benjamins Publishing.

Gile, D. (2008). Local cognitive load in simultaneous interpreting and its implications for empirical. research. *International Journal of Interpretation and Translation*, *6*(2), 59–77. https://doi.org/10.1075/forum.6.2.04gil

Givón, T., & Shibatani, M. (2009). *Syntactic complexity: Diachrony, acquisition, neuro-cognition, evolution* (Vol. 85). Amsterdam: John Benjamins Publishing.

Green, D. W. (1998). Mental control of the bilingual lexico-semantic system. *Bilingualism: Language and Cognition*, *1*(2), 67–81. https://doi.org/10.1017/s1366728998000133

Hatzidaki, A. (2007). The process of comprehension from a psycholinguistic approach—Implications for translation. *Meta*, *52*(1), 13–21. https://doi.org/10.7202/014715ar

Hirvela, A., & Du, Q. (2013). "Why am I paraphrasing?" Undergraduate ESL writers' engagement with source-based academic writing and reading. *Journal of English for Academic Purposes*, *12*(2), 87–98. https://doi.org/10.1016/j.jeap.2012.11.005

Hvelplund, K. T. (2011). Allocation of cognitive resources in translation: An eye-tracking and key-logging study. (Publication No. 10.2011, ISBN9788759384640) [Doctoral dissertation, Co-penhagen Business School (CBS)]. https://hdl.handle.n-et/10398/8314

Hvelplund, K. T. (2014). Eye tracking and the translation process: Reflections on the analysis and interpretation of eye-tracking data. *MonTI Special Issue—Minding Translation*, 201–223. https://doi.org/10.6035/monti.2014.ne1.6

Hvelplund, K. T., & Dragsted, B. (2018). Genre familiarity and translation processing: Differences and similarities between literary and LSP translators. In I. Lacruz & R. Jääskeläinen (Eds.), *Innovation and expansion in translation process research* (pp. 55–76). Amsterdam: John Benjamins Publishing Company.https://doi.org/10.1075/ata.18.04tan

Izquierdo, I. G. (2000). The concept of text type and its relevance to translator training. *Target: International Journal of Translation Studies*, 12(2), 283–295.

Jabokson, R. (1959). On linguistic aspects of translation. In R. A. Brower (Ed.), *On translation* (pp. 232–239). Cambridge: Harvard University Press.

Jakobsen, A. L. (2002). Orientation, segmentation, and revision in translation. In G. Hansen (Ed.), *Empirical Translation Studies: Process and Product* (pp. 51–73). Frederiksberg Denmark: Samfundslitteratur.

Jankowiak, K., & Lehka-Paul, O. (2022). Novel metaphor transla-tion is modulated by translation direction. *Applied Psycholing-uistics*, *43*(1), 177–192. https://doi.org/10.1017/S0142716421000461

Jensen, K. T. (2012). Indicators of text complexity. In A. L. Jakobsen, I. M. Mees, & S. Göpferich (Eds.), *Behind the mind : Methods, models and results in translation process research* (pp. 61–78). Frederiksberg: Samfundslitteratur Press.

Just, M. A., & Carpenter, P. A. (1980). A theory of reading: From eye fixations to comprehension. *Psychological Review*, *87*(4), 329–354. https://doi.org/https://doi.org/10.1037/0033-295X.87.4.329

Kajzer-Wietrzny, M. (2019). Linking words in inter- and intralingual translation—Combining corpus linguistics and key-logging data. In L. Vandevoorde, J. Daems, & B. Defrancq (Eds.), *New empirical perspectives on translation and interpreting* (pp. 114–138). London: Routledge. https://doi.org/10.4324/9780429030376-6

Kelly, D. (2005). *A handbook for translator trainers* (1st ed.). London: Routledge.http://doi.org/https://doi.org/10.4324/9781315760292

Kim, C. S., Gunlogson, C., Tanenhaus, M. K., & Runner, J. T. (2015). Context-driven expectations about focus alternatives. *Cognition*, *139*, 28–49. https://doi.org/10.1016/j.cognition.2015.02.009

Kroll, J. F., & Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations.

Journal of Memory and Language (Vol. 33, Issue 2, pp. 149–174). https://doi.org/https://doi.org/10.1006/jmla.1994.1008

Kruger, H. (2012). A corpus-based study of the mediation effect in translated and edited language. *Target: International Journal of Translation Studies*, *24*(2), 355–388. https://doi.org/ 10.1075/target.24.2.07kru

Li, X. (2015). Putting interpreting strategies in their place: Justifications for teaching strategies in interpreter training. *Babel*, *61*(2), 170–192. https://doi.org/10.1075/babel.61.2.02li

Liang, J., Fang, Y., Lv, Q., & Liu, H. (2017). Dependency distance differences across interpreting types: Implications for cognitive demand. *Frontiers in Psychology*, *8*(2132), 1–10. https://doi.org/10.3389/fpsyg.2017.02132

Liu, Y., Zheng, B., & Zhou, H. (2019). Measuring the difficulty of text translation: The combination of text-focused and translator-oriented approaches. *Target: International Journal of Translation Studies*, *31*(1), 125–149. https://doi.org/10.1075/target.18036.zhe

Ma, X. (2021). Coping with syntactic complexity in English–Chinese sight translation by translation and interpreting students. *Across Languages and Cultures*, *22*(2), 192–213. https://doi.org/10.1556/084.2021.00014

Ma, X., Li, D., Tsai, J.-L., & Hsu, Y.-Y. (2022). An eye-tracking based investigation into reading behavior during Chinese-English sight translation: The effect of word order asymmetry. *The International Journal of Translation and Interpreting Research*, *14*(1), 66–83. https://doi.org/10.12807/ti.114201.2022.a04

Matuschek, H., Kliegl, R., Vasishth, S., Baayen, H., & Bates, D. (2017). Balancing Type I error and power in linear mixed models. *Journal of Memory and Language*, *94*, 305–315. https://doi.org/10.1016/j.jml.2017.01.001

Mishra, A., Bhattacharyya, P., & Carl, M. (2013). Automatically predicting sentence translation difficulty. *Proceedings of the 51st Annual Meeting of the Association for Computational Linguistics*, *2*, 346–351.

Montalt, V., Ezpeleta-Piorno, P., & García-Izquierdo, I. (2008). The acquisition of translation competence through textual genre. *Translation Journal*, *4*(12), 1–12. http://hdl.handle.net/10234/25245

Munday, J. (2016). *Introducing translation studies: Theories and applications* (4th ed.). London: Routledge. https://doi.org/ https://doi.org/10.4324/9781315691862

R Core Team. (2019). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. https://www.r-project.org/

Schmaltz, M. (2018). Problem solving in the translation of linguistic metaphors from Chinese into Portuguese: An empirical-experimental study. In F. M. Federici & C. Walker (Eds.), *Eye tracking and multidisciplinary studies on translation* (pp. 121–133). Amsterdam: John Benjamins. https://doi.org/https://doi.org/10.1075/btl.143.07sch

Schoonbaert, S., Duyck, W., Brysbaert, M., & Hartsuiker, R. J. (2009). Semantic and translation priming from a first language to a second and back: Making sense of the findings. *Memory and Cognition*, *37*(5), 569–586. https://doi.org/10.3758/MC.37.5.569

Sjørup, A. C. (2008). Metaphor comprehension in translation: Methodological issues in a pilot study. In S. Göpferich, A. L. Jakobsen, & I. M. Mees (Eds.), *Looking at eyes: Eye-tracking studies of reading and translation processing* (pp. 53–77). Samfundslitteratur. Copenhagen Studies in Language No. 36.

Sjørup, A. C. (2013). *Cognitive effort in metaphor translation: An eyetracking and key-logging study* [Unpublished doctoral dissertation]. Copenhagen Business School (CBS). https://hdl.handle.net/10398/8698

Tirkkonen-Condit, S. (2002). Metaphoric expressions in translation processes. *Across Languages and Cultures*, *3*(1), 101–116.https://doi.org/https://doi.org/10.1556/Acr.3.2002.1.8

Tsai, Y. (2015). A Learner corpus study of attributive clauses and passive voice in student translations. In C. Ying (Ed.), *Handbook of research on teaching methods in language translation and interpretation* (pp. 85–101). Hershey: IGI Global.

Uemlianin, I. A. (2000). Engaging text: Assessing paraphrase and understanding. *Studies in Higher Education*, *25*(3), 347–358. https://doi.org/10.1080/713696160

Vila, M., Martí, M. A., & Rodríguez, H. (2014). Is this a paraphrase? What kind? Paraphrase boundaries and typology. *Open Journal of Modern Linguistics*, *4*(01), 205–218. https://doi.org/10.4236/ojml.2014.41016

Whyatt, B. (2017). Intralingual translation. In J. W. Schwieter & A. Ferreira (Eds.), *The handbook of translation and cognition* (pp. 176–192). Hoboken: John Wiley & Sons, Inc.

Whyatt, B. (2018). Testing indicators of translation expertise in an intralingual task. *Herme—Journal of Language and Communication in Business*, *57*(57), 63–78. https://doi.org/10.7146/ hjlcb.v0i57.106194

Whyatt, B., Kajzer-Wietrzny, M., & Stachowiak, K. (2017). Intralingual and interlingual translation: Designing a comparative study of decision-making processes in paraphrase and translation. In A. L. Jakobson & B. Mesa-Lao (Eds.), *Translation in transition: Between cognition, computing and technology* (pp. 135–158). Amsterdam: John Benjamins Publishing Company.

Whyatt, B., & Naranowicz, M. (2020). A robust design of the translator's skill set: Evidence for transfer of metacognitive skills to intralingual paraphrasing. *Interpreter and Translator*

Trainer, *14*(1), 1–18. https://doi.org/10.1080/1750399X.2019.1617028

Whyatt, B., Stachowiak, K., & Kajzer-Wietrzny, M. (2016). Similar and different: Cognitive rhythm and effort in translation and paraphrasing. *Poznan Studies in Contemporary Linguistics*, *52*(2), 175–208. https://doi.org/10.1515/psicl-2016-0007

Yan, J.-X., Pan, J., & Wang, H. (2018). *Research on translator and interpreter training* (D. Li Ed.). Berlin Heidelberg: Springer. https://doi.org/https://doi.org/10.1007/978-981-10-6958-1

Zethsen, K. K. (2009). Intralingual translation: An attempt at description. *Meta: Translators' Journal*, *54*(4), 795–812. https://doi.org/10.7202/038904ar

Appendix A

Pairwise Comparison Results in the Translation Difficulty of Experimental Texts

contrast	estimate	SE	df	z.ratio	p.value
Text1- Text 2	-0.1762	0.436	Inf	-0.404	0.9999
Text1- Text 3	-0.2254	0.56	Inf	-0.403	0.9999
Text1- Text 4	-0.7217	0.544	Inf	-1.326	0.8891
Text2- Text 3	-0.0492	0.561	Inf	-0.088	1.0000
Text2- Text 4	-0.5455	0.546	Inf	-0.998	0.9748
Text3- Text 4	-0.4963	0.522	Inf	-0.951	0.9809

Appendix B

News Texts

Text 1

A train crash in eastern Taiwan killed dozens of people, in what could be the province's deadliest rail disaster. **The train travelling from Taipei derailed close to Qingshui, a scenic stretch of coastline where marble cliffs drop into the Pacific Ocean.** According to the transportation ministry, a construction truck operated by the railway administration slid into the track from a worksite on the hillside and collided with the train. *Leaders of nearby countries extended their sympathies to the victims and offered assistance to the authorities.* The area where the crash occurred is well-known for hazardous traffic conditions. Eastern Taiwan is blocked off by towering mountain ranges and the only road linking the main eastern city of Hualian to the north passes sheer cliffs with narrow curves in several places. *As the lightly populated east is popular with tourists, many people travel by train to avoid mountain roads.* Fortunately, an improved road bypassing some of the most dangerous sections with tunnels was opened one year ago. (165 words)

Text 2

It has been ten years since a tsunami laid waste the Pacific coast of Japan. The tsunami and the undersea earthquake which triggered it threw the lives of tens of millions into anxiety. The Fukushima reactors melted after this tsunami knocked out their cooling systems. Water subsequently used to cool the reactors became polluted with radioactive nuclides. **In Shanghai and San Francisco iodised salt jumped off the shelves as people looked for prevention of which they had no need.** Recently, Japan announced that they will construct equipment to release polluted water into the Pacific, which has been condemned by environmentalists, fishermen and neighbouring countries. **This decision risked reviving some of the trauma of the nuclear**

accident and worsening its legacy of pollution. However, Japanese authorities argued that there was no practical alternative to releasing the water as storage space ran out. *They added there was no risk to human health and discharges will start in about two years*. (158 words)

Text 3

France is the country where iconic tourist attractions like the Eiffel Tower meet charming French countryside, and splendid grandeur of châteaux can only compete with the lavishness of the Cote D'Azur resorts. The country of wine, seductive language and romantic citizens who elevate their culinary fantasies to the level of obsession is perhaps one of the most popular tourist destinations in the world drawing like a magnet all sorts of travelers from singles, to couples to anyone in between. With so much to do and see, our France travel tips below come in handy. *Lyon is one of the gastronomic cities in France and is believed to be the place where cinematography emerged. The city is best explored by foot, by renting a bike or using public transportation.* Wander along the narrow streets of Old Lyon to remind yourself how it all started taking in all the incredible architecture, lovely restaurants and various grocery stores of simply people watch. (155 words)

Text 4

Tourists to South Korea can expect a country proud of its cultural roots as well as a country blessed with beautiful topographical areas that only add to the diversity to be had within its many cities and towns. *The capital of Seoul is home to less than 10 million people.* Travelers in this capital city can visit the National Museum of Korea where over 220,000 items are on display, including a historical gallery and an outdoor exhibit. Fine arts, calligraphy, clothing and food exhibits are also found here, to give the vacationer a wide range of Korea's history and cultural significance through a variety of mediums. Travelers to South Korea are met with many wonderful things to behold, and some that may be more thought provoking than others, such as the Adult Sculpture Park. Definitely not for the shy or easily embarrassed, this park allows adults to walk amid the sculptures for a different type of attraction. (157 words)

Note. ***Bold****: critical sentences*
Italic: control sentences