Routledge
Taylor & Francis Group

Perspectives
Studies in Translation Theory and Practice

ISSN: 0907-676X (Print) 1747-6623 (Online) Journal homepage: https://www.tandfonline.com/loi/rmps20

Is consecutive interpreting easier than simultaneous interpreting? – a corpus-based study of lexical simplification in interpretation

Qianxi Lv & Junying Liang

To cite this article: Qianxi Lv & Junying Liang (2019) Is consecutive interpreting easier than simultaneous interpreting? – a corpus-based study of lexical simplification in interpretation, Perspectives, 27:1, 91-106, DOI: 10.1080/0907676X.2018.1498531

To link to this article: https://doi.org/10.1080/0907676X.2018.1498531

PERSPECTIVES
2019, VOL. 27, NO. 1, 91–106
https://doi.org/10.1080/0907676X.2018.1498531

Routledge
Taylor & Francis Group

Is consecutive interpreting easier than simultaneous interpreting? – a corpus-based study of lexical simplification in interpretation

Qianxi Lv and Junying Liang

Department of Linguistics, Zhejiang University, Hangzhou, People's Republic of China

ABSTRACT

Lexical simplification parameters, labeled as representative of the cognitive load in various processes, have been applied in corpus-based studies on translation universals and interpreting outputs. We speculate that the output of simultaneous interpreting (SI), the extreme situation of language control, might be more simplified than that of consecutive interpreting (CI) due to the high cognitive load. To test this hypothesis, the present study examines the simplification patterns of rendered texts, based on a corpus composed of SI and CI output texts, read-out translated speeches and non-interpreted, original English speeches in three dimensions: information density, lexical repetitiveness and lexical sophistication. The results demonstrate that all of the parameters apply more to CI than to SI, indicating that the CI output is more simplified than the SI output. This pattern of results implies that the cognitive load of CI, if not higher, may be as high as that of SI. The research reported here is the first to compare quantitatively the lexical features of the output of CI versus SI. The counterintuitive results lend support to the modification of the established Effort Model of CI.

ARTICLE HISTORY
Received 1 October 2017
Accepted 5 July 2018

KEYWORDS
Consecutive interpreting; simultaneous interpreting; cognitive load; lexical simplification; corpus-based

Introduction

Cognitive demand during the task of interpreting arises from the division of 'energy' between listening to the incoming stream in the source language and orally rendering the output in the target language. In light of the high cognitive pressure involved in simultaneous multiple-tasking, Gile (1998) formulated the 'competition hypothesis' within the well-known Effort Model, claiming that even if the three types of effort (listening, reformulating and production effort) share resources and may be somewhat cooperative, the net result of their coexistence will usually be an increase in processing capacity requirements.

Among the various modes of interpreting, simultaneous interpreting (SI) has been addressed by different authors as a 'complex' (De Groot, 2000), 'extreme condition' (Meuleman & Van Besien, 2009; Obler, 2012) in terms of cognitive tasks. CI interpreters (CIs),

CONTACT Junying Liang jyleung@zju.edu.cn Department of Linguistics, Zhejiang University, Hangzhou 310058, People's Republic of China

Supplemental data for this article can be accessed at https://doi.org/10.1080/0907676X.2018.1498531

on the other hand, do not have to share processing capacity between tasks under a high cognitive load; nor are there problems arising from 'an accumulation of tasks under the pressure of time resulting in capacity requirement peaks' (Gile, 2009). Furthermore, in CI, the presumably higher cost of speech production in the B language could be accommodated in the self-paced reformulation stage (Gile, 2009). Given that SI exerts great cognitive demands, it makes sense to posit that the output of SI may be more lexically compromised than that of CI.

In keeping with our interest in investigating the quantitative linguistic factors discriminating between SI and CI, as two different *modes* or *modalities* (Bernardini, Ferraresi, & Miličević, 2016) of interpreting, the current study seeks to examine the potential lexical characteristics involved via a corpus study.

Baker (1993) has proposed the idea of linguistic translation universals (TUs) and suggested that the translated language can be perceptibly different from the target native language (Xiao, 2010), which is at best 'an unrepresentative special variant of the target language' (McEnery & Xiao, 2007). Corpus-based translation studies have proposed several TUs, of which explication (Tang & Li, 2016), simplification (Laviosa, 1997, 1998a, 1998b), and normalization (Teich, 2001) have subsequently been investigated in both translation and interpreting. The viability of using interpreted outputs to explore the features setting apart interpreting from translation has been examined, and the results 'militate in favor of seeing interpreting as an extreme case of translation universals' (Shlesinger & Ordan, 2012).

Generally speaking, simplification is realized in translated texts by simpler lexical, syntactic, and stylistic features (Blum & Levenston, 1978), characterized by a low information load and a limited range of vocabulary (Laviosa, 1998a; Xiao & Yue, 2009).

Simplification parameters were first proposed in two seminal articles by Laviosa (1997, 1998a), and have since been replicated in an array of research paradigms. The simplification features that Laviosa (1998a) identified as TUs can be expressed in terms of the following broad tendencies: (a) lower informativeness/lexical density; (b) higher repetitiveness; (c) less lexical sophistication. Work in this line of interpreting contexts has not reached a consensus, and this discord is reflected even in literature investigating the same language combination (e.g. Hu and Tao (2010); Li & Wang (2012)).

The tendency towards lower informativeness or lexical density in interpretations as compared with the original speeches varies according to the language combination and possibly also the language direction. The results of interpretations from Spanish into Italian or English (Russo, Bendazzoli, & Sandrelli, 2006; Sandrelli & Bendazzoli, 2005) conform to the hypothesis. However, this pattern does not hold true for English speeches interpreted from Italian (Bernardini et al., 2016), French, Dutch, German and Spanish (Kajzer-Wietrzny, 2013a, 2013b, 2015) or interpretations from French into Dutch (Plevoets & Defrancq, 2016). Mixed results are obtained in such language combinations as interpretations into Italian from English (simplified in Bernardini et al. (2016), but a null effect in Sandrelli & Bendazzoli (2005)), and interpretation into English from Chinese (simplified in Hu and Tao (2010); Li and Wang (2012), but the opposite in Chen and Cui (2010)).

Higher repetitiveness or lower lexical variety also gives rise to contrasting results in different languages, whether in the investigation of list head coverage or in that of type-token ratio (TTR) (Bernardini et al., 2016; Russo et al., 2006; Sandrelli & Bendazzoli,

2005). Again, mixed results are found for interpretations into English from Chinese (Chen & Cui, 2010; Hu & Tao, 2010; Li & Wang, 2012) and interpretations from English into Italian.

Few studies in the literature have employed core vocabulary coverage when examining interpreting. Bernardini et al. (2016) and Kajzer-Wietrzny (2013b) report contrasting results on the characteristics of interpreted English.

While corpus-based interpreting studies have produced insightful results, the picture given by the simplification hypothesis alone seems to be rather incoherently and inconsistently grounded. There may be two reasons underlying this discrepancy. Firstly, the putative lexical simplification is conceived to be dependent on the language combination or direction, and possibly also on the mode of delivery of the source text; thus, this claim needs to be further tested to support the claim of universality. Secondly, early studies in the literature seldom verify these discrepancies with quantifiable measures, but rather explain them in a rather patchwork manner. In short, those prior studies are still limited with respect to potential distinctions in the mediation effect (modality effects; e.g. SI vs CI) and textual factors not related to interpreting process (sentence length, corpus size, word length, etc.). These are probable sources of discrepancies in addition to the variations in methodological choices.

The bulk of the research addressing the issue of interpreting has stressed the varying cognitive demands and processes involved in different modes of interpreting. The inconsistency of corpus-driven interpreting studies also reveals the possible existence of a 'modality effect' in the lexical context, instead of an overriding pattern across modes. It is therefore surprising that experimental research on the distinction between SI and CI is sparse (except for Becker, Schubert, Strobach, Gallinat, & Kühn, 2016; Morales, Padilla, Gómez-Ariza, & Bajo, 2015; Strobach, Becker, Schubert, & Kühn, 2015), and a quantitative investigation into different modes of interpreting is needed to discern the specific features that could set each of them apart and to group these features into broader categories.

The present study serves as a product-oriented study comparing the cognitive demands of SI versus CI, with a self-made inter-model corpus of transcribed interpretation, read-out translated speech and non-interpreted, original speech texts. Given the above-mentioned potential differences in cognitive load that may exist in the previous literature, our expectation for the present study is that there should be lower variability and sophistication in lexical selection and less information density in SI compared to CI. We performed the calculations using uniform methods across modes of interpreting, and controlled for possible confounding textual factors. In this way, we anticipate being able to investigate even more nuanced aspects of the processes that underlie both interpreting modes and meet the challenge of elaborating conceptualized models (e.g. Gile, 2009). Hence, we raise three questions:

(1) How do the various simplification parameters apply to CI and SI?
(2) What factors may account for the different simplification patterns of various modes of interpreting? Will symmetry be achieved when these factors are controlled?
(3) What are the implications of these quantitative results for the cognitive load involved in different interpreting processes?

Material and methods

The current research intends to verify whether distinctive lexical patterns exist in the output across different modes of interpreting due to varying cognitive demands. To realize this goal, we built a self-made corpus with transcribed real-world materials for four sub-corpora, namely, 1) a consecutive interpreting corpus consisting of the interpretation of press conferences of the National People's Congress from 2009 to 2016 in China given by Chinese Premiers Wen Jiabao and Li Keqiang; 2) a corpus of simultaneous interpreted texts made up of 21 interpretations of keynote speeches recorded at the Boao Forum of Asia, Davos Forum from 2009 to 2016, as well as BRICs summits, sessions of the UN General Assembly, and China-ASEAN conferences given by Chinese leaders such as Wen Jiabao, Li Keqiang and Xi Jinping during that time period, among which there are on average 2 items from each year; 3) a read-out translated speech corpus (Tr-sp) of recorded government work reports from 2009 to 2016 given by Chinese Prime Ministers Wen Jiabao and Li Keqiang; and 4) a non-interpreted, original English speech corpus (Or-sp) of State of the Union Messages from 2009 to 2016 delivered by the President of the United States, Barack Obama. The audio-visual fragments were transcribed according to the standard guidelines,[1] and have additionally been tagged for parts of speech. The source language is Chinese and the target language is English, and SI and CI were carried out from the mother tongue into the second language. The government work report is (written) translated in advance and read out by the interpreters. The Or-sp and Tr-sp corpora are employed as baselines in the investigation. All the files form a comparable and homogeneous corpus based on the following characteristics:

(1) similarity of content: prototypical general political discourse and similar topic area;
(2) the same speakers and interpreters: the speakers of source speeches are the (former) Prime Minister of China and the interpreters are experienced, expert interpreters from the Department of Translation and Interpretation of China's Ministry of Foreign Affairs;
(3) the same time span (Table 1).

For practical purposes, lexical simplification was operationalized through the following parameters:

- Lexical Density: the percentage of lexical versus grammatical words in a text to measure the informational load (Stubbs, 2003);
- Standardized Type-Token Ratio (STTR): the ratio between the number of different words and the total
  number of words computed every *n* words (the default setting is 1,000 in the WordSmith Tools) as a measure of lexical variability (Scott, 2012);
- List Head Coverage: the percentage of the corpus covered by the top 100 words in its frequency list (for details of the list of words investigated, see Appendices S1 and S2);
- Hapax Legomena: word forms that appear only once in the corpus (Kajzer-Wietrzny, 2013a; Xiao & Hu, 2015)
- Core Vocabulary Coverage: the proportion of high frequency words to low(er) frequency words, where high frequency words are defined as the 100 most frequent

words in the large reference corpora of English (in this case, the BNC word frequency lists – spoken) (Bernardini et al., 2016) (for details of the list of words investigated, see Appendix S3).
- Other basic features of the texts have also been summarized for further comparison:
- Mean Sentence Length: the average number of words per sentence in a text;
- Mean Word Length: the average number of letters per word in a text.

All measures were computed on a single-text basis to account for variability among texts within different sub-corpora. Given that the measures used are particularly susceptible to text size (Kajzer-Wietrzny, 2013b), the sub-corpora were segmented to balance the text size. Thus, each sample file has 4,000 tokens on average to ensure the validity of comparisons between sub-corpora of different sizes. The segmentation was made without splitting a complete paragraph, and 69 equally-sized files were obtained.

Lexical Density was calculated by dividing the number of lexical words by the number of running words (Laviosa, 1998a, 1998b). Running words were counted through AntConc, lexical words were identified by using the automatic POS tagging tool 'Free CLAWS WWW tagger' (UCREL) (Garside & Smith, 1997) with 96–97% accuracy, and tags were manually checked and classified as lexical (using adjective, noun, digit, lexical verb, and open-class adverb tags) or functional (using all other tags excluding those for punctuation signs and unclassified items). A total of 16 lexical word tags were identified in this way. The Standardized Type-Token Ratios were produced by the WordSmith Tool based on consecutive 1,000-word chunks of texts. List Head Coverage is defined based on cumulative frequencies at the sub-corpus level, by summing up the number of occurrences of each list head word in its sub-corpus (see Appendix S1). To obtain the Core Vocabulary Coverage, we computed the percentage of high-frequency words across the entire set of texts.

In the case of by-text analyses, the one-way ANOVA test was performed by using SPSS 22.0 to compare all sub-corpora (simultaneous and consecutive interpreting, read-out translated speech and non-interpreted, original English speech), followed where appropriate by post-hoc pairwise comparisons using Wilcoxon rank sum tests (with Bonferroni correction[2].

Results and analysis

A one-way ANOVA with simplification parameters (listed above) was performed on (the) various modes of rendering (SI, CI, Tr-sp and Or-sp). In the same vein, as an indicator of (non-)homogeneity within the different sub-corpora, we computed variances pertaining to those measures on a single-text basis and evaluated the significance of differences across

Table 1. Sizes of sub-corpora.

Sub-Corpora	Num. of files	Running words in texts	Sentence count	% of corpus (word/sentence)
Simultaneous Interpreting	21	57,999	3171	21/26.7
Consecutive Interpreting	8	57,154	2706	21/33
Translated Speech	8	11,3211	4657	40/24.3
Original Speech	8	53,596	3073	19/16
Total	37	281,960	13,607	100

different sub-corpora using an independent T-test. Table 2 presents summary statistics on the indices of simplification for all sub-corpora with the results of a T-test comparing the simplification tendency of SI versus CI in the two right-hand columns.

The principal component analysis confirmed that the three dimensions relevant to lexical simplifying characteristics are the following differentiating variables: 1) informativeness (Lexical Density); 2) repetitiveness (STTR, List Head Coverage and Hapax Legemona); 3) lexical sophistication (Core Vocabulary Coverage). These aspects account for 85.253% of the simplifying features (KMO = .754, Bartlett's Test of Sphericity = 187.653, $p < .001$). We therefore concluded that these variables were sufficiently robust to differentiate among all groups and continued our analyses with these variables. The component plot in rotated space is displayed in Appendix S4.

The overall statistics show that the lexical features of the four text types we examined are significantly different (Lexical Density: $F_{(3,\ 66)} = 55.809$, $p < 0.001$, $\eta_p^2 = .720$; STTR: $F_{(3,\ 66)} = 17.338$, $p < 0.001$, $\eta_p^2 = .445$; List head coverage: $F_{(3,\ 66)} = 17.599$, $p < 0.001$, $\eta_p^2 = .448$; Core Vocabulary Coverage: $F_{(3,\ 66)} = 250.356$, $p < 0.001$, $\eta_p^2 = .920$; Hapax Legomena: $F_{(3,\ 66)} = 11.194$, $p < 0.001$, $\eta_p^2 = .341$). Specifically, the output of CI shows the most simplified pattern in all aspects, whereas the translated read-out speech texts are the most lexically dense and sophisticated. The non-interpreted, original English speech texts and CI output are the least sophisticated type, with no significant difference between them ($T_{(25)} = -1.33$, $p = .098$). The original English speech, however, is the least lexically repetitive text type in terms of STTR and Hapax Legomena, and shows a similar repetitive tendency to the translated read-out speech according to the data for List Head Coverage.

The last two columns point to a uniform and statistically significant trend. Reference to original and translated speeches demonstrates that almost all parameters unequivocally applied to CI. ANOVA tests for these three sub-corpora (CI, Tr-sp and Or-sp) yielded

Table 2. Summary of ANOVA on simplification parameters of sub-corpora.

Lexical Density%	Mean	SD	F	Sig.	T	Sig.
SI	61.445	1.176	55.809	0.000	8.048	0.000
CI	56.907	1.752				
TR	64.275	1.11				
OR	59.715	3.198				
STTR	Mean	SD	F	Sig.	T	Sig.
SI	42.118	1.752	17.338	0.000	4.459	0.000
CI	39.261	1.636				
TR	41.554	1.655				
OR	43.727	1.452				
List Head Coverage%	Mean	SD	F	Sig.	T	Sig.
SI	54.334	2.344	17.599	0.000	−2.733	0.011
CI	56.389	1.556				
TR	52.231	1.861				
OR	52.637	1.483				
Hapax Legomena%	Mean	SD	F	Sig.	T	Sig.
SI	15.124	1.372	11.194	0.000	2.314	0.029
CI	14.052	1.06				
TR	15.837	1.38				
OR	17.109	1.843				
Core Vocabulary Coverage%	Mean	SD	F	Sig.	T	Sig.
SI	45.179	1.905	250.356	0.000	−14.926	0.000
CI	54.631	1.409				
TR	42.605	1.662				
OR	55.518	2.031				

a clear pattern – Lexical Density: $F_{(2,52)} = 73.096$, $p < .001$, $\eta_p^2 = .738$; STTR: $F_{(2,52)} = 26.132$, $p < .001$, $\eta_p^2 = .501$; List Head Coverage: $F_{(2,52)} = 29.358$, $p < .001$, $\eta_p^2 = .530$, and Hapax Legomena: $F_{(2,52)} = 15.660$, $p < .001$, $\eta_p^2 = .376$. The only measure by which CI failed to show simplifying characteristics compared to the original speeches was the Core Vocabulary Coverage ($p > .05$), though it was still significantly more simplified than translated speeches ($T_{(40)} = 23.197$, $p = .035$, $\eta_p^2 = .969$). The simplification pattern of CI is illustrated in Figure 1. To our surprise, the lexical feature for SI exhibited the opposite tendency. Only the parameters concerning lexical repetitiveness – STTR ($T_{(25)} = -2.586$, $p < .001$, $\eta_p^2 = -0.447$), List Head Coverage ($T_{(25)} = 2.227$, $p = .035$, $\eta_p^2 = 0.397$) and Hapax Legomena ($T_{(25)} = -3.190$, $p = .004$, $\eta_p^2 = -0.521$) – reflected simplification for SI. The parameters reflecting the other two aspects went against the hypothesis for SI, as its output is lexically denser and more sophisticated than the original speeches.

Most of the literature available in this regard implicitly assumes one particular interpreting mode to be representative of interpreting output. Our results indicate, rather, that the outputs of SI and CI vary significantly. To test whether these results can be generalized, we mingled SI and CI together and compared them with the original English speeches. The simplification pattern for this group corroborates most extant studies in that only the indices for lexical repetitiveness – STTR ($M = 59.17$, $SD = 2.74$, $T_{(39)} = -4.509$, $p < 0.001$, $\eta_p^2 = -0.631$), List Head Coverage ($M = 55.36$, $SD = 2.74$, $T_{(39)} = 4.022$, $p < 0.001$, $\eta_p^2 = .586$) and Hapax Legomena ($M = 14.58$, $SD = 1.32$, $T_{(39)} = -5.004$, $p < 0.001$, $\eta_p^2 = -0.618$) – conformed to the idea that interpreted English is less lexically varied than original English speeches.

As displayed in Figure 2, all parameters applied more significantly to CI than to SI, as is demonstrated by the T-test. This unexpected pattern underwent further analyses for verification.

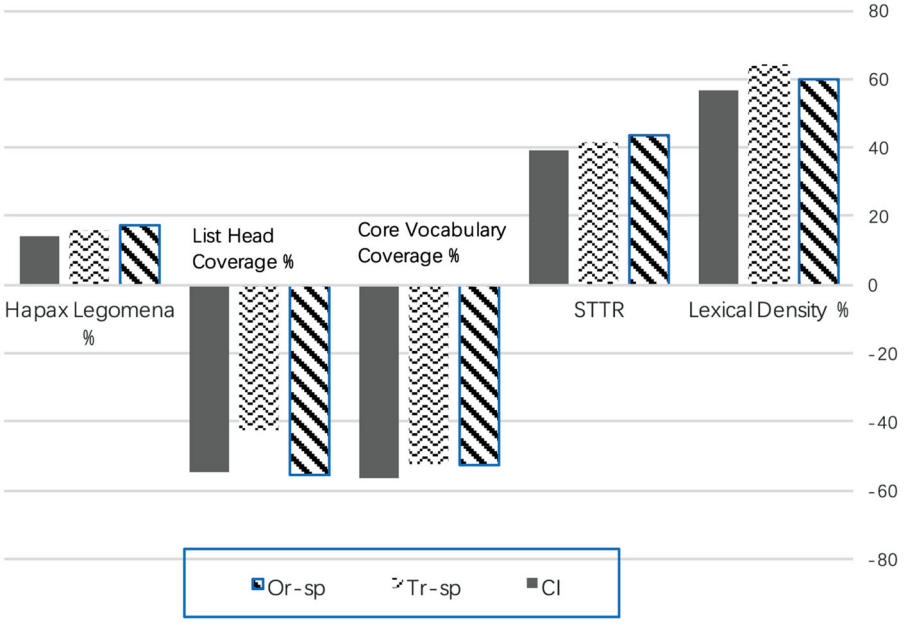

Figure 1. Simplification pattern of CI versus Or-sp and Tr-sp.

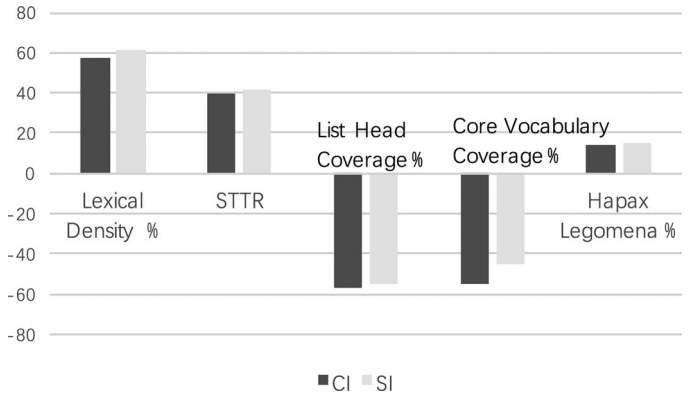

Figure 2. A Comparison of simplification parameters between SI and CI.

Lexical Density is believed to be affected by the Average Sentence Length (Xiao & Yue, 2009), and a zero-lagged bivariate-correlation was calculated. The planned positive correlation was found, $R = .670$, $p < .001$, two-tailed. Figure 3 shows the regression between the Lexical Density and the Average Sentence Length of the sub-corpora SI and CI. First, a simple linear regression predicting Lexical Density with Sentence Length was fitted; this

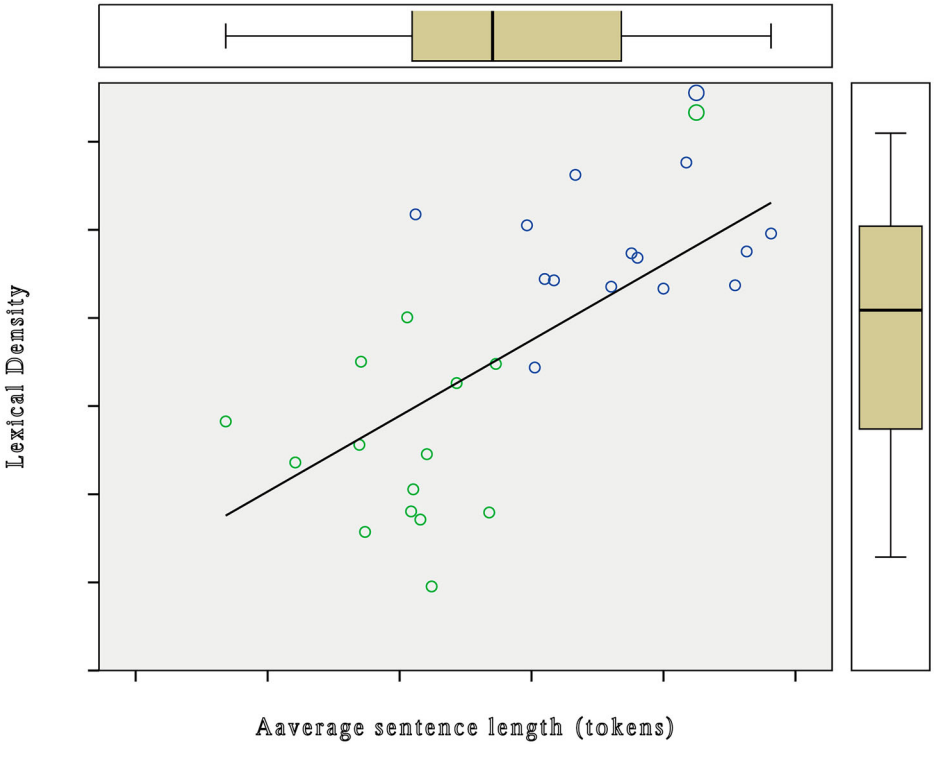

Figure 3. Regression of lexical density on average sentence length.

revealed a significant correlation in all sub-corpora. We further tested to see if the data conformed to the assumption, and none of the assumption was violated. Here, it was found that the Average Sentence Length explained a significant amount of the variance in the Lexical Density, $F_{(1,\ 26)} = 21.167$, $p < .001$, $R^2 = .449$, R^2Adjusted = .428, and the former did significantly predict the scores for the latter (Beta = .670, $T_{(27)} = 4.601$, $p < .001$).

To rule out the effect of differential sentence length on Lexical Density, we selected 6 files from each of the SI and CI sub-corpora, of which the Average Sentence Lengths matched with each other ($p > 0.05$). The T-test results reinforced the finding that CI ($M = 56.488\%$, $SD = 1.78$) is less informatively dense than SI ($M = 61.386\%$, $SD = 1.53$), $T_{(10)} = 5.251$, $p < .001$, $\eta_p^2 = 0.826$. There are cases where the source texts of CI and SI have a similar lexical density, but those of their interpretations differ significantly. One example of source texts featuring a noun phrase with a complex attribute is illustrated in Appendix S5. The lexical density of source texts is 61.54% for CI and 63.6% for SI, and that of the target text is 50% for CI and 77.8% for SI.

Three indices, namely STTR, List Head Coverage and Hapax Legomena, reflect the tendency toward repetitiveness. The correlations between each two of these indices were significant at the 0.01 level (two-tailed), $R^2 = -.539$, $R^2 = -.797$, $R^2 = .724$. CI displayed significantly more repetitiveness in terms of STTR ($T_{(26)} = 4.459$, $p < 0.001$, $\eta_p^2 = .588$) and Hapax Legomena ($T_{(26)} = 2.314$, $p = 0.029$, $\eta_p^2 = .401$). These two percentage values express the overall variability and the proportion of words used only once respectively. In terms of List Head Coverage, the hundred most frequent words in the analyzed corpus also accounted for a considerably greater proportion of tokens in the CI corpus (58.389% in comparison to 56.334% for SI), $T_{(26)} = -2.733$, $p = 0.011$, $\eta_p^2 = -0.459$. The above data suggested that CI demonstrated a tendency towards simplification on all dimensions of lexical variation. Controlling for the size of corpora did not attenuate the asymmetry between SI and CI in the relevant respects. As illustrated in Table 3, in the 10 most frequently-used content lemmas shared by both the SI and CI sub-corpora, 9 of them were rendered with the same word type more repeatedly in CI than in the source text. In SI, however, 8 of them were used less frequently than their counterparts in the source text. All things considered, it can be suggested that SI shows more variability than CI.

Table 3. A comparison of the repetitiveness of the 10 most frequent tokens.

		CI			SI		
ST	TT	TT	ST	ST/TT	TT	ST	ST/TT
发展	*develop*	308	266	1.16	928	1164	0.80
经济	*econom*	364	319	1.14	816	917	0.89
增长 / 增加 / 增多 / 增强	*grow*	158	110	1.44	412	455	0.91
合作	*cooperat*	87	74	1.18	278	284	0.98
金融 / 财政	*financ*	144	116	1.24	196	192	1.02
改革	*reform*	184	159	1.16	162	242	0.67
投资 / 投入	*invest*	84	80	1.05	135	184	0.73
政府	*government*	395	234	1.69	99	115	0.86
关系	*relat*	117	137	0.85	58	60	0.97
人民 / 群众	*people*	398	118	3.37	262	147	1.78

The final measure of simplification employed in this study helps us to estimate the range of vocabulary used. The higher the proportion of the most frequent English words in the analyzed corpus, the narrower the range of vocabulary, that is, the less lexical sophistication. CI was demonstrated to have a narrower range of vocabulary than SI, as represented by the Core Vocabulary Coverage, $T_{(26)} = -14.926$, $p < 0.001$, $\eta_p^2 = -0.943$. Though the sub-corpora had been segmented to ensure equal size, the sentence counts varied and a positive correlation was found, $R = .769$, $p < .001$. A linear regression model predicting the Core Vocabulary Coverage with sentence count was highly significant and showed a strong correlation, $F_{(1,\ 26)} = 37.557$, $p < .001$, $R^2 = .591$. To better control for confounding factors and also to avoid the cause-effect ambiguity, we split the data based on sentence counts and obtained 6 texts from each of SI and CI with similar sentence counts ($p > .05$), and a T-test on Core Vocabulary Coverage was performed. The results revealed a tendency coherent with the one obtained on the raw data, $T_{(10)} = -7.826$, $p < 0.001$, $\eta_p^2 = -0.914$, and we concluded that this variation could be disregarded as a factor affecting the intermodal analysis of simplification.

Overall, the output of CI displays the most simplified lexical pattern. On the one hand, compared with other rendered texts such as SI and translation, CI output shows a greater tendency towards less informativeness, variety and sophistication than the original English texts. On the other hand, CI output is also more simplified than that of SI in all these three aspects. This difference remains solid after confounding textual factors such as corpus size, average sentence length and sentence count have been excluded.

Discussions

The results of the present study are the very first observations of their kind suggesting that different modes of interpreting affect lexical traits of the output in a quantitative context. While previous studies on interpreting studies generally regard SI as an extreme situation of multitasking with the highest cognitive load, here, our findings evidently show that CI imposes heavier cognitive demands and hence yields more lexically simplified output. CI conforms to the model for translation universals in terms of simplification, but SI does not. In terms of the lexical features of the output, CI is more repetitive, less informative, and less sophisticated than the original English speeches and read-out translations. Conversely, for SI, although it is more lexically repetitive than non-interpreted discourse, the level of informativeness and sophistication is even higher than the original speeches, as it is diluted with higher Lexical Density and lower Core Vocabulary Coverage. This result for SI corroborates previous observations and research (Chachibaia & Colenso, 1998).

On the one hand, the output of CI is more lexically simplified than that of SI in all dimensions, even when such confounding variables as corpus size, average sentence length and sentence counts are ruled out. On the other hand, these elements may well underlie the incongruity of previous studies, especially those for identical language combinations (e.g. Hu & Tao, 2010; Li & Wang, 2012). More importantly, it can be ascertained through our data analysis that the cognitive demands in SI and CI deviate notably in quantitative contexts. This finding is in line with most interpreting models (e.g. Gile, 2009) and behavioral studies (Becker et al., 2016; Strobach et al., 2015). However, the unanticipated results draw our attention to the cognitive demands on CI, especially during the usually

'underestimated' phase of reformulation, as is illustrated in the Effort Models of Gile (2009, 2017).

Gile (2017) modified the Effort Models of interpretation based on his former outline (Gile, 2009). The model for simultaneous interpretation is represented as follows:

$$\text{SIM} = L + M + P + C$$

L: Listening M: Short-term memory P: Production C: Coordination

and the model for consecutive interpreting is divided into two phases: the comprehension phase and the reformulation phase.

(1) **Comprehension phase: L + M + NP + C**
NP: Note Production
(2) **Reformulation phase: NR + SR + P + C**
NR: Note Reading SR: Speech Reconstruction

The increment in cognitive load suggested in these models is largely identical to that on working memory (hereafter, WM) (Gile, 2009). The load is exerted both on the maintenance component and on the executive control mechanism of WM, as established in Baddeley's working memory model (Baddeley & Hitch, 1974). On the one hand, the *Short-term memory* effort corresponds to the storage component of WM, with an emphasis on its transient nature. On the other hand, the executive function consists of the *Coordination* of all other processing efforts in these models. According to Gile (2009), all types of effort are competing for limited processing resources, and one type of effort may suffer due to the rising load on another. In this study, we suggest that the distinctions between SI and CI in the demand for maintenance and coordination have an impact on the capacity assigned to the *Production* effort, and thus affect the output. A recent quantitative investigation into the syntactic features of both interpreting modes also demonstrates that CI imposes a heavier demand on WM than SI and consequently yields lower dependency distances (Liang, Fang, Lv, & Liu, 2017).

Generally speaking, the information to be maintained in CI is inherently larger in volume compared to SI. It is apparent that the storage component taxes CI interpreters much more than SI interpreters (SIs) and thus endangers interpreters' ability to keep their attention oriented towards encoding information for the output. According to Gile (2009), the delay in production means that both short – and long-term memory play a more significant role in CI than in SI.

According to Cowan (1999), working memory is a temporarily active part of long-term memory, and the focus of attention is limited in capacity. In the context of the present study, it is possible to postulate processing models for SI and CI based on Cowan's model of working memory. In SI, the input is presented to the interpreter in segments short enough to be accommodated within a maximum time lag (ear-voice span) of no more than a few seconds. Thus, only the most local content with minimal structural and contextual information is stored (Gumul, 2012). Once interpreted, the small segments no longer need to be stored in WM and thus alleviate the load. By contrast, CI interpreters receive the source-language text as a whole or in portions of at least a few sentences (Gumul, 2012). More chunks of information need to be kept in the focus of attention

before they can be integrated into a coherent target speech sentence in CI. Thus, the total cognitive load on CI may keep accelerating and accumulating during the course of interpreting (Liang et al., 2017). Notes lacking in sufficient and clear structural information may not serve well as a reminder, as 'an idea can be distorted completely if its relation to the previous idea is not clearly indicated' (Rozan, 2004). Thus, cognitive saturation may arise from memorizing discourses of significant length and insufficient note-taking information. In these cases, CIs may forget the speaker's chain of thought and have a strong preference for stereotypical (general in meaning), high-frequency words. The lower degree of lexical variation and richness in the output of CI is a product of avoiding potential threats of cognitive saturation.

On the other hand, the different mechanisms of coordination may be another factor underlying the distinctive lexical features of the output of SI and CI. The time constraints directly influence the sentence reformulation process, which differs in SI and CI (Liang et al., 2017). Owing to the virtual simultaneity of the input and output, SI essentially produces syntactic structures in line with the source text under the linearity constraint (Bacigalupe, 2010). In contrast, in the reformulation phase, CI interpreters are described as more 'self-paced' (Gile, 2005). Unlike the sentence-by-sentence pattern in SI, CI formulates the target speech independently. Thus, to deal with the high working memory burden generated by the large volume of information as well as the insufficient note-taking, CIs may have a strong preference for syntactic structures with lower information density to lessen the burden on working memory and processing difficulty. Gumul (2012) also suggests that CIs appear to be more prone to shifts in cohesion, as the category change and omission rates are considerably higher than in SI. Besides, when the texture-related information is too detailed to be retained easily, texture and context can be rather short-lived and 'can be stored more effectively via structure' (Hatim & Mason, 1997). In press conferences, the speech usually contains a lot of detailed information such as numbers and technical terms in various industrial sectors. Thus, in the comprehension phase, interpreters also tend to memorize more structurally-related information to reduce the memory burden. The lower lexical density (higher percentage of functional words) in CI compared to SI and the non-interpreted, original speeches is a manifestation of this preference, which is also borne out in the examination of dependency distance in SI and CI output (Liang et al., 2017).

As is illustrated in the example in Appendix S5, in the SI interpretation, the structure of a noun phrase with a complex attribute is largely retained and its lexical density goes up, whereas in CI, the same structure is interpreted as a relative clause, the lexical density of which is reduced to 50%.

Consequently, lexical simplification in CI favors and complements the following revised effort model (Liang et al., 2017) in terms of lexical features:

(1) **L + M + NP + C**
(2) **NR + M + P + C + SR (-Time constraint)**

The load on memory during the reformulation is evidenced by the preference for less varied, high-frequency words, and the lower lexical density demonstrates CI interpreters' inherent tendency towards restructuring into less complex structures with the aim of reducing the processing burden.

Moreover, English and Chinese are highly distinct in terms of lexical features, syntactic flexibility and structures (Taso, 1982); thus, the effort attached to the reorganization of sentence structures and continuous retrieval of lexical units may aggrevate the lexical simplification in Chinese-English interpreting. Additionally, by applying the event-related potentials technique, Liao and Chan (2016) find that switching from the dominant to the non-dominant language demands extra effort compared with switching into the dominant direction, which may be another way of accounting for the significant simplification observed in the cases under discussion in this article.

The findings of the present study, along with the findings on dependency distance (Liang et al., 2017), can also be viewed as evidence for interpreting universals – the language features setting interpreting output apart from non-interpreted, original language and (written) translated language.

Conclusion

The present study mainly examines potential variation in the influence of different interpreting modes on the lexical patterns of their outputs. The results show that all parameters of the simplification pattern are more applicable to CI than to SI in all dimensions, suggesting that CI yields the most lexically simplified output. This research demonstrates for the first time that CI is not easier than SI. Compared with the output of SI, CI output is more repetitive, less informative, and less sophisticated in terms of lexical features. To account for the mechanisms underlying these simplification differences, we proposed possible explanations from both the storage and coordination components of WM in CI: 1) the preference for less varied, general-in-meaning words due to the heavy load on WM in the reformulation phase; 2) the preference for structures of lower information density to alleviate the burden. The findings serve as evidence for interpreting universals, independent from translated language. Nevertheless, further studies with other language pairs are needed before we can consider this tendency to be robust or a probable universal.

Notes

1. VALIBLE corpus: http://www.oxfordhandbooks.com/view/10.1093/oxfordhb/9780199571932.001.0001/oxfordhb-9780199571932-e-017#oxfordhb-9780199571932-e-017-div1-3
2. In statistics, the Bonferroni correction is one of several methods used to counteract the problem of multiple comparisons and is known as a relatively strict test method.

Acknowledgement

Special thanks go to Dr. Matthew Reeve for his insightful comments and also his help in polishing the language.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the [National Social Science Foundation of China #1] under Grant [No.17BYY068], and the [Fundamental Research Funds for the Central Universities #2] (Program of Big Data PLUS Language Universals and Cognition, Zhejiang University).

Notes on contributors

Qianxi Lv is a doctoral candidate at Department of Linguistics, Zhejiang University. Her research interests include interpreting studies, psycholinguistics, and quantitative linguistics.

Junying Liang is a full professor in psycholinguistics and translation studies at Department of Linguistics, Zhejiang University. She holds a doctorate degree in cognitive psychology, and her current research focuses on psychological approaches to translation studies.

References

Bacigalupe, A. L. (2010). Information processing during simultaneous interpretation: A three-tier approach. *Perspectives*, *18*(1), 39–58. doi:10.1080/09076760903464278

Baddeley, A. D., & Hitch, G. (1974). Working memory. In G. H. Bower (Ed.), *The psychology of learning and motivation: Advances in research and theory* (Vol. 8, pp. 47–89). New York, NY: Academic Press.

Baker, M. (1993). Corpus linguistic and translation studies: Implications and applications. *The Journal of Physiology*, *464*(1), 321–342.

Becker, M., Schubert, T., Strobach, T., Gallinat, J., & Kühn, S. (2016). Simultaneous interpreters vs. Professional multilingual controls: Group differences in cognitive control as well as brain structure and function. *NeuroImage*, *134*, 250–260. doi:10.1016/j.neuroimage.2016.03.079

Bernardini, S., Ferraresi, A., & Miličević, M. (2016). From EPIC to EPTIC: Exploring simplification in interpreting and translation from an intermodal perspective. *Target*, *28*(1), 61–86. doi:10.1075/target.28.1.03ber

Blum, S., & Levenston, E. A. (1978). Universals of lexical simplification. *Language Learning*, *28*(2), 399–415. doi:10.1111/j.1467-1770.1978.tb00143.x

Chachibaia, N. G., & Colenso, M. R. (1998). Simultaneous interpreting of a scientific discussion. *Perspectives*, *6*(2), 217–224. doi:10.1080/0907676X.1998.9961337

Chen, J., & Cui, Y. (2010). 基于语料库的中国《政府工作报告》英译本词汇特征研究. [A corpus-based study on lexical features in the English translation of report on the work of the government]. 当代外语研究, *6*, 39–43.

Cowan, N. (1999). An embedded-processes model of working memory. In A. Miyake & P. Shah (Eds.), *Models of working memory: Mechanisms of active maintenance and executive control* (pp. 62–101). New York, NY: Cambridge University Press.

De Groot, A. M. B. (2000). A complex-skill approach to translation and interpreting. In S. Tirkkonen-Condit & R. Jääskeläinen (Eds.), *Tapping and mapping the processes of translation and interpreting outlooks on empirical research* (pp. 52–70). Amsterdam: John Benjamines.

Garside, R., & Smith, N. (1997). A hybrid grammatical tagger: Claws4. In R. Garside, G. Leech, & A. McEnery (Eds.), *Corpus annotation: Linguistic information from computer text corpora* (pp. 102–121). London: Longman.

Gile, D. (1998). Conference interpreting as a cognitive management problem. In J. H. Danks, G. M. Shreve, S. B. Fountain, & M. K. Mcbeath (Eds.), *Cognitive processes in translation and interpreting* (pp. 196–214). London: SAGE Publications.

Gile, D. (2005). Directionality in conference interpreting: A cognitive view. In R. Godijns & M. Hindedael (Eds.), *Directionality in interpreting. The 'retour' or the native?* (pp. 9–26). Ghent: Communication and Cognition.

Gile, D. (2009). The effort models of interpreting. In D. Gile (Ed.), *Basic concepts and models for interpreter and translator training* (pp. 157–190). Amsterdam: John Benjamines.

Gile, D. (2017). The effort models and gravitational model: Clarifications and update [PowerPoint], Retrieved from http://www.cirinandgile.com/powerpoint/The-Effort-Models-and-Gravitational-Model-Clarifications-and-update.pdf

Gumul, E. (2012). Variability of cohesive patterns: Personal reference markers in simultaneous. *Linguist Silesiana*, *33*, 147–72.

Hatim, B., & Mason, I. (1997). Interpreting: A text linguistic approach. In B. Hatim & I. Mason (Eds.), *The translator as communicator* (pp. 30–50). New York, NY: Routledge.

Hu, K., & Tao, Q. (2010). 汉英会议口译语料库的创建与应用研究. [The compilation and application of Chinese-English conference interpreting corpus.]. *中国翻译*, *5*, 49–56.

Kajzer-Wietrzny, M. (2013a). Idiosyncratic features of interpreting style. *New Voices in Translation Studies*, *9*(1), 38–52.

Kajzer-Wietrzny, M. (2013b). *Interpreting universals and interpreting style* (*Doctoral dissertation*). Retrieved from http://www.academia.edu/download/30927567/Paca_doktorska_Marty_Kajzer-Wietrzny.pdf

Kajzer-Wietrzny, M. (2015). Simplification in interpreting and translation. *Across Languages and Cultures*, *16*(2), 233–255. doi:10.1556/084.2015.16.2.5

Laviosa, S. (1997). How comparable can 'comparable corpora' be? *Target*, *9*(2), 289–319. doi:10.1075/target.9.2.05lav

Laviosa, S. (1998a). Core patterns of lexical use in a comparable corpus of English narrative prose. *Meta: Journal des Traducteurs*, *43*(4), 557–570. doi:10.7202/003425ar

Laviosa, S. (1998b). The corpus-based approach: A new paradigm in translation studies. *Meta: Journal des Traducteurs*, *43*(4), 474–479. doi:10.7202/003424ar

Li, D., & Wang, K. (2012). 汉英同传中词汇模式的语料库考察. [A corpus-based study on lexical patterns in simultaneous interpreting from Chinese into English]. 现代外语, *35*(4), 409–415.

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

Liao, C., & Chan, S. (2016). Direction matters: Event-related brain potentials reflect extra processing costs in switching from the dominant to the less dominant language. *Journal of Neurolinguistics*, *40*, 79–97. doi:10.1016/j.jneuroling.2016.06.004

McEnery, A. M., & Xiao, R. Z. (2007). Parallel and comparable corpora: What are they up to? In G. Anderman & M. Rogers (Eds.), *Incorporating corpora: Translation and the linguist* (pp. 278–291). Clevedon: Multilingual Matters.

Meuleman, C., & Van Besien, F. (2009). Coping with extreme speech conditions in simultaneous interpreting. *Interpreting*, *11*(1), 20–34. doi:11.1075/intp.11.1.03meu

Morales, J., Padilla, F., Gómez-Ariza, C. J., & Bajo, M. T. (2015). Simultaneous interpretation selectively influences working memory and attentional networks. *Acta Psychologica*, *155*, 82–91. doi:10.1016/j.actpsy.2014.12.004

Obler, L. K. (2012). Conference interpreting as extreme language use. *International Journal of Bilingualism*, *16*(2), 177–182. doi:10.1177/1367006911403199

Plevoets, K., & Defrancq, B. (2016). The effect of informational load on disfluencies in interpreting: A corpus-based regression analysis. *Translation and Interpreting Studies*, *11*(2), 202–224. doi:10.1075/tis.11.2.04ple

Rozan, J. (2004). *Note-taking in consecutive interpreting (Vol. 3)*. Cracow: Tertium Society for the Promotion of Language Studies.

Russo, M., Bendazzoli, C., & Sandrelli, A. (2006). Looking for lexical patterns in a trilingual corpus of source and interpreted speeches: Extended analysis of EPIC (european parliament interpreting corpus). *International Journal of Interpretation and Translation*, *4*(1), 221–254. doi:10.1075/forum.4.1.10rus

Sandrelli, A., & Bendazzoli, C. (2005, July). *Lexical patterns in simultaneous interpreting a preliminary investigation of EPIC (European parliament interpreting corpus)*. Proceedings from the corpus linguistics conference (pp.1-18), Birmingham, University of Birmingham.

Scott, M. (2012). *Wordsmith tools (version 6) [computer software]*. Stroud: Lexical Analysis Software. Retrieved from http://www.lexically.net/wordsmith/

Shlesinger, M., & Ordan, N. (2012). More spoken or more translated? Exploring a known unknown of simultaneous interpreting. *Target*, *24*(1), 43–60. doi:10.1075/target.24.1.04shl

Strobach, T., Becker, M., Schubert, T., & Kühn, S. (2015). Better dual-task processing in simultaneous interpreters. *Frontiers in Psychology*, *6*, 1590. doi:10.3389/fpsyg.2015.01590

Stubbs, M. (2003). Two quantitative methods of studying phraseology in English. *International Journal of Corpus Linguistics*, *7*(2), 215–244. doi:10.1075/ijcl.7.2.04stu

Tang, F., & Li, D. (2016). Explicitation patterns in English-Chinese consecutive interpreting: Differences between professional and trainee interpreters. *Perspectives*, *24*(2), 235–255. doi:10.1080/1750399X.2017.1379647

Taso, F. F. (1982). English and Chinese (Mandarin). *Annual Review of Applied Linguistics*, *3*, 99–117.

Teich, E. (2001). Towards a model for the description of cross: Linguistic divergence and commonality in translation. In E. Steiner & Y. Colin (Eds.), *Exploring translation and multilingual text production: Beyond content* (pp. 191–228). Berlin: De Gruyter.

Xiao, R. (2010). How different is translated Chinese from native Chinese? *International Journal of Corpus Linguistics*, *15*(1), 5–35. doi:10.1075/ijcl.15.1.01xia

Xiao, R., & Hu, X. (2015). *Corpus-Based studies of translational Chinese in English-Chinese translation*. Berlin: Springer/Shanghai: Shanghai Jiao Tong University Press.

Xiao, R., & Yue, M. (2009). Using corpora in translation studies. In P. Baker (Ed.), *Contemporary corpus linguistics* (pp. 237–262). London: Continuum.