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The impact of directionality on interpreters' syntactic processing: Insights from syntactic dependency relation measures

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Abstract

This study investigates the impact of interpreting direction on interpreters' syntactic processing strategies, utilizing a bidirectional parallel corpus from UN Security Council meetings of Chinese-English simultaneous interpretations and their original speeches. Two syntactic measures of dependency, namely, dependency distance and dependency direction, are used to examine the syntactic complexity and typological characteristics of interpreted speech in comparison to that of non-interpreted speech in the target language, to reflect how interpreters process sentences. The study showed that when interpreters worked from L2 to L1, they employed less complex syntactic structures, indicating a tendency towards simplification, while such a pattern was not observed in the opposite direction. Additionally, interpreters were found to adjust the word order of interpreted speech in both directions to produce an idiomatic rendition. These findings suggest that when professional interpreters prepare adequately, the constraint of directionality on their cognitive capability appears to be limited. Language pair-related factors, including the influence of the source language and the normative requirement to comply with target language conventions, tended to have a greater impact on how they processed sentences in both directions.

Keywords: Directionality; Dependency distance; Dependency direction; Syntactic complexity; Simultaneous interpreting

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1. INTRODUCTION

There is a long-held perception in the conference interpreting profession that interpreters should work into their first language (L1 or A language) rather than delivering 'retour interpreitng', that is, interpreting into their second language (L2 or B language).[1] This ingrained perception permeates interpreting practice and training, where it is believed interpreters can perform better when interpreting into a language with which they are more familiar (Donovan, 2004; Seleskovitch, 1978). Proponents of this practice posit that this is because L2 language production requires more active cognitive engagement than L2 language comprehension in bilingual language processing (Abrahamsson and Hyltenstam, 2008; Ortega, 2014). In this sense, interpreters are likely to face greater cognitive and linguistic challenges when they reformulate meaning in L2, which is described as the interpreter's "inherent and constitutional weakness" compared to their L1 (Déjean Le Féal, 2005, 170). An interpreter's comparatively limited linguistic proficiency in L2 may lead to several issues during interpreting, such as impaired ability to achieve accuracy, reliance on literal translation, attentional deficits, and increased disfluency markers (Daro` et al., 1996; Déjean Le Féal, 2005). Therefore, there is a prevailing belief that interpreters should interpret into their native language, where they have a greater accumulation of linguistic and cognitive resources. This is thought to enable them to achieve more effective and accurate interpreting.

However, largely due to market demand and the limited availability of interpreters working in the required languages, it is not always practical for interpreters to work in just one direction (Hale, 2007; Hale et al., 2020). In fact, interpreters do not always stand on the same ground with respect to their preferred working direction. While professional interpreters are frequently reported to prefer working into L1 (Donovan, 2004), different voices are heard from time to time, particularly among interpreting learners (Bartłomiejczyk, 2004, 2006; Martin, 2005; Nicodemus and Emmorey, 2013). At the same time, existing studies examining the impact of directionality on interpreter performance show mixed results. Empirical evidence suggests that when interpreters' professional competence is sufficient, they are less likely to be affected by directionality (Nicodemus and Emmorey, 2015). However, when the source speech becomes difficult to process, which may include non-native accents, unfamiliar content, and fast delivery, different performance patterns may be observed in the two directions (Daro` et al., 1996). This suggests that, for interpreters, it is sometimes more important to develop an accurate understanding of the source text than to deliver a flawless rendition in the target language (Martin, 2005). A major trend in existing studies on interpreting directionality focuses on uncovering how directionality affects an interpreter's performance, with various aspects of performance, including accuracy, fluency, and audience reception, examined to assess the extent of influence (Chang and Schallert, 2007; Gile, 2005). Such studies provide valuable insights to inform practice and training by investigating the impact of directionality from a macro perspective. Yet, very little research has been initiated to explore how the influencing power of directionality may manifest at different linguistic levels of interpreting output and what may be its implications for understanding how directionality affects an interpreter's language processing approach. An emerging line of corpus-based research that explores the unique properties of interpreted speech and their manifestations in different interpreting directions reveals the potential of adopting corpus methods to investigate the impact of directionality on an interpreter's performance (Bendazzoli, 2018; Dayter, 2018; Sandrelli and Bendazzoli, 2005; Xu and Li, 2022). However, existing studies are limited in number and tend to rely on lexical analysis, leaving other key linguistic levels such as the syntactic largely unexplored.

Against this research backdrop, this study aims to explore how directionality affects an interpreter's syntactic processing approach based on a bidirectional parallel corpus consisting of original English and Chinese speeches and their simultaneous renditions. Departing from a product-oriented perspective, this study concentrates on examining the way interpreters process sentences, including the syntactic options preferred, strategies chosen, and approaches to formulating a rendition in the target language. Two measures of syntactic dependency, namely dependency distance and dependency direction, were used to examine the syntactic complexity and language typological characteristics of interpreted speeches to show how interpreters process sentences in different directions and how this process interacts with socio-cognitive factors. Following this introduction, Section 2 presents a review of existing literature on the relationship between directionality and interpreter performance. Section 3 introduces the two measures of syntactic dependency employed in this study. Section 4 describes the corpus design and compilation, as well as the data analysis method. Sections 5 and 6 present the results and discussion, respectively. Section 7 concludes the study by summarizing the key findings and identifying its limitations.

[1] In this study, the terms "L1" or "A language" refer to the first language a person acquires naturally during early childhood and in which they reach native speaker level, while "L2" or "B language" refer to the language a person learns through formal education after the acquisition of their L1.

2. DIRECTIONALITY AND INTERPRETER PERFORMANCE

Directionality in interpreting and its impact on interpreter performance have been a much-debated issue in interpreting studies. Earlier investigations primarily focused on how an interpreter's asymmetric possession of linguistic resources in L1 and L2 affects their language processing capacity in comprehension and production, thus generating different sets of evidence to support 'native' versus 'retour' interpreting (Godijns and Hinderdael, 2005; Kroll and Stewart, 1994). In this vein, numerous studies have documented professional interpreters' preference for working into their L1, accompanied by empirical evidence demonstrating their enhanced performance in this direction (Chang and Schallert, 2007; Daro` et al., 1996; Donovan, 2004; Nicodemus and Emmorey, 2015). In a survey-based study, however, Bartłomiejczyk (2004), found that, compared to professional interpreters' positive attitude towards L2-L1 practice, student interpreters tended to perceive they had better performance in the opposite direction. This finding is supported by a series of investigations which showed that novice interpreters were more capable of achieving accurate and complete renditions in retour interpreting, as it was easier for them to comprehend the source speech in their native language (Denissenko, 1989; Kurz and Farber, 2003; Tommola and Helevä, 2016). At the same time, counter-evidence has also emerged, demonstrating that novice interpreters' output in retour interpreting had more disfluency markers and inaccurate renditions, mostly due to increased cognitive load when they needed to produce and monitor their rendition in their L2 (Chou et al., 2021; Martin, 2005; Nicodemus and Emmorey, 2015).

In light of the mixed results revealed thus far, some researchers have begun to realize that attributing the disparities in an interpreter's performance solely to directionality may not accurately reflect the dynamics of interpreting. This is because the activity of interpreting is shaped by a wide range of intertwined factors, which may include the interpreter's qualifications, competence, the task difficulty, specific language pairs, and audience reception (Bartłomiejczyk, 2006; Chang and Schallert, 2007; Gile, 2005). For example, in their study on directionality in English and American Sign Language interpreting, Nicodemus and Emmorey (2015) discovered that student interpreters produced better output when working into their L1. By contrast, the performance of professional interpreters was not influenced by directionality in terms of accuracy and articulation quality, suggesting that professional qualifications may play a more significant role in their performance. Chang and Schallert (2007) demonstrated that professional interpreters may adjust their strategies to meet the demands of interpreting in different directions. When performing retour interpreting, professional interpreters often employ a meaning-based interpreting approach — which includes generalization, transformation, and inferencing — to compensate for the comparatively limited linguistic resources they possess in their L2. This approach contrasts with L2-L1 interpreting, where professional interpreters tend to use existing phrases and idioms to convey meanings rather than relying on generalization. Daro` et al. (1996) further revealed that when faced with difficult texts, interpreters were more likely to omit information in retour interpreting, possibly because they need to devote more cognitive attention to self-monitoring output in their L2.

Adopting an alternative approach, an emerging corpus-based direction in interpreting studies aims to unveil the unique properties of interpreted speech, thereby distinguishing it from other language varieties, such as speech by native speakers and second language (L2) speech (Dayter, 2018; Li et al., 2022; Sandrelli and Bendazzoli, 2005). This approach has unlocked the potential for using corpus-assisted methods to investigate interpreters' language processing activities across different directionalities, whether interpreting into or out of their mother tongue. The unique properties of interpreted speech are often described as featuring universals or *interpretese* (Bendazzoli, 2018; Shlesinger, 2008). Based on a parallel aligned bidirectional corpus of original and simultaneously interpreted speech in both Russian and English, Dayter (2018) discovered that interpreters who worked from English into their native Russian produced renditions with lower lexical density and variety. This phenomenon suggests a simplification in the interpreted speech. This simplification phenomenon, characterized by a tendency for interpreters to use simpler language in their renditions, has been extensively researched and is increasingly recognized as a unique property of interpreted speech (Bernardini et al., 2016; Kajzer-Wietrzny, 2012; Liu et al 2023; Lv and Liang, 2019; Xu and Liu, 2023). On the other hand, the simplification phenomenon was not observed in retour interpreting. Dayter (2018) suggested that this absence might be due to interpreters exercising more caution when producing renditions in their L2, potentially leading to over-correction and the adoption of more complex lexical devices to ensure output quality. Xu and Li (2022) questioned Dayter's explanation, proposing that interpreting into L2 is likely to impose greater cognitive demands on interpreters. This increase in cognitive load could reduce lexical complexity and lead to an increased use of high-frequency words in their output. This argument was supported by their study of legislative proceedings in Hong Kong Cantonese and their corresponding translation and interpreting into English. Xu and Li (2022) demonstrated that when the interpreters worked from Cantonese (their L1) into English (their L2), their interpreted speech exhibited less lexical variety, confirming the presence of simplification in retour interpreting. In the same vein, Sandrelli and Bendazzoli (2005) revealed that interpreted speech was more simplified — that is, with a lower level of lexical density — when the interpreters in the study worked from Italian into English, whereas a higher lexical density was observed in the other direction. This result suggests an

impact of directionality on interpreters' lexical choices. However, it is unclear from Sandrelli and Bendazzoli's study whether the interpreters were working into their L1 or L2 in the relevant directions.

The corpus-based approach has shown its effectiveness in exploring the impact of directionality on interpreter performance. However, most studies have relied on lexical analysis by examining how the lexical complexity of interpreting output varies, as opposed to non-interpreted speech in different directions. Very little is known about how directionality may lead to variation at other linguistic levels, such as the syntactic.

3. DEPENDENCY RELATION ANALYSIS

Employing a comparative corpus-based approach, the present study explores how directionality affects the way interpreters process sentences by modelling the syntactic characteristics of interpreting output in comparison to speech produced by native speakers in different interpreting directions. The relevant syntactic characteristics are examined using two measures of syntactic dependency: dependency distance and dependency direction.

Dependency distance (DD) measures the linear distance between two syntactically related words in a sentence (Hudson, 2010; Liu, 2008). These two syntactically related words form a dependency relation, with one word serving as a governor and the other as a dependent (Liu et al., 2009). DD is widely used as an indicator to reflect syntactic complexity and the associated cognitive load during language processing activities (Liu, 2008, 2010; Liu et al., 2017). Syntactic complexity refers to the level of sophistication in the grammatical structure of a sentence (Ortega 2003, 2014; Lu, 2010). Due to its effectiveness in reflecting the growth of language users' syntactic repertoire and their ability to use it, syntactic complexity is widely used in second language research (Ortega 2003). More recently, this construct has been used by researchers to examine the unique properties of translational language and the processing efforts involved in producing translation or interpreting (Fan and Jiang 2019; Liu and Afzaal 2021; Liu et al 2023). On the other hand, dependency direction describes the linear positioning of two words that form a dependency relation, involving a choice between "governor precedes dependent" or "governor follows dependent" (see below), characterising a sentence or an entire language variety in terms of its language typology (Liu, 2010). These two concepts were originally employed for typological studies of languages by measuring their dependency relation (Liu, 2008, 2009; Liu et al., 2017; Liu and Xu, 2012). This body of research has found that, due to the limited capacity of human working memory and grammatical constraints (Liu, 2008), there is a universal preference for dependency distance minimization (DDM). This preference reflects a tendency in natural languages to "structure sentences in such a way as to minimize overall dependency distance" (Gildea and Temperley, 2010; Lei and Wen, 2020; Liu, 2008; Liu et al., 2017). For instance, Liu (2008) compared the mean dependency distance (MDD) of 20 languages and found that all 20 languages had an MDD of less than 4. Notably, Chinese had the longest MDD at 3.662, while English had an MDD of 2.543, indicating differences in dependency distance between languages.

Recent years have seen a growing interest in utilizing dependency relation metrics to analyze language use across various cross-linguistic contexts (Fan and Jiang, 2019; Liang et al., 2017; Liang and Sang, 2022; Ma et al., 2024; Wang and Liu, 2019; Yan and Liang, 2022). These applications range from predicting the difficulty of interpreting tasks (Jiang and Jiang, 2020) and examining the distinctive characteristics of different interpreting modalities (Liang et al., 2017) to investigating the specific attributes of translational language, such as simplification and interference (Fan and Jiang, 2019; Liang and Sang, 2022; Ma et al., 2024). These studies have shown the effectiveness of measures of dependency in capturing the unique properties of translational language as a way to understand translators' and interpreters' working approaches, strategies, and processing efforts. For example, in their study on Chinese-English translation, Fan and Jiang (2019) discovered that English texts translated from Chinese exhibited a longer MDD compared to those generated by native speakers, suggesting greater syntactic complexity. Similar observations were made by other scholars (Liang et al., 2017; Liang and Sang, 2022). In their comparison of the MDD in translated, consecutively interpreted and simultaneously interpreted English texts, Liang and colleagues noted that the MDD in translated outputs exceeds that in interpreted outputs. This difference is attributed to the reduced time constraints faced by translators, allowing them more cognitive resources to refine their language use and enhance the sophistication of their output (Liang et al., 2017). Moreover, in analyzing the longer MDD in English abstracts translated from Chinese relative to those originally written in English, Liang and Sang (2022) posited that the increased syntactic complexity in translations might stem from the influence of the source language, as Chinese typically exhibits a longer dependency distance than English. They further demonstrated that translational English is particularly affected at the phrase level, with an increased occurrence of adjective-noun dependency pairs, a common feature of Chinese linguistic structure.

Conversely, studies investigating the dependency relation attributes of interpreted speech often yield contrasting findings (Liang et al., 2017; Yan and Liang, 2022; Xu and Liu 2023). Xu and Liu (2023), in their examination of syntactic complexity variations among interpreted speech, L1 speech, and L2 speech, observed that interpreters performing retour interpreting (from Chinese to English) produced speech with a lower MDD compared to L1 speech, something

they attributed to the array of challenges faced by interpreters, including time constraints, multitasking demands, the need for accuracy, and the effort to generate an L2 output, prompting them to adopt simpler syntactic structures to mitigate the cognitive burden. This finding aligns with Xu and Li's (2022) research, which also evidences the simplification in interpreted speech at the lexical level. Intriguingly, a recent study by Ma et al. (2024) reported a shorter MDD in translated English literary texts relative to native English compositions, indicating a trend towards simplification in this case — a contrasting result to the majority of existing studies utilizing MDD to assess the syntactic complexity of translations (Fan and Jiang, 2019; Liang and Sang, 2022; Liang et al., 2017). However, most research in this field has focused on interpreting or translation in only one language direction, either L1 to L2 or L2 to L1. This raises the question of whether the simplification observed in either direction is also present in the opposite direction and how it mirrors the underlying language processing activities across different directions.

Aiming to bridge the gaps in existing literature, this study explores the impact of directionality on interpreters' syntactic processing approach by comparing the characteristics of dependency relations in interpreted speech with those in non-interpreted speech produced by native speakers across different directions. Specifically, it addresses the following research questions:

RQ1: How does directionality affect the characteristics of dependency relations in interpreted speech when compared to those of speech produced by native speakers?
RQ2: How do the characteristics of dependency relations in interpreted speech reflect the interpreter's syntactic processing approach in each direction?

4. THE STUDY

4.1. Corpus compilation

For this study, the United Nations Chinese-English Simultaneous Interpreting Corpus (UNSI) was compiled to facilitate both parallel and comparable corpus analyses (Xiao, 2015). UNSI is a bidirectional parallel corpus consisting of Chinese and English speeches delivered at United Nations (UN) Security Council meetings and their simultaneous renditions. UNSI comprises four sub-corpora: original English speeches (NE), original Chinese speeches (NC), and their simultaneous renditions into Chinese (Interpreted Chinese, IC) and English (Interpreted English, IE). Given the diversity of languages spoken by participants at the UN Security Council meetings, important gatherings where Council members deliberate on global peace and security issues, simultaneous interpreting is provided to enhance communication. Due to the high stakes associated with these meetings, the speeches are highly formal and typically lack colloquial elements. Highly competent professional interpreters are engaged to ensure the provision of quality services. These interpreters can access the speech scripts prior to the start of the interpreting assignment to make the necessary preparations (Cheung, 2019; Wu et al., 2021). The transcripts of all the speeches in their original languages and the corresponding renditions in the required languages can be accessed through the UN Digital Library.

A total of 207 pairs of speeches and their renditions were collected from UN Security Council meetings that occurred between 2021 and 2022. These meetings were all held on-site. Each pair consists of one English speech and one Chinese speech delivered at the same meeting, addressing the same topic. This ensured comparability across the four sub-corpora in terms of genre, speaker identity, formality, time, and interpreting mode. The English speeches were delivered by representatives from the United Kingdom, while the Chinese speeches were given by representatives from China. The interpreters, who were native Chinese speakers, performed both from and into their L1. The design of this corpus facilitates the comparison of interpreted speech with original non-interpreted speech in the same language, allowing for the identification of distinctive features of interpreted speech while considering the source speech's influence. Parallel comparisons were made in both interpreting directions to explore the effects of directionality on interpreters' syntactic processing approach. Detailed information on the four sub-corpora is provided in Table 1.

Table 1
An overview of the UN Chinese-English Simultaneous Interpreting Corpus (UNSI).

Sub-corpus	Texts count	Token no.	Source	Producer
NE	207	100,137	Original English speech	Native English speakers
IE	207	143,498	Interpreted English speech	Interpreters
NC	207	189,866	Original Chinese speech	Native Chinese speakers
IC	207	161,992	Interpreted Chinese	Interpreters

4.2. Calculating DD and dependency direction

Dependency relations between the words making up a sentence constitute its basic syntax (Hudson, 2010; Liu, 2008, 2009). The "core properties" of any dependency relation in a sentence must adhere to the following three principles: "1. It is a binary relation between two linguistic units; 2. It is usually asymmetrical and directed, with one of the two units acting as the head and the other as dependent; 3. It is labelled, and the type of the dependency relation is usually indicated using a label on top of the arc linking the two units" (Liu, 2010: 1568). Based on these three principles, the dependency relation of a sentence can be presented in a dependency graph as shown in Fig. 1 below.

In this dependency graph, all the words are connected by grammatical relations, forming several pairs of dependency relations. In each dependency pair, the labelled arc is projected from a governor to a dependent, demonstrating asymmetrical relations between the two words. The governor is the central organising word or "head", while the dependent relies grammatically on the governor (Jurafsky and Martin, 2019). In each sentence, there is a single designated root node, often a verb. The root node has no incoming arcs and serves as a governor for other words in the sentence. For example, in the sample sentence shown in Fig. 1, the attribute *the* depends on the subject it modifies, i.e., *women*, and the subject is the dependent of the root verb that follows, i.e., *bought*. The number below each word represents the linear position of the word in the sentence.

The DD can be obtained by subtracting the numeric position of the dependent from the governor. For example, the DD between "the" and "woman" is 2–1 = 1, the positive value indicating that the dependent precedes the governor. In cases where the numeric position of the dependent is greater than the governor, the DD can be a negative value, indicating that the governor precedes the dependent. In both cases, the absolute value is used to calculate the DD between two related words. The distribution of dependency direction can be derived during the calculation of DD. When there is a positive value, it means the governor follows the dependent, indicating a head-final relation. If the governor precedes the dependent, there will be a negative value, indicating a head-initial relation.

The current method used for calculating DD was firstly introduced by Liu et al. (2009). The mean dependency distance (MDD) of a sentence can be obtained using the formula below:

$$MDD\ (sentence) = \frac{1}{n-1}\sum_{i=1}^{n-1}|DD_i|$$

In this formula, n represents the number of words in the sentence, and DDi represents the dependency distance of the i-th syntactic link in the sentence. As the root verb in each sentence normally does not have a governor, its DD is zero. Using this formula, the MDD of the sentence in Fig. 1 can be calculated as (1 + 1 + 1 + 2)/4 = 1.25. This formula can be adapted to calculate the MDD of an entire text or treebank, as shown below. In this formula, n is the total number of words and s is the number of sentences in the text, and DDi is the i-th syntactic link of the text or in the treebank.

$$MDD\ (treebank) = \frac{1}{n-s}\sum_{i=1}^{n-s}|DD_i|$$

Dependency directions in a sentence can be both head-final and head-initial. Liu (2010) examined the dependency direction in 20 languages and discovered that natural languages differ in terms of the distribution of dependency direction. Chinese is predominantly a head-final language, while English favours a balanced distribution of dependency direction (Liu, 2010). Liu (2009) introduced a method for obtaining a frequency distribution of head-final and head-initial dependencies, as demonstrated below. Since a sentence typically contains only two types of dependency relations — head-final and head-initial — the sum of the frequency distribution of the two should equal 100% in a sentence (Liu, 2010; Wang and Liu, 2019). For example, the sentence in Fig. 1 has three head-final grammatical pairs and one head-initial pair. Therefore, the percentage of head-final dependency is 75%, while the head-initial percentage is 25%.

$$\text{Percentage of head}-\text{final dependency} = \frac{frequencies\ of\ the\ head-final\ dependency}{total\ number\ of\ dependencies\ in\ the\ treebank} \times 100$$

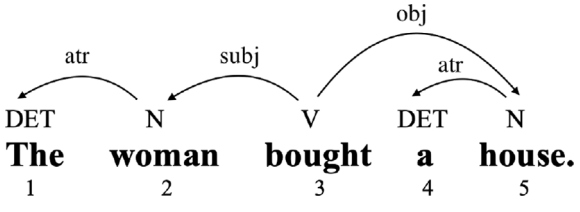

Fig. 1. Dependency relations of a sample sentence "The woman bought a house."

$$\text{Percentage of head} - \text{initial dependency} = \frac{\textit{frequencies of the head} - \textit{initial dependency}}{\textit{total number of dependencies in the treebank}} \times 100$$

The four sub-corpora were analyzed using the Stanford Parser, a neural network-powered dependency parser that reveals the grammatical structures and dependency relations within a sentence (Chen and Manning, 2014). The results of the automatic parsing were manually verified for accuracy before being exported to an Excel spreadsheet to calculate the MDD and dependency direction.

5. RESULTS

5.1. MDD variations across the four sub-corpora

The MDD has been calculated for each text in the four sub-corpora and is presented in Fig. 2. The relevant descriptive statistical information is summarised in Table 2. The findings reveal that Chinese is typologically distinct from English, generally exhibiting a longer MDD compared to English. This tendency applies to both original Chinese speech (NC) and interpreted Chinese speech (IC). Pairwise comparison within each language type shows that the MDD is different between interpreted speech and non-interpreted speech. Specifically, the MDD of IC (M = 3.210, SD = 0.252) is shorter than that of NC (M = 3.293, SD = 0.226). This result shows that when native-Chinese interpreters work from English into their L1, the interpreted Chinese is syntactically less complex than the original Chinese speech, supporting the existence of the phenomenon of simplification in interpreting. In the other direction, the MDD of IE (M = 2.589, SD = 0.145) is longer than that of NE (M = 2.511, SD = 0.167), showing an increased level of syntactic complexity in retour interpreting. These findings appear to challenge the widely held perception that when interpreters produce

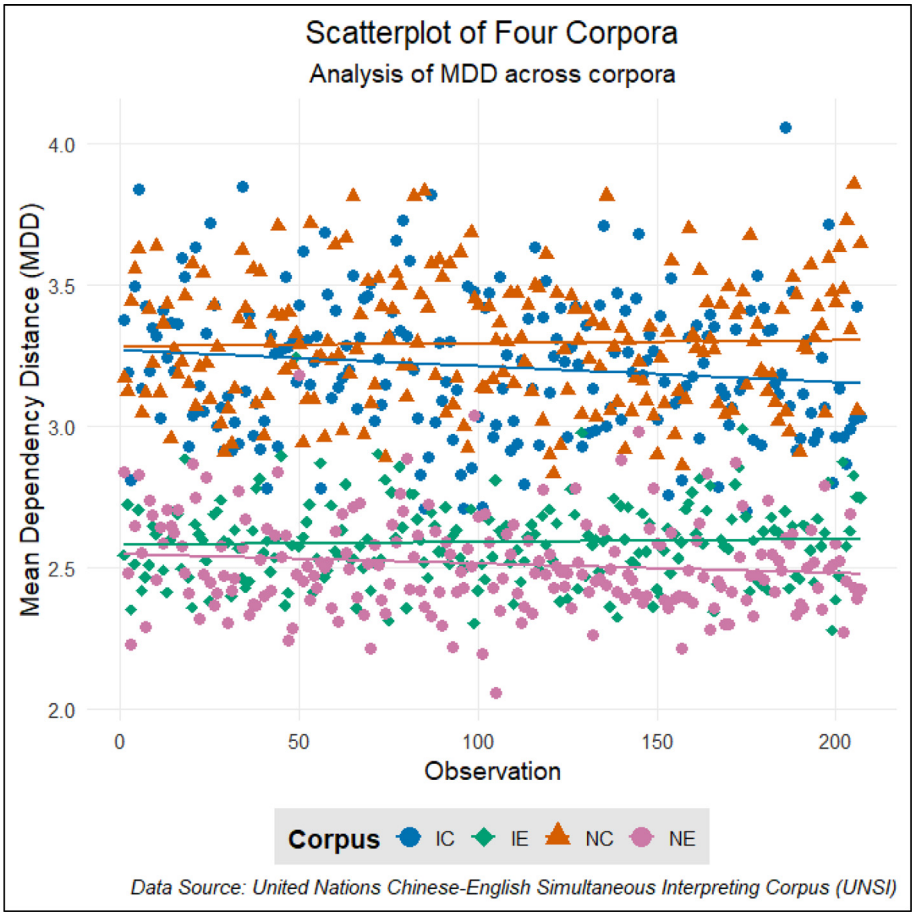

Fig. 2. MDD variations across the four sub-corpora.

Table 2
An overview of statistical information on MDD in the three sub-corpora.

Sub-corpus	Mean	Standard Dev.	Median	Maximum	Minimum
NE	2.511	0.167	2.48	3.18	2.06
IE	2.589	0.145	2.59	3.24	2.28
NC	3.293	0.226	3.28	3.86	2.83
IC	3.210	0.252	3.19	4.02	2.67

a rendition in L1, they possess greater linguistic and cognitive capabilities to refine their output (Donovan, 2004; Seleskovitch, 1978). Conversely, when they have to convey the interpreted message in L2, their constrained linguistic proficiency often limits their utilisation of sophisticated structures (Déjean Le Féal, 2005; Xu and Li, 2022). On a different note, when the dependency relations of the two source languages are considered, it seems that the different syntactic processing patterns observed in the two directions are related to this specific language pair. Given that Chinese tends to have a longer MDD than English (Liu, 2008, 2010), the longer MDD of IE and the shorter MDD of IC may be due to the syntactic structure of their respective source languages 'shining through' the interpreted speech. This finding confirms that the source language has a significant influence on the syntactic structure of interpreting output, and that this influence is evident in both directions of interpreting.

To assess whether there are statistically significant differences in MDD variations among the four sub-corpora, a one-way ANOVA test was conducted. The normal distribution of residuals within the dataset was confirmed, as each sub-corpus contained over 30 texts, and this was further validated through a Shapiro-Wilk test (w = 0.9901, $p < 0.01$). The results of the ANOVA test indicate that the MDD variation among the four sub-corpora is statistically significant ($F(3, 824) = 841.2$, $p < 0.01$). A subsequent Tukey's post-hoc test, detailed in Table 3 below, revealed that all pairwise MDD differences among the four sub-corpora are statistically significant ($p < 0.01$). This finding demonstrates that interpreted speech differs structurally from non-interpreted speech produced in the same language. The syntactic complexity variation patterns among source speech, interpreted speech and non-interpreted speech in the same target language suggest that the dependency relations of the source language affect an interpreter's syntactic processing approach, regardless of the interpreting direction (Fig. 3).

5.2. Dependency direction preference of the four sub-corpora

Following Liu's approach (2010), the dependency direction of the four sub-corpora is calculated at the corpus level. The result shows that both original and interpreted Chinese speech tend to be more head-final than original and interpreted English speech. In addition, when the dependency direction of interpreted speech is compared to non-interpreted speech in the target language, the interpreted English (44.45%) is less head-final than original English (45.43%) whilst the interpreted Chinese (58.94%) is more head-final than original Chinese (56.97%). This is shown in Table 4 below.

In order to test whether the identified distinctions have statistical significance, the dependency direction of each text was calculated. The distribution percentage of head-final relation is shown in Fig. 4. The result of a one-way ANOVA test, as presented in Fig. 5, shows that the dependency direction preference of the four sub-corpora does not reveal a similar pattern ($F = 1796$; $p < 0.01$). The Tukey's post-hoc test further confirms that all the pairwise MDD differences among the four sub-corpora are statistically significant ($p < 0.01$). These findings suggest that interpreting activity may introduce changes to the dependency direction of the interpreted speech but it does not change the overall dependency direction preference of that particular language. This can be shown in Figs. 4 and 5 where Chinese is predominantly a head-final language while English tends to be more head-initial. These preferences are applicable to both interpreted

Table 3
Tukey's post-hoc test results for MDD differences among the four sub-corpora.

Sub-corpus	Difference	*P* value
NE-NC	−0.782	<0.01*
IC-NC	−0.083	<0.01*
IE-NC	−0.703	<0.01*
IC-NE	0.698	<0.01*
IE-NE	0.078	<0.01*
IE-IC	−0.621	<0.01*

Note: * indicates a statistically significant difference in the measure.

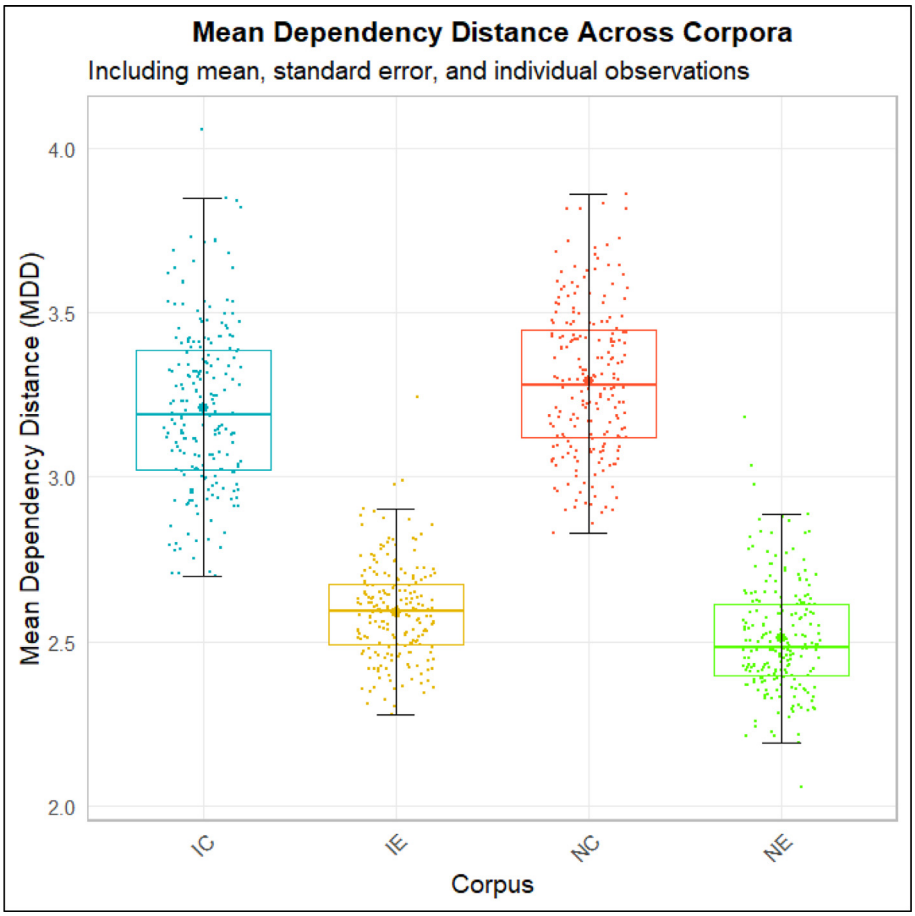

Fig. 3. ANOVA test results for variations in MDD across the four sub-corpora.

and original speech. Moreover, the result also shows that the word order characteristics of interpreted speech are insensitive to source language influence. On the contrary, the interpreted speech tends to favour the dependency direction of the target language in both directions of interpretation. This preference is evident in interpreters' efforts to produce idiomatic renditions and adhere to the conventions of the target language. This can be reflected in the rendition of the sample sentence in Figs. 6 and 7 (Table 5).

Fig. 6 below shows the dependency relation of a Chinese sentence. A literal English translation is provided under each Chinese word to allow for alignment between Chinese and English words.[2] This sentence contains a subject禁化武组织, a verb 坚持 and an object独立, 客观, 公正的原则. The object is a noun phrase, including the three modifiers 独立, 客观, and 公正. This sentence contains five head-final relations and one head-initial relation, resulting in head-final relations accounting for 83.3% of the total. Fig. 7 presents the interpreter's accurate interpretation of this sentence into English. The interpreter maintained the same grammatical structure, including a subject *the OPCW*,[3] a verb *will adhere to* and an object *the principle of independence, objectivity and impartiality*. While the three major grammatical components were maintained in the same position as the source text, the percentage of the head-final relation in the English rendition is 63%. The reduced presence of head-final relations in the interpreted sentence has to do with the rendition of the noun phrase. In Chinese, it is typical for modifiers to be placed before the noun they modify (Liang and Sang, 2022; Liu, 2010). Therefore, the object structure in the source text is predominantly head-final, contributing three head-final relations to the sentence. The English language also has the same convention for placing modifiers before nouns

[2] According to Chinese writing conventions, it is customary to not include spaces between individual words. In this example, spaces are inserted to provide additional room for presenting an English translation of each word below.

[3] OPCW is short for Organisation for Prohibition of Chemical Weapons.

Table 4
Dependency direction distribution percentage of the three sub-corpora.

Sub-corpora	Head-final dependency frequency	Head-final distribution percentage	Head-initial dependency frequency	Head-initial distribution percentage	Total dependency frequency
NE	48,226	45.43%	57,936	54.57%	106,162
IE	67,701	44.45%	84,594	55.55%	152,295
NC	64,083	56.97%	48,396	43.04%	112,479
IC	56,284	58.94%	39,169	41.03%	95,453

(Biber et al., 2010). However, when there are multiple modifiers or when the noun is used in a formal context, it is common for the modifiers to be placed after the noun (Berlage, 2014). Prepositions are often used to link the modifiers and the noun to clarify the relationship between the modifiers and the noun. Consequently, the English rendition of the object yields three head-initial relations. In this sense, the reduced percentage of the head-final relations indicates the interpreter's efforts to comply with the target language word-order convention in order to produce an idiomatic rendition.

6. DISCUSSION

6.1. Directionality and simplification

Based on a bidirectional parallel corpus of original English and Chinese speeches from UN Security Council meetings and their simultaneous interpretations, this study explored how directionality affects the way interpreters process sentences. Two tree-based dependency relation measures were used for analysis: MDD and dependency direction. Consistent with previous research by Liu (2008) and Liu et al. (2009), our findings indicate that Chinese, whether in its original form or as an interpreted language, tends to have a longer MDD compared to English. This finding confirms the validity of MDD as an effective measure for categorising different language types.

In addition, this study shows that the expected phenomenon of simplification is not present in both directions of interpretation. Specifically, when interpreters worked into Chinese (L1), the syntactic structure of their rendition was less complex than that of non-interpreted Chinese speech, confirming the existence of simplification. In contrast, when interpreters worked into English (L2), the syntactic structure of interpreted speech became more complex. This result contradicts Xu and Liu's (2023) study which showed that when interpreters worked in retour interpreting (from Chinese into English), the MDD of interpreted English text was shorter than that of English text produced by native speakers. Xu and Liu attributed this observed syntactic simplification to the high cognitive demand on simultaneous interpreters, which caused them to resort to more simplified syntactic structures to prevent cognitive overload. These contradictory results may have to do with the different types of simultaneous interpreting under investigation. Xu and Liu (2023) observed simultaneous interpreting of impromptu speech, which means there was no preparation time and interpreters needed to produce an L2 rendition in real time. In the present study, the interpreters were able to access the speech scripts beforehand and could carry out pre-interpreting preparations. In this sense, the interpreting activity in the present study resembles translation, where practitioners have sufficient time to polish their output by using complex syntactic structures, a phenomenon found in previous studies (Fan and Jiang, 2019; Liang and Sang, 2022; Liang et al., 2017).

However, it is worth noting that the same phenomenon of increased syntactic complexity was not observed when interpreters worked from their L2 into their L1. As discussed in previous research, producing a rendition in one's native language should be more instinctive and require less cognitive effort, which should enable the interpreter to demonstrate greater proficiency in deploying complex structures (Donovan, 2004; Seleskovitch, 1978). Seen from this perspective, the inconsistent manifestation of simplification in the two directions may indicate that the identified different syntactic processing approach may not necessarily be linked to the interpreter's asymmetric command of L1 and L2, and the associated cognitive capability (Xu and Li, 2022; Xu and Liu, 2023; Liang et al., 2017). When it comes to professional interpreters who have prepared adequately, the extent to which directionality impacts on their performance may be limited. This finding lends support to previous research, which reveals that professional interpreters feel equally confident in both directions and their performance is largely unaffected by directionality (Nicodemus and Emmorey, 2015).

6.2. Directionality and source language influence

Moreover, this study found that when interpreters worked from a low-MDD language (English) to a high-MDD language (Chinese), the MDD of their rendition (interpreted Chinese) was lower than that of the original speech (non-

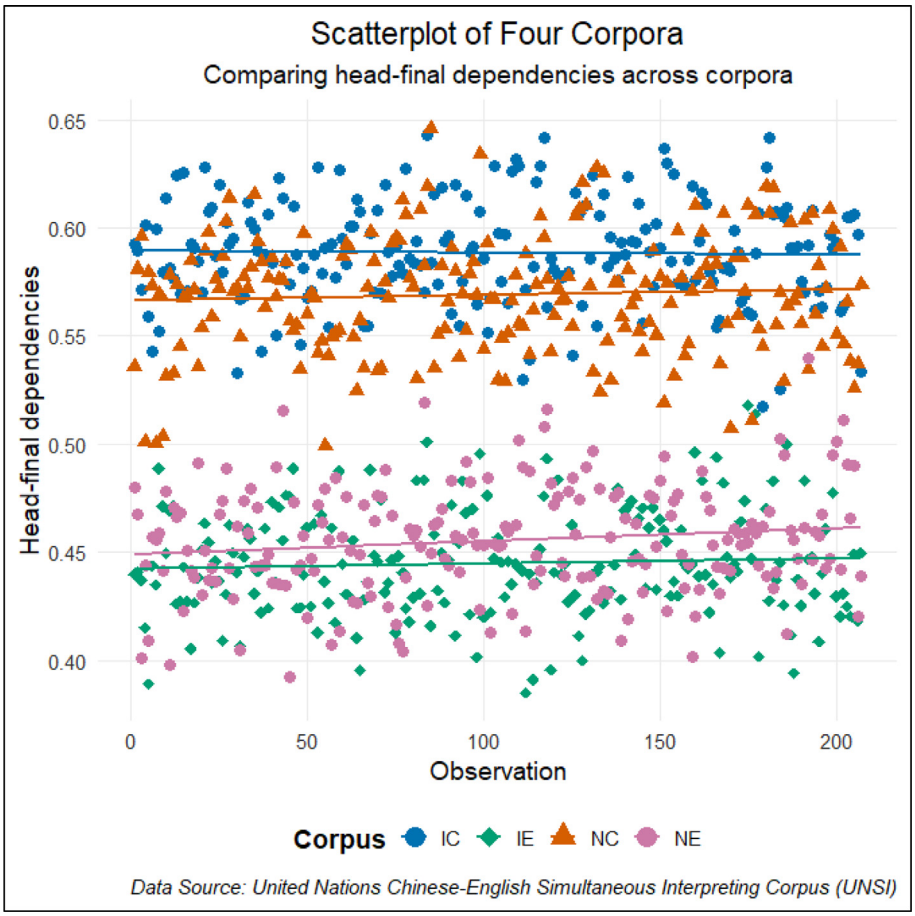

Fig. 4. Head-final dependency distribution across the four sub-corpora.

interpreted Chinese). Conversely, when they worked from a high-MDD language (Chinese) to a low-MDD language (English), the MDD of their rendition (interpreted English) was higher than that of the original speech (non-interpreted English). This finding suggests that the syntactic processing patterns found in the two directions may be associated with this specific language pair (Chinese-English) and the respective source language influence.

Source language influence, often described as interference or "shining through", is increasingly seen as a unique property of translational language (Evert and Neumann, 2017; Teich, 2003; Toury, 1995). As a form of cross-lingual communication, interpreting involves significant bilingual language processing on the part of interpreters. In this process, interpreters need to activate their competence in both languages to comprehend the source speech and deliver an adequate rendition to the target audience. Consequently, the interpreted speech is formulated under substantial cross-linguistic influence and may exhibit certain linguistic patterns or regularities that are characteristic of the source language (Xiao, 2015). The phenomenon of source language influence has been extensively explored in translation studies (Dai and Xiao, 2011; Evert and Neumann, 2017; Lapshinova-Koltunski, 2022), while its manifestation in interpreted speech has garnered more attention recently, particularly with the emergence of corpus-based interpreting studies. For instance, Ma and Cheung (2020) have shown that interference in interpreting is closely linked to the mode of interpretation. By comparing interpreters' performance in simultaneous interpreting with and without text, Ma and Cheung found a higher degree of interference in the latter case, where interpreters adopt more synthesis strategies to cope with a greater cognitive load. The present study provides further corroborative evidence for Ma and Cheung's (ibid) study. These findings indicate that it is difficult for interpreters to completely "switch off" one of their languages when using the other, which suggests that source language influence may be inevitable in cross-linguistic processing.

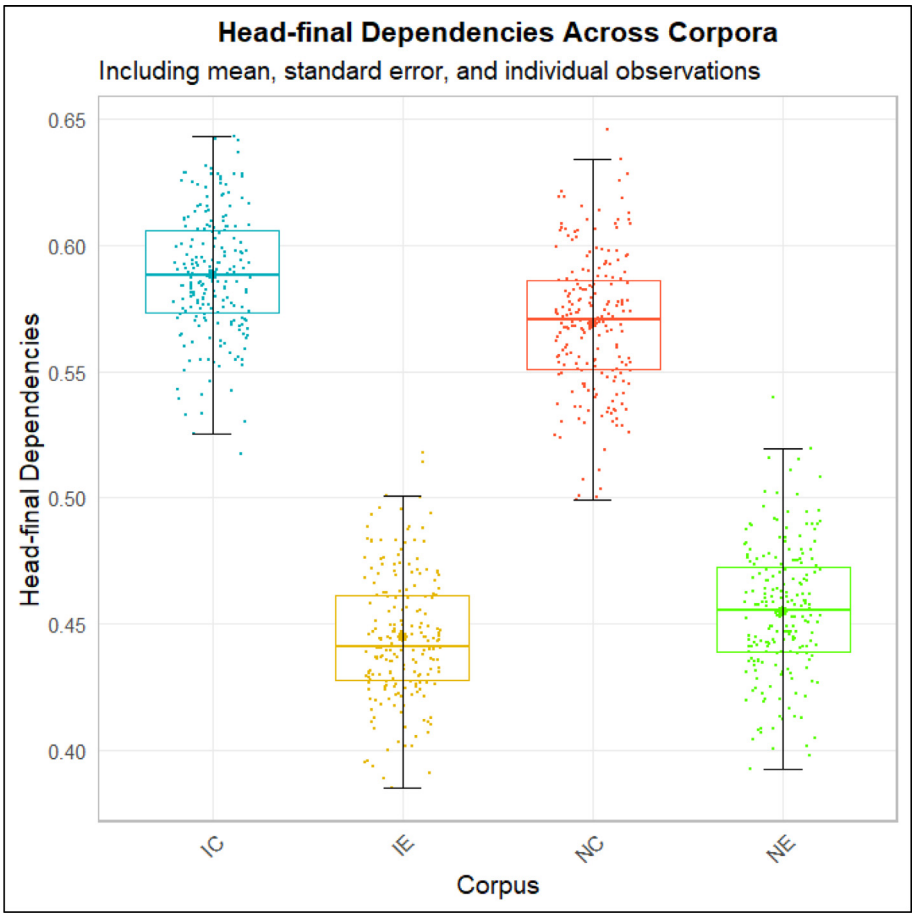

Fig. 5. The percentage of head-final dependency distribution across the four-corpora.

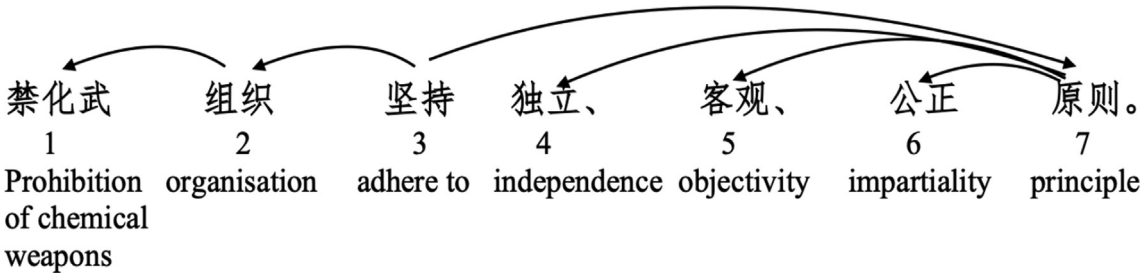

Fig. 6. Dependency relation of the source text in Chinese.

Fig. 7. Dependency relation of the rendition in English.

Table 5
Tukey's post-hoc test results of the percentage of head-final dependency distinction.

Sub-corpus	Difference	*P* value
IE-IC	−0.144	<0.01*
NC-IC	−0.019	<0.01*
NE-IC	−0.133	<0.01*
NC-IE	0.124	<0.01*
NE-IE	0.011	<0.01*
NE-NC	−0.114	<0.01*

6.3. Directionality and compliance with target language convention

Regarding preference of dependency direction, the results revealed that Chinese is primarily a head-final language, regardless of whether it is interpreted or not, which is consistent with previous research (Liu, 2008). Additionally, this study discovered that cross-linguistic processing led to variations in the dependency direction preference of interpreted speech. However, this variation was not introduced by the source language but rather indicated a convergence toward the respective word order characteristics of the target language. This observed pattern, which was applicable to both directions, may be related to the interpreter's interpreting approach.

In the present study, the simultaneous interpreting was conducted by highly qualified and experienced conference interpreters who had access to the speech scripts in advance. Given their professional expertise and years of practice, it can be argued that these interpreters are more cognizant of their professional responsibilities, potentially leading them to aim for idiomatic renditions (Kruger and Van Rooy, 2016; Redelinghuys, 2019). Therefore, instead of adopting a literal interpreting approach, which may be occasionally used by interpreters to minimise cognitive effort (Englund-Dimitrova, 2005), these interpreters were more capable of performing 'reordering' and achieving accuracy at the pragmatic level by actively manipulating the word order of their rendition to align it with target language conventions (Hale, 2007; Ma and Li 2021; Wang and Zou, 2018). This finding aligns with the research conducted by Wang and Liu (2019), who posited that the influence of the source language on interpreting is not unlimited, given that interpreted speech, as a distinct language variety, possesses its own mechanisms for conforming to the conventions of the target language. The present study further elucidates that this adaptability is linked to the interpreter's professional competence, awareness of professional norms, and the specific contexts in which interpreting occurs.

7. CONCLUSION

Utilizing a corpus-based comparative methodology, this study explored the impact of directionality on interpreters' approaches to syntactic processing. It employed measures of MDD and dependency direction to analyze the characteristics of dependency relations in interpreted versus non-interpreted speech, shedding light on sentence processing strategies in two interpreting directions. The research validated the effectiveness of measures of dependency relations in highlighting the distinctive features of interpreted speech and revealing varied syntactic processing strategies between the two directions. The results indicate that the differences in syntactic processing strategies observed among professional interpreters, who are well-prepared, may not necessarily stem from their language proficiency or cognitive capabilities. Instead, factors related to language pair, such as the influence of the source language and the need to adhere to target language conventions, appear to have a more significant influence on sentence processing strategies. This aligns with the results reached by Chang and Schallert (2007) who suggested that the diverse strategies employed by professional interpreters across different directions result not only from the asymmetry between their first and second languages but also from a combination of other elements, including professional standards and the discourse structures of the languages they work with.

While this study has yielded intriguing results, it does acknowledge certain constraints. It focused on a singular group of highly skilled professional interpreters within a specific context of simultaneous interpreting with text. The analysis focused on a pair of typologically distinct languages, each with unique dependency relation characteristics, and was restricted to observing linguistic patterns at the syntactic level. Given the broad spectrum of factors potentially affecting an interpreter's performance across different directions, there is a significant need for continued research. Future studies should embrace a holistic approach, investigating the various structural elements of interpreted speech relative to directionality as well as the various relevant socio-cognitive factors. This kind of comprehensive exploration is crucial for developing a thorough understanding of interpreting as a distinctive linguistic phenomenon.

CREDIT AUTHORSHIP CONTRIBUTION STATEMENT

Han Xu: Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Kanglong Liu:** Writing – review & editing, Visualization, Validation, Supervision, Methodology, Data curation, Conceptualization.

Data availability

Data concerning the study are publicly available on Open Science Framework (https://osf.io/ytvbj/).

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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