The impact of directionality on the process and product in consecutive interpreting between Chinese and English: Evidence from pen recording and eye tracking

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ABSTRACT

Directionality is a recurring topic in interpreting studies. Focusing on consecutive interpreting (CI), this study aims to contribute further empirical data to the topic by analysing the impact of directionality on the process and product of CI, with special attention paid to the cognitive aspect. Pen recording and eye tracking were used to record CI with notes amongst professional interpreters with Chinese as L1 and English as L2. The direction of interpreting was found to affect the cognitive processing and product in both phases of CI. Phase I of L2 to L1 interpreting seemed to burden the interpreters with a higher level of cognitive load than L1 to L2 interpreting, leading to a strategic choice of using more language notes (full words rather than abbreviations) and fewer symbols. Phase II of L2 to L1 interpreting appeared to be less cognitively demanding than the other direction and the interpreters produced a more fluent target speech, but the target speech was less accurate.

KEYWORDS

Directionality, consecutive interpreting, process, product, cognitive load.

1. Introduction

Directionality is a recurring topic in translation and interpreting studies (Gile 2005). It refers to the question as to whether there is any difference between working from an interpreter's first language (L1) into a second language (L2) or the reverse[1]. On the one hand, interpreters may have personal preferences to work into a certain language. For example, they may prefer to produce interpretations into their L1, which is stronger, given the greater cognitive effort required for language production (Nicodemus and Emmorey 2013). On the other hand, directionality is a potentially important factor that impacts the quality of interpretation (Godijns and Hinderdael 2005; Kalina 2005). Some have even argued that interpreters can only create high-quality target speech when working into their L1, especially in simultaneous interpreting (SI) (Seleskovitch 1999).

However, most studies focusing on the issue of directionality in interpreting have only investigated SI and signed language interpreting, while consecutive interpreting (CI) has received inadequate attention. Apart from that, there is not enough empirical evidence overall and the jury is still out there on the topic (Gile 2005). This study aims to contribute further empirical data by analysing both the process and product of CI and in both L2 to L1 and L1 to L2 directions, with special attention paid to the cognitive aspect. The issue of directionality is not only meaningful for translation and interpreting research. This study helps to shed light on the ways the brain

engages cognition to language comprehension and language production, while the differences found between the two directions of CI could be taken as evidence for the asymmetry between L1 and L2 processing.

2. Directionality in interpreting

One of the regularly recurring themes in interpreting research is that of directionality and the associated issue of whether preference should be given to interpreting into L1 or L2. This section will provide a brief overview of the relevant literature, with a main focus on the empirical findings, rather than the theoretical views such as those by Seleskovitch and Lederer (1989) and Denissenko (1989), which have already been reviewed in many related studies (see Gile (2005) for example).

Of the previously studied themes on interpreting directionality, two emerge as the most discussed: (1) the influence of directionality on interpreting, especially the quality of interpreting; (2) the factors interacting with directionality, particularly those that might cancel out its influence.

2.1. The influence of directionality on interpreting

Studies in this group mainly focus on the influence of directionality from three aspects: interpreting quality (e.g. Tommola and Helevä 1998; Van Dijk *et al.* 2011; Fu 2012, 2013; Nicodemus and Emmorey 2015; Lin *et al.* 2018), strategy use (e.g. Al-Salman and Al-Khanji 2002; Bartłomiejczyk 2006; Chang and Schallert 2007; Gumul 2017; Wu and Liao 2018), and cognitive load (e.g. Rinne *et al.* 2000).

The impact on interpreting quality is the most extensively researched aspect, with the majority of the attention paid to information completeness, fluency of delivery, and target language quality.

With novice SI interpreters as participants, a study by Tommola and Helevä (1998) found a slight advantage of the L1 to L2 direction in information completeness as measured by propositional accuracy. Experimenting with professional SI interpreters, Rinne *et al.* (2000) reported higher information completeness in the L1 to L2 direction. A similar result was found in signed language interpreting: Van Dijk *et al.* (2011) found that their professional interpreters produced more accurate products when working from L1 (spoken Dutch) into L2 (Sign Language of the Netherlands).

Standing in contrast, Chang and Schallert (2007) detected higher information completeness rendered in L2 to L1 SI with Chinese L1 interpreters (but no difference was found with English L1 interpreters). Nicodemus and Emmorey (2015) also observed that in signed language interpreting, novice interpreters were more accurate when interpreting into their L1, whereas expert interpreters were equally accurate in the two directions.

Directionality was found to be an important factor that influences the fluency of delivery in interpreting. In Lin *et al.* (2018), the SI performance of novice interpreters was more fluent in the L2 to L1 direction. The same trend was found in signed language interpreting. In a group of professional interpreters, Wang and Napier (2015) found that native signers performed significantly better in terms of delivery in the English (L2) to Auslan (L1) direction. Similarly, Nicodemus and Emmorey (2015) found that their novice interpreters' speed of interpretation was scored significantly higher (meaning the delivery was well-paced, neither too fast nor too slow) when working into English (L1) than into American Sign Language (L2). At the same time, however, they found that professional interpreters were slightly (but not significantly) better when interpreting from L1 into L2 in terms of flow.

Only a couple of studies tackled the issue of directionality in CI, and the focus was invariantly on fluency. Mead (2005) used both novice and professional interpreters as participants and found that they were both more fluent in L2 to L1 interpreting, with novices making a high proportion of long filled pauses in L2 production, showing marked disfluencies. Fu (2013) detected a significant directional impact on novice interpreters' disfluency features. He found more ungrammatical pauses in the L1 to L2 direction, but more repairs in the L2 to L1 direction.

In terms of the influence of directionality on target language quality, Nicodemus and Emmorey (2015) reported that novice signed language interpreters produced more natural prosody when working into L1, but there was no difference between the two directions in expert interpreters. Wang and Napier (2015) found that the native signers were significantly superior to the non-native signers in terms of the target text features in English-to-Auslan interpreting.

Varied strategic approaches may be taken by interpreters to cope with the different demands of the two interpreting directions. For example, Bartłomiejczyk (2006) found that, in SI from L2 to L1, novice interpreters used more inferencing, parallel reformulation, and transcodage, whereas in SI from L1 to L2, they used more syntactic transformation, approximation, and paraphrase. In a study looking specifically at explicitation in interpreting, Gumul (2017) found that novice interpreters used explicitation more frequently in L1 to L2 SI, especially by means of adding connectives, reiteration, meaning specification, and disambiguating metaphors. According to the retrospective report, this was mainly due to the interpreting constraints felt by the participants in L2 production, and they were adopting repair or preventive strategies.

The influence of directionality on cognitive load in interpreting has been investigated in several studies which started from an interdisciplinary perspective. Gran and Fabbro (1988) reported significantly increased

disruption in the tapping rate for L1 to L2 SI as compared to the other direction, due to the less automatic and more cognitively taxing language production control in L2. Kurz (1995) detected EEG differences between the two SI directions, and found an increase of interhemispheric coherence in the beta band in the L1 to L2 direction, indicating a higher level of cognitive load. Hyönä *et al.* (1995) used pupil dilation as a measure of cognitive load in SI and found that the pupil dilated more when the subjects performed lexical translation from L1 to L2 than when they translated from L2 to L1. Rinne *et al.* (2000) observed that the brain activation patterns of interpreters were modulated by direction, and recorded more extensive activation during SI from L1 to L2.

2.2. Factors that interact with directionality in interpreting

The influence of directionality on interpreting, albeit clearly shown by empirical evidence in various studies, is modulated and sometimes even "offset" (Gile 2005: 9) by other relevant factors. These factors that interact with directionality in interpreting can be roughly divided into two types: interpreter-related and task-related factors. On the one hand, the interpreter characteristics of motivation (Pavlović 2007), training and working experience (Fernández 2005; Chmiel 2016), language proficiency (de Bot 2000), and working memory (Lin *et al.* 2018) have a bearing on how individual interpreters might deal with interpreting into different directions. On the other hand, the task characteristics, such as interpreting mode (Nicodemus and Emmorey 2013), language pair (Padilla 2005), features of the speech (Dose 2017), features of the speaker and the audience (Chang and Schallert 2007), and market (Fernández 2005; Lim 2005), need to be carefully controlled or systematically manipulated so as not to obscure the actual influence of directionality.

More importantly, the interpreter and task characteristics often work together to jointly interact with directionality. Survey studies (Lim 2005; Nicodemus and Emmorey 2013) confirmed the stronger motivation to work into L1, supporting the traditional bias of spoken language interpreters for the L2 to L1 direction (e.g. Seleskovitch and Lederer 1989: 135; Déjean le Féal 1998, 2005). But this preference was found to be modulated by language pair, interpreting mode, and training and working experience.

Another survey conducted by Pavlović (2007) among translators and interpreters in Croatia (mostly working with L1 Croatian and L2 English) showed that one-third of the respondents preferred the L1 to L2 direction, one-third preferred the other direction, and the rest reported having no preference regarding directionality. Furthermore, questionnaire results from Al-Salman and Al-Khanji (2002) showed that the majority of respondents were more comfortable when interpreting from Arabic into English (L1 to L2) than vice versa.

In signed language interpreting, the anecdotal preference of L1 (spoken language) to L2 (signed language) interpreting was confirmed by Nicodemus and Emmorey (2013). Apart from discovering the different directionality preferences among spoken and signed language interpreters, the study also revealed that spoken language interpreters received an education with a slight bias for more training in L2 to L1 interpreting, while the signed language interpreters received almost twice as much instruction in the L1 to L2 direction.

The above-mentioned literature highlights the relation between directionality and interpreting. Nevertheless, the majority of the studies cast their attention on SI and signed language interpreting, leaving CI quite under-researched in comparison. Since the interpreting mode could potentially affect whether or not an interpreter would work in one direction or the other (for example, in Lim (2005), those who were willing to work into L2 in CI preferred not to work in that direction in SI), it would be beneficial to devote more research effort to the consecutive mode. In addition, research into the impact of directionality on CI will be meaningful for interpreter education programmes to enhance curriculum designs. Furthermore, interpreting is a cognitively demanding language task which can serve as a useful tool to investigate the cognitive processes involved in the bilingual brain, and CI taps into different mental processes from the other interpreting modes. This study, as a result, tries to contribute some empirical evidence on the topic of directionality in CI.

2.3. Tapping into the process and product of CI

According to Gile's Effort Models (2009: 175–176), phase I of CI is the comprehension phase, consisting of the sub-processes of listening and analysis, note-taking, short-term memory operations, and coordination; phase II is the speech production phase, consisting of the sub-processes of remembering, note-reading, and production.

The product of phase I is the written notes produced by the interpreters, whereas the product of phase II is the translated speech in the target language. Extensive research has been carried out on the product of both phase I (i.e. the notes, see Chen (2016) for a review) and phase II (i.e. the target speech, see Collados Aís and García Becerra (2015) for an overview).

The process of CI, however, seems under-researched in comparison. Earlier process research on CI relied on the method of video recording (e.g. Andres 2002), which involved manually checking the timing of note-writing, was labour-intensive and not very accurate. Digital pen recording is a newer and viable research method to tap into phase I of CI, which has been applied in more recent studies (Orlando 2010, 2014; Chen 2017, 2020). As to phase II, a research method with substantial potential for investigating the cognitive processes is eye tracking, a method that has long been applied in fields such as reading and cognitive sciences, but only became a popular

research method in Translation Studies during roughly the past decade (Hvelplund 2017).

This study used digital pen recording and eye tracking to collect data from a group of professional interpreters while they were performing CI in both the L2 to L1 and the L1 to L2 direction, with an aim to further our understanding of directionality in CI. The study attempts to address the following questions:

1. What is the impact of directionality on the process and product of CI phase I, the comprehension phase?
2. What is the impact of directionality on the process and product of CI phase II, the speech production phase?

More specifically, the interest lies in exploring the impact of directionality on the process of CI phase I (as indicated by the temporal features of note-writing captured via pen recording), the product of phase I (the written notes), the process of phase II (as indicated by the eye movements captured via eye tracking), and the product of phase II (as indicated by the information completeness and fluency of delivery of the target speech).

3. Method

3.1. Participants, interpreting tasks, and procedures

The data collection period lasted from August 2015 to July 2016. A sample of 26 professional interpreters with Chinese as L1 and English as L2 were recruited to perform CI with notes. They all had Professional Interpreter accreditation by NAATI, the Australian National Accreditation Authority for Translators and Interpreter. The sample mean age was 36.4 years (*SE* = 2.36). The participants had an average of 7.4 years of professional experience (*SE* = 1.43) and had provided 167 CI services on average in the past 12 months (*SE* = 58.1). They lived and worked in Australia, a country where their L2 was spoken.

Two source speeches (one in Chinese and one in English) were created and strictly controlled for variances to make the two CI tasks as similar as possible (see Table 1), differing only in directionality. Here is a summary of the procedures (please refer to (Chen 2017) for more details): (1) two English scripts on similar topics were created and an analysis by CPIDR 5 (Brown *et al.* 2008) showed that they had similar word count, proposition count, and idea density[2]; (2) one of the scripts was translated by the author (who is a professional translator/interpreter) to make a Chinese script; (3) two speeches were recorded by native speakers of Chinese and English in sound-proof studios using the relevant scripts; (4) the recorded speeches were edited using Audacity and controlled for variables such as pauses, duration, and speed.

Direction	Topic	Word count	Proposition count	Idea density	Duration
E-C	How to register a business in Australia	631	321	0.51	4'59"
C-E	How to purchase a property in Australia	630*	324*	0.51*	4'47"

* The calculations were based on the original English script to enable comparison between the two texts. The Chinese character count was 944.

Table 1. A summary of the two tasks.

The fact that the C-E script was a translated text rather than originally drafted in Chinese potentially limits the comparability of E-C and C-E texts. In order to mitigate this effect, the translated text was refined stylistically and grammatically by two Chinese speaking editors working at a local Chinese radio station. The editors were highly professional for the job due to the nature of their work (editing scripts for radio broadcasting). It was also worth mentioning that the texts, although talking about business registration and property purchase, were of a general rather than (semi-)legal nature and no legal terminology was involved (please refer to (Chen 2018) for a copy of the texts).

The participants were tested individually in a language laboratory. They performed the two CI tasks in randomised order so that about half of them performed L2 to L1 interpreting first, and other L1 to L2 interpreting first. They were allowed to take a break for as long as they needed between the tasks. During the experiment, the participants' note-taking process was recorded by a digital tablet equipped with a digital pen, powered by the Eye and Pen software (http://eyeandpen.net/en/). The entire interpreting process was also recorded by a head-mounted eye tracker (the SMI ETG). A retrospection session (audio-recorded) cued by the written notes followed the tasks, and the participants were asked to recall whatever they could remember about the interpreting process, and report the content, form, and language of each note unit.

3.2. Data and analysis

Due to the combined data loss of pen recording and eye tracking, only 18 participants had both their pen and eye data successfully collected.

During the experiment, the Eye and Pen software recorded not only all the written note units, but also the timestamp of every event, including the start/end time for writing each note unit and the start time for playing each source speech audio, allowing for the calculation of the ear-pen span (EPS). The EPS was calculated as the time span between the moment a speech unit was heard and the moment it was written down as notes, and used as an indicator of the cognitive processing in phase I (see (Chen 2017) for

more detailed explanations). The form and language of the notes were also analysed, following the rules specified in Dam (2004a, 2004b).

The eye tracker recorded the eye movements and a video of the entire interpreting process. The eye measure of average fixation duration was used as an indicator of the cognitive processing in phase II. The quality of interpreting was measured in terms of information completeness and fluency of delivery. To measure information completeness, the target speeches were transcribed, propositionalised, and scored against the source text propositions; a group of three raters assessed the information completeness and the final score was the average of the three (see (Chen 2017) for more specifications). To measure fluency of delivery, Audacity was used to prepare the audios for the automatic rating (e.g. the source speech was removed from the recording). Praat (Boersma and Weenink 2018) was used to automatically analyse the target speech audios, using Praat Script Syllable Nuclei v2 (Quené *et al.* 2010) with default settings.

Paired samples t-tests were used to compare the two directions of interpreting. All statistical analyses were performed by running IBM SPSS Statistics 24. Two-tailed *p* values less than 0.05 were considered to be statistically significant. Cohen's *d* (the difference between the means divided by the pooled standard deviation) was used to indicate the effect sizes, which were classified as small (d = 0.2), medium (d = 0.5), and large (d = 0.8).

4. Results

4.1. The impact of directionality on CI phase I

The time lag between listening and note-writing, namely the EPS (reported in milliseconds), was significantly different between the two directions (Figure 1). The EPS in the L2 to L1 task (M = 2262, SD = 635) was significantly shorter than that in the L1 to L2 task (M = 2632, SD = 681); $t(21) = -3.39$, $p = .003$, d = 0.72. This means that the interpreters followed the source speech more closely when listening to an L2 speech compared to an L1 speech.

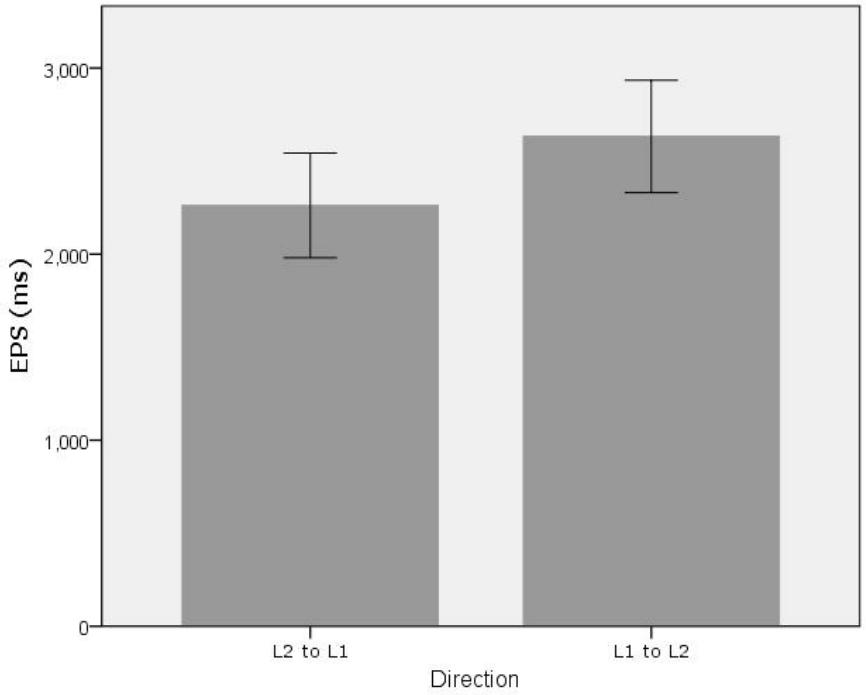

Figure 1. The EPS in the two directions of interpreting.

There was no significant difference in the quantity of notes taken by the participants between the L2 to L1 direction (*M* = 182.14, *SD* = 27.71) and the L1 to L2 direction (*M* = 179.32, *SD* = 27.56), *t*(21) = 0.90, *p* = .38.

The participants in this study preferred language to symbol in interpreting overall, but there were differences between the two directions (Table 2). The percentage of language notes in the L2 to L1 direction was significantly higher than that in the L1 to L2 direction, whereas the percentage of symbol notes in the L2 to L1 direction was significantly lower than that in the L1 to L2 direction. This means that the participants used more language notes and fewer symbol notes when listening to an L2 speech compared to an L1 speech.

	L2 to L1		L1 to L2				
	M	*SD*	*M*	*SD*	*t*	*df*	*d*
Language (%)	75.2%	7.3%	68.6%	8.1%	8.49***	21	1.81
Symbol (%)	19.8%	7.6%	22.5%	8.5%	-3.59**	21	0.77

** $p < .01$, *** $p < .001$

Table 2. Differences between the two directions in terms of the language / symbol choice.

The participants did not have a clear preference for abbreviation or full word in either direction. There was a significant directional difference in terms of their use of full words, but not abbreviations (Table 3). The percentage of full word notes in the L2 to L1 direction was significantly higher than that in the L1 to L2 direction. That is to say, the participants used a higher proportion of full words in note-taking when listening to L2 as opposed to L1.

	L2 to L1		L1 to L2				
	M	*SD*	*M*	*SD*	*t*	*df*	*d*
Abbreviation (%)	39.6%	10.2%	37.6%	7.3%			
Full word (%)	35.5%	7.6%	31.0%	8.5%	3.76**	21	0.80

** $p < .01$

Table 3. Differences between the two directions in terms of the abbreviation / full word choice.

Looking at the two sets of data together (Table 2 and Table 3), we can see that the participants not just used more language notes when interpreting from L2 to L1, but the increased language notes were mostly full words instead of abbreviations.

The participants in this study preferred L2 (English) to L1 (Chinese) when choosing the language for note-taking in both directions, but there were differences between the two directions (Table 4). The percentage of L1 notes in the L2 to L1 direction was significantly lower than the other direction, whereas the percentage of L2 notes in the L2 to L1 direction was significantly higher than the other direction. What this shows is that the participants' preference for L2 in note-taking was modulated by the direction of interpreting: the preference was enhanced when comprehension was in L2, and weakened when it was in L1.

	L2 to L1		L1 to L2				
	M	*SD*	*M*	*SD*	*t*	*df*	*d*
L1 (%)	16.4%	13.4%	26.7%	16.4%	-2.60*	21	0.55
L2 (%)	58.8%	15.2%	41.9%	16.5%	4.16***	21	0.89

* $p < .05$, *** $p < .001$

Table 4. Differences between the two directions in terms of the choice of language.

4.2. The impact of directionality on CI phase II

In phase II, the participants' average fixation duration in the L2 to L1 direction was shorter than that in the L1 to L2 direction, and the data shows a clear tendency to significance (Table 5). This seems to indicate that when the participants were producing a target speech in L1, the cognitive load tended to be lower.

	L2 to L1		L1 to L2				
	M	*SD*	*M*	*SD*	*t*	*df*	*d*
Average fixation duration	271.48	70.99	281.77	76.34	-2.03*	17	0.48

* p = .058

Table 5. Difference between the two directions in the average fixation duration in CI phase II.

There were significant differences between the two directions in terms of the information completeness of the target speech (Table 6). The information completeness score in the L2 to L1 direction was significantly lower than that in the L1 to L2 direction. That is to say, the quality of interpreting performance in terms of information completeness was better in L1 to L2 interpreting compared with L2 to L1 interpreting.

	L2 to L1		L1 to L2				
	M	*SD*	*M*	*SD*	*t*	*df*	*d*
Information completeness	73.27	9.54	77.24	8.73	-3.72**	21	0.79

** p < .01

Table 6. Difference between the two directions in terms of information completeness.

Praat was used to analyse the target speech on such parameters as the number of silent pauses, duration, phonation time, and speech rate (number of syllables/duration). The duration and phonation time of the target speeches in the two directions were not significantly different (Table 7). Differences were found in the fluency of delivery between the two directions as measured by the number of silent pauses and speech rate (Table 7). The number of silent pauses in L2 to L1 direction was significantly lower than that in the L1 to L2 direction, while the speech rate of the L2 to L1 direction was significantly higher than that in the L1 to L2 direction. Taken together, the data show that when producing an L1 target speech, the participants had fewer pauses and a higher speech rate, pointing to a better fluency of delivery in the L2 to L1 direction.

	L2 to L1		L1 to L2				
	M	*SD*	*M*	*SD*	*t*	*df*	*d*
No. of silent pauses	121.00	41.39	160.73	44.67	-4.68***	21	1.00
Duration (s)	382.88	82.92	392.89	86.93	-.56	21	
Phonation time (s)	283.54	46.74	265.62	60.24	1.79	21	
Speech rate	3.31	0.53	2.95	0.49	4.79***	21	1.00

*** p < .001

Table 7. Differences between the two directions in terms of fluency of delivery.

I also calculated the proportion of pause duration in the target speech and found that silent pauses counted for 24.5% of the entire duration of speech in the L2 to L1 direction, and this was significantly lower than the 31.8% in the L1 to L2 direction ($t(21) = -4.85$, $p < .001$, $d = 1.03$). This is converging evidence for better fluency in L1 target speech production.

5. Discussion

The impact of directionality was found on both the process and product in the two phases of CI. In the listening and note-taking phase, when the participants listened to an L2 speech, they acted more hastily and there was a shorter time lag between listening and note-taking. An earlier study (Chen 2020) showed that a very short EPS was detected when interpreters came across numbers, way shorter than the average EPS in the entire task. Considering that numbers have long been regarded as a drain on the cognitive resources (Mead 2015), a shorter EPS might be the interpreters' strategy to cope with the high cognitive load. Similarly, the shorter EPS in L2 to L1 interpreting found in this study might indicate a strategic choice resulting from a higher level of cognitive load associated with listening and comprehension in L2 compared with L1. This is both intuitively plausible and empirically supported by listening studies (e.g. Borghini and Hazan 2018).

The product of CI phase I, that is the notes, showed differences in both the form and language between the two directions. The participants not only used a higher proportion of language notes and a lower proportion of symbol notes in L2 to L1 interpreting than vice versa, but their increased proportion of language notes were full words, rather than abbreviations. That is to say, when faced with the more cognitive demanding L2 listening and comprehension, the interpreters opted for fewer symbols and more full words in note-taking. This is in line with previous studies which have stated that if symbols and abbreviations are not fully mastered by the interpreter, "retrieving them from one's memory when they are needed for writing may take up too much time and processing capacity" (Gile 2009: 179).

In terms of the language of note-taking, this study found that the participants preferred L2, which was English, in both directions of interpreting. This might have to do with the interpreters' working experience and L2 competence (the participants are professional interpreters who live and work in a country where their L2 is spoken), as well as the language combination (compared to Chinese, the alphabetic language of English might be preferred because phonetic spelling and misspelling can be used for note-taking).

However, directionality had an impact on this preference for L2. The preference was enhanced when interpreters were listening to an L2 speech and weakened when they were dealing with an L1 speech. A possible explanation is that comprehension in L2 and taking notes in L2 is intra-

language processing, arguably less cognitively demanding than the inter-language processing of comprehension in L1 and taking notes in L2.

In phase II of CI, this study found that the average fixation duration during note-reading was shorter in the L2 to L1 direction, potentially indicating a lower level of cognitive load. This is in line with the findings in a number of studies that production in L1 is less cognitively taxing than in L2 (Hyönä *et al.* 1995; Kurz 1995; Gran and Fabbro 1988; de Bot 2000; Rinne *et al.* 2000).

The quality of interpreting was also found to be affected by directionality. This study measured the target speech quality on two criteria: information completeness and fluency of delivery.

It was found that the information completeness was higher in the L1 to L2 direction, corroborating findings in some studies (Tommola and Helevä 1998; Rinne *et al.* 2000; Van Dijk *et al.* 2011) but contradicting others (Chang and Schallert 2007; Nicodemus and Emmorey 2015). For example, Chang and Schallert (2007) observed higher information completeness in SI from L2 to L1. The current study differs from their study in the interpreting mode studied, and also the participants in this study lived and worked in an English-speaking country and had high L2 proficiency. These could potentially explain the contradiction in the findings. As to Nicodemus and Emmorey (2015), they studied signed language interpreting, and it was likely that the mode of interpreting came into play, causing the difference in the findings.

This study also examined the fluency of delivery between the two directions of interpreting and found that the fluency of L2 to L1 interpreting was better than that of L1 to L2 interpreting, as evidenced by the number of silent pauses, speech rate, and proportion of pause duration. This finding echoes a number of studies which found L1 production to be more fluent, be it in SI (Lin *et al.* 2018), CI (Mead 2005), or signed language interpreting (Nicodemus and Emmorey 2015; Wang and Napier 2015).

6. Conclusion

This study examined a group of Chinese(L1)/English(L2) professional interpreters while they performed CI in both directions. To the best of my knowledge, this study is the first to examine the varied influences of directionality on both the process and the product of the two phases in CI.

In phase I, the comprehension phase, the participants followed the source speech more closely and used higher proportions of language and full word notes and a lower proportion of symbol notes when listening to L2 compared with L1. The evidence seems to reveal that, faced with a higher level of cognitive load in L2 comprehension, interpreters would adapt their strategy by using more language notes (full words rather than abbreviations) and

less symbols. In phase II, producing a target speech in L1 was associated with a lower average fixation duration, better fluency, but a lower level of information completeness. The data seems to indicate that while the interpreters were experiencing a lower level of cognitive load during L1 production, generating a more fluent target speech, the target speech was less accurate than the other direction. Findings of this study could be informative for developing compatible training strategies to tackle the specific challenges in the two interpreting directions.

Examining the findings in this study together with those in previous studies, it becomes evident that a series of factors might come into play on directionality in interpreting. This study managed to identify some clear differences between the two directions by confining the scope of research. It only looked at one interpreting mode (CI), with only one type of participant (professional interpreters) and one language combination (Chinese L1 and English L2). It would be very interesting to see how generalisable these findings are when some of the parameters are systematically manipulated.

What this study would also like to conclude is that CI provides a unique avenue for investigating the links between different languages in the human brain. What CI presents is a challenging bilingual processing task naturally divided into two distinct phases, one featuring comprehension and the other, production. With further effort devoted into the topic, the differences in cognitive processing found between the two directions of CI in the two phases could provide potential evidence for the asymmetry between L1 and L2 processing, and between language comprehension and production.

Acknowledgments

This work has been supported by the Fundamental Research Funds for the Central Universities (grant number SWU1809688) and the China National Committee for Translation & Interpreting Education (grant number MTIJZW201903).

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Biography

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Notes

[1] This study uses the L1 and L2 labels following Chmiel (2016) since the nomenclature is sufficiently neutral for this interdisciplinary research.
[2] A proposition consists of the main verb and all its arguments, whereas the idea density is calculated as the number of propositions divided by the number of words (Brown *et al*. 2008).