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A new perspective on models and theories of simultaneous interpreting

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In this article, we consider influential theories and models of simultaneous interpreting through the prism of current theories and findings in psycholinguistics. We review evidence suggesting that meaning is routinely accessed during comprehension, and, on this basis, suggest that it is unlikely that interpreters produce translation equivalents without accessing meaning. We also reflect on data showing cross-linguistic activation in two-language settings, and suggest that such cross-linguistic activation regularly takes place in simultaneous interpreting, without interfering with the processing of meaning. Finally, we consider the role of prediction in simultaneous interpreting. Evidence suggests that prediction regularly takes place during simultaneous interpreting and may facilitate the interpreting process. On the basis of this theoretical analysis, we consider that simultaneous interpreting involves a synergy, rather than just an overlap, of comprehension and production. We outline the pedagogical implications of our conclusions, and explain why viewing simultaneous interpreting from this new perspective may open up directions for future research.

Keywords: simultaneous interpreting, multilingualism, prediction, executive control

1. Introduction

Simultaneous interpreting involves comprehension of an utterance or a series of utterances in the source language, and concurrent production of the translation of those utterance(s) in the target language. Source and target language are thus activated in parallel, and in direct relation to one another (the target utterance should convey the same meaning as the source utterance). Although there is of course a lag, source and target language utterances still overlap around 70% of the time (Chernov 1994, 139). This overlap has interested scholars since the early days of Interpreting Studies research, and has led to simultaneous interpreting often

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being regarded as a complex and difficult task (e.g., Christoffels, De Groot, and Waldorp 2003; Agrifoglio 2004; Ahrens 2011; Seeber 2013).

Simultaneous interpreting might be akin to 'dual-task' experiments, in which language processing is impaired by a concurrent task such as having to remember unrelated words (e.g., Ito, Corley, and Pickering 2018). But in simultaneous interpreting, the two tasks of listening to the source utterance and uttering its translation in the target language are related. In some instances, concurrent comprehension and production processes do facilitate each other, for example when bilingual picture naming is facilitated by comprehension of the translation of the name (Costa, Miozzo, and Caramazza 1999). So, in fact, language processing during simultaneous interpreting might be less hard than we might otherwise expect.

Over the years, conference interpreting trainers, practitioners, and theorists have sought to explain how interpreters process language in order to faithfully interpret from one language into another during simultaneous interpreting, often with pedagogical aims in mind. Here, we review several longstanding theories from Interpreting Studies, which are at once descriptive and prescriptive (Moser 1978; Seleskovitch and Lederer 1989; Paradis 1994; Gile 1995, 2009), and which have influenced scholars' conception of the simultaneous interpreting process, as well as the way in which simultaneous interpreting is trained. The theories included in this brief review consider two main routes for language processing during simultaneous interpreting: a semantically-mediated and a non-semantically-mediated route.

In the main body of the article, we consider the process of simultaneous interpreting through the prism of up-to-date theories of language processing during bilingual comprehension and production from the field of psycholinguistics, and we ask whether the theories of simultaneous interpreting that we have reviewed are or could be aligned with these theories and associated data. We review evidence suggesting that interpreters almost always access meaning before producing their response. However, we also consider evidence that they do occasionally interpret either without or before accessing meaning. We then consider how overlapping comprehension and production may have both a facilitatory and an inhibitory effect on simultaneous interpreting. Finally, we consider how prediction may facilitate simultaneous interpreting. We conclude by reflecting on the pedagogical implications of a fine-grained appreciation of the simultaneous interpreting process, as well as on questions that remain unanswered and future directions for research.

2. Limitations of early theories on simultaneous interpreting

During simultaneous interpreting, target language output lags somewhat behind source language input. This lag has been estimated as approximately 5 words (Gerver 1976, 172), 1–6 seconds (Cokely 1986, 3) or 2–3 seconds (Barik 1973,237). Lag times can vary greatly, including lag times of the same interpreter during the same speech: Chernov (2004, 190) found that the lag time was 2.5–3 seconds at the beginning of each passage in a speech, reaching up to 6 seconds towards the end of difficult passages, but also narrowing to as little as 0.5 seconds. Meanwhile, Gerver (1976) found that lag depended on source speech delivery rate, with a lag of 5 words at 95 words per minute (wpm), but a lag of 8.5 words at 164 wpm. However, it is unclear how interpreters are processing language during this lag.

Previous literature has argued that language processing during simultaneous interpreting could vary in two important ways. First, the unit of interpreting may differ: interpreters may wait to hear and comprehend a word, a phrase (for instance, a nominal phrase), a clause, or a sentence before beginning to produce their own utterance. Second, they may interpret using two different routes: a semantically-mediated route (e.g., hearing *dog*, accessing the meaning DOG, and then producing *chien*); or a non-semantically-mediated route (e.g., hearing *dog* and producing *chien* via a direct link). These two routes have been referred to in different ways. The semantically-mediated route has been called a vertical approach (De Groot 1997; Macizo and Bajo 2004, 2006), or a strategy based on awareness of meaning (Paradis 1994). It has also been described as "intelligently" rendering a message based on a non-linguistic representation (Seleskovitch and Lederer 2001, 146) or reformulating an utterance based on a representation of its meaning (Gile 2023). Traditionally, it was assumed that when interpreters use this route, they first fully comprehend the message in the source language and only then activate the target language for production (e.g., Gerver 1976; Moser 1978; Gile 1995; Seleskovitch and Lederer 2001).

In contrast, the non-semantically-mediated route has been called a horizontal approach (De Groot 1997; Macizo and Bajo 2004, 2006), transcoding (Seleskovitch and Lederer 1989, 2001), and direct transcoding (Paradis 1994). This route has been viewed as an inferior route used by interpreting students and inexperienced interpreters, consisting in "regurgitating" translation equivalents (Seleskovitch and Lederer 1989, 37). But it has also been viewed as a route used by experienced interpreters, who have learned to rapidly produce certain translation equivalents, rather than by students and inexperienced interpreters (Paradis 1994). Some authors suggest that the two routes may be combined (Christoffels and De Groot 2005; Seeber 2011). For instance, Christoffels and De Groot (2005) suggested that even when the non-semantically-mediated route is used, inter-

preters may continue language processing until meaning is understood. Others considered that both routes may be used separately at different points in a speech, but that the semantically-mediated route is preferable (Seleskovitch and Lederer 1989, 2001).

Discussion of these routes has also included implicit or explicit discussion of the size of the unit of interpreting. When he discussed the semantically-mediated route, Paradis (1994) did not specify the unit's length, but he referred to the comprehension of a (whole) message. But when he discussed the non-semantically-mediated route, he referred to "one linguistic element in SL [source language]" and "its structural equivalent in TL [target language]" (1994, 329). This suggests that he considered that meaning was accessed for longer units but not for shorter units (see also Gerver 1976; Moser 1978; Seleskovitch and Lederer 1989, 2001).

Nowadays, most theorists believe that interpreting largely takes place via the semantically-mediated route (e.g., Setton 1999; Setton and Dawrant 2016; Pöchhacker 2023). However, the view persists that when interpreting students produce an interpretation that closely follows the syntactic structure or lexical choices of the original speech, they are not focusing sufficiently on the meaning of the utterance, and that representing meaning conceptually (rather than linguistically) before producing an interpretation is a technique that needs to be encouraged in students (Setton and Dawrant 2016).

In this article, we hypothesize that interpreters almost always use a semantically-mediated route, and we will review data and theories from the field of psycholinguistics that support the use of such a route during simultaneous interpreting, in both trained and untrained bilinguals engaged in an interpreting task. However, we will also review psycholinguistic evidence for direct (i.e., non-semantically-mediated) links between words across languages (or links via phonological representations). For example, the incorrect translation of false friends (e.g., Chmiel, Janikowski, and Cieślewicz 2020) suggests that interpreters do sometimes produce equivalents without accessing meaning. Such occasional errors should not be used to explain what is happening as standard, but neither can they be ignored in an account of bilingual language processing during simultaneous interpreting. Such errors by interpreters do not mean that interpreters are not accessing meaning at all, but they do mean that interpreters may also make mistakes because of the availability of this non-semantically-mediated route (for instance because they provide their interpretation before accessing meaning). We will also consider syntactic priming across languages and discuss how this applies in a simultaneous interpreting context.

We also call into question the idea that interpreters must be trained to interpret via a semantically-mediated route. The psycholinguistics literature demonstrates that language comprehension takes place extremely quickly (Marslen-

Wilson 1973; Swinney 1979; Rayner and Clifton 2009) and that the meaning of linguistic and extra-linguistic context influences comprehension during listening (Tanenhaus et al. 1995; Spivey et al. 2002; Huette et al. 2014). People also integrate speaker gestures and visual expressions during comprehension (e.g., Holler and Levinson 2019), and, when interpreters have a clear view of speakers' faces and gestures or of a written text, they also integrate this multimodal input (Chmiel 2025). Therefore, interpreting without accessing meaning is highly unlikely. It is of course possible that interpretation is occasionally based on direct activation of a translation equivalent, perhaps when the content is highly technical or specialised. For example, interpreters may directly map *polyesteramide composition* into German or *hake* into French, because they do not understand organic chemistry or recognise particular species of fish.

To sum up, most existing accounts acknowledge that interpretation may pass by both a semantically-mediated route (accessing meaning) and a non-semantically-mediated route (without accessing meaning) within the same discourse. In our review we will provide evidence that suggests that (1) a semantically-mediated route can work at any unit size from word level to sentence level, (2) a non-semantically-mediated route can also work at any unit size from word level to sentence level (for instance, for a multi-word phrase), and (3) the immediate production of a translation equivalent does not rule out the accessing of meaning. Thus, the size of the unit interpreted does not necessarily determine the cognitive process that takes place, and it is not possible to determine whether or not an interpreter has accessed meaning based on the interpretation produced. In addition, we consider evidence that suggests that not only may two different routes be used within the same discourse, but also that two different routes may be used while interpreting the same word or larger unit.

3. The synergy between comprehension and production in simultaneous interpreting

In the following sections, we review psycholinguistic evidence that supports a role for both semantically-mediated and non-semantically-mediated language processing during simultaneous interpreting. On the one hand, as noted above, the speed of comprehension makes it highly unlikely that people comprehend during simultaneous interpreting without processing meaning (e.g., Marslen-Wilson 1973). Meaning may be accessed at the level of one word as well as over a series of words (or both). On the other hand, cross-linguistic activation takes place at different levels of representation, at least when both languages are being used (Kroll et al. 2010). Thus, in a two-language setting, such as simultaneous interpreting,

we may assume that, for a given utterance, both source and target language are activated at the levels of phonology, syntax and semantics.

We suggest that for any given utterance, be it a word or a series of words, meaning may be accessed, and *at the same time* the language of production may be activated via cross-linguistic activation, potentially through direct links. In other words, interpreters might hear *dog*, access the meaning DOG and produce *chien* based on the meaning, but, at the same time, they may have already activated *chien* while hearing *dog*, and this cross-linguistic activation may help them produce the translation equivalent more quickly and easily. In this section, we review evidence of cross-linguistic activation showing that in two-language contexts, both languages are concurrently activated. We also consider whether such cross-language activation may take place without meaning being accessed.

By cross-linguistic activation, we mean that when bilinguals hear a word in either of their languages, they may activate information from both languages. This information may be phonological (e.g., Marian and Spivey 2003), although activation can also happen at the lexical level; for instance, when people name a picture in one of their languages, naming is facilitated if they see its name in their other language (e.g., Costa, Miozzo, and Caramazza 1999).

Cross-linguistic activation may also take place across groups of words. For instance, multi-word phrases may be stored in the lexicon just as single words are (Jackendoff 2002), and could thus in theory be activated across both languages. Zeng, Branigan, and Pickering (2020) point out that some multi-word phrases also have the same syntactic form across two languages (for instance, the English phrase *major problem* and its Chinese translation *zhuyao wenti* are matched on a one-to-one basis and in the same order, with *major* translating as *zhuyao*, and *problem* as *wenti*). This might facilitate cross-language activation, because these multi-word phrases could be activated across languages on both the single-word and the multi-word level. The facilitation effect of such multi-word phrases might be reinforced during training, when interpreters may also have been trained to provide a more literal interpretation in some situations, such as when speakers read out lexically dense statements (containing little or no redundant information) (Setton and Dawrant 2016) or else when interpreter trainers train students on multi-word phrases likely to appear in specific contexts (e.g., the EU; Wu 2024). In addition, experienced interpreters may benefit from the effects of entrenchment, when they have used the same translation for the same phrase many times (see Halverson 2019). There is evidence to suggest that multi-word phrases lead to fewer hesitations during simultaneous interpretation (Plevoets and Defranq 2016).

Cross-linguistic activation may also take place on the syntactic level. Hatzidaki, Branigan, and Pickering (2011) show cross-linguistic syntactic number

agreement in English–Greek and Greek–English bilinguals. Participants read aloud a noun phrase in either English or Greek, in which the noun and its translation had different syntactic number across the two languages (e.g., *The money*; singular or Τα λεφτά; plural). They were asked to complete the phrase in either the same language, or in the other language. Participants sometimes produced a verb which agreed in number with the translation of the subject noun (e.g., "The money *are useful*"), and they did so much more often when they switched language (e.g., "Τα λεφτά *are useful*"). This finding suggests that they concurrently activated both languages' syntax (on many occasions at least), and hence that some aspects of syntax can be concurrently activated in both languages (and used during production).

Since cross-linguistic activation may take place at different levels of representation (phonological, lexical, syntactic), it may be possible to activate a phonological, lexical, or syntactic equivalent in the target language without accessing meaning (in either the source or target language, or both). However, evidence for this is mixed. For instance, Catalan–Spanish bilinguals were faster at naming pictures, in both Spanish and Catalan, when the Spanish names were phonologically similar to their Catalan equivalent (Costa, Caramazza, and Sebastian-Galles 2000). This cognate-facilitation effect suggests cross-linguistic activation at either the phonological or the lexical level (or both), independently of activation of meaning. However, faster naming times for cognates may be explained in ways which do not require concurrent lexical or phonological activation in both languages. For instance, cognates may share a closer conceptual representation than non-cognates in both of a bilingual's languages, and thus the semantic representations of cognates may be retrieved more rapidly at the conceptual level even without both languages being activated at the phonological level (Costa, La Heij, and Navarrete 2006). It is also possible that cross-language activation in a one-language setting is due to the way in which word associations are transferred from L1 to L2 during learning, with traces of L1 remaining within the L2 lexicon (Costa et al. 2017; Winther, Matusevych, and Pickering 2023).

Although there is some debate about the extent to which more than one of a bi- or multilingual's languages are activated when only one language is relevant (e.g., Costa et al. 2017), cross-linguistic activation certainly occurs when two (or more) languages are relevant (e.g., Hatzidaki, Branigan, and Pickering 2011; Bernolet, Hartsuiker, and Pickering 2012). Simultaneous interpreting is a two-language context, and so it is theoretically possible that utterances may occasionally be interpreted without the interpreter accessing meaning. However, there are different explanations for how cross-linguistic activation takes place, and it may be that semantic activation always accompanies phonological and syntactic cross-linguistic activation. What we can be relatively confident about is that both source

and target language are activated during source-language comprehension, rendering early accounts which suggest that meaning may first be comprehended in the source language alone highly unlikely (e.g., Moser 1978; Seleskovitch and Lederer 1989, 2001). Instead, we can assume that comprehension and production interact during simultaneous interpreting at the phonological, lexical, and syntactic levels as interpreters access the meaning of an utterance.

4. The facilitative role of cross-language activation in simultaneous interpreting

Cross-language activation may sometimes support simultaneous interpreting and sometimes inhibit it. Certain features shared between source and target language may facilitate production in the target language. For instance, it may be less costly to interpret cognates, or sentences that share syntactic structure in the source and target language. Costa, Miozzo, and Carramazza (1999) found that Catalan–Spanish bilinguals were faster at naming pictures in Catalan when pictures were presented with their name in Spanish than when they were presented with a distractor word. This facilitation likely also extends to a simultaneous interpreting context. For example, Christoffels, De Groot, and Waldorp (2003) found that bilinguals were faster at translating cognates than non-cognates (into both their L1 and their L2).[1]

Speakers tend to repeat the syntactic structure of utterances they have produced or comprehended (see Pickering and Ferreira 2008). They do so even when they fully understand the sentence, by regenerating the sentence using the activated words. Potter and Lombardi (1998) had participants listen to dative target sentences (e.g., "The prompt secretary wrote her boss a message every week") and semantically unrelated prime sentences, which were either dative sentences that did not have the same syntactic structure as the target sentence (e.g., "The tycoon willed that mansion to his young nephew very grudgingly") or else control sentences that were not dative sentences (e.g., "My favourite shirt glowed when the room was completely dark"). When participants recalled target sentences, they were more likely to change to the alternative dative syntactic structure when this had been primed. Thus, Potter and Lombardi (1998) argue that hearing a sentence not only primes and activates meaning, it also primes and activates syntactic structure.

1. Note, however, that interpreters sometimes choose a synonym rather than the cognate equivalent during simultaneous interpreting (Chmiel, Janikowski, and Cieślewicz 2020).

Syntactic priming also takes place across languages. Hartsuiker, Pickering, and Veltkamp (2004) had a confederate and an L1-Spanish L2-English participant describe picture cards to one another. The confederate spoke Spanish while the participant spoke English. The confederate used scripted sentences with active, passive, intransitive, or object-verb-subject structures. The authors found that participants were more likely to produce a passive sentence in English after hearing a passive sentence in Spanish. This suggests that syntactic structure is shared across a bilingual's languages (see also Kantola and Van Gompel 2011; for a review see Van Gompel and Arai 2018).

Similar effects occur during translation. Maier, Pickering, and Hartsuiker (2017) had participants read a dative sentence and then provide a spoken translation. Participants tended to translate correctly. They also tended to repeat grammatical structure across languages (as in Hartsuiker, Pickering, and Veltkamp 2004); and when the same grammatical structure was not available in the target language, they repeated the order of thematic roles. Thus, they presumably accessed sentence meaning and were syntactically or thematically primed to repeat structure. There is no reason to assume processing during simultaneous interpreting is different in this respect from processing during translation, though it would be useful to conduct a similar investigation using simultaneous interpreting. Note, therefore, that like evidence of cognate facilitation, evidence of syntactic priming in simultaneous interpreting does not necessarily support an account according to which simultaneous interpretation is based on non-semantically-mediated syntactic links between languages. Instead, syntactic priming effects take place when meaning is accessed.

Syntactic priming effects appear to be stronger when they are associated with the repetition of words. Pickering and Branigan (1998) found that double object constructions primed the production of double object constructions when the verb was different in the prime and the target sentence. But the priming effect was considerably greater when the verb was repeated across sentences, indicating that lexical repetition reinforces syntactic priming.

This syntactic boost effect may also take place across languages. Bernolet, Hartsuiker, and Pickering (2012) considered whether cross-linguistic activation on the phonological level affected syntactic priming by comparing syntactic priming between sentences that included cognate and non-cognate translation equivalents. Participants heard a confederate produce either an *s*-genitive sentence (e.g., "the boy's rose is green") or an *of*-genitive sentence (e.g., "the rose of the boy is green") in their L1 (Dutch). They then described a different picture that could either be expressed as an *s*-genitive or an *of*-genitive sentence in their L2 (English). The syntactic priming effect was significantly larger for sentences that

contained cognates than those that contained non-cognates. This means that syntactic priming effects may be reinforced in simultaneous interpreting when sentences containing cognates are interpreted.

We might ask whether syntactic priming could also speed up utterance planning and production in simultaneous interpreting. If interpreters are able to plan and produce their own utterance more quickly, this could reduce demands on memory. However, the evidence that people produce utterances that repeat structure more quickly than utterances that do not is not extensive. Arguably the best evidence comes from Smith and Wheeldon (2001). Participants saw two objects moving on the screen, and were asked to describe these pictures using either a conjoined noun phrase or a simple noun phrase (e.g., "The eye moves up and the fish moves down" or "The eye and the fish move apart"). They were then shown a different two objects, and asked to describe these using a target phrase that either had or had not been primed by the preceding phrase (e.g., "The spoon and the car move up"). Although conceptually the phrases were not linked, and the direction of movement was not the same in syntactic prime and target sentences (e.g., pictures moved horizontally for the prime and vertically for the target), there was a facilitatory effect for target sentences that followed syntactically matched primes. This indicates that syntactic priming alone speeds up production, and suggests that re-using syntactic structures can increase fluency and reduce effort (Levelt and Kelter 1982).

Of course, cross-linguistic activation may also have a negative effect, making production in the target language more costly. More cognitive resources may be required when interpreters encounter an utterance whose syntactic structure (specifically, order of words) is different in source and target languages. For instance, a German clause with a subject-object-verb structure could not be interpreted into English using the same syntactic structure (Seeber and Kerzel 2012). Note that Seeber and Kerzel (2012) suggest that this increase in cognitive load occurs because sentence constituents must be stored in working memory while the interpreter waits for the verb, rather than because the interpreter must reformulate the syntactic structure. But reformulating syntactic structure may also require more resources.

Cross-linguistic activation may also have a negative effect when interpreters encounter false friends e.g., *billion* in English vs. *bilion* in Polish (which means trillion) (Chmiel, Janikowski, and Cieślewicz 2020). The fact that they sometimes produce the false friend rather than the correct translation — 11% of the time in Chmiel, Janikowski, and Cieślewicz (2020) — suggests that interpreters may not always access meaning before producing their interpretation.

Further, interpreters are often encouraged (during training) to reformulate by using different syntactic structures from the original, or else to avoid the use of a

cognate translation when another translation is available (see Chmiel, Janikowski, and Cieślewicz 2020). So, interpreters may sometimes avoid repeating syntactic structures when it is possible to do so, and so they may use additional cognitive resources even when it is not necessary.

Research on interference in interpreting (e.g., Chmiel, Janikowski, and Cieślewicz 2020) is based on the premise that both languages are indeed activated at the lexical level when the interpreter hears a word in the source language, and thus that slower production is a result of interpreters inhibiting inappropriate lexical competitors (e.g., false friends) or else having to increase activation of the correct translation. However, there are also other explanations for slower lexical access in bilinguals (Costa, La Heij, and Navarrete 2006; Costa et al. 2017). Although lexical access may be slower in bilinguals than in monolinguals, this may occur simply because bilinguals use each of their languages correspondingly less often than monolinguals (Costa, La Heij, and Navarrete 2006), and therefore produce individual words less frequently.

Similarly, research on cognitive control in simultaneous interpreters tends to assume that cross-linguistic activation regularly makes simultaneous interpreting highly cognitively challenging (e.g., Babcock et al. 2017). Thus, many researchers have focused on the types of executive control that must be required to keep both languages active while selecting one language for comprehension and the other for production, and at the same time avoiding information loss and interference (e.g., Yudes, Macizo, and Bajo 2011; Babcock and Vallesi 2017). Cognitive control may also be needed when interpreters buffer any units to be interpreted that have been comprehended but that have not yet been produced in the target language (e.g., Moser 1978; Seeber 2011). Other researchers consider that increased cognitive control is required for multi-tasking during simultaneous interpreting (see Stachowiak-Szymczak and Korpal 2019; Chmiel, Janikowski, and Lijewska 2020; Dong and Li 2020). This assumes that comprehension and production (and attendant processes, such as self-monitoring and correction) are separate tasks (e.g., Gile 1995; Seeber 2011).

If simultaneous interpreting requires significant cognitive control, then interpreters may have superior cognitive control capacities (e.g., Hervais-Adelman and Babcock 2020). This is the hypothesis on which many studies comparing cognitive function in simultaneous interpreters and other groups are based (Morales et al. 2015; Woumans et al. 2015; Chmiel 2016; Babcock et al. 2017; Babcock and Vallesi 2017). However, the results of these studies have been inconsistent. For instance, Chmiel (2016) found an interpreter advantage in working memory tasks as measured by L1 reading and listening span, and Babcock and Vallesi (2017) found that interpreters performed better than non-interpreters in short-term and verbal working memory tasks (as measured by letter, matrix, and operation span

tasks) and sustained control (as measured by a task-switching task). However, Köpke and Nespoulous (2006) and Woumans et al. (2015) did not find any interpreter advantage. Such inconsistent results may relate to differences in the measures used, the extent to which specific measures relate to the various working- and short-term memory domains, small sample sizes, or differences in interpreter and comparison populations. In spite of such methodological concerns, Mellinger and Hanson (2019) concluded that there is some evidence that professional interpreters have greater working memory capacity than other groups. But even if interpreters do have enhanced working memory (or enhanced use of their working memory capacity for simultaneous interpreting), we do not know whether interpreting enhances memory or use of working memory, or whether people with high working memory are attracted to the profession.

Furthermore, the negative effects of cross-linguistic interference during simultaneous interpreting have been extensively investigated, whereas facilitatory effects of cross-linguistic activation in simultaneous interpreting have received hardly any attention. Thus, the complexity of simultaneous interpreting may have been overstated, meaning that any cognitive effects of this complexity might be smaller than expected and difficult to detect. As we have seen, evidence from the psycholinguistics literature shows that cross-linguistic activation could also support the simultaneous interpreting process. However, the Interpreting Studies literature to date has focused mainly on the challenges that may occur due to cross-linguistic activation (or interference).

5. Prediction and its potential facilitative impact on simultaneous interpreting

Evidence of prediction during comprehension might suggest that interpreters regularly access meaning during simultaneous interpreting. We know that comprehension is not a purely incremental process, because comprehenders often predict what they are about to hear (see Pickering and Gambi 2018). By prediction we mean the pre-activation of aspects of an utterance, such as its meaning, its syntax, or its phonology, before it is heard. Prediction is distinct from integration, which refers to the rapid understanding of an utterance that has been heard because it can be quickly interpreted in relation to the sentential context. We also distinguish prediction from what has sometimes been called *anticipation* in the Interpreting Studies literature, when interpreters produce a sentence constituent in the target language before hearing it in the source language (Wilss 1978; Van Besien 1999; Seeber 2001; Hodzik and Williams 2017) or else when interpreters provide a translation of the expected, rather than the actual ending of a sentence (Chernov

2004). While evidence of predictive production does indicate that interpreters sometimes predict upcoming words before they hear them, in Chernov (2004) interpreters did not produce the translation of the expected ending predictively. Thus, interpreters may have based their interpretation on an a posteriori analysis of the full sentence — in other words, using integration rather than prediction (see Pickering and Gambi 2018).

Recent evidence shows that prediction routinely takes place during simultaneous interpreting, just as it does in everyday comprehension. For everyday comprehension, in a seminal eye-tracking study using the visual world paradigm, Altmann and Kamide (1999) showed that, when participants listened to sentences containing a verb (e.g., *eat*) that was constraining for one object in a visual scene (e.g., *a cake*), they looked at the cake before it was mentioned in the sentence, whereas when they heard a sentence containing a non-constraining verb (e.g., *move*), they did not.

For simultaneous interpreting, in another eye-tracking study using the visual-world paradigm, Amos, Seeber, and Pickering (2022) found that both interpreters and bilinguals untrained in simultaneous interpreting looked at objects depicting predictable words before they were mentioned, while simultaneously interpreting from French into English. Similarly, Amos, Seeber, and Pickering (2023) found that student interpreters predicted the meaning of upcoming words while listening in their L2 and interpreting into a range of different mother tongues. Students predicted both before and after training, and there was no evidence that training affected prediction. These studies support very rapid comprehension of the source language during simultaneous interpreting and show that interpreters are aware of context as they interpret. Just as prediction often takes place during monolingual (e.g., Altmann and Kamide 1999) and bilingual (e.g., Dijkgraaf, Hartsuiker, and Duyck 2017; Ito, Corley, and Pickering 2018) comprehension, it often takes place in simultaneous interpreting (Amos, Seeber, and Pickering 2022, 2023) — much more regularly than had previously been shown in traditional studies of predictive production (e.g., Jörg 1997; Van Besien 1999; Seeber 2001; Kurz and Färber 2003). This suggests that upcoming meaning is predicted even when cognitive resources are limited.

Prediction may be advantageous during simultaneous interpreting. For instance, Chernov (1994, 2004) suggests that interpreters use preceding context to formulate both general and precise expectations about upcoming content, allowing them to plan their own utterances with greater ease and better monitor their own production, as well as reduce demands on working memory. Amos and Pickering (2020) suggest that concurrent production and comprehension during simultaneous interpreting may support prediction, with predictable words being anticipated using the production mechanism in the source language, and target

language equivalents being activated, and sometimes produced, prior to hearing the predictable word. This would reduce the need for buffering chunks of information during simultaneous interpreting, as suggested in Moser's (1978) model. It is thus possible that rather than relying on short-term or working memory to store series of words until they can extract their meaning, interpreters are at times directly relying on strong expectations about what the speaker will say when they produce their interpretation (see also Lederer 1981; Chernov 2004).

In some challenging simultaneous interpreting situations, prediction and predictive cross-language activation may be particularly beneficial as they could allow interpreters to comprehend the original speech faster and to produce their own utterances less effortfully, leaving them with more resources to deal with particular challenges. An analysis of speeches read at the UN Human Rights Council revealed that when source texts were read at higher speeds, even experienced interpreters omitted information (Barghout, Ruiz Rosendo, and Varela García 2015; see also Ruiz Rosendo and Galván 2019). Korpal and Stachowiak-Symczak (2018) found that a higher source speed led to lower accuracy in reporting numerical data. It may be more challenging to interpret for speakers who are not speaking their native language (Albl-Mikasa and Gieshoff 2022). Meanwhile, Plevoets and Defranq (2018) found that greater lexical density (as measured by the ratio of content words to utterance length) in the source speech led to more hesitations.

Prediction may also be helpful when dealing with false friends and language interference during simultaneous interpreting. Chambers and Cooke (2009) had native English speakers listen to constraining and non-constraining sentences in their L2, French, as they looked at four objects. For the sentence "*Marie va nourrir/décrire la poule*" 'Marie will feed/describe the chicken', one of the objects depicted a chicken (*poule* in French), and one of the objects depicted an English interlingual homophone of the French preferred name (a pool). When participants heard the constraining verb (*feed*), they looked at the target object (the chicken) and rarely considered the interlingual homophone (the pool) (see also FitzPatrick and Indefrey 2010). This suggests that (interfering) cross-language activation on the phonological level may be weaker in a predictable than a non-predictable context — and thus that rapid accessing of meaning reduces the interfering effects of direct links. In an interpreting setting, contextual processing, and specifically prediction during comprehension, could facilitate the production of the correct translation, rather than a false friend.

But can prediction be encouraged or augmented during simultaneous interpreting? There is evidence that prediction can be encouraged (or discouraged) during reading. In an event-related potentials (ERP) experiment, Brothers, Swaab, and Traxler (2017) had participants read predictable sentences after being instructed to either read carefully, or else read and anticipate the final (pre-

dictable) word. They found that the brain response to predictable words was greater when participants were instructed to read and predict, as opposed to when they were instructed to read only, suggesting that prediction might be stronger when its importance is emphasized.

In a second experiment, Brothers, Swaab, and Traxler (2017) manipulated the relevance of predictive cues, by having participants read predictable sentences that were presented within a set of predictable sentences that used a predictable word, within a set of predictable sentences in which the predictable word was replaced by a less predictable word, or within a set of sentences in which half used the more predictable word and half the less predictable word. Participants whose predictions were regularly confirmed read predictable words more quickly than participants whose predictions were regularly disconfirmed, suggesting that participants whose predictions were regularly confirmed benefited more from predictive effects. Participants whose predictions were sometimes confirmed read predictable words more quickly than those in the second group, but more slowly than those in the first group. This suggests that prediction can be encouraged or discouraged, depending on its benefits to comprehension.

In an experiment that used a task akin to consecutive interpreting, Zhao, Chen, and Cai (2022) had participants read sentences that made a critical word more or less predictable (e.g., "Without the sunglasses/hat, the sun will hurt your eyes on the beach," where *eyes* is the critical word) before either recalling the sentence or else interpreting it into Chinese. They found that the predictive effect was greater when participants read to interpret than when they read to recall. However, Amos et al. (2023) found no difference in predictive behaviour when participants listened to, or else listened to and then consecutively interpreted, sentences which contained a predictable word.

Prediction thus appears to be a regular part of language processing in simultaneous interpreting, just as in language comprehension more generally, and takes place regardless of training or expertise. Prediction would not be possible without comprehension of meaning, as predictions are based on what the listener considers plausible in a given context. Evidence of prediction in simultaneous interpreting in students, trained interpreters, translators, and bilinguals demonstrates that meaning is routinely accessed during simultaneous interpreting — regardless of training or expertise. This evidence thus provides support for the use of the semantically-mediated route (or at least for the accessing of meaning) during simultaneous interpreting by any bilingual carrying out the task of interpreting. Although prediction may have beneficial effects in simultaneous interpreting, there is a lack of direct evidence to date that prediction can be encouraged or augmented during simultaneous interpreting.

6. Discussion and directions for future research

As we have reviewed, early accounts of the semantically-mediated route in simultaneous interpreting generally assumed that interpreters access meaning in the source language before producing their interpretation in the target language. Accounts of the non-semantically-mediated route posited that some (short) utterances may be interpreted without accessing meaning. In general, early theories linked the route of interpretation with the size of the unit interpreted: the semantically-mediated route was linked to longer series of words, whereas, for the non-semantically-mediated route, links at the phonological or lexical level were considered to be used for individual words. A semantically-mediated route was considered superior.

The evidence that we have reviewed does not provide support for a link between the size of the unit interpreted and the accessing (or not) of meaning. Regardless of the length of the unit, given the speed at which meaning is accessed, interpreters likely almost always access meaning. However, they may also benefit from non-semantically-mediated links between words and multi-word phrases due to cross-linguistic activation at the phonological and syntactic levels, and may base their interpretation on this cross-linguistic activation. Based on the available evidence, it appears likely that the semantically-mediated and the non-semantically-mediated route may operate in tandem for the same word or unit during simultaneous interpreting.

We have also reviewed evidence of cross-linguistic activation on the semantic, syntactic, and phonological levels. This evidence shows that both source and target language are likely concurrently activated for the duration of a simultaneous interpreting event. Such cross-linguistic activation could support production during simultaneous interpreting, as words and phrases in the target language could be activated by hearing their source language equivalents. On the other hand, it may also cause interference between source and target language. Research to date has focused almost exclusively on interference between source and target language, and relatedly, on whether interpreters have superior cognitive control to non-interpreters (e.g., Babcock and Vallesi 2017). Thus, the extent and frequency to which cross-language activation may be facilitatory or interfering during simultaneous interpreting remains underexplored. When syntactic structure in source and target language is similar, the original speech is at a slow and even pace, and the content is not particularly dense and relatively predictable, then concurrent production may not only be possible, but may even be relatively low effort for highly proficient bilinguals.

The evidence we have reviewed also shows that the repetition of syntactic structure across languages does not imply that interpreters have bypassed mean-

ing. But many trainers of interpreters have assumed that, in order to encourage students to leave aside the syntactic structure of the original, students must be told to focus on the meaning of an utterance (e.g., Setton and Dawrant 2016). But telling students to focus on the meaning (e.g., to 'deverbalise' or represent the message non-linguistically; e.g., Seleskovitch and Lederer 2001) may not be the most effective way of encouraging them to abandon the syntactic structure of the original, as the syntactic structure is still primed when people access the meaning of the source language utterance (Potter and Lombardi 1998). Thus, it may instead be better to provide students with concrete techniques to move away from the syntactic structure of the original when it differs between languages (such as training them to start their interpretation with a word that did not start the sentence in the source speech; e.g., Setton and Dawrant 2016). Similarly, instructors should not assume that when students use cognates or repeat syntactic structure across languages, they are not accessing meaning.

We also considered evidence of prediction during simultaneous interpreting (e.g., Amos, Seeber, and Pickering 2022). Prediction during simultaneous interpreting demonstrates that meaning is regularly accessed during an interpreting task, and hence that an interpretation based on the non-semantic route is unlikely. Importantly, prediction also occurs with people who have no experience of simultaneous interpreting, and so trainers should assume that from the beginning of their simultaneous interpreting training, students access meaning (if they are proficient in the language of comprehension). Prediction may also allow people to plan their utterances earlier and help them avoid any interfering effects of cross-language activation.

Although there can be synergies between comprehension and production, it remains true that simultaneous interpreting is challenging and complex, and certain scenarios may present additional challenges for simultaneous interpreters. For instance, interpreters may need to interpret statements that are made 'for the record' and thus require a highly accurate interpretation that reflects the word choice of the original (Setton and Dawrant 2016); they may have to interpret speeches that are produced at high speed (Barghout et al. 2015); they may have to interpret speakers who are not speaking in their native language (e.g., Albl-Mikasa and Gieshoff 2022), and they may have to interpret across languages that differ in word order (Seeber and Kerzel 2012).

One question that emerges is to what extent cross-language activation and prediction might be further encouraged in order to support the interpreting process, particularly in these challenging conditions. On the one hand, it may be that in challenging situations, interpreters should attempt to use synergies created by cross-linguistic activation and not try to consistently reformulate, something which may require greater cognitive effort. Students could be taught to use different

strategies in challenging versus less challenging interpreting situations. On the other hand, when interpreters are able to predict, this may allow them to produce their renditions more quickly, meaning they can keep pace with faster speakers, or else plan to utter a verb in the target language before they hear it in the source language. In addition, interpreters may be able to rely on predictions about what will be said, rather than on memory of what has been said, when planning and producing their utterances. Thus, interpreters might need to be taught to rely more on the semantically-mediated or the non-semantically-mediated route based on the content to be interpreted.

It is possible that predictions could be encouraged by emphasising the importance of prediction to students and practitioners of interpreting and crucially, by providing them with the means to predict in different scenarios. This means teaching students common phrases used during conferences, as well as common conference procedures so that students are better able to predict upcoming content in specific contexts (Setton and Dawrant 2016). A future study might consider to what extent teaching prediction specifically leads to improvements in interpreting quality.

7. Conclusions

As we have reviewed, early research, which continues to be influential today, tended to view comprehension and production as separate processes during simultaneous interpreting. Researchers also considered the accessing (or not) of meaning during simultaneous interpreting to be linked to the size of the unit interpreted. In this article, we have confronted these theories with up-to-date psycholinguistic theories and data on cross-linguistic activation and prediction, and in so doing we have demonstrated that while semantically-mediated language processing is central in simultaneous interpreting, there are also non-semantically-mediated cross-linguistic links which may assist interpreters in their production. We have also provided evidence that calls into question the idea that the size of the unit interpreted and the interpreter's accessing of meaning are linked.

Previous research has also focused on the complexity of the simultaneous interpreting task. However, evidence of cross-linguistic activation and prediction during simultaneous interpreting shows that there may be synergies between comprehension and production during simultaneous interpreting. These synergies may facilitate language processing during simultaneous interpreting. One open question is the extent to which the facilitative effects of cross-linguistic activation and prediction might be further exploited during simultaneous interpreting, and whether it is possible to train interpreting students to predict more and

to capitalize on cross-linguistic activation to a greater degree. Greater theoretical insight in this regard may help trainers teach students to interpret more accurately and adapt their interpreting technique to suit different challenging situations.

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