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How do experts interpret?

Implications from research in Interpreting Studies and cognitive science

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In this article, expertise in simultaneous interpreting is defined as the result of well-practiced strategies in each of the comprehension, translation, and production processes, and the interaction among these processes, which are specific to the needs of the task of simultaneous interpreting. What allows the interaction among the comprehension, translation, and production processes to act in sync is interpreters' ability to manage their mental resources in an efficient manner, particularly in the way attention is managed. Expert-novice difference is examined by comparing skills and sub-skills, by analyzing the cognitive abilities underlying the act of simultaneous interpreting, and by providing evidence and counter-evidence from Interpreting Studies and cognitive science.

Keywords: attention, expert, expertise, novice, simultaneous interpreting

1. Introduction

How expert interpreters go about their trade has long been a popular topic in the field of Interpreting Studies. Even though many studies have attempted to explore this topic from different perspectives (e.g. Barik 1973, 1975; Liu Schallert & Carroll 2004; Moser-Mercer, Frauenfelder, Casado & Künzli 2000; Padilla, Bajo, Cañas & Padilla 1995) and have helped paint a general picture of expertise in interpreting, we still do not know much about the types of processes and abilities involved. This is partly due to the fact that expertise in interpreting cannot be clearly defined since the task of interpreting does not have clearly set goals. The commonly mentioned goals of interpreting, e.g. to facilitate communication across languages and cultures, are too vague to guide research that can measure the achievement of such goals. Even the often-used criteria for judging the quality of interpreting, i.e.

accuracy, completeness, appropriate language use, and smooth delivery, lack agreed-upon and reliable methods of measurement to produce consistent findings. This situation is to a large extent due to the great variety of texts produced by interpreters, which makes generalization difficult.

Owing to the lack of clearly defined objectives and consistently reliable measuring devices for performance, research in Interpreting Studies has often opted to compare expert and novice performance in order to determine if there are observable differences in behaviors or abilities that can be attributed to different stages of expertise development (e.g. Liu et al. 2004; Padilla et al. 1995). However, we have to note that expertise defined through this contrastive approach is rather relative since any more skilled group can be considered the “experts” and a less skilled one the “novices”¹ (Chi 2006: 22). This relativity in defining experts and novices is another factor underlying the difficulty in comparing the results of different studies on interpreting expertise and in making generalizations across studies. However, this relative approach can illuminate our understanding of how experts become the way they are, so that novices can learn to become experts (Chi 2006: 23). Indeed, knowing how expert interpreters perform their craft differently from novices and how expertise progresses along a developmental course is crucial to the success and efficiency of interpretation training.

In this article, I will first examine the skills of interpreting. I will then discuss the sub-skills and cognitive abilities that may underlie the act of interpreting. In the next step, I will present what some researchers have proposed to account for expertise in interpreting by offering evidence and counter-evidence from Interpreting Studies and cognitive science.

2. Skills in interpreting

Since the interpreting process itself cannot be directly studied, the interpretation output is often analyzed to provide insight into the component processes executed and thus the skills used to perform the task (Dillinger 1989). Studies on the quality of interpretation output have shown that expert interpreters are more accurate than novice interpreters. For example, when measured by the percentage of propositions correctly interpreted, expert interpreters accurately interpreted approximately 17% more of the content than bilingual non-interpreters (Dillinger 1989,

1. In addition to “expert interpreters,” studies of interpreting have also used other terms, such as “professional interpreters,” “experienced interpreters,” etc. In this article, the term “expert interpreters” will be used unless the discussion requires otherwise. Likewise, the term “novice interpreters” will be used to include both interpreters still in training and people with no experience in interpreting, unless otherwise required in the context.

1990). Using a system that did not count propositions to categorize a meaning unit, Liu (2001) found that expert interpreters were more accurate (45%) in their performances than second-year interpretation students (33%) and first-year students (25%) (see also Liu et al. 2004). When the number of errors and omissions (combined to be termed “translation disruptions”) was used as a measure of quality in interpreting, expert interpreters committed fewer disruptions (about 5%) than both student interpreters (about 8%) and bilingual non-interpreters (about 10%) (Barik 1975).

It is quite possible that expert interpreters’ more accurate output results from better comprehension during interpreting. It is also possible that different processes are at work when it comes to producing more accurate output.

Interpreting involves three obvious processes and skills: comprehension, translation, and production. I will discuss each of these processes and skills individually as well as in combination, offering empirical evidence from the literature as to the roles each of these skills play in expert interpreting.²

2.1 The comprehension process and skill

Dillinger (1989) investigated whether comprehension during simultaneous interpreting was different from that during listening – in terms of syntactic processing, proposition generation, and frame-structure processing as shown in free recall. The results showed that in general, the two comprehension tasks were not different from each other in these aspects. Dillinger concluded that “comprehension in interpreting is not a specialized ability, but the application of an existing skill under more unusual circumstances” (1989: 97).

If comprehension during simultaneous interpreting involves the same set of components as during listening, we would assume that expert and novice interpreters do not perform much differently in comprehending the input materials during simultaneous interpreting. In the same study, Dillinger (1989, 1990) also investigated the difference in the comprehension process between experts and bilingual non-interpreters as shown in accuracy in interpreting and in recall. The results showed that there was no significant difference in the two groups’ ability of syntactic processing. In terms of semantic processing, expert interpreters performed significantly better than non-interpreters in the category of directness of mapping (how closely the syntactic importance of the clause matches the semantic importance of the information), indicating more efficient proposition generation

2. Most of the studies reported here use simultaneous interpreting as the mode of choice in the experiments. Therefore, the discussion in this article pertains to this mode of interpreting, unless otherwise specified.

(Dillinger 1989). To be more exact, expert interpreters seemed to have learned “to be more selective in the surface information they will process semantically, as a function of the conceptual frame structure that is to be built with it” (1989: 86). Despite Dillinger’s own conclusion that the expert interpreters in his study had not acquired any qualitatively different skills particular to simultaneous interpreting (1989, 1990), I would argue that being more selective in processing information and more sensitive to the conceptual frame structure of the source speech do constitute a qualitative difference between experts and novices.

It is worth noting that many of the differences observed between expert interpreters and non-interpreters in Dillinger’s study were associated with the more difficult procedural text (versus the easier narrative text), thus suggesting that “any special comprehension abilities may only appear clearly with more difficult materials” (Dillinger 1989:89). I would further argue that the procedural text in Dillinger’s study is closer to the speeches professional interpreters usually encounter in their work, while narrative discourses are much more uncommon. Therefore, the observed differences or lack thereof may be attributed to how close the experimental task is to the domain of interpreting. Indeed, studies have shown that the ecological validity of a task was a more important factor for experts than for novices (Hodges, Starkes & MacMahon 2006).

Other studies using different investigative approaches have also shown selectivity by experts when processing information during simultaneous interpreting. For example, in determining the seriousness of different omissions made by his participants in simultaneous interpreting, Barik (1975) found that a substantially greater proportion of the omissions made by expert interpreters were of the minor type, while only less than half of the ones made by novice interpreters (student interpreters and bilingual non-interpreters) were minor omissions.

A similar conclusion was made in a study that investigated whether expert and novice interpreters were different in their selection of more important or less important information when circumstances limited the possibility of full interpretation (Liu et al. 2004). The results showed that this was indeed the case. Expert interpreters demonstrated a greater ability in distinguishing the more essential meaning units from the more secondary ones, correctly interpreting 48% and 42% respectively. The second-year students were less selective in interpreting the more or less important meaning units (34% vs. 32% respectively in accuracy rates), and first-year students, in turn, did not seem to be able to discriminate the importance of the meaning units, with accuracy rates of essential and secondary meaning units both at 25%.

Also studying whether interpreters processed sentences the same way in simultaneous interpreting as in listening, Isham (1994) found that expert interpreters adopted two distinctive approaches when processing information during

simultaneous interpreting. Some interpreters' comprehension pattern resembled that of typical listeners in that their recall protocols reflected the effects of clause boundary and sentence boundary, while other interpreters performed differently, exhibiting their own pattern of information processing. Studies in brain research have shown that the comprehension process can take place at a conceptual level rather than at a sentential or discourse level, where no distinction is shown between sentence and discourse-level boundaries while context is being constructed (e.g. Salmon & Pratt 2002). This shows that the choice and use of strategy plays a more important role than expected in information processing. It also implies that the way interpreters process information may be shaped by the specific tasks involved in simultaneous interpreting.

In addition to the studies that examined interpreters' output, several studies that investigated the processing behavior of experts and novices during simultaneous interpreting also provided evidence of expert interpreters' more semantic-based approach to information processing. Using an error detection task in dichotic listening, these studies found that professional interpreters detected significantly more semantic errors while student interpreters significantly more syntactic ones (Fabbro, Gran & Gran 1991; Ilic 1990).

Expert interpreters' superiority in semantic processing was also shown in lexical processing. In performing a word categorization task, expert interpreters reacted faster than student interpreters and non-interpreters in categorizing non-typical words, possibly suggesting more efficient access to the semantic information of words (Bajo, Padilla & Padilla 2000). The same study also showed that training in simultaneous interpreting seemed to contribute to the development of this ability, as student interpreters showed significant improvement in this task after one year of training in simultaneous interpreting while non-interpreters did not improve significantly.

These results suggest that differences in syntactic processing cannot adequately explain expert-novice difference in comprehension. The difference may lie more in processing efficiency and different approaches to semantic processing. It is also possible that the difference between experts and novices lies in the production process, as Dillinger himself suggested (1989, 1990), or in the translation process, or both. The fact that Dillinger's expert interpreters were more accurate than non-interpreters in their interpretation output but not in their recall seemed to suggest this possibility, as interpretation output reflects the result of the interaction of different processes in simultaneous interpreting, while recall reflects the result of comprehension and the work of long-term memory.

2.2 The translation process and skill

In simultaneous interpreting, part of the translation process can be indirectly inferred from the way interpreters segment the source speech. The interpreters' segmentation choices do not seem to be only guided by how the interpreters decode the input materials, as professional interpreters were found to either cut into the segmented chunks of the source speech, or combine two or more of the original chunks (Goldman-Eisler 1972). How interpreters segment the source speech can be influenced by the translation process itself, in that an equivalent in the target language must be identified (Goldman-Eisler 1972; Kirchhoff 1976/2002). This "equivalence relation" (Kirchhoff 1976/2002: 114) between the source language and the target language makes the process of simultaneous interpreting a dynamic one where the interpreter is constantly making decisions on how to segment the source speech (see also Oléron & Nanpon 1965/2002). This situation may partially explain the variation in the ear-voice-span (EVS)³ observed in simultaneous interpreting of different language combinations (e.g. Goldman-Eisler 1972; Oléron & Nanpon 1965/2002). We may further argue that a critical aspect of the expertise in simultaneous interpreting lies in the interpreter's ability to recognize patterns in the equivalence relation between the two languages in question.

If the equivalence relation determines the minimum size of a segment, it is the interpreter's processing capacity that determines the maximum size of the segment during simultaneous interpreting (Kirchhoff 1976/2002). The translation process also takes effort. Translating words aloud takes about 50 percent more time than simply repeating the words (Oléron & Nanpon 1964, cited in Oléron & Nanpon 1965/2002). Cheung (2001) found that student interpreters who were allowed to use the English terms in the source speech performed better than those who were required to produce an all-Cantonese output in simultaneous interpreting. The code mixing of English and Cantonese in interpretation output and skipping part of the translation process helped reduce the mental resource requirements during simultaneous interpreting.

Facing the extra task of translating during simultaneous interpreting, interpreters inevitably have to adopt strategies specific to this task. Studies have found that expert interpreters tend to process larger chunks of input (e.g. Davidson 1992; McDonald & Carpenter 1981). This may at least partially explain why expert interpreters often sound less literal in their interpretations than novices (Barik 1975; McDonald & Carpenter 1981; Sunnari 1995). This phenomenon may be attributed, on the one hand, to expert interpreters' ability to resort to more semantic-based

3. The time lag between when the original message is heard to the time the translated message is uttered.

processing; it may also be a result of the way expert interpreters segment the source speech and how they plan to translate that segment into the target language.

2.3 The production process and skill

The interpreter's output speech is often characterized by a *ritardando* and *accelerando* pattern and is generally less smooth than usual speech (Gerver 1969; Shlesinger 1994). When compared with the output in a shadowing task, the interpretation speech often contains more pauses (Gerver 1969). When the input rate increases, the interpreters may lag farther behind the speaker, speak less and pause more, but their own speech rates remain generally unchanged (Gerver 1969) and are usually maintained at 96-110 words per minute (wpm) (Gerver 1975). Research has shown that an individual's overt and covert speech seems to have comparable speed limits (Landauer 1962, cited in Cowan 2000/2001). Interpreters' normal speaking rate during simultaneous interpreting is comparable to the optimal input rate of 95-112 wpm for simultaneous interpreting (Gerver 1969), implying a limit on working memory that can be used for processing information during simultaneous interpreting, be it maintaining the source speech subvocally or uttering one's own speech overtly.

Considering the fact that the normal rate of spontaneous speaking is 160-180 wpm (Foulke & Sticht 1969, cited in Dillinger 1989), the empirical evidence mentioned above points to the obvious interference by the comprehension process (and the translation process) on the production process, and shows how interpreters manage their processing to overcome the interference by using strategies or control mechanisms (Dillinger 1989). One such strategy or control mechanism may be the interpreters' specific use and control of their attention by sharing or switching back and forth between the different tasks, manifested in the more frequent pauses and the reduction of their own speaking rate.

Other strategies in the production process are observed. Chernov (1979), while comparing the number of syllables in both English input and Russian output texts in simultaneous interpreting, found that expert interpreters' output contained fewer syllables than that of novice interpreters. Chernov explained that when the source speech was presented at a faster rate than the interpreters' own speech rate, or when the target language translation was longer than the source language text, expert interpreters adopted strategies involving either lexical or syntactical compression in order to not lag too far behind the source speech. Other researchers (e.g. Sunnari 1995) also observed similar strategies used by expert interpreters, such as the deletion of superfluous or redundant words, and the choice of shorter sentences or shorter words in their output.

There have not been many studies that directly investigate expert-novice difference in interpretation delivery. In part of her study investigating the output by expert interpreters and second-year and first-year interpretation students, Liu (2001) asked raters to listen to the output of simultaneous interpreting without listening to the source speeches. The results showed that expert interpreters' output was considered much more meaningful, more coherent, and sounded smoother and more natural than the other two groups. In another study, it was found that novice interpreters had a tendency to pick out segments in a speech and link them arbitrarily, resulting in an output lacking coherence (Sunnari 1995). Also, beginner interpreters' output showed high variations in speed and disruptions in the speech/pause ratio, while expert interpreters strove to maintain a steady output rate (Kirchhoff 1976/2002: 115).

These results may naturally lead to the assumption that expert interpreters have better verbal skills than novices. Some studies have attempted to compare the verbal fluency of experts and novices by adopting tools from psychology. One study used verbal fluency tasks to compare expert and novice interpreters and found no difference between the two groups (Moser-Mercer et al. 2000). In her study on the development of expertise in consecutive interpreting, Cai (2001) found that interpreters' language ability (as measured by the number of compound sentences or incomplete sentences produced) was the least important factor among all the variables that could distinguish professional interpreters, trained students and untrained students.

If expert interpreters' better-sounding output is not a result of their higher degree of verbal fluency, this expert-novice difference may lie in the different approaches or strategies adopted in the production process or in the interaction of different processes during simultaneous interpreting. How interpreters monitor their output during simultaneous interpreting may be one such factor.

2.3.1 *Output monitoring*

We monitor our speech output when we talk. We often discover our speech mistakes and correct them, but sometimes fail to do so, possibly due to external (e.g. noise) or internal distractions (e.g. forming a thought). Interpreters also monitor their speech output during simultaneous interpreting, as evidenced by the fact that interpreters sometimes correct themselves during simultaneous interpreting (e.g. Gerver 1969). What makes output monitoring different in simultaneous interpreting, in addition to the extra cognitive load of continuing to process the incoming message, is that two streams of speech are received at the same time (Isham 1994). This seems to be an independent factor that causes interference with comprehension in spoken language simultaneous interpreting, as spoken language interpreters showed inferior recall of the source speech compared to sign language interpreters (Isham

1994; Isham & Lane 1993). This phenomenon can be explained by what has been observed in working memory research: that verbal and spatial information interfere more with the same type than different types of information (Baddeley 1986).

The “phonological interference” (Isham 1994: 204), caused by two streams of speech interfering with each other is something interpreters have to learn to overcome in the development of expertise. Research has shown that the ability to be less affected by this effect is indeed one of the characteristics that differentiate expert from novice interpreters.

Delayed auditory feedback, a measure often used to judge speech fluency, was adopted in several studies to tap possible expert-novice difference in interpretation output delivery (Fabbro & Darò 1995; Moser-Mercer et al. 2000; Spiller-Bosatra & Darò 1992). Combined, these studies showed that more experienced interpreters were less affected by delayed auditory feedback than less experienced interpreters. These authors attributed the lack of interfering effects by the condition of delayed auditory feedback to the interpreters’ acquired ability to pay less attention to their own output and thus more attention to comprehending the input.

Research has shown that perception of speech stimuli was worse when participants engaged in flawless whispered reading than when participants switched their attention away from whispered reading (Cowan, Lichy & Grove 1990; cited in Cowan 2000/2001). In simultaneous interpreting, however, interpreters cannot afford to switch their attention away from the output as it has to be checked against the input content for accuracy. This comprehension-production interaction seems to be only possible when the interpretation output is checked against some semantic representation of the input rather than its speech representation, the maintenance of which will undoubtedly take up space meant for temporarily storing the incoming information. Therefore, rather than conceptualizing the output monitoring process as a process of comparing the output with the input, it may be more appropriate to view it as a quick checking mechanism, the extent of which is determined by the interpreter’s processing capacity at that moment.

This strategic adjustment apparently does not and cannot only happen in the process of production. As mentioned earlier, expert interpreters seem to adopt more semantic-based processing strategies in the comprehension and translation processes that allow them to free up some of their mental resources. One further beneficial effect of the ability to resort to more semantic-based processing is the interpreter’s ability to anticipate the upcoming information based on the context that is provided. There is evidence from brain research that words correctly predicted from the context evoked a smaller amplitude of N400 (a waveform showing a difference between event-related potentials, which are the brain’s response to stimuli) than words not predicted, suggesting less processing effort by the brain (Salmon & Pratt 2002). A better ability to predict upcoming information may free

up some of the mental resources of the interpreter during the production process, as the parallel comprehension process of the next information segment becomes a process of checking and confirming what has been predicted, rather than the usual more effortful comprehension process.

3. Expert-novice differences in sub-skills of interpreting and cognitive abilities

After reviewing the evidence of the differences between expert and novice interpreters, our next question is: how do we make a link between these observed performance differences and the sub-domain cognitive abilities that may underlie these differences? While the aforementioned studies mostly examined the task of simultaneous interpreting and its product (i.e. output), other studies have investigated hypothesized underlying cognitive abilities that are thought to be related to expertise in interpreting. These include the ability to listen and speak at the same time (e.g. Chincotta & Underwood 1998) and working memory span (e.g. Kopke & Nespoulous 2006; Liu et al. 2004; Padilla et al. 1995).

3.1 Concurrent articulation and articulatory suppression

It is often thought that interpreters having to listen and speak at the same time is what causes difficulties in simultaneous interpreting. However, research has suggested that simultaneous listening and speaking *per se* may not be a difficult task to master and that it, by itself, does not represent a differentiating ability between expert and novice interpreters. For example, it was shown that expert interpreters did not perform better than student interpreters in the task of shadowing (Moser-Mercer et al. 2000). In further analysis, it was observed that expert interpreters made more substitution-type errors than student interpreters. This result seems to suggest a possible difficulty that expert interpreters faced in changing their processing strategies from simultaneous interpreting to shadowing (see also Sabatini 2000/2001).

Studies have consistently found longer EVS for simultaneous interpreting than for shadowing (e.g. Anderson 1994; Gerver 1969; Tresiman 1965). The extra time required for the task of simultaneous interpreting is due to the different processes needed for this task, i.e. comprehension, translation, and speech planning. These extra processes require extra effort. Also, it was shown that significantly fewer words were correctly interpreted than were correctly shadowed as the input rate increased (Gerver 1969). The different performances in simultaneous interpreting and shadowing suggest that different strategies may be involved in performing these two tasks.

Research has shown that verbal stimuli are maintained through subvocal articulatory rehearsal (i.e. subvocalization) before they are further processed, and that subvocalization plays a key role when the order of the stimuli is important for processing or remembering the information, such as in the case of stimuli with complicated syntactic structure (Baddeley 1986). When the articulatory rehearsal mechanism is suppressed (i.e. articulatory suppression), recall for stimuli is affected (Baddeley 1986). During simultaneous interpreting, interpreters are constantly engaged in articulatory suppression as they continue to utter their output in the target language. Evidence of the negative effect of articulatory suppression on recall is also documented in the interpreting literature. It has been shown that interpreters' recall of input material after simultaneous interpreting is not as good as after listening (Chincotta & Underwood 1998; Darò & Fabbro 1994; Gerver 1974; Isham 1994; Isham & Lane 1993; Lambert 1989). In addition to the fact that interpreters have to devote their limited mental resources to different tasks at the same time, the suppressed subvocalization mechanism also seems to be a major factor.

However, in a study that investigated the effect of concurrent listening and speaking by measuring accuracy of the interpretation output instead of recall, Gerver (1972) found that interpreters' performance did not suffer (with over 85% of output correctly interpreted) when an average of 75% of the total time was spent on listening and speaking at the same time (cited in Gerver 1976). The discrepancy between the quality of interpretation output and post-interpretation recall may be explained by the fact that, as mentioned earlier, the interpretation output directly reflects the on-going interaction of different processes in simultaneous interpreting, while recall shows the effect of further processes on the processed information after entering the long-term memory.

Research comparing more and less experienced interpreters has shown that while all interpreters' recall of the input material is affected by articulatory suppression, the recall of more experienced interpreters is not as seriously affected as that of those who are less experienced (e.g. Chincotta & Underwood 1998; Pinter 1969, cited in Gerver 1976). Chincotta & Underwood (1998) suggest that extensive practice at listening and speaking at the same time may have partially released expert interpreters from the effect of articulatory suppression, thus allowing their attention to be directed more efficiently than novice interpreters to the input materials with minimal monitoring of the spoken output. The results and the implications thereof are very similar to those in studies involving the effect of delayed auditory feedback mentioned earlier.

It is quite possible that expert interpreters learn to take a "short-cut" in processing information by bypassing the mechanism of maintaining the input stimuli in a verbatim manner. The evidence provided by some studies discussed earlier, such as Isham (1994) and Salmon and Pratt (2002), shows that comprehension takes

place without adhering to sentence boundaries, and that expert interpreters seem to adopt a more semantic-based processing strategy, implying that this “short-cut” approach may be used.

3.2 Working memory

While it is undisputed that our mental resources are limited in their capacity, there have been several past attempts to investigate individual differences in mental capacities that may account for performance differences in various cognitive tasks.

Although it is the long-term memory on which the interpreters rely to store all kinds of knowledge and information (language and world knowledge), it is the interpreters’ working memory that is crucial in carrying out all the processes during interpreting. Different studies in interpreting have attempted to investigate this aspect of the interpreters’ ability. Most of them borrowed concepts and tools from cognitive psychology to explain and measure working memory span and its efficiency. Despite using the expert-novice paradigm and similar concepts and measuring tools, most of the studies have produced inconsistent results. Some studies showed that working memory span increased with experience in interpreting (Bajo et al. 2000; Darò & Fabbro 1994; Padilla et al. 1995), while others revealed no difference in working memory span among interpreters with different experience levels (Kopke & Nespoulous 2006; Liu et al. 2004).

The studies by Bajo et al., Darò and Fabbro, and Padilla et al. used digit span tests to measure interpreters’ short-term memory capacity. All three studies found that interpreters with higher level expertise had a larger digit span. However, Kopke and Nespoulous (2006) found no difference in simple span tasks between expert and novice interpreters. Simultaneous interpreting involves a continuous on-line processing of information and allocation of working memory resources to different concurrent tasks. It is unlikely that a mere large storage capacity can account for the successful management of the task. The results of some of these studies also contradicted what has been observed in different studies: a lack of correlation between short-term memory span and higher-order language comprehension performance (Gathercole & Baddeley 1993).

While simple digit or word span tests measure the holding capacity of working memory, other more elaborate span tests, such as the reading span test, measure working memory efficiency at maintaining and processing information (Dane-man & Carpenter 1980). The Bajo et al. study and the Padilla et al. study also used the reading span test and likewise found that interpreters with higher expertise levels had a larger span. Liu (2001) used the listening span test, similar in basic concept to the reading span test but different in presentation mode, and found no difference between expert interpreters and the two groups of novice interpreters

(see also Liu et al. 2004). Kopke and Nespoulous (2006), also using the listening span test, found significant differences but observed that novice interpreters outperformed the experts in their working memory span.

The mixed results shown by these studies seem to suggest that the interpreters' working memory span does not fully explain or account for expertise in interpreting. Other mechanisms may be at work or even play a more important role in interpreting expertise.

3.3 Attention

Attention is often conceptualized as part of the human memory system or mental resources (e.g. Baddeley 1986; Cowan 2000/2001). It has been proposed that, when performing multiple tasks, one's attention either has to be shared by the tasks or has to be switched back and forth between tasks. While the manner in which attention can be shared is unclear, there seems to be more empirical evidence for the latter view (Cowan 2000/2001).

Cowan (2000/2001) proposed two possible explanations for the function of attention during simultaneous interpreting. One calls for rapid attention-switching between the listening task and the speaking task, and the other involves well-practiced listening and speaking skills that require less attention. Despite the lack of direct evidence, there seems to be some indirect evidence to support both hypotheses.

One piece of evidence that seems to support the attention-switching view is that interpreters pause more and longer when the input rate increases (Gerver 1969). It seems that more frequent and longer pauses amid the production of output are ways that allow the interpreters to direct their attention to the more difficult comprehension task. Cowan's second hypothesis cannot explain this phenomenon.

As mentioned earlier, it has been observed that novice interpreters' output is comparatively more fragmented and incoherent than that of experts (e.g. Liu 2001; Sunnari 1995). It is possible that novice interpreters have not acquired the ability to switch their attention between listening and speaking at the right time. They may pay too much attention to monitoring their output and fail to catch the incoming message. According to Cowan (2001), "separate items or chunks can be combined into a single, larger chunk only if they can be present in the focus of attention at the same time" (cited in Cowan 2000/2001: 136). During simultaneous interpreting, if chunks of information – whether from the just-translated segment, the currently-stored new information, or the still present abstract representation of the previous information – are to be coherently linked together, it appears that the interpreter's attention has to be brought to these elements in order for them to form a larger, meaningful chunk of information. If any of these segments of information fall out of the focus of attention, the result may be fragmented and incoherent.

In a study involving the solicitation of learners' own feedback on the process of acquiring expertise in simultaneous interpreting, beginning students cited "concentration" as the main difficulty in acquiring the simultaneous interpreting skill (Moser-Mercer 2000). These student interpreters might have been referring to their difficulty in devoting more attention to comprehending the source speech.

It is generally agreed in the literature on attention that switch of attention takes time and effort and that switch of attention takes place only when higher priority stimuli appear in the other channel (Solso 1998). This implies that, in addition to the ability of efficiently managing their attention, interpreters also have to be efficient at judging the overall situation so as to allow their attention to switch effectively between tasks.

Cowan's second hypothesis indicates well-practiced listening and speaking skills as contributing factors to expertise in simultaneous interpreting. Some observed strategies adopted by expert interpreters in the processes of comprehension, translation, and production, as mentioned earlier, may provide evidence for this view. For example, faster access to lexical information, selectivity in processing information, the use of bigger chunks as translation units, and the ability to pay less attention to their own output, are strategies which seem to allow expert interpreters to proceed with the simultaneous interpreting task with more efficiency and with less effort.

It is also possible that both mechanisms depicted in Cowan's hypotheses are at work when it comes to expertise development in simultaneous interpreting. That is, expertise may involve each component process becoming less effortful and the attention mechanism more efficient. Studies in brain research provide some evidence of expertise-related efficiency in the components of a task as well as in the attentional control of the overall task. For example, functional Magnetic Resonance Imaging (fMRI) scans of a skilled portrait artist and of a non-artist were made as each drew a series of faces. The level of activation appeared lower in the expert than in the novice, suggesting that a skilled artist may process facial information more efficiently and with less effort (Solso 2001). More specifically, most studies involving the practice of cognitive tasks showed practice-related decreases in brain activation in the area involving working memory and attentional control (Hill & Schneider 2006). For example, in a skill acquisition experiment involving a motor tracking task on the effect of practice on brain activation, it was observed through fMRI that both quantitative and qualitative changes occurred in brain activity as a skill was acquired. There was a general reduction of brain activation, but changes differed substantially across areas. Activation in the areas where working memory and attentional control were involved either nearly dropped out or was reduced substantially, while areas involving motor and perception remained active (Hill & Schneider 2006). These results seem to imply that as expertise is

acquired, the efficiency gained is more pronounced in the functions of attention and working memory than in the component processes of the task.

The above observation supports the fundamental premises of Gile's Effort Models (1995) in that the processes and operations of interpreting take effort⁴ and that the development of expertise in interpreting may not result in automatic processes, i.e. in significantly decreased requirements on processing capacity for these processes and components, but in better management of mental resources. That is to say, while the comprehension effort and the production effort may become less capacity-demanding as expertise develops, it is the increasingly efficient capacity management mechanism that contributes the most to the advancement of the skill of interpreting.

In Gile's model, the coordination effort assumes the role of managing and coordinating the three basic efforts of comprehension, memory and production (Gile 1995: 169). In this aspect, the coordination effort in Gile's model is not unlike the attention mechanism in Cowan's theory, while the memory effort in the Effort Models is viewed as more of a storage mechanism where information is temporarily kept before further processing takes place. Again, the essence of the Effort Models implies that rather than an increased capacity (i.e. bigger storage) of the interpreters' memory, it is the efficient resource management that contributes to the advancement of interpreting expertise. In this sense, the coordination effort seems to play the most crucial role.

4. Defining expertise in interpreting

What do all these studies on interpreting expertise tell us? What characteristics stand out to allow us to distinguish an expert interpreter from a novice?

From the analysis of studies on interpreting expertise, we observe that expert interpreters' performance is characterized by fewer errors, faster responses, and less effort being made. Expert interpreters are better at providing more accurate and complete interpretations and they seem to be quicker at accessing lexical information, all performed using less effort. However, what makes expert interpreters different from novices goes beyond accuracy, speed and effort. Expert interpreters also demonstrate qualitative differences in their interpretation processes and output. They may not differ from novice interpreters in the syntactic processing of comprehension, but they do differ in their ability to use more flexible semantic processing. One such semantic processing strategy is their ability to perceive and

4. The three basic components of interpreting, therefore, are termed the comprehension effort, the memory effort, and the production effort in the Effort Models (Gile 1995).

distinguish the importance of the input material and to pay more attention to the overall conceptual framework of the source speech. It is quite possible that experts learn to bypass the subvocalization of the source speech and take a “short-cut” in processing information. In addition, expert interpreters’ ability to quickly understand the overall structure of the source speech may contribute to their success in predicting upcoming information, which in turn, helps them engage in a less effortful comprehension process, freeing up their mental resources for other processes.

Expert interpreters’ more semantic-based processing strategy and their ability to perceive the importance and overall structure of the source speech during comprehension may also contribute to their ability to segment the input material into bigger chunks during the process of translation. Through extended practice in the task of simultaneous interpreting between two specific languages, expert interpreters may also develop the ability to recognize patterns in the equivalence relation between the two languages and thus allow a faster transition from the source language to the target language.

While expert interpreters and novices do not differ in their general verbal fluency, the former have learned to pay less attention to their own output. They may monitor their output by adopting a quick checking mechanism against the semantic representation of the input.

From the analysis above, we observe that expert interpreters seem to have developed well-practiced strategies in each of the comprehension, translation, and production processes. However, these strategies are developed and practiced as a result of the interaction among the comprehension, translation and production processes that are specific to the needs of the task of simultaneous interpreting. What allows the interaction among the comprehension, translation, and production processes to act in sync is the interpreters’ ability to manage their mental resources in an efficient manner. Particularly, it seems that expert interpreters have developed an ability to efficiently manage their attention so that it can be switched between different processes according to the specific demand at a particular moment during the task of simultaneous interpreting. An effective act of attention-switching, in turn, calls for good judgment of the overall situation during interpreting so as to allow the interpreter’s attention to switch effectively between tasks.

We are just beginning to piece together evidence to create a more coherent picture of the expertise of interpreting. Despite the complexity of the interpreting task, we are beginning to see that the current knowledge and new findings in other fields, such as cognitive science, are quite compatible with some findings in Interpreting Studies and with a model specific to the task of translation/interpreting, the Effort Models. Our challenge now is to produce more well-designed empirical studies on interpreting that are guided by research questions relevant to the current understandings of human cognition.

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