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CONFERENCE INTERPRETING AS A COGNITIVE MANAGEMENT PROBLEM

THE LITERATURE ON conference interpreting is largely devoted to the investigation of the mental processes of interpreting, in particular in the simultaneous mode. Several process models of simultaneous interpretation (SI) have been developed (Gerver 1976; Mizuno 1995; Moser 1978; Moser-Mercer [1997]). Unfortunately, due to the complexity of interpreting and to insufficient interest in the subject, little progress has been achieved in the testing and development of such models. Although efforts in this direction are continuing, other approaches, more goal-oriented and less ambitious, also have potential value.

One such endeavor started out with the recognition that errors, omissions, and weakened linguistic and delivery output were numerous even in the performance of experts. It is striking that most texts on interpreting have paid little attention to performance limitations and failures as a phenomenon *per se*. Professional interpreters have tended to gloss over such failings and to ascribe inadequate performance to poor working conditions or to interpreter incompetence. Psychologists have used errors and omissions as tools to test the influence of other variables (Barik 1969; Gerver 1976), but only rarely has the extent of the phenomenon been investigated in the field. It is easy to understand why practicing interpreters do not wish to draw attention to such weaknesses. The fact is, however, that errors and omissions can be very numerous. Although their precise definition and identification is problematic (Stenzl 1983) in observational and experimental studies, there are also many very clear-cut cases: wrong numbers, wrong names, wrong propositional content occurring up to several times per minute of interpretation (Gile 1984, 1989, 1995a). Of interest, many such errors and omissions are found in the performance of interpreters enjoying a high professional reputation and in environments in which no unfavorable conditions, such as noise, excessive delivery speed, poor pronunciation, technical complexity of speech, complexity of syntactic structure in the source language, and so on, can be identified. In many cases, they cannot be explained by the interpreter's weaknesses in terms of source language or target language proficiency, world knowledge, or interpreting skills. The evidence suggests that there is an intrinsic difficulty in interpreting, which lies in the cognitive tasks involved.

This chapter presents the Effort Models, a set of rather gross cognitive models of interpreting developed in the early 1980s (and first mentioned in writing in Gile 1983) to account for this intrinsic difficulty, and discusses their explanatory power with respect to well-known problem triggers. It then goes on to elaborate on possible implications with respect to fundamental theoretical and practical issues, to discuss methodological issues in their further exploration, and to request input from psychologists and linguists.

The Effort Model of simultaneous interpretation

The efforts

This Effort Model was developed initially to be used as a conceptual framework for interpretation students. Therefore, while drawing on the concept of processing capacity and its finite availability, it was designed with the simplest possible architecture that would yield the required explanatory power. In particular, complex operations were bundled into three "efforts" (the name was chosen to underscore their nonautomatic nature), presented as distinct entities in spite of the probable existence of overlapping cognitive components.

The listening and analysis effort (L) is defined as consisting of all comprehension-oriented operations, from the analysis of the sound waves carrying the source language (SL) speech that reach the interpreter's ears, through the identification of words, to the final decisions about the meaning of the sentence.

The production effort (P) is defined in the simultaneous mode as the set of operations extending from the initial mental representation of the message to be delivered, through speech planning, and up to the implementation of the speech plan.

The memory effort (M) is the high demand on short-term memory during simultaneous interpreting, due to the operation of several factors including (a) the time interval between the moment SL speech sounds are heard and the moment their processing for comprehension is finished, (b) the time interval between the moment the message to be formulated in the target language (TL) speech is determined and the completion of its formulation, (c) tactical moves, which are used, for instance, if an SL speech segment is unclear to the interpreter because of bad sound, strong accent, unclear logic, errors in the SL speech, and so on (the interpreter may decide to wait until more context is available to help understand the unclear segment), and (d) linguistic reasons, as will be discussed in a later section.

Tactical decisions on how to deal with particular problems (coping tactics) will be considered here as part of the production effort, although they are often related to professional, sociological, or psychological factors rather than to linguistic or cognitive factors, and their impact may be largely felt in the memory effort as well.

The Effort Model and its operational requirements

Using these definitions, simultaneous interpretation (SI) can be modeled as a process consisting of the three "efforts" described above, plus a coordination effort (C) (Eysenck and Keane 1990):

(1) $SI = L + P + M + C$

In the most general case, at any point in time, the three basic efforts are processing different SL speech segments. When interpreting a speech consisting of a succession of segments A, B, C, and so on, production may be working on A, memory on B, and listening and analysis on C. This, however, is not a set rule. For instance, anticipation often results in a production effort being performed on a segment not yet heard in the SL.

In the most general case, at any point in time, the three basic efforts are simultaneously active (there is now ample evidence that interpreters do indeed listen and speak simultaneously during most of their interpreting time; in addition to the findings of Gerver and Barik, see, for example, Čenkova 1988, for the Russian–Czech combination). Total processing capacity requirements (TR) are therefore presented as a sum (although not necessarily an arithmetic sum, as some resources may be shared) of individual processing capacity requirements:

(2) $TR = LR + MR + PR + CR$

where LR = capacity requirements for L, MR = capacity requirements for M, PR = capacity requirements for P, and CR = capacity requirements for C.

At each point in time, each effort has specific processing capacity requirements that depend on the task(s) it is engaged in – a particular comprehension, short-term memory, or production operation being performed on specific information segments. Due to the high variability of requirements depending on the incoming speech flow and on its segmentation into processing units by the interpreter (Goldman-Eisler 1967), processing capacity requirements for each effort can vary rapidly over intervals of a few seconds or even fractions of a second. At any time, if interpretation is to proceed smoothly, the capacity available for each effort (LA, MA, PA, and CA) must be equal to or larger than its requirements for the task at hand:

(3) $LA > LR$,
(4) $MA > MR$,
(5) $PA > PR$, and
(6) $CA > CR$.

This goes beyond the mere condition that total available capacity (TA) be at least equal to total requirements (TR):

(7) $TA > TR$

The model becomes meaningful when it is assumed that the total processing capacity available at any time is finite, and that meeting conditions 3 to 7 is not trivial. As explained above, it is precisely the evidence that the interpreter's capacity is often insufficient to perform the interpreting tasks correctly that inspired the effort models.

Interpretation difficulties and failures

The layperson tends to believe that interpretation errors and omissions occur when the interpreter does not know a term or concept in the SL or TL. This does happen, but the effort models explain frequent errors and omissions associated not with such lack of knowledge but with cognitive load. When one or more of the conditions defined by inequalities 3 to 7 is or are not met, one of two things may happen. Either the execution of a task is delayed, which may lead to heavier cognitive load on the processing of the next segments and, ultimately, to failure sequences as discussed below, or the task is not executed, which is not necessarily detected, as both the sensitivity and the linguistic and world knowledge of observers are often insufficient (see Gile 1995a, 1995c).

For instance, if an incoming SL speech segment requires increased capacity for production, the interpreter may have to wait until more processing capacity can be directed toward the production effort, possibly after having been freed from the listening effort that is busy with an incoming segment. This may result in increased load on memory, as further SL speech segments continue to arrive and have to be processed for comprehension and then stored until they are reformulated into the TL or omitted. If additional processing capacity is then allocated to the memory effort, this may in turn deplete the capacity available for the listening and analysis effort, leading to a potential problem in the comprehension of another incoming SL speech segment. Such failure sequences can account for errors or omissions occurring at a distance from a difficulty in the SL speech and affecting SL speech segments that pose no problem *per se*.

In fact, distal failures need not come from a problematic segment at all. The short delay needed to change processing capacity allocation to the various efforts as SL speech processing tasks are completed, and new tasks have to be undertaken, may be enough to generate capacity shortages at various points in the processing of sentences containing no particular difficulty. Figure 1 gives a hypothetical example, with a sentence having one comparatively dense segment, for instance, "Ladies and Gentlemen, *the International Association of Frozen Food Manufacturers* is happy to welcome so many of you in Paris for this meeting." The dense segment (in italics) goes from t2 to t3, while total requirements resulting from an addition of the requirements for L, P, and M reach their maximum value between t6 and t7.

Sometimes no significant waiting is possible, for instance, when identifying a word from sounds, which are known to disappear rapidly from memory. In such a case, the relevant SL segment is not understood, which may result in an error or omission.

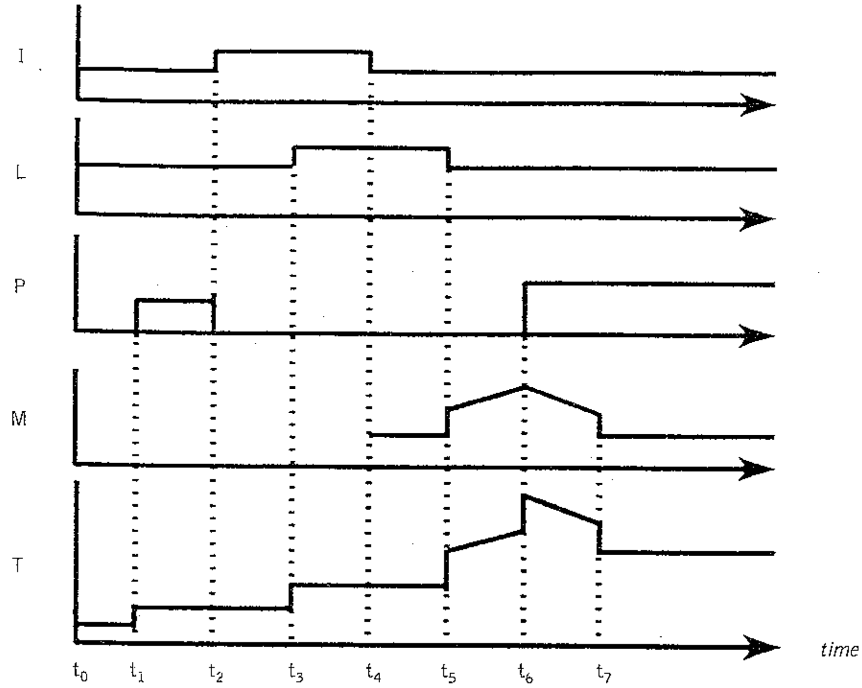

Figure 1 A theoretical and schematic representation of the processing capacity involved during the simultaneous interpreting of a simple sentence with a single informationally dense segment.

The Effort Model of consecutive interpreting

The model

In consecutive interpreting (CI), the interpreter alternates with the speaker, translating SL speech segments of at least several sentences after the speaker has completed them and has paused for translation. CI can therefore be viewed as a two-phase process: a listening phase, during which the interpreter listens to the SL speech, and generally takes notes, and a reformulation phase, during which the interpreter makes a TL speech from memory and from notes. The listening phase can be modeled as follows:

(8) CI (listening) = L + M + N + C

L is the listening and analysis component already referred to for SI. N refers to note-taking, which differs from note-taking in other circumstances in several ways. In particular, CI notes do not cover all the information contained in the SL speech, but essentially serve as reminders to help the interpreter retrieve said information from memory (Rozan 1956). The effort N therefore involves decisions on which information should be noted and how it should be noted (as full words or abbreviations, in the SL, the TL, or another language, as symbols, drawings, and so on), as well as the implementation of these decisions. M is the same short-term memory component as in SI, which in this case occurs between the time SL information is received and the moment it is taken down, or the moment the interpreter decides not to note it, or the moment it disappears from working memory. C is the same coordination component as in the Effort Model for SI.

The reformulation phase can be modeled as follows:

(9) CI (reformulation) = Rem + Read + P

The Rem component refers to the operations involved in recall from memory, and notes of the SL speech segment being translated. The Read component refers to the reading (or deciphering) of the notes taken during the listening phase. The P effort is the same as in SI.

Processing capacity requirements in consecutive interpreting

When the processing capacity requirements of CI are analyzed in the same way as in the Effort Model for SI, three features stand out.

First, in terms of processing capacity, only the listening phase is critical. In the reformulation phase, processing capacity allocation is done by the interpreter at his or her discretion, and there is no risk of overloading due to a high density of the speech over time. In particular, if some difficulty arises in the execution of one task by one effort, the execution of tasks by other efforts can be delayed without risking information loss, as no further information comes in during that time. Whereas in the listening phase, the three efforts may be viewed as highly competitive, in the reformulation phase, there seems to be much more potential for cooperation, in particular between note-reading and remembering. Incidentally, this could explain why many interpreters accept work into a B language (active, but nonnative) in consecutive, but not in simultaneous, interpreting. The presumably higher cost of speech production in the B language could be accommodated in the reformulation stage of consecutive, but not under the heavier pressure of simultaneous, interpreting.

Second, processing capacity requirements associated with the note-taking effort are largely determined in the time it takes to write notes, during which incoming information accumulates in working memory. Memory failure may therefore be more frequent in CI than in SI.

Finally, processing capacity requirements in consecutive interpreting depend to a large extent on the way the interpreter takes his or her notes, in other words, on a technical skill not found in SI.

Sight translation and SI with text

In sight translation (ST), the translator or interpreter translates an SL text aloud while reading it. The listening and analysis effort becomes a reading and analysis effort; the speech production effort remains, but there is no memory effort as in simultaneous or consecutive interpreting because the SL information is available on paper at any time.

(10) ST Reading + Production

Sight translation is not paced by an SL speaker. Its rhythm depends on the translator, and as is the case with the reformulation stage of CI, he or she has some margin of freedom in allocating processing capacity to the reading and analysis effort or to the production effort.

On the other hand, in consecutive interpreting, notes are used only as an aid to trigger memory of an SL speech that was heard and understood previously. In sight translation, however, the reading effort also carries the burden of the initial comprehension of the text. Moreover, whereas notes represent only part of the information and are laid out to help visualize the logical structure of the speech (see Rozan 1956), written texts carry all of the information content of the author's message, plus language components associated with rules of syntax and style that carry little information (in particular, function words, forms of politeness, and so on). Their layout is determined by graphic presentation conventions, and not by the need to see the logic of the discourse at a glance; their information density and linguistic style make instantaneous oral translation more difficult.

Yet another difference lies in the fact that, while in consecutive, and to a lesser extent in simultaneous, interpreting, the memory of the SL words fades away to a significant degree before the reformulation of their content in the TL (generally 1 to several seconds after they were heard), in sight translation, they continue to be visually present throughout. It follows that the risk of linguistic interference is probably higher in sight translation than in SI – and higher in SI than in CI because of the rapid fading of SL words from memory. Finally, in SI and in the listening phase of consecutive interpreting, the information is retrieved mainly from sound (but also from the speaker's body language and from visual information displayed on a screen as slides or overhead transparencies as well as in handouts). In the reformulation stage of consecutive interpreting, it is retrieved from memory and from the interpreter's notes. In sight translation, it is retrieved solely from the writing in the text. What implications this might have in terms of effort requirements, and in particular in terms of cooperation or interference between the SL reading input and the spoken TL output, is not clear.

SI with text (the speaker is reading a text that the interpreter also has in the booth) can be performed as a mixture of SI and sight translation going from "pure" SI (without any reference to the text) to "pure" sight translation (without any reference to the sound). The one extreme (pure simultaneous) deprives the interpreter of the visual help. The other extreme (sight translation) is considered risky for two reasons in addition to the linguistic interference factor. First, by neglecting the actual speech, the interpreter may miss possible deviations by the speaker from the written text (side comments, additions, and other changes). Second, when focusing on the text, the interpreter is tempted to translate all of it even when the speaker is reading very fast, and "compression" tactics involving selected omissions would be required. As a result, the interpreter may lag further and further behind and eventually be forced to omit a large speech segment.

The explanatory power of the Effort Models

A series of problematic speech-segment types, well known to professionals and often mentioned in the literature, can be classified and explained using the Effort Models.

Problems arising from an increase in processing capacity requirements

High information density in the SL increases processing capacity requirements, because more information must be processed per unit of time. This applies to both the listening and analysis effort and the production effort in simultaneous, and the note-taking effort in consecutive, interpreting. High speech density may be the most frequent source of interpretation problems and failures. It is associated with fast delivery of the speech; enumerations (which are devoid of low-density connective segments); external factors, such as poor sound quality (which also increases the processing capacity required for speech comprehension); and prepared speeches, in particular when read from polished texts. Not only are prepared speeches more densely formulated than spontaneous speech (Halliday 1985), they are delivered with fewer false starts and hesitations, which have a low information content and account for a large proportion of the total speech time. Moreover, it is argued by some authors (see, for instance Déjean le Féal 1978) that the intonation pattern of speeches read from texts is not as helpful for comprehension as that of spontaneous speeches (although this has been challenged by a recent study by Shlesinger 1994).

There are also information-reordering-associated problems. Names composed of several words may require a reordering of their components in the TL. For instance, *Association internationale des interprètes de conférence* becomes *International Association of Conference Interpreters*. As long as there is no automated response to the name as an entity, this increases the memory effort requirements in a twofold mechanism. First, because of the high information density of such names, depending on the specific language pair, the interpreter may have to wait until they have unfolded completely before starting to translate, with no possibility of unloading memory gradually. Second, the reordering process requires repeated scanning and comparison of the SL name and its gradually developing TL translation, as opposed to direct word-to-word or meaning-to-word reformulation. This slows down the process even further and therefore increases the load on memory. Compound technical terms pose a similar problem, as in *water cooled double-walled high integrity stainless steel tank*.

Differences between the syntactic structures of the SL and the TL can increase the memory effort's processing capacity requirements because of the waiting involved before being able to reformulate the SL segment into the TL.

A language-specific difficulty identified in Japanese is associated with the high proportion of homophones in its vocabulary, due to the importation of Chinese words and morphemes into the more restricted Japanese phonological space, which reduces the redundancy of speech signals – hence the potentially higher vulnerability to processing capacity mismanagement (see below) and increased processing capacity requirements for comprehension. In a study by Gile (1986), words read aloud to Japanese listeners often invoked several different lexical units, and sometimes none. In Japanese, not only are homophones numerous, there is little grammatical and other redundancy. It is not clear to what extent the linguistic and situation context can offset these difficulties, as no testing was done on actual speeches.

Problems associated with signal vulnerability

Some SL speech segments are not necessarily difficult to process but are more vulnerable to a momentary shortage of processing capacity in the listening effort because of their short duration or low redundancy. This in particular is the case with numbers and short names, including acronyms. In an experiment involving the simultaneous interpretation of a speech, the proportion of names incorrectly understood and/or reformulated was very high (Gile 1984). The same difficulty should also apply to a significant proportion of the vocabulary of some languages such as Japanese and Chinese, where the difference between many words lies in a single phoneme. Such signal vulnerability makes proper and precise processing capacity management critical, as a very brief shortage of processing capacity in the listening and analysis effort may be enough to cause significant loss.

The models imply two types of trigger mechanisms for failure: saturation, that is, a situation where the sum of capacity requirements is larger than the total available capacity; and individual deficit, where the interpreter's total available capacity covers total requirements but the capacity available for one or more effort(s) (L, M, P, and so on) at a particular moment is not enough to cover its/their requirements for the task(s) at hand.

Saturation inevitably results in individual deficits. Individual deficits not mediated by saturation are more a matter of capacity management. They may occur when the interpreter devotes more capacity than necessary to TL speech production (trying to formulate an idea very elegantly when the speech is informationally dense and much capacity needs to be devoted to the listening and analysis effort), when he or she writes too many notes in consecutive interpreting, and so on. Individual deficits may also occur because of a short attention gap in the listening and analysis component occurring at the time a vulnerable SL segment is uttered by the speaker (numbers, short names, and so on). Such management problems are partly associated with faulty techniques and tactical decisions (see below), and partly related to inappropriate subconscious, automated processes acquired during initial interpretation training at school or during one's professional experience in the field.

As explained earlier, saturation and individual deficits may lead to immediate failures, or to failures at a distance from a difficult SL segment, often with the result that it is not the difficult SL speech segment that is omitted or translated erroneously, but another segment, which is not problematic *per se*. It seems that, to date, the Effort Models' failure sequences are the only explanation put forward for this rather frequent type of failure.

Interpretation strategies, tactics, and other issues

Interpretation strategies and tactics

The explanation of failure mechanisms through saturation and individual deficits leads to the obvious quest for means to reduce effort requirements. The advantages of many strategies adopted in interpreting can be analyzed in such terms. For instance, advance preparation of conferences may be assumed to increase the availability of the relevant lexicon of the SL and TL, of technical terms, and other relevant linguistic knowledge and world knowledge, and therefore to reduce the processing capacity requirements both in the listening and analysis component and in the production component. Regulation of the ear–voice span – that is, the time between the moment a segment is heard and the time it is reformulated in the TL – can be assumed to aim at optimizing the balance between short-term memory load and speech production requirements. The further an interpreter lags behind the speaker, the clearer the understanding of his or her message, hence the easier its reformulation but the heavier the burden on working memory. The same can be said of the "segmentation" strategy advocated in SI from German into French, that is, reformulating successive short segments of the SL into the TL without waiting for all of the idea to be uttered (see Ilg 1978).

In consecutive interpretation, using many symbols in note-taking (Matyssek 1989) helps reduce the time required to note ideas. However, until they are mastered, retrieving them from memory and/or recognizing their meaning from the notes in the reformulation phase may require more time and processing capacity than would be the case when writing plain words. Also, as mentioned above, laying out the notes in a particular way can reduce capacity requirements of the Rem component (i.e., recalling the content of the speech).

In sight translation, preparing the SL text by dividing it into "translation units" using slashes makes it possible to focus eye movements on shorter text segments, and thus reduce the time and processing capacity required for comprehension. Writing glosses in the SL text and numbering words in the order in which they will be translated into the TL reduce production capacity requirements.

In addition to strategies, interpreters use coping tactics to prevent or contain damage when a problem occurs or threatens to occur (Gile 1995b). Each tactic has a price in terms of potential information loss, credibility loss, impact loss, and time and processing capacity cost. For instance, consulting documents in the booth and explaining or paraphrasing a term for which the interpreter has no TL equivalent requires much time and processing capacity. Taking notes during SI so as not to forget proper names or numbers can be costly in time, and it introduces further processing capacity requirements because of the added writing activity. In both cases, there is a risk of memory overload. The advisability of each coping tactic in a given situation can be analyzed on the basis of such parameters. The Effort Models underscore the importance of time and processing capacity in such assessments.

Theoretical and pedagogical issues

The Effort Models also provide a convenient conceptual framework for a discussion of fundamental theoretical questions. Chief among these is the issue of language specificity. It has been argued vocally by proponents of the *théorie du sens*, which prevailed in the 1970s, that interpretation is language-independent, on the alleged grounds that competent interpreters understand any language in exactly the same way as other listeners in their respective mother tongues, and that speech production in the TL is spontaneous and effortless (Gile 1995a). Other authors believe that syntactic differences between the SL and TL do make a difference (Fukuii and Asano 1961; Ilg 1978; Kunihiro, Nishiyama and Kanayama 1969; Wilss 1978).

The debate was limited to claims and counterclaims. The Effort Models would suggest, as explained earlier in the chapter, that syntactic differences that force interpreters to wait longer before starting to formulate their TL speech tend to increase the load on the memory effort. One might even go further and talk about the intrinsic requirements of specific languages in terms of the listening effort and/or in terms of the production effort. As mentioned above, languages with many short words and homophones and few grammatical indicators, such as Chinese and Japanese, could be more vulnerable in the listening effort because of the lack of redundancy. Languages with a limited vocabulary and a rather rigid grammar that imposes strict conditions on the order of elements in the sentence as well as grammatical agreement conditions could be associated with higher production effort requirements. Specific information density patterns may also have implications on processing capacity requirements. Many Japanese sentences have a rather long predictable ending (Gile 1992), which might reduce significantly the processing capacity requirements of the listening and analysis effort over enough time to have an impact on interpreting strategies.

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Discussion

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Validating and fine-tuning the Effort Models

If the assumptions underlying the Effort Models' architecture are found to be compatible with state-of-the-art knowledge of cognitive psychology and psycholinguistics, it will still be necessary to test the hypotheses underlying the hypothesized processes. Such testing is difficult for some of the following reasons.

Processes occurring during interpreting involve, simultaneously, speech perception and production, content analysis, decision making, storage, retrieval, and comparison of sounds and other information in various components of memory. Moreover, it may reasonably be assumed that because of their simultaneousness and the cognitive load involved, they interact with and modify each other. Hence the possibility that research findings on single processes conducted in cognitive psychology and psycholinguistics in non-interpreting environments do not apply fully.

The complexity of interpreting is compounded by the important part highly variable strategies play, as evidenced by the above-mentioned wide interindividual distribution pattern of errors and omissions.

Because of the probable high degree of interaction between the processes occurring in interpretation, it is difficult to isolate them in an experimental setup, except possibly for rather gross bundles such as speech comprehension or note-taking in consecutive interpreting. Setting aside some manipulations of the SL speech (Dillinger 1989; Gerver 1976) and of noise and other environmental conditions (Gerver 1976), strict selective control of independent variables is tricky.

Indicators for quantitative evaluation are a problem. Many indicators used in psychological experiments are difficult to use because they require breaking down interpretation into isolated tasks. More holistic indicators such as errors and omissions are tricky (Stenzl 1983). They can be useful but lack sensitivity, reliability, and precision. Noninvasive on-line physiological indicators would be most helpful if they could measure cognitive load directly. Not only would they provide a means of testing many hypotheses described above, they could serve as guiding tools in interpreter training. No adequate indicators seem to have been found. Pupil dilation measurements required that the interpreter's head be maintained in a certain posture (Tommola and Hyönä 1990), and EEG measurements imposed "mental interpretation," without TL sound (Kurz 1996).

Some of the difficulties of empirical testing could be partly offset by increasing sample sizes and by multiplying replications. The sheer effect of large numbers would reduce the effect of random variation and there would be more possibilities for comparing actual interpretation occurrences using specific differences in selected variables (e.g., language combination, speed, previous knowledge of the subject) retrospectively. For professional, psychological, and practical reasons, however, access to subjects and material is difficult, and the use of students as subjects is problematic. Neither their processes nor their strategies can be safely assumed to reflect those of professional interpreters, if only because very few pass their final exams and become interpreters. The large sample size, multiple replication paradigm is therefore not a realistic one.

Conclusion

The concept of processing capacity and the Effort Models have proved useful for explanatory purposes. However, they have to be validated both against state-of-the-art knowledge in the cognitive sciences and with experimental methods before any fine-tuning and further development can be done. One of the main difficulties in such validation lies in the identification of precise, reliable, and sensitive indicators. It is precisely because of these difficulties that the input of researchers from the cognitive sciences is highly desirable.

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