this volume) no natural evolution of translation skills in the monolingual subject. Even in bilinguals, translation skills (e.g., those of so-called natural translation) have a unique and limited character separating them from the skills of professional translation. In the end, translation is the result and the particular domain of a division of labor, a specialist mode of communication, which translators and interpreters are not just proficient in but are employed to provide in the service of others.

The six unique characteristics of translation—doubling/mediating, rephrasing at a distance, displaced situationality, bilingual and multilingual intertextuality, derived creativity, and expanded pragmatic directedness—deserve specific attention and specifically designed research strategies to explain them. The explanation of their individual properties as well as their interrelation and interaction demand concerted efforts by investigators from various fields. *Translatio* will expose its secrets only to a team of interdisciplinary researchers able to fit each of the six pieces of the puzzle of translation together.

The challenge, in the context of the chapters collected in this volume, is to investigate if and how the six parameters postulated in my chapter reflect the psychological reality of *translatio.* Translation studies, as they have been conducted in an academic setting for less than 50 years, need scientific rigor. Many brilliant things have been said about translation over the past centuries. Many more brilliant efforts have been made in the several thousand years since the fall of the Tower of Babel to achieve *translatio* in the service of multilingual humankind. But it is perhaps not an exaggeration when I say that the tasks that lie ahead for translators and interpreters alike require a more consistent and efficient theoretical foundation than ever before.

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2

The Cognitive Study of Translation and Interpretation

Three Approaches

ANNETTE M. B. DE GROOT

Forms of Translation

Translation and interpretation involve the rephrasing of a communication expressed in one language, the source language (SL), in another language, the target language (TL). The term *translation* is used both in a broad and in a more narrow sense. In the broad sense, it refers to all operations where an SL unit is turned into a TL unit, irrespective of the modality of input and output (writing, speech, sign language). The modalities of input and output may be the same or different. When the term is used in its narrow sense, it refers only to the activity of reformulating written SL text into written TL text. It then contrasts with the term *interpretation,* which denotes the activity of orally rephrasing SL speech in TL. This ambiguity in terminology can be mildly confusing at times. More seriously, the use of a single cover term for both

the written and the oral forms can be misleading. It is clear that the two share many general features (see Neubert, this volume, for a detailed analysis). But the use of a single term to refer to both may veil the—fundamental—differences between them. The differences, especially in terms of the processes involved, are in fact so substantial that the two may require a different set of skills to be performed optimally (Carroll, 1978). Yet more fine-grained differences between forms of translation occur (which again may require different skills; see Gerver, Longley, Long, & Lambert, 1984). This introduction presents some of the forms that have been used. I will focus my discussion on aspects of the various forms of translation that I believe are of special interest from a cognitive point of view. In the remainder of this introduction, I will suggest a number of causes for the relative lack of interest that cognitive researchers have demonstrated in the study of translation. Subsequently, I will present, in three separate sections, the three approaches that could profitably be taken—indeed, have been taken—in this study, organizing a number of the pertinent studies in these sections.

Interpretation occurs in two main versions. In both of them, input as well as output consist of speech, but the two differ in the timing of the input and the output relative to one another. In simultaneous interpretation, the interpreter listens and speaks at the same time most of the time. In contrast, in consecutive interpretation, the interpreter alternates between listening and speaking. The person delivering the speech speaks for a while, during which the interpreter listens (and generally takes notes); only when the speaker finishes does the interpreter take the floor.

Even more subtle differences occur, for instance, between consecutive and semiconsecutive interpretation. Gerver (1976) refers to these two as "continuous" and "discontinuous," respectively. In the former, the speaker completely finishes his or her speech before the interpreter starts his oral rendition (consecutive); in the latter, the speaker segments his or her speech and has the interpreter continue after each segment (semiconsecutive). Yet two other forms are what Gile (this volume) calls "sight translation" and "simultaneous interpretation with text" (cf. McDonald & Carpenter, 1981, who refer to the former of these two as "simultaneous translation"). They are in fact mixtures of the two "pure" forms of translation that were introduced earlier, where input and output both consisted of either speech (only) or writing (only). In sight translation, there is no speaker delivering a speech but, instead, a written SL text, which the interpreter translates orally into TL. In simultaneous interpretation with text, a speaker reads his or her speech aloud from paper

while the interpreter has the same text at his or her disposal when producing the oral rendition.

Another distinction is not based on task differences but on characteristics of the person translating and the translation setting. Harris and others used the term *natural* translation to refer to translating done by bilinguals without any special training in translation and under everyday circumstances. They contrasted this form with *professional* translation, that is, translating by professional translators who are practicing their profession (Harris, 1977, 1980; Harris & Sherwood, 1978; Malakoff, 1992; Malakoff & Hakuta, 1991; Shreve, this volume).

Translation Form and Processing Demands

Reflecting upon these various forms of translation (the above list is by no means exhaustive; see, e.g., Crystal, 1987, and Harris, 1977, for other distinctions), upon how they might differ from each other in terms of the processing involved and the demands they pose on the translator/interpreter, and upon the reasons that led to their introduction into the practice and/or the study of translation, is an instructive undertaking for anyone with an interest in cognitive processing. For instance, a comparison of simultaneous and consecutive interpretation immediately suggests one (maybe the single) critical difference between the two. Only in simultaneous interpretation does attention constantly have to be divided between comprehension of the input and production of the output. The proportions of attentional capacity required for comprehension on the one hand, and production on the other, must continuously fluctuate, depending upon various characteristics of the input (e.g., its rate and clarity of diction, its grammatical complexity, its information density) and output (e.g., whether its articulation characteristics are simple or complex). This unremitting and fluctuating capacity-sharing will heavily tax the limited processing resources of the simultaneous interpreter.

Orchestrating the portions of attention that must be assigned to the various ongoing activities may be the vulnerable spot in simultaneous interpretation. In contrast, the Achilles heel of consecutive interpretation is likely to be the relatively long interval between input and output, which taxes memory excessively. Memory load can be decreased by embedding an activity that could be regarded as yet another form of (partial) translation in the interpretation

process, namely, by taking notes while the speaker delivers his or her speech. The quality of the interpreter's output may to a large extent depend on his or her note-taking skills and ability to reconstruct the input from these notes. The demand on the interpreter's memory is decreased when, instead of the normal consecutive form, the semiconsecutive form is employed. Of the various forms of interpretation introduced above, sight translation will tax memory the least. Because the written input is permanently available, there is no urgent need to memorize it. A relatively large part of the processing resources can therefore be spent on comprehending the input and producing the output. In sum, each form of translation discussed so far involves a unique set of processing activities and their balancing. It should be of interest to any student of cognitive processing to gain more insight into how, in the different forms of the task, the various task components are traded off against one another (see Gile, 1995b, pp. 81-118, and this volume for a more complete analysis of the demands posed by the various forms of interpretation).

The Relevance of Natural Translation

The last form of translation introduced above, natural translation, was mentioned because its very occurrence demonstrates some other aspects of translation that are of relevance to those with an interest in cognition. Apparently, translation contains components that do not require training in a formal setting. That particular part of the full skill, the natural part, is thought to be concomitant, or coextensive, with bilingualism. Any individual with a certain degree of competence in two languages also can, to some extent, communicate between the two; in other words, he or she can translate (Harris, 1977, 1980; Harris & Sherwood, 1978; Malakoff, 1992; Malakoff & Hakuta, 1991). This form of translation can already be observed in very young bilinguals. Expressions of the skill start to show soon after the onset of their first linguistic utterances (e.g., Harris, 1980).

These observations have some interesting implications, both theoretical and practical. The phenomenon of natural translation suggests that already at a young age the bilingual has functionally separated his or her two languages. To be able to translate between two languages implies that the person knows what linguistic elements in his or her bilingual memory belong to one language system and what elements belong to the other. This conclusion is interesting in its own right, but has wider implications as well. It conflicts with

a popular view of code-switching (the alternating by bilinguals between their two languages in speech production), namely, that it evidences linguistic confusion. Instead, it may indicate, as Malakoff (1992) has argued, that code-switching is a deliberate linguistic activity (see also Bentahila & Davies, 1992). To express a particular thought, the bilingual selects the language that lends itself best to that purpose. At a practical level, the phenomenon of natural translation, being coextensive with bilingualism, suggests that translation may prove to be of use as a tool to assess the level of proficiency a bilingual has in his or her second language (Malakoff & Hakuta, 1991; Swain, Dumas, & Naiman, 1974). Furthermore, it may have implications for the training of translators and interpreters. What comes naturally need not be trained. Therefore, examining natural translations to understand their characteristics and to determine the knowledge and skills they manifest may lead to changes in existing translation and interpretation curricula. The time gained could then be used to devote more attention to those aspects of these skills that do not come naturally but require formal instruction.

Cognitive Psychology and the Study of Translation

The above may have shown that the study of *translation* (henceforth used in the broad sense, covering all forms of translation, unless explicitly contrasted with interpretation) is likely to reveal many interesting facets of human intellectual performance. The complete process, from input to output, covers many subprocesses and knowledge structures that have each traditionally been (and still are) given considerable attention by the cognitive-psychology research community: language comprehension, language production, memory, attention, visual and auditory perception, decision making. Yet, as judged from the dearth of articles on translation that have appeared in the mainstream journals of the field, relatively few cognitive psychologists have devoted research efforts to the unraveling of these intricate activities. Relevant work has been done, in fact enough of it to have led several authors to propose models that provide complete outlines of the interpretation (Gerver, 1976; Moser, 1978) and translation (Bell, 1991) processes. But the majority of this work was performed within disciplines other than cognitive psychology (e.g., linguistics and translation studies). So why is it that cognitive psychologists have not explored translation more extensively?

Part of the answer may be that, due to the fact that these forms of human achievement are not emphasized in the mainstream journals and textbooks, the cognitive-psychology research community has never given them enough thought to recognize them as relevant research topics. Another part of the answer is possibly that those in the field who have recognized their relevance have judged them too complex to grapple with (see also Gerver, 1976). They may have given priority to the study of simpler tasks, maybe implicitly assuming that only after behavior in simple tasks is understood is it opportune to head on to the more complex tasks that encompass these simpler ones. Albrecht Neubert (this volume) has given an eloquent introduction to the complexity of the translation and interpreting tasks. Some advocates of the latter view may even hold the opinion that if all of the simple tasks contained by a complex task are understood, the complex task as a whole is understood as well and requires no further study. This way of thinking would fit a view of translation that I will call "vertical" here.

VERTICAL VERSUS HORIZONTAL TRANSLATION

The notion of vertical translation construes translation as containing two main processes: full comprehension of the SL text/discourse (henceforth: *text*), including its pragmatic intention, followed by production of the constructed meaning in TL text. In their turn, both of these main components, comprehension and production, contain a number of subcomponents, for instance, in comprehension there may be perceptual (auditory or visual) analysis of the stimulus, word recognition, syntactic analysis, semantic analysis, and pragmatic analysis. To the extent that this vertical view holds, by knowing the details of L_1 comprehension, L_2 comprehension, L_1 production, and L_2 production (both in the auditory and the visual mode), we would at the same time know the essentials of translating from L_1 as source language to L_2 as target language, and vice versa. And, of course, much is known already on each of these four processes. Of the four, L_2 production is the least investigated, but even here there are recent studies (see, e.g., the attempts to adapt Levelt's, 1989, model of production in L_1 to production in L_2; de Bot, 1992; de Bot & Schreuder, 1993; Poulisse & Bongaerts, 1994).

But the vertical view described above is not without its competition. An alternative view, which I will call "horizontal" translation, construes translation as "transcoding," that is, as the replacement of SL linguistic structures of various types (words, phrases, clauses) by the corresponding TL. Even strong

advocates of the vertical view acknowledge that translation involves some horizontal processing, but consign this horizontal processing to an inferior status. It is thought to characterize translation by amateurs or to demonstrate temporary breakdowns in professionals (Paradis, 1994). Seleskovitch, presumably the strongest advocate of the vertical view, argues that there is more of such horizontal processing (in her terminology, "code-switching") in text-to-text translation than in interpretation (Seleskovitch, 1976a). The alleged cause of this difference between the two is the differential availability of the word forms in translation and interpretation. The written words in translation are permanently present and available to the translator, making translation an "open prey" (Seleskovitch, 1976a, p. 95) for transcoding. In contrast, the spoken words in interpretation are more transient. According to Seleskovitch, their forms are lost almost immediately after they have been uttered by the speaker and only their sense remains in the interpreter's memory. With the word forms lost, no transcoding can take place. Others doubt this notion of (complete) deverbalization of the speech input during interpretation. For instance, Gile (1991) notes that it is based on "flimsy" evidence. The implication is that Seleskovitch may have underestimated the role of transcoding in interpretation. Translation and interpretation may thus both entail vertical as well as horizontal processing, albeit, possibly, in different proportions.

Because translation does not appear to proceed only vertically, a cognitive psychologist's opinion that all we need to know about this skill could be inferred from our knowledge of comprehension and production in L_1 and L_2 (see above) would obviously be flawed. But it would be flawed for another reason as well. Even if processing in translation would to a large extent (or even exclusively) be vertical, it would be very unlikely that the various processing components exactly mimic the corresponding processes in monolingual comprehension and production. The unique set of requirements for translation (especially interpretation) to comprehend and produce language material simultaneously or in continual alternation and in different languages, is likely to modulate the various processing components, as compared with these same components in monolingual language use. As an example, word recognition may be more top-down, that is, depend more on higher level contextual information, in interpretation than in monolingual comprehension of speech.

All in all, I believe cognitive psychology should embrace translation as an object of study. Doing so would be bound to increase our understanding of human intellectual potential. In their turn, the new insights in translation

performance to be acquired from these intensified research efforts could result in practical recommendations for both the training and the professional practice of translators and interpreters. In the remainder of this text, I will present, in three separate sections, three approaches that could profitably be taken—in fact, have been taken, albeit not very systematically so—in the cognitive study of translation. They differ from one another along two dimensions: the size of the SL unit to be translated (subtextual units, such as words or sentences, versus text), and whether or not the task of translating complete text is compared with performance in a similar complex task. A number of studies that are exemplary of each of these three approaches will be discussed.

Approach 1: Translating Words and Sentences

One approach to take in the study of translation is to focus on stimuli smaller than a complete text, for instance, words and sentences. The goal would be to discover the factors that affect translation of that particular language unit. This approach departs from the assumption that translating a complete text must depend at least partly on the ease with which the elements that constitute the text are translated when presented in isolation. Detailed knowledge of the factors that affect translation of each of these different units should thus contribute to our knowledge of text translation. This is the approach we have taken so far in the translation studies performed in our laboratory, working primarily with the word as the stimulus unit (de Groot, 1992a; de Groot & Comijs, 1995; de Groot, Dannenburg, & van Hell, 1994; de Groot & Hoeks, 1995). Note, however, that this approach has been criticized vehemently (because of its alleged lack of ecological validity) by what Gile (1994) calls the "practisearchers" of interpreting, professional interpreters who are also actively engaged in interpretation research.

BACKGROUND

That we have thus far explored this particular approach to the study of translation was not based on an a priori weighing of the benefits and drawbacks of the various possible approaches. Instead, our earlier work on the structure of the bilingual mental lexicon led us straight to the choice of the word as stimulus in our first translation studies. In those earlier studies, we

focused on the question of how individual translation pairs, their meanings and word forms, are represented in bilingual memory. Like researchers before us (Chen & Leung, 1989; Kroll & Curley, 1988; Kroll & Stewart, 1994; Potter, So, von Eckardt, & Feldman, 1984), we soon discovered that word translation is a convenient research tool to investigate this question. Finally, as a last logical step, working intensively with this simple task in a number of studies (e.g., de Groot, 1992a, 1992b; de Groot et al., 1994) and seeing how performance at it responded to a large number of experimental manipulations, our interest in the task itself, and in what factors affect its performance, was aroused. In addition to using word translation as a tool to study bilingual memory, we then started to consider it as the object of our studies as well. Ultimately, this shift in focus did not entail a rigorous sway away from the original goal of our studies. Having determined that a particular variable, say, word concreteness, determines translation performance, the next step is to point out the source of the effect. It turns out that a number of these effects may be explained by assuming different bilingual memory representations for different types of words (see, e.g., de Groot, 1993).

TRANSLATING ISOLATED WORDS

In our word-translation studies, we have primarily investigated translation between Dutch and English, in both directions, that is, with both of these languages serving both as SL and as TL. Another characteristic of these studies is that our own first-year students (in psychology, at the University of Amsterdam) were the participants. Their native language was always Dutch, and English was their strongest foreign language. Although their command of English is typically quite good, these participants do not qualify as perfectly balanced bilinguals. Finally, our word stimuli were always presented visually, and the participants produced the TL forms orally.

We have employed three different versions of the word-translation task: "normal" and "cued" translation production and "translation recognition." On each trial in the normal production task (e.g., de Groot et al., 1994), the participants are presented with a word and are asked to come up with the translation of that word as quickly as possible, but without sacrificing accuracy. The cued version of the task is the same as the normal version, except that in addition to the to-be-translated word the initial letter of the response word is presented on screen (de Groot, 1992a, 1992b; Sanchez-Casas, Davis, & Garcia-Albea, 1992). This initial letter serves as a retrieval cue. On each trial

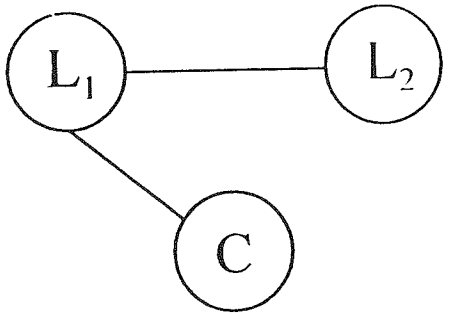
in translation recognition, a pair of words is presented, one word in one language and the other in another language. The participants are asked to decide whether or not the word pair consists of translation equivalents (de Groot, 1992a, 1992b; de Groot & Comijs, 1995).

Across all studies, we have manipulated 13 independent (predictor) variables: concreteness (or imageability, which is highly correlated with concreteness), definition accuracy, context availability, familiarity, frequency, and length (each of these six as determined for both the Dutch words and their English translations, which together amount to twelve variables), and cognate status (see de Groot et al., 1994, for a description of these variables). These variables cluster around four factors: a semantic factor, a familiarity factor, a length factor, and cognate status. The (word) stimuli in our studies were always nouns only, and they typically had a clear dominant translation in the TL. Response time, percentage errors, and, in translation production, percentage omissions, served as the dependent variables. The total percentages of variance in both response time and percentage omissions accounted for by the 13 variables in the two studies that included all variables (the production study of de Groot et al., 1994, and the recognition study of de Groot & Comijs, 1995) were very high, namely, about 60% in both translation directions. Each of the four factors mentioned above contributed to performance. The accounted variance in percentage errors was considerably smaller, about 30%. Another finding of interest was that some small directional differences occurred; the semantic variables (concreteness, definition accuracy, and context availability) affected translation slightly more in translating from the native (L_1) to the—weaker—foreign language (L_2) than vice versa.

BILINGUAL MEMORY REPRESENTATION

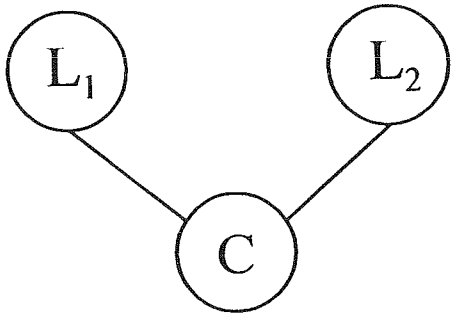
As mentioned above, many of the effects of these stimulus manipulations can be explained in terms of different bilingual memory representations for different types of words. Figures 2.1 through 2.6 depict six types of representation that have been proposed in the literature. They share the assumption that there are two layers of representational elements.

In one of them (the top layer in the figures), the (orthographic and phonological) forms of words are stored; in the second (the bottom layer), word meanings are stored. The layer of word forms contains two sets of elements (the lexical representations), one for each of the bilingual's two languages. The layer of word meanings contains either elements (the conceptual



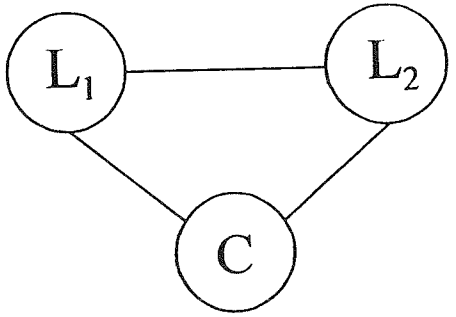
a

Figure 2.1. Bilingual lexical and conceptual memory: a.



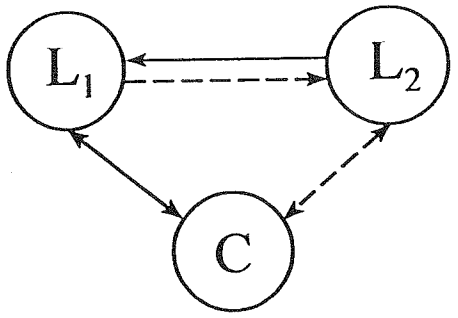
b

Figure 2.2. Bilingual lexical and conceptual memory: b.



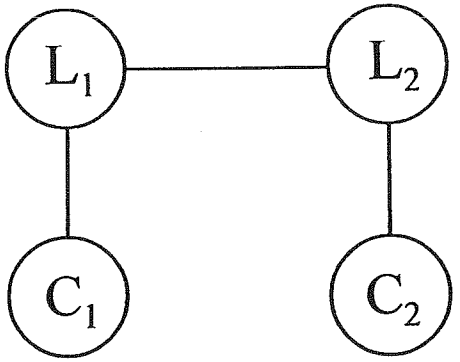
c

Figure 2.3. Bilingual lexical and conceptual memory: c.



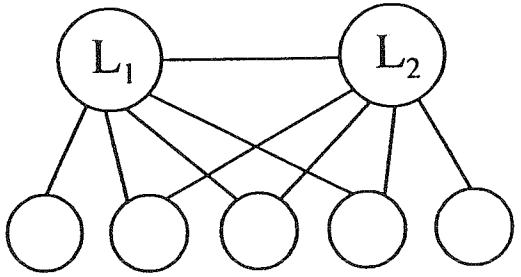
d

Figure 2.4. Bilingual lexical and conceptual memory: d.



e

Figure 2.5. Bilingual lexical and conceptual memory: e.



f

Figure 2.6. Bilingual lexical and conceptual memory: f.

representations) that are shared between the two languages (b), or elements that are language specific (e). There are (a) or are not (b) direct connections between the lexical representations of the two languages at the form level of representation, and there are (c) or are not (a) direct connections between L_2 lexical representations on the one hand and conceptual representations on the other hand. Furthermore, the meaning of a word is represented in a single unit (node) in conceptual memory (c), or spread out across a number of units, that each individually represents one aspect of the word's meaning (f). This latter type of conceptual representation is termed *distributed.* A final dimension along which the various types of representation can differ (not shown in the figures) is in terms of the strength of the connections between corresponding nodes in the different memory stores, for instance, between an L_1 lexical representation and the conceptual representation of this same word in conceptual memory. Of the types of representation in Figures 2.1–2.6, those depicted in a and b are presumably most widely known. They are usually referred to as "word-association" and "concept-mediation" representations, respectively (see, e.g., Chen & Leung, 1989; Kroll & Curley, 1988; Potter et al., 1984).

EFFECTS EXPLAINED

To illustrate how these memory structures may explain the above effects of various stimulus manipulations, let us look at the effects of word concreteness and word frequency: Concrete words are translated more quickly (and more accurately) than abstract words, and high-frequency words are translated more quickly (and more accurately) than low-frequency words. The concreteness effect could be explained in at least two ways (de Groot, 1992a, 1992b; see Paivio & Desrochers, 1980, for an alternative interpretation). According to one explanation, concrete words are relatively often represented in structures of the type depicted in c (with a conceptual representation shared between the two languages), whereas abstract words are more often represented in structures of the type shown in e (with language-specific conceptual representations). The former type enables two routes to the translation response (along the direct connection between the lexical representations and, indirectly, via conceptual memory), whereas the latter type only permits translation along one route (the direct connection between the lexical representations). If additional translation routes benefit performance, this difference between representational structures could account for the concreteness

effect. The second explanation of the concreteness effect assumes distributed conceptual representations (f). Concrete words share more of the individual elements in these representations between languages than abstract words do. As a consequence, there are more connections from an SL word, via these elements, to its translation in the TL in the case of concrete words. This has the effect that concrete TL words will be activated relatively strongly and, consequently, be more available for production (see de Groot, 1992b, for further details).

As for the frequency effect, this could be explained in terms of differences in the strength of the connections between memory nodes. By definition, high-frequency words are used more often than low-frequency words. This will be the case in both monolingual and bilingual communication settings. If language use involves accessing structures of the types shown in Figures 2.1–2.6 (which I will assume here), and if each additional use increases the strength of the memory connection(s) involved, the connections within the structures representing high-frequency words will be stronger than within those representing low-frequency words. Stronger connections may result in faster processing along the connections and/or in higher levels of activation of the memory nodes at the receiving end of the connections, resulting in higher availability of the units that are represented there.

Finally, the effects of translation direction described above (larger effects of semantic word variables in L_1 to L_2 translation than in L_2 to L_1 translation) may be explained in terms of a weaker version of the asymmetry model of bilingual memory (d) as proposed by Kroll and Stewart (1994). This model assumes memory structures similar to those in c, except that they contain two connections between the L_1 and L_2 lexical representations: a weak one from L_1 to L_2, and a strong one in the reverse direction. Kroll and Stewart argued that word translation from L_1 to L_2 is always conceptually mediated, that is, it proceeds from the L_1 lexical representation, via the conceptual representation shared by the L_1 word and its translation in L_2, to the L_2 lexical representation. In contrast, translation from L_2 to L_1 was thought always to proceed along the—strong—direct connection from the L_2 lexical representation to the L_1 lexical representation. Kroll and Stewart (1994) formulated this strong version of the asymmetry model on the basis of their finding that manipulating a semantic word variable only affected translation from L_1 to L_2. It had no effect whatsoever on translating from L_2 to L_1. Our data, which only show small directional asymmetries (semantic variables only play a slightly larger role in L_1 to L_2 translation than in L_2 to L_1 translation), only support a weak version of the model (which assumes that concept mediation occurs in both

directions, but somewhat more often from L_1 to L_2 than vice versa). In yet another study, the asymmetry seems to have disappeared completely (La Heij, Hooglander, Kerling, & van der Velden, in press). It remains to be investigated what caused the different patterns of results in these studies. In all three studies, the same population of participants was used (Dutch undergraduates) and the same language combination was tested (Dutch-English). So these two cannot have caused the differences. The use of different stimulus materials remains as a possible cause.

QUALITATIVE DATA

In the studies discussed so far in this section, only quantitative data were collected (response times, percentages errors, and omissions). Janet van Hell, a student in our laboratory, recently attempted to obtain qualitative as well as quantitative information on how participants in word-translation studies go about their task. The participants were asked to translate the stimulus words as quickly and as accurately as possible (again from Dutch into English and vice versa), and to report, subsequent to each response, how they thought they had retrieved the response word. The most salient result was that on the majority of trials (72% overall in L_1-to-L_2 translation and 66% overall in L_2-to-L_1 translation), they said they simply knew the response. As discussed by Ericsson and Simon (1984), only conscious processes can be verbalized. The absence of a more informative verbal report on the majority of trials thus suggests that the translation of many words involves an automatic, unconscious process. It should be added, however, that the frequency of the words used in van Hell's study was rather high. By definition, these high-frequency words occur often in language use, both monolingual and bilingual (see above), and as a consequence, their processing will have become relatively (as compared with low-frequency words) automatic. If words of lower frequency had been used, translation might have been automated less often. Under those circumstances, a smaller percentage of "I knew" responses might have been obtained and more diverse qualitative information on word translation might have been obtained.

LIMITATIONS

All in all, we believe that in our studies on word translation we have gathered a substantial amount of knowledge on the factors that play a role in that task. (Recall that about 60% of the variance in response time and in the omission

data was accounted for, both in translation production and in translation recognition.) But this conclusion needs to be qualified immediately: As set forth above, in most of our studies we have drawn our participants from the population of first-year psychology students. These bilinguals have a reasonably good command of their L_2 (English), but certainly it is worse than their command of their native language, Dutch. Also, our participants were not specifically trained in translation. Instead, their translation skill was concomitant with their bilingualism (Harris, 1977, 1980). The factors that affect word-translation performance in these participants do not necessarily all influence (and to the same extent) word translation by other individuals, say, professional translators.

Furthermore, although across our studies we have used words varying on many dimensions (see the 13 predictor variables above), in a number of respects the choice of materials has deliberately been restricted. As mentioned earlier, the stimuli were always nouns and they were selected to have a single or a clearly dominant translation in the TL. This dominant translation was always a single word. We have never presented words for translation that map onto more than one word in TL (diversification) or, conversely, combinations of words in SL that map onto a single word in TL (neutralization). We have presented words that contain more than one lexical morpheme in SL but that are monomorphemic in TL (for instance, the Dutch word *handschoen,* which is *glove* in English; translated literally into English, the form *hand-shoe* would emerge), or vice versa, but too few of them were included to look at systematic effects. Also, only occasionally have words occurred in our stimulus sets that contain two lexical morphemes in both SL and TL but for which the corresponding lexical morphemes in the translation equivalents would not be each other's translation when presented in isolation. For instance, the English *lifejacket* translates into *reddingsvest* in Dutch, but when presented in isolation, *life* would be translated into *leven* rather than *redding,* and *jacket* would probably be translated into *jasje,* not *vest.* Intuition suggests (and personal experience supports) that these three types of translation equivalents are particularly hard to translate, certainly harder than translation pairs consisting of one monomorphemic word in both SL and TL. Presented with *handschoen,* there appears to be a tendency to produce *hand-shoe* rather than *glove;* presented with *lifejacket,* the incorrect *levensjasje* seems to get in the way of *reddingsvest.* And, if presented with a single word in SL that maps onto more than one word in TL, the translator(s) in these studies may be completely stymied. Experiments need to be set up to substantiate these intuitions and to indicate how general the problems caused by these types of translation pairs are. (Do they occur in all translators, irrespective of their level of expertise in the task?) And, of course, the underlying cause of such translation difficulties in terms of a processing model and/or a representation model would need to be addressed.

These potential word-translation problems are not just interesting and informative in their own right. The reason I have cited them at length is that their conclusions may also be pertinent to the question raised earlier, whether translation proceeds vertically, horizontally, or both. If these types of translation pairs turn out to be especially problematic at all translator levels, they suggest the operation of horizontal translation. The reason is that in vertical translation the form is stripped off of the SL word and only its sense lasts. This sense is subsequently voiced in TL. It is hard to see how, with the SL form lost, it could possibly affect the retrieval of the TL word.

Two limits on the scope of our word-translation studies have been mentioned so far. They have only included one kind of subject and only one kind of material. A third limitation is that the language combination that we tested has nearly always been Dutch-English. Our findings may therefore not (all) hold for other language pairs. For instance, a cognate relation between translation equivalents, which our studies have shown to be a relevant factor, will only determine translation performance if such a relation actually exists between the languages in a language pair. With the strong influence of this variable gone, others may assume a stronger role. Finally, our studies were restricted in that SL words were always presented visually. However, there seems no ground to assume that the observed effects would not have materialized had auditory stimuli been presented. Only with larger stretches of language presented for translation will presentation modality be expected to start having an effect (due to, for example, differential demands on memory).

TRANSLATING WORDS IN CONTEXT

The restrictions of our studies discussed so far, especially those in terms of the selection of participants, materials, and language combination, suggest many possible extensions of this line of work. But it may be expedient to start looking first at whether, and to what extent, the findings so far hold if words are not presented in isolation but in context. The results need not hold under those circumstances, or the effects may be attenuated or boosted.

An effect that may respond to embedding words in context is the effect of word concreteness. This possibility is particularly strong, especially given the

monolingual work of Paula Schwanenflugel and her colleagues. They demonstrated that the concreteness effect (faster and more correct processing of concrete than abstract words, for instance, in lexical decision)—which is ubiquitous when concrete and abstract words are presented in isolation—decreases or disappears when these words are presented in context (e.g., Schwanenflugel & Shoben, 1983). They explained this finding in terms of the context-availability model of comprehension. This model states that comprehension processes are facilitated by adding contextual information to the materials to be comprehended. This contextual information may be generated by the comprehender from his or her knowledge store, or provided by some external source. The model furthermore assumes that it is generally more difficult for the comprehender to retrieve from his or her own knowledge store contextual information for abstract words than for concrete words. This differential difficulty in coming up with context for concrete and abstract words is thought to cause the common concreteness effect. It is attenuated or disappears in context, because under those circumstances abstract words are understood better. The model is also supported by a different but conceptually similar experimental approach: presenting concrete and abstract words in isolation, but either matched or not matched on context availability. In this type of study, the natural high correlation between concreteness and context availability is thus severed. It turns out that when abstract words are matched on context availability with concrete words, the common concreteness effect in lexical decision does not obtain. The two types of words are processed with the same facility (Schwanenflugel, Harnishfeger, & Stowe, 1988).

In our laboratory, Janet van Hell has run a number of studies to see whether concreteness effects in translation also respond to the manipulation of contextual information. Indeed, the familiar concreteness effect turned up when, with isolated presentation of words, the common confounding between concreteness and context availability existed. However, the effect disappeared when concrete and abstract words were matched on context availability. This pattern of results occurred in both translation directions (van Hell & de Groot, in preparation-a). In a second study, she presented concrete and abstract words for translation both in a sentence context and in isolation. When the translation words were presented in isolation, a large effect of concreteness occurred. But with one particular type of sentence context (one in which the translation word was highly predictive), the size of the concreteness effect decreased substantially (van Hell & de Groot, in preparation-b). Both of these studies thus suggest that context can modify the effect of concreteness on

word translation. The roles of other word characteristics in word translation may also respond to the manipulation of context. Yet we believe that disclosing many of the determinants of the translation of isolated words has been worthwhile, if only because during the translation of text, all bilinguals, also those with a high level of proficiency in both SL and TL, as well as experts in translation occasionally seem to relapse into word-to-word translation.

TRANSLATING SENTENCES

A further extension of this line of work could be to manipulate the above word characteristics in contexts larger than individual sentences. But a different way to proceed is to look at manipulations beyond the level of the word, for instance, at the sentence-grammatical level and with the sentence serving as stimulus unit. Candidate manipulations are the grammatical complexity of sentences; the relation between SL and TL in terms of how subject, object, and verb are typically ordered within the sentences (for instance, both SVO languages, or SL, which is an SVO language, and TL, an SOV language); and sentences containing grammatical ambiguities versus unambiguous sentences. From monolingual studies, we know that manipulations of sentence structure influence processing, but, as argued before, their effects may be modified in bilingual (here: translation) settings. A final point to note about these sentence-stimulus studies is that, unlike with the word-stimulus studies, a comparison between visual and auditory presentation may become pertinent. The reason is that with sentences as the unit to be translated, the role of memory—different for the two modalities—clearly becomes a factor.

Approach 2: Studying Text Translation by Manipulating Input Characteristics

The studies discussed in the previous section dealt with relatively small stimuli: words and sentences. In the two approaches to be discussed in this and the next section, the stimulus is always a complete text. The approach presented in this section is conceptually similar to that of the previous one in that in both of them the effects of experimentally manipulating particular characteristics of the input on output performance are studied. But the fact that larger stimuli are presented imposes the use of different experimental

procedures and dependent variables. The approach taken in the studies to be presented in the next section is fundamentally different: Translating complete text is compared with processing this same text in a task that shares many (ideally, all but one) components with the particular form of translating under study. In fact, a number of studies have combined the last two approaches (Gerver, 1974a; Treisman, 1965).

Two input characteristics feature prominently in the early experimental studies on simultaneous interpretation: input rate and the quality of the input (noisy or clear). These studies responded to the common experience of professional interpreters that these two features of the input have a great impact on performance. The primary dependent variables in these studies were various types of errors (omissions, additions, incorrect translations) and ear-voice span (EVS), that is, the interval between the moment a particular part of the speaker's speech hits the interpreter's ear and the moment the interpreter outputs the translation of that speech segment. The EVS has been measured in terms of time units (e.g., Barik, 1973; Oléron & Nanpon, 1964; Treisman, 1965) and in terms of words or other semantic units (e.g., Adamowicz, 1989; Gerver, 1969; Goldman-Eisler, 1972; Treisman, 1965). The EVS responds to various characteristics of the materials to be translated (e.g., information density), the interpreters (e.g., their level of expertise), and the languages of input and output (see Goldman-Eisler, 1972, for an effect of the latter). It has been argued (Kade & Cartellieri, 1971) that the optimal moment for the interpreter to start interpreting an input unit is immediately after all syntactic and semantic ambiguities in this unit have been resolved. If the interpreter misses this moment, there is the danger that a part of the input will be forgotten. Starting to interpret before all ambiguities have been resolved involves the risk of misinterpretation, from which it may be hard to recover. In short, ideally the EVS should be as short as the prevailing circumstances permit.

SIGNAL-TO-NOISE RATIO

Gerver (1974a) showed that manipulating the quality of the input signal, by either presenting it clearly or adding noise to it, affects the number of errors made, with, of course, more errors occurring under noisy presentation conditions. Participants in this study were professional interpreters who translated passages presented at a rate of 120 words per minute from French to English (the language combination and translation direction they were used

to in their professional practice). That noise added to the signal affects performance makes perfect sense, of course; to recognize the degraded words in the input, the interpreter will have to allocate a relatively large amount of his or her limited attentional resources to figure out, on the basis of contextual information, what words the mutilated sounds convey. In contrast, with undegraded input, word recognition will generally proceed automatically. Consequently, all the available attentional capacity can be divided over the remaining processing components, more precisely, over those that are not—and may never become—automated.

Whereas in Gerver's (1974) study, auditory noise affected the number of errors made in simultaneous interpretation, further analyses of the same experimental data—now on the second of the above two dependent variables, the EVS (measured in terms of number of words)—indicated that measure is not affected by the signal-to-noise ratio (see Gerver, 1976). It averaged about 5.7 words across the various noise levels. Gerver (1976, p. 175) concluded that under noisy circumstances, simultaneous interpreters sacrifice accuracy so as to maintain a constant EVS.

INPUT RATE

In contrast to manipulating background noise, varying the input rate appears to affect both the numbers of errors and the EVS in simultaneous interpretation: A suboptimal rate leads to more errors and longer EVSs than an optimal rate. The optimal input rate is around 100 to 120 words per minute, and the upper limit for acceptable performance is at a rate between 150 and 200 words per minute (see Gerver, 1976, pp. 172-174, and Seleskovitch, 1976a, for reviews). With a high input rate, the time span over which the individual words are presented in the input is, of course, relatively short. The identification of words presented within a very brief time span may be expected to be hampered as compared with that of words presented over a longer span. Manipulating input rate might therefore be considered to be equivalent to the manipulation of background noise; both have the effect of degrading the quality of the auditory input. Indeed, in the research field of visual word recognition, degradation of the input is typically effectuated either by superimposing a visual-noise stimulus on the word display or by presenting the word very briefly by means of a tachistoscope. However, the fact that manipulating background noise on the one hand and input rate on the other results in different patterns of effects in simultaneous interpretation (an effect on the

EVS only occurring with the manipulation of input rate) suggests that they affect processing differently. The reason presumably is that input rate affects a second feature of the input in addition to the auditory quality of the individual words, namely, its information density: The higher the rate, the more information per unit of time. The information density in the input may become reflected in the size of the EVS. The two correlate positively. There is some evidence that when only information density but not input rate is varied (and the latter is comfortable to the interpreter), again only the number of errors, not the EVS, is affected (Treisman, 1965). Here again, accuracy seems to be sacrificed (this time by bilinguals who are not professional interpreters) to maintain a constant EVS. It thus appears that when the difficulty of the task is gradually increased, accuracy is the first to be affected, but then, subsequently, both accuracy and the EVS are affected.

TEXT STRUCTURE

A third characteristic of the input that has been varied is the type of text to be translated, specifically, the degree to which the text is structured (Adamowicz, 1989; Barik, 1973). Adamowicz departed from the observation that simultaneous interpreters anticipate what the speaker is going to say next (see also Schweda-Nicholson, 1987). This phenomenon manifests itself in the fact that interpreters occasionally produce elements in their rendition of the speech that they have not received as input yet. These anticipations are based on various sources of knowledge, both intralinguistic and extralinguistic. Examples of relevant extralinguistic knowledge (Adamowicz, 1989; Schweda-Nicholson, 1987) are the information an interpreter has about the following: the type of meeting, the subject matter of the meeting, the roles assumed by the various speakers during the meeting, the makeup of the audience, general world knowledge, and even the location of the conference. Various types of intralinguistic knowledge that might be exploited while anticipating upcoming input are the meaning and syntax of the preceding context and the overall structure of the text.

Note that the use of extra- and intralinguistic knowledge to anticipate incoming language is not unique to interpreters. It is in fact part and parcel of monolingual language comprehension. These knowledge structures may be used to actually predict the identity of (some of) the input elements before they are encountered. But more important, they constitute a prerequisite for comprehension. Text typically makes explicit just a small proportion of the

message it intends to convey. What is not provided explicitly needs to be inferred from memory structures accessed through individual words or phrases in the input. If there is no element in the input that may provide access to the relevant knowledge structure in memory, or if the relevant memory structure is lacking, understanding fails (see Bransford, 1979, for an extensive discussion).

Adamowicz (1989) manipulated text structure by presenting students trained in interpreting (10 in all, with Polish as the native language and English as the second) with two types of text: prepared (an opening address of a conference) and spontaneous (text delivered at a press conference). Prepared texts typically have a highly standardized textual schema. The various components of this schema may be anticipated by interpreters on the basis of text already processed. In contrast, spontaneous texts do not unfold along the predictable lines of a ready-made schema. Therefore, they do not support anticipation. Adamowicz chose EVS as the critical dependent variable. She argued that anticipations on the basis of text-schematic knowledge should result in a relatively short EVS (in her terminology, a short lag between speaker and interpreter). The lag can be short because the interpreter has made a hypothesis as to the proposition to be expressed by the speaker (Adamowicz, 1989, p. 156). If text structure is exploited by the interpreter, the condition with prepared text should thus show a shorter EVS than the one with spontaneous text. This prediction was substantiated by the data. Although the prevailing EVS was the size of a noun or verb phrase in the case of the (prepared and hence structured) opening address, it was typically the size of a complete clause in the case of the (spontaneous, that is, unprepared) press conference text.

Barik (1973) also manipulated text structure, presenting his participants with four types of materials: spontaneous, unrehearsed; semiprepared; prepared oral (a live recording of a formal speech); and prepared written (a recording of a written article of an informational nature). He (1973, p. 242) hypothesized that this manipulation might affect the interpretation process, and hence the EVS (which he measured in seconds), for at least two reasons, one benefiting structured discourse and the second benefiting spontaneous speech. Spontaneous speech is less grammatical, contains more colloquialisms, and is delivered less evenly by the speaker. These characteristics may hamper the interpretation process. On the other hand, spontaneous speech is typically more redundant than more formal texts. The higher information density in the latter may make them more difficult to interpret (compare this

with the effect of input rate, discussed above). Barik did not explicitly consider the role of text structure in anticipating elements of the speaker's speech, as Adamowicz (1989) did. His participants were six French-English bilinguals, all differing from one another along two dimensions. Out of the six, two were professional conference interpreters, two were students of interpreting, and two lacked any experience in interpreting; within each set of two, one was French dominant and the other English dominant. Unlike Adamowicz (1989), Barik did not obtain clear effects from the text-type manipulation. Neither the EVS nor any of the remaining dependent variables that he used (see Barik, 1973) responded appreciably to this manipulation. This null effect may be statistical, due to the rather small and heterogeneous set of participants. Of course, differences in the type of texts used in the two studies may also have caused the different results. But whatever the cause, it should be clear that in studying the role of text structure in interpreting, a number of variables need to be controlled for (e.g., information density of the input, interpretation skill of the participants).

SYNTACTIC AMBIGUITY

So far, the roles of three specific characteristics of the input have been discussed: signal-to-noise ratio, input rate, and text structure. A fourth characteristic that has been examined is syntactic ambiguity. McDonald and Carpenter (1981) had two amateur and two expert translators orally translate written English text into German, recording their eye movements. The investigators hypothesized that processing during translation might build on normal comprehension processes. Earlier work on reading (Just & Carpenter, 1980) had shown that readers assign meaning to a word as soon as possible (the immediacy strategy), and that they parse (chunk) words into constituent phrases or clauses. If indeed translation builds on normal comprehension, as in reading, the translation process should also be characterized by chunking and the use of the immediacy strategy.

The critical manipulation in McDonald and Carpenter's study was the inclusion of ambiguous phrases like the following: *Mike hit the nail right on the head.* When presented in isolation, these phrases may be assigned either a literal or an idiomatic interpretation. The phrases were included in textual contexts that supported either their literal or their idiomatic interpretation. The disambiguating information always followed the ambiguity. The different interpretations of these ambiguous phrases require different parsings. The

idiomatic interpretation demands that the entire phrase be processed as a single chunk, whereas the literal interpretation enables the chunking of the phrase in smaller syntactic units (e.g., *Mike hit the nail and he hit it right on the head*). The relevant questions were whether in translation, as in normal reading, the input is chunked in units larger than individual words, and whether the size of the chunks responds to the appropriate interpretation of the ambiguous phrase. The eye-fixation data suggested an affirmative answer to both questions. The translation units were typically phrasal units rather than words, mimicking the chunking that occurs in normal reading. Support for the use of the immediacy strategy was also obtained. When the preceding context strongly biased the literal interpretation of the subsequent ambiguous phrase, the phrase used in its idiomatic sense typically would be parsed incorrectly (that is, as if it were used in its literal sense). Upon encountering the disambiguating information in the next clause, the translator would have to backtrack and correctly process the ambiguous phrase (that is, as a single unit). In conclusion, as in normal reading, translation appears to be characterized by input chunking and the use of the immediacy strategy. These findings support the view expressed earlier that the literature on monolingual comprehension and production processes already tells us a great deal about the translation process.

The overall model of the translation process that McDonald and Carpenter (1981) derive from their data divides the complete process into three phases (passes): (a) a relatively fast initial phase in which input chunking and comprehension take place and that resembles normal monolingual reading, (b) a time-consuming translation phase, and (c) an error recovery phase. This three-step model is supported by Gerloff's (1987) study. Gerloff had her participants translate written text orally, from French into English. But in this study, the participants (six in all, all but one being native speakers of English studying French) were asked to say aloud everything they were doing and thinking while translating. The think-aloud protocols were recorded and used as data. Like eye movements, verbal protocols provide a window on on-line mental processing during translation. A restriction of the technique is that the protocol will contain only a reflection of the processing operations the translator is conscious of. Automatic processing components leave no trace in the protocol (Ericsson & Simon, 1984). Because in amateur translators fewer processing components will have become automatic than in expert translators, the technique will reveal more about the translation processes in amateurs (Krings, 1987). Despite the limitation that only conscious processes leave

a trace in the protocol, the technique has been proven to be a valuable tool in the study of translation, especially when the focus is on the translation process rather than the finished product. Gerloff's (1987) verbal-protocol data showed signs of the same three stages in the translation process as were suggested by McDonald and Carpenter (1981). McDonald and Carpenter also suggested that during the first stage, SL comprehension, the translator preferably chunks the input in phrase- or clause-sized units, as he or she would do in monolingual reading. Support for similar chunking operations, but in the context of the simultaneous interpretation of auditorily presented text by professional interpreters, was obtained by Goldman-Eisler (1972). Finally, Gerloff observed that the participants' processing primarily occurred in TL, English. This finding is analogous to McDonald and Carpenter's (1981) observation that Phase 2 in their model, translation, is relatively longer than the other stages.

WORD-TYPE MANIPULATIONS

The word-type manipulations discussed before may constitute a further source of variability in performance when a complete text is to be translated. It was stated there that the word-type effects obtained in word-translation studies—for instance, those of concreteness, frequency, and cognate status—may not all hold, or not all to the same extent, when the critical words are embedded in context. I do not know of studies that have systematically tried to establish the role of these variables in text translation, but some anecdotal support exists for the view that they may also affect the translation of complete texts. Barik (1975) noted that some categories of words are particularly problematic for interpreters, namely, function words and abstract words. According to Barik, function words may cause problems because they typically have multiple meanings. To assign such a word the appropriate meaning, a relatively large part of subsequent context needs to be processed first. An interpreter's strategy to keep the EVS as short as possible (for fear of forgetting part of the input) may lead to a faulty first translation pass, which would require a costly correction. As for the detrimental effect of abstract words, Barik (1975, p. 293) suggested it was due to the different connotative implications of these words across languages. In other words, they may not have a clear translation equivalent in the TL (see also de Groot, 1992b; Taylor, 1976). But, ultimately, the difficulty with abstract words may be caused by characteristics of their representations in bilingual memory. As pointed out earlier,

translation pairs for abstract words are represented in memory structures that are less tight than those of concrete words: There are fewer memory connections between the word-form representations of abstract translation pairs than between those of concrete pairs. A likely consequence of this is that an abstract SL word will activate its translation in TL to a lesser extent than a concrete SL word would. This, in turn, will render an abstract TL word less available for processing and, as compared with the translation of concrete words, translating of abstract words will be hampered. It is plausible that manipulating other properties of words, such as word frequency, will exert an effect on text translation as well, and for similar reasons (compare this with the earlier discussion of frequency effects in word translation).

Approach 3: Comparing Text Translation With Similar Complex Tasks

A third approach that may be informative is to compare performance in text translation with performance in tasks that contain many of the same components (subprocesses) of the translation task, and in which the participants process the same text as in the translation task. If the translation task and the comparison task share all components but one, a difference between the tasks in terms of participants' performance may be attributed to the component absent in one task and present in the other. By comparing the translation task systematically with each of a set of comparison tasks, each differing from the translation task by only one component, the specific demands of each individual component of the translation task will be learned and the complete task will be mapped out. This method of studying a particular task, here text translation, is reminiscent of the subtraction method in cognitive psychology (see, e.g., Eysenck & Keane, 1990, p. 34).

The argument above sketches the ideal application of the subtraction method to the study of translation. Unfortunately, to apply it in a systematic way, all of the components of the translation task and its comparison task should be known beforehand. It must also be the case that the corresponding components in the two tasks involve exactly the same processing. Neither of these two prerequisites will be easily met, if ever, in a specific study. Furthermore, the method presupposes that a complete collection of appropriate comparison tasks can be invented in the first place, or is already available. Any

attempt to devise such a set will not be a trivial exercise. Despite these restrictions, the method is bound to provide us with at least some relevant insights in the translation process, as is suggested by the results of the small number of studies that have applied the method: comparisons involving simultaneous interpretation on the one hand and shadowing and paraphrasing on the other.

SHADOWING, PARAPHRASING, AND SIMULTANEOUS INTERPRETATION

In a shadowing task, the participants receive speech as input and are asked to repeat this input exactly as it was received (and, consequently, in the same language). Although theoretically shadowing could be done without syntactically and semantically analyzing the input, by merely imitating its phonetic form, various studies have shown (e.g., Marslen-Wilson, 1973) that shadowers analyze the input signal at the higher syntactical and semantic levels, and that they do so on-line rather than afterward, on the basis of the stored memory trace of the input's phonetic form. Furthermore, the data suggest that this is true for close shadowers (with delays between input and corresponding output, or EVS, of only about 300 milliseconds) as well as distant shadowers (with an EVS of between 500 and 800 milliseconds). This established, it is clear that shadowing shares many components with simultaneous interpretation. Both the shadower and the simultaneous interpreter are simultaneously involved in comprehending and producing speech. A critical difference is that only in interpreting is a conversion of the input into another language required.

Paraphrasing involves the conversion of a message expressed in a given language into an equivalent message in the same language but worded differently. When both input and output concern speech rather than writing, and the person producing the paraphrase does so on-line (simultaneously), the demands of the paraphrasing task appear very similar to those of simultaneous interpretation. Not only do the two tasks share the requirement of simultaneous comprehension and production of speech, but, unlike shadowing, they also both require a translation act, an act of recoding (see Neubert, this volume, on rephrasing) the same content in a different form. Indeed, translation (here: simultaneous interpretation) and paraphrasing are occasionally referred to as "interlanguage paraphrasing" and "intralanguage translation," respectively (Malakoff & Hakuta, 1991). In one way, translation may

be expected to be more difficult than paraphrasing. Only the former involves the simultaneous engagement of two language systems. But in another respect, paraphrasing may be more demanding. Malakoff and Hakuta (1991) suggest that translation requires only a smaller vocabulary in each of the two languages, whereas paraphrasing calls for a larger vocabulary in the language concerned.

In sum, in all three tasks—simultaneous interpretation, shadowing, and paraphrasing (in the form specified above)—the person performing the task is simultaneously involved in comprehension of someone else's speech and production of the equivalent message in his or her own speech. In simultaneous interpretation, the languages of comprehension and production differ, whereas in shadowing and paraphrasing, they are the same (input and output may be both in L_1 or both in L_2). Finally, whereas simultaneous interpretation and paraphrasing require a translation (recoding) act, shadowing does not.

THREE STUDIES

Both Gerver (1974a) and Treisman (1965) compared performance on simultaneous interpretation and shadowing by testing the same individuals on both tasks. The participants in Gerver's study were professional interpreters, whereas those in Treisman's study were ordinary bilinguals, both balanced and unbalanced. In both studies, the tested language combination was English-French. Treisman obtained larger percentages of errors and a larger EVS in the interpretation task than in the shadowing task. A further finding of interest was that, as assessed by numbers of errors, information density affected both interpretation and shadowing (with increasing information density resulting in larger numbers of errors), although interpretation was more affected by information density than shadowing. There was no effect of information density on EVS in either task. Finally, the shadowing performance of unbalanced bilinguals, again in terms of numbers of errors, was better in their stronger than in their weaker language. The balanced bilinguals shadowed equally well in their two languages. In all cases of shadowing (both in the stronger language and in the weaker language), there were fewer errors than in interpretation. This latter finding suggests that it is not the relative unfamiliarity of one of the two languages involved that is responsible for deterioration in interpreting performance. Instead, the deterioration in performance is likely to be due to the fact that interpretation involves, in the words of Treisman (1965), a more complex transformation between input and output

than does shadowing. As pointed out above, only the former task requires a translation act.

Gerver (1974a) looked at the effect of task, again simultaneous interpretation versus shadowing, on omissions and errors. In addition to task, he manipulated the signal-to-noise ratio. As in Treisman's study, more errors occurred in interpretation than in shadowing. Furthermore, more omissions occurred in interpretation. Both of these variables were also significantly affected by the signal-to-noise ratio, with, of course, more errors and omissions the higher the noise level. On errors, but not on omissions, the two variables interacted in that the highest level of noise had a greater effect on interpreting than on shadowing. This latter finding is reminiscent of Treisman's observation that increasing the information density of the text had a particularly dramatic effect on interpretation.

Green, Schweda-Nicholson, Vaid, White, and Steiner (1990) included all three of the tasks under discussion. Their theoretical focus was on hemispheric lateralization in professional simultaneous interpreters (see also Fabbro, Gran, & Gran, 1991), particularly as compared with the lateralization in bilingual controls (lacking any professional experience in interpretation) and monolinguals. The interpreters and bilingual controls performed the shadowing and interpretation tasks; the monolinguals, who evidently cannot be asked to interpret between two languages, performed the shadowing and paraphrasing tasks. The dependent variable in this study was the subjects' performance on a second task, finger-tapping, to be performed simultaneously with the interpretation, shadowing, or paraphrasing task. Tapping rate was assumed to be interfered with by the concurrent task. Such interference would show from a comparison with a control condition, in which only the tapping task had to be performed. One of the relevant questions was whether the amount of interference in finger-tapping would respond to changing the concurrent task, and, if so, in what way. Such an effect would suggest differences in the demands posed by the concurrent tasks. The larger the interference, the more demanding the concurrent task. (The remaining questions were specifically concerned with lateralization patterns and how they respond to task manipulations and characteristics of the participants; these will not be discussed here.)

The data for the two groups of bilinguals showed more interference with the interpretation than with the shadowing, supporting the view that the former task is more demanding. This finding converges with those of Gerver (1974a) and Treisman (1965) reported above, where instead of finger-tapping, EVS and errors were used as dependent variables. Furthermore, the monolinguals' data showed more interference in the paraphrasing task than with shadowing, suggesting that paraphrasing is the more demanding of these two concurrent tasks. But here the difference in interference between the two tasks was only marginally significant. The combined data suggest that shadowing is easier than paraphrasing, which in turn is easier than simultaneous interpretation. In other words, it appears that both the conversion process (required in interpretation and paraphrasing but not in shadowing) and language switching (required in interpretation but not in paraphrasing and shadowing) consume processing resources. But before this conclusion can be firmly drawn, performance of the same (bilingual) individuals in all three tasks should be compared. As pointed out above, Green et al. (1990) had each individual participant perform only two of the three tasks.

Comparing Versions of the Translation Task

The above studies all compare an interlanguage translation task (in fact, simultaneous interpretation in all cases) with one or more tasks that do not involve interlanguage translation. A different type of study that would exemplify the present approach would directly compare the various forms of interlanguage translation and interpretation, thereby revealing the roles of the characteristics on which they differ from each other. For instance, a direct comparison between simultaneous and consecutive interpretation may disclose the role of simultaneity of listening and speaking in the former, and of memory in the latter. The role of memory in consecutive interpretation can also be studied in a comparison between that task and semiconsecutive interpretation. And the roles of working under extreme time pressure (absent in normal text-to-text translation but present in simultaneous interpretation) and of modality of input and output (speech or writing, or a mixture of the two) could be disentangled by more systematically manipulating speed instructions and modality. It is plausible that differences in time pressure between tasks play a more prominent role in differential performance in these tasks than do the modality differences with which time pressure is often confounded. This would, for instance, be suggested if simultaneous translation as implemented by McDonald and Carpenter (1981), such as written input combined with oral output, to be produced as rapidly as possible, were to show behavior more similar to simultaneous interpretation than to text-

to-text translation. Even though studies of this type promise to further our insights into processing in the various translation tasks, only a few seem to have been performed so far (see Gerver, 1972, in Gerver, 1976, pp. 176-178).

Conclusion

I started this chapter with the statement that the cognitive study of translation has received relatively little attention so far—compared with the interest this research domain intrinsically holds for cognitive psychologists. Nevertheless, as I hope to have shown in this (selective) review, the scattered studies have already revealed many of the relevant variables: the signal-to-noise ratio and input rate in simultaneous interpretation as well as structuredness, syntactic ambiguity, and word characteristics of the input. They also have suggested that the language switch and the conversion (rephrasing) process that are both required in translation contribute separately to the complexity of the full task. Finally, they have pointed at a number of the sources of the effects of the variables that have been identified.

It remains to be seen to what extent these findings can be generalized across individuals and across language combinations. The question of individual differences in translation (that is, between professional and natural translators, and between individuals with lower and higher levels of L_2 knowledge) has been touched upon only briefly in this text. Yet, as is obvious from studies that focus on individual differences more explicitly (e.g., Gerloff, 1986, 1987), translation strategies/processes can differ substantially between individuals. One of the crucial differences between translators may turn out to be the relative amounts of vertical and horizontal translation processing they exhibit. More insight into the relative amounts of vertical and horizontal translation is also pertinent to the question of to what extent the present findings generalize across language combinations. The more translation is vertical (with the linguistic forms of the SL text lost during the translation process), the more of the above findings should be independent of language combination and intrinsic to the tasks themselves. If, however, the role of horizontal processing remains strong in all types of translation, by beginners as well as experts, variables that have demonstrated an influence for one particular combination of SL and TL may turn out to be immaterial with a different language pair (Gile, 1991, pp. 165-166). In that case, we still have a major task ahead of us.

3

Can Translators Learn Two Representational Perspectives?

KLAUS GOMMLICH

In an empirical analysis of approximately 2,000 editor's comments contained in a limited corpus of technical translations done by professional translators, some interesting data have presented themselves: 40% of all the editorial comments referred to typographical errors, mainly an indicator of stress or sloppiness on the translator's side; 26% of the comments related to inappropriate use of nonterminological lexical items in the target language (TL); 13% reflected deviations in terminology; and the rest (21%) were distributed over 11 lexico-grammatical categories such as word order, sentence cohesion/sentence connectors, unjustified deletions, modifying and qualifying structures, and so on. All translators translated into their first language, and all translators translated only those texts whose field of specialization was familiar to them. The relatively low percentage of comments concerning terminology is an indication that the translators knew their field of specialization rather well. What is puzzling is the fact that nearly half of the editorial comments (47%) concerned so-called general linguistic aspects of the texts. This seems surprising, considering that all of the translators were well trained and had professional experience in their respective fields.

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