COMPREHENSION PROCESSES IN SIMULTANEOUS INTERPRETING[1]

María Teresa Bajo, Francisca Padilla & Presentación Padilla
Departamento de Psicología Experimental
Departamento de Traducción e Interpretación
Universidad de Granada, Spain

Zusammenfassung
In zwei Versuchsreihen haben qualifizierte Dolmetscher, Dolmetschstudenten, zweisprachige Versuchspersonen und Fachkräfte aus anderen Berufszweigen Aufgaben gelöst im Zusammenhang mit dem Arbeitsgedächtnis, dem Textverständnis und dem Zugang zur Semantik und dem Lexikon. In der ersten Serie haben wir versucht, das Textverständnis unserer Versuchspersonen zu definieren, sowie auch andere Aspekte dieser Kompetenz (Aktivierung des Lexikons und der Semantik). In der zweiten Versuchsreihe haben wir versucht die Fähigkeit und Effizienz des Arbeitsgedächtnisses zu überprüfen. Die Ergebnisse erweisen eine relative Überlegenheit der Dolmetscher im Bereich der linguistischen Fähigkeiten und in der Benutzung des Arbeitsgedächtnisses und sind ein Hinweis dafür, dass diese besondere Strategien benutzen zur Erweiterung ihrer Fähigkeiten und Effizienz und damit ihr Verständnis verbessern.

Résumé
Au cours de deux séries d'expérience, des interprètes professionnels, des étudiants en interprétation, des sujets bilingues et des praticiens provenant d'autres domaines du savoir ont réalisé des tâches incluant la mémoire opérationnelle, la compréhension et l'accessibilité lexicale et sémantique. Lors de la première série, nous avons cherché à établir la capacité de compréhension de nos sujets, mais aussi à cerner certains aspects relatifs à cette activité (activation lexicale et sémantique). La deuxième série de tests visait à établir la capacité et l'efficacité de la mémoire opérationnelle des interprètes. Les résultats ont montré la supériorité des interprètes quant aux compétences linguistiques et l'usage de leur mémoire opérationnelle, car il a été prouvé que ceux-ci acquièrent des stratégies spécifiques dans le but d'améliorer leurs capacités et leur efficacité, renforçant ainsi leurs processus de compréhension.

Resumen

En dos series experimentales, intérpretes profesionales, estudiantes de interpretación, bilingües y profesionales de otros campos del saber realizaron tareas relacionadas con la memoria de trabajo, comprensión, acceso léxico y semántico. En la primera, intentamos definir la habilidad de comprensión de nuestros sujetos, así como aspectos diferentes relacionados con esta habilidad (activación léxica y semántica). En la segunda serie, intentamos definir la capacidad y eficacia de la memoria de trabajo de los intérpretes. Los resultados mostraron la superioridad de los intérpretes en destrezas lingüísticas y en el uso de su memoria de trabajo, al indicar que desarrollan estrategias peculiares para ampliar su capacidad y eficacia, y así potenciar sus procesos de comprensión.

1. Introduction

It is only recently that cognitive psychologists have shown interest in the processes involved in translation and interpretation (Danks, Shreve, Fontan & McBeath 1997). In many cases this interest arises from the special difficulty that these tasks impose upon the processes of comprehension and speech production. For example, in simultaneous interpreting, these processes have to be performed concurrently, in different linguistic codes and under strong temporal pressure.

The interpreter must simultaneously concentrate on and understand a unit of meaning or chunk of discourse in a given language (L1) while translating and producing a previous unit of meaning or chunk of that discourse in a second language (L2). In order to implement this the interpreter must be able to maintain the new unit in his/her working memory, access the meaning of the words and phrases involved, connect the information received to previous information, and translate this unit into a new linguistic code while producing the translated version of a previous unit.

Obviously, if the task is to be adequately accomplished, all these mental operations must be performed efficiently. The theories proposed in interpreting studies (Gile 1995) emphasize the role of working memory in producing quality interpretation. The efficient use of working memory is especially significant for the comprehension processes (Gile 1995). In fact, in interpreting it is estimated that at least 80% of the effort or cognitive resources is devoted to listening and understanding the discourse and only 20% to speech production (Padilla 1995). The research presented here focuses on the processes of comprehension in simultaneous interpreting.

The methodological approach used in most of the experiments in this paper is that of cognitive-correlates introduced by Hunt, Frost and Lunnenborg (1973) in their studies on human cognitive abilities. This methodological approach starts with the selection of groups of subjects who differ in the cognitive process or skill that we are interested in. Subjects in these groups are

then compared in their performance in a series of simple tasks which are assumed to be involved in this skill.

When applied to translation or interpreting, the method consists of selecting subjects with different levels of skill in both tasks (practitioners, trainee interpreters/translators, bilingual subjects etc.) and then comparing their performance in tasks involving processes such as memory or comprehension that are assumed to play a role in the skill. The superiority of the highly-skilled subjects in one of these simpler tasks would suggest that its underlying process is also present in the more complex translating/interpreting task.

2. Hypothesis

The first question that we explored was whether the comprehension processes involved in interpreting are different in nature from those involved in normal reading or listening and if so, how. According to psycholinguistic theories of discourse comprehension (Kintsch 1988; Gernsbacher 1990) two groups of processes play an essential role in comprehension, especially when it takes place in conditions of simultaneity (Gile 1997). First, linguistic processes such as lexical/semantic access, propositional analysis, syntactic processing etc. need to be performed efficiently to construct a mental representation of the discourse. Second, working memory capacity and resources need to be distributed among the different processes involved. In our experiments we have focused our attention on these linguistic and memory processes, and we have attempted to determine whether they are performed differently in interpreting.

Dillinger (1994) has recently suggested that interpreters do not carry out comprehension processes in ways that differ qualitatively from the ways in which other people carry them out. The ability to interpret, that is, to simultaneously understand, translate and produce discourse, is only due to the greater linguistic skills that these people possess because of their degree of bilingualism. That is, knowledge and use of two or more languages enhance the linguistic skills of the interpreters and these enhanced abilities make it possible for them to simultaneously understand and produce language. Alternatively, other proposals (Daro & Fabro 1994; Padilla, Bajo, Cañas & Padilla 1995) emphasise the role of working memory and linguistic training as determinants of the interpreting skill. This debate has important pedagogical implications, because if the first hypothesis is proved, much of the training given to potential interpreters in cognitive skills would be irrelevant, and it should be oriented only to increase knowledge of their second or third language. Therefore, an important question in our experiments was to determine whether the interpreters' training and experience had an effect over and above the possible effect of knowledge and use of two languages.

In our first experiments we compared the performance of professional interpreters, bilingual subjects, interpreting students and professionals (from other fields) in cognitive tasks emphasising linguistic abilities (reading time and accuracy, lexical access, semantic processing etc.). We expected that the interpreters would perform better than the groups of students and professionals from other fields. Our hypothesis was that this superiority would be due to their training and practice of the linguistic skills involved in comprehension and not only to their biligualism. The comparison of interpreters and bilinguals would provide some insight into the nature of this superiority. If, as Dillinger (1994) suggests, knowledge of two languages is the essential factor in translation/interpretation, interpreters and bilinguals should show equivalent performances. The comparison of bilinguals and interpreters involves evaluation of the performance of two groups with superior linguistic skills due to their knowledge of two languages. Hence, if there are no significant differences in their performance, and they are both superior to the students and other professionals, we would have an indication that the quality of interpreting depends much more on these skills than on factors such as memory or attention. On the other hand, if the interpreters are superior to the bilingual subjects we would assume that the linguistic skills acquired through second language learning are not the essential determiners of good performance in interpreting.

3. Subjects

The interpreter group was composed of 10 practitioners, trained at the School of Translators and Interpreters of the University of Granada (former degree). Half of them had just passed their final interpretation exam with excellent results; the other half had been working as interpreters for about 5 years.

The bilingual group was composed of 8 bilingual (English, Spanish, German or Arab) subjects; 6 of them had been living in the country of their second language for an average of 13 years, two of them regularly spoke one of the languages at home and the other at school. None of them were translators or interpreters, but they were students at the University of Granada.

The student group was composed of 10 students from the second year of the interpreting program. They had not yet had any training in simultaneous interpreting when they performed the experimental tasks (at the beginning of the academic year).

Finally, a group of 10 professionals from other fields made up the control group. The persons selected for this group had finished their undergraduate studies in fields such as Linguistics, Arts, Philology and Law. All of them had an excellent academic record.

4. Comprehension task: method and results

Every subject was asked to perform a moving window comprehension task adapted to Spanish by de Vega (1987). This moving window method allows the progressive presentation of the material by the subject him/herself. At the beginning of the trial, the subjects viewed a computer screen filled with patterns of spaces in the place where text would usually be found; dashes corresponded to letters, and spaces corresponded to spaces between words. Successive words were revealed by pressing a key; except for the current word the screen remained masked with dashes. With each subsequent key press, the previous word was masked and a new word appeared. Words appeared to march across the screen at a pace set by the readers' key presses. The interval between key presses defined reading times. In this way this method allows the measurement of reading speed. In addition, after presentation of the text, subjects had to answer a set of questions that appeared on the screen. The purpose of these was to evaluate understanding and recall of different aspects of the text. The moving window task thus permits an evaluation of the speed and accuracy of comprehension processes.

Figure 1 shows the proportion of correct recall for each of the groups. As can be seen, the bilinguals tend to be slightly worse than the rest of the groups, but this tendency did not reach significance ($p > 0.05$). Thus all the subjects showed an approximately similar understanding and recall of the stories.

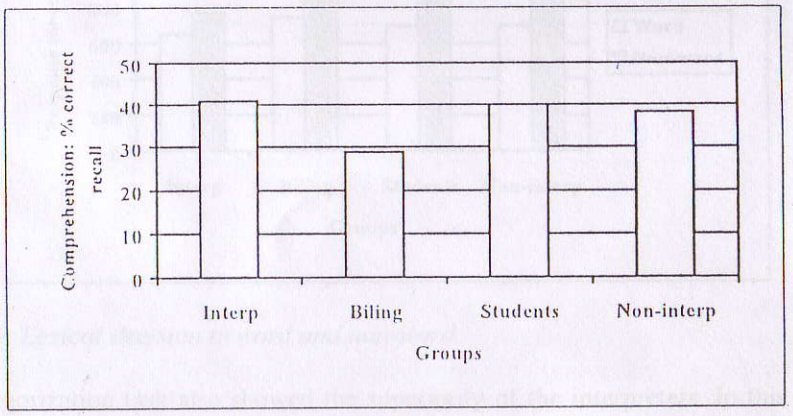

Figure 1: *Comprehension: % correct recall*

However, there were significant differences in reading times among the groups ($F(3,34) = 2.77$, $p = 0.05$), in the analysis of variance. Comparisons between the different groups showed significant differences between the interpreters

and non-interpreters ($p = 0.01$) and between the interpreters and the bilinguals ($p = 0.05$). Figure 2 shows mean reading times obtained for each group.

Results seem to indicate that the interpreters show greater efficiency in processing the information present in the text. They were capable of reading at greater speed with no decrease in accuracy in their understanding and recall of the text. Our first experiment thus indicates that the superiority shown by interpreters is not only due to the linguistic skills derived from their knowledge of two languages, but possibly to the training in some other skills involved in comprehension. In our second and third experiments we attempt to clarify whether other linguistic processes normally trained in interpretation schools are also enhanced in the interpreters.

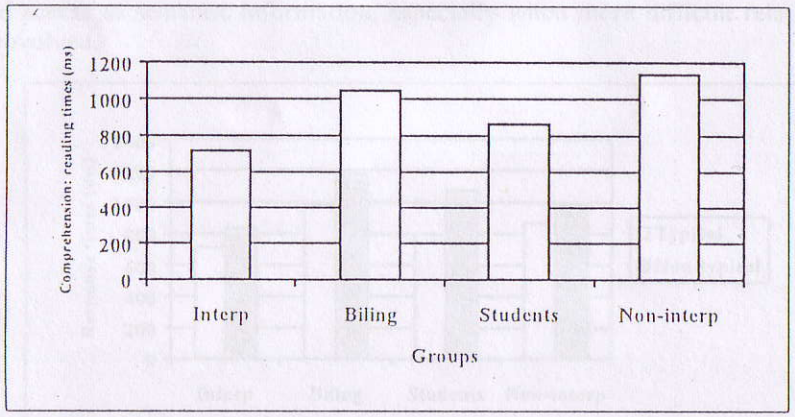

Figure 2: *Comprehension: Reading times*

5. Lexical decision and categorization: method and results

Part of the interpreters' training concentrates on reinforcing their skill in accessing semantic information. For instance, some exercises consist of quickly verbalizing a synonym or a term related to a word given by the lecturer, clozing, etc. This training concentrates on immediate understanding of the meaning, but also on accessing the form of the word so as to produce it quickly. To explore the possible superiority of the interpreters in these linguistic processes we selected two tasks: one emphasizing lexical access and another emphasizing semantic access.

Our subjects participated in a lexical decision and a categorization task. In lexical decision, a word or a group of pronounceable letters (a non-word) were presented on the computer screen. Subjects had to decide as quickly as

possible if the presented stimulus was a word or a non-word by pressing the corresponding key. In categorization a word and the name of a category was presented and the subject had to decide if the concept denoted by the word was a member of the category. In lexical decision we manipulated the difficulty of the task by manipulating the frequency of the words involved. Lexical decisions for less frequent words require more processing demands and therefore we hypothesized that the possible differences between the groups might then be larger.

Figure 3 shows mean response times in the lexical decision task for words and non-words as a function of the groups. The effect of group was not significant when we analysed the word data ($p > 0.05$); however, there were significant group differences in the analysis performed on the response times to non-word $F(3,34) = 3.01$, $p = 0.04$. As can be observed in figure 3 the interpreters tend to be better than the rest of the groups. The differences are especially significant if we compare the interpreters to the bilinguals ($p = 0.005$) in the non-word condition. Contrary to what we expected, although word frequency had an overall effect ($F(1,34) = 95.88$, $p < 0.01$), the interaction between frequency and group was not significant ($p > 0.05$).

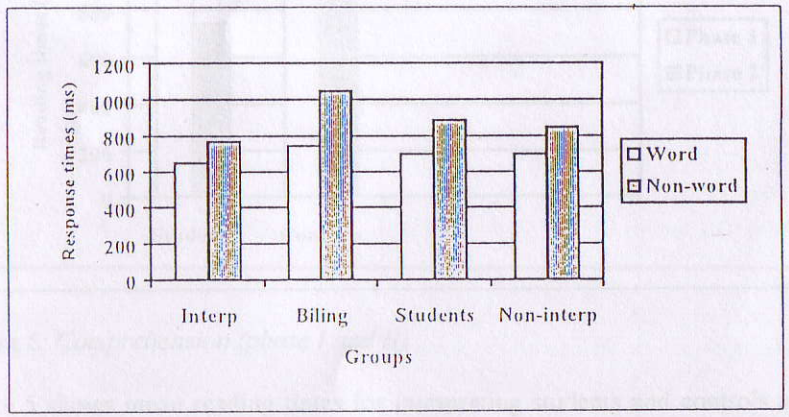

Figure 3: *Lexical decision to word and non-word*

The categorization task also showed the superiority of the interpreters. In this task we presented pairs of words and the subjects had to decide if the concept denoted by the second word was a member of the category represented by the first. An important variable in categorization is the typicality of the exemplars of the category (Rosch 1975). Many categorization experiments have shown that response times depend on typicality, with more typical exemplars being responded to faster than less typical ones (Rosch & Mervis 1975). For this

reason we manipulated this variable in an attempt to manipulate the difficulty of semantic access. We hypothesized that the possible superiority of interpreters might be more evident when more difficult categorical relations were involved.

Figure 4 shows the results of the categorization task. Both typicality ($F(1,34) = 75.14$, $p < 0.01$) and the interaction between typicality and group ($F(3,34) = 4.402$, $p = 0.01$) were significant. When non-typical exemplars were involved, the interpreters' responses were faster than those of the bilinguals ($p < 0.05$), the professionals control ($p < 0.05$) and the interpreting students' (< 0.05). Figure 4 shows that reaction times of the bilinguals, students and controls were very similar and slower than the times of the interpreters. This difference is more significant for the less typical exemplars (136 ms difference with respect to the nearest group). Hence, the interpreters seem to have more rapid access to semantic information, especially when more difficult relations are involved.

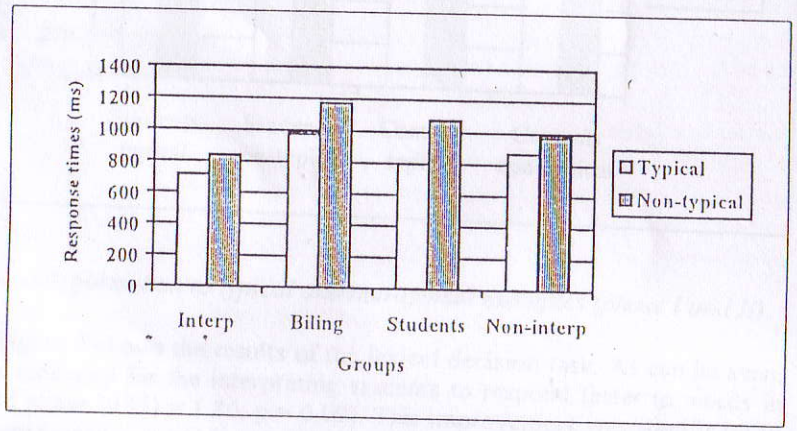

Figure 4: *Categorization to typical and non-typical examples*

These results seem to indicate again that the linguistic skills of the interpreters are superior to those of the bilinguals, and that, therefore, different processes from those involved in second language competence may be responsible for this superiority.

6. The role of training in the interpreters' superiority

We also wanted to explore whether the differential effects in linguistic operations that we found in interpreters were really due to training. This is important for teaching interpreting because we would be able to infer that,

apart from knowledge of the second language (as Dillinger suggests, 1994), specific training in other linguistic skills leads to better use of them.

With this purpose in mind, at the end of the academic year we asked subjects in the student group to take part in the second phase of the study. Our aim was to compare their performance in the second phase with that of the first phase. Thus, the students performed the comprehension, categorization and lexical decision tasks once at the beginning of the academic year, before receiving training in linguistic skills, and then at the end of the year, after the intensive training received during this period (8 subjects participated in both phases). To take into account the possible effect of practice on the tasks, a group of 10 university students (non-interpreters) also participated in the experiment as controls. They participated at the beginning of the academic year (phase 1) and at the end of it (phase 2). If, in our previous experiments, training was the cause of the interpreters' superior performance, we expected that interpreting students would show improved performances in the second phase.

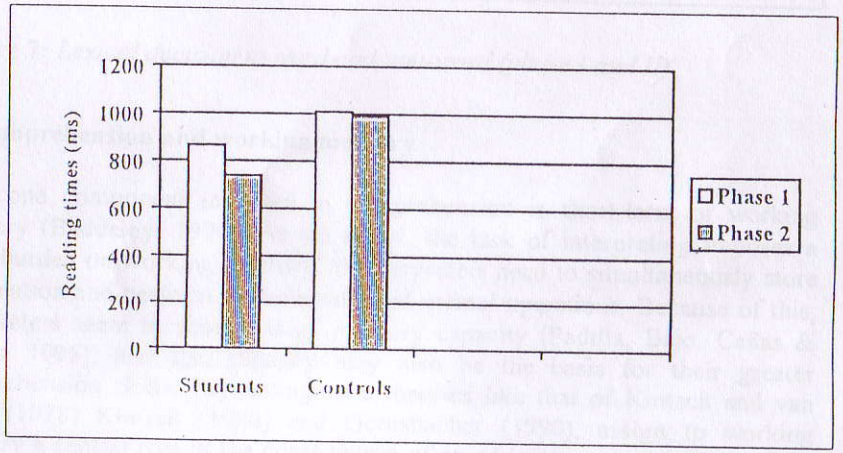

Figure 5: *Comprehension (phase I and II)*

Figure 5 shows mean reading times for interpreting students and controls as a function of phase. As can be seen, only the group of interpreting students experienced a reduction in the response times from the first phase to the second ($t(15) = 2.08$, $p = 0.06$). The slight reduction in time from phase 1 to phase 2 experienced by the control group was not significant ($t(16) = 0.89$, $p = 0.38$).

The categorization task showed the same pattern of results (Figure 6). The control group showed no significant improvements in any of the three conditions of the task. Thus both typical and non-typical members were categorized equally fast in the first and second phase of the experiment, $t(16) = -0.63$, $p = 0.53$ for typical exemplars and $t(16) = 0.61$, $p = 0.55$ for non-typical

exemplars. On the other hand, the group of interpreting students showed significant improvements for both typical ($t(15) = 2.12$, $p = 0.05$) and non-typical ($t(15) = 2.40$, $p = 0.02$) exemplars. The training received by the students of interpretation does seem to have helped them to have faster access to their semantic knowledge.

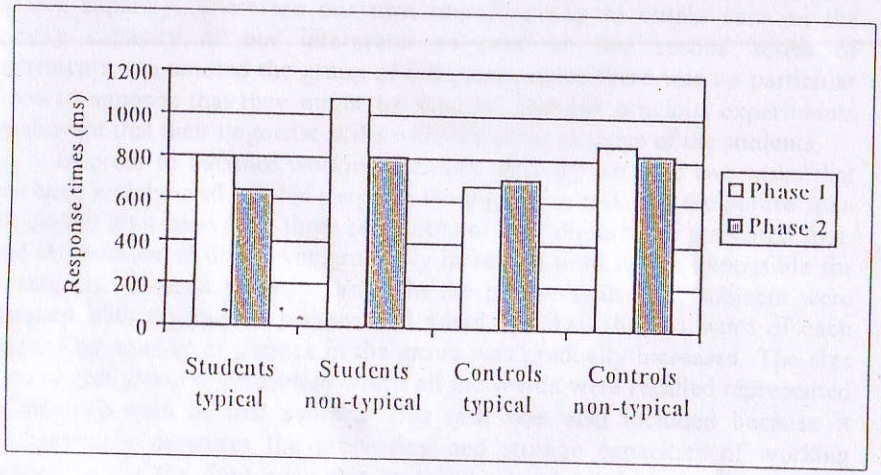

Figure 6: *Categorization to typical and non-typical examples (phase I and II)*

Finally, Figure 7 shows the results of the lexical decision task. As can be seen, there is a tendency for the interpreting students to respond faster to words in the second phase ($t(15) = 1.86$, $p = 0.09$). This improvement was significant in the non-word condition ($t(15) = 3.37$, $p = 0.04$). In contrast, response times for the control group remained identical in both phases and conditions ($t(15) = -0.17$, $p = 0.86$ and $t(16) = 0.82$, $p = 0.42$).

Our results seem to indicate that linguistic skills such as access to semantic and lexical information that are particularly developed in interpreters are not only due to the greater linguistic skills that knowledge of two languages gives them. This superiority did not show in the bilingual group, which also had linguistic competence in two languages. Our data show that these skills are susceptible to training, as our interpreting students performed the tasks much more effectively after training.

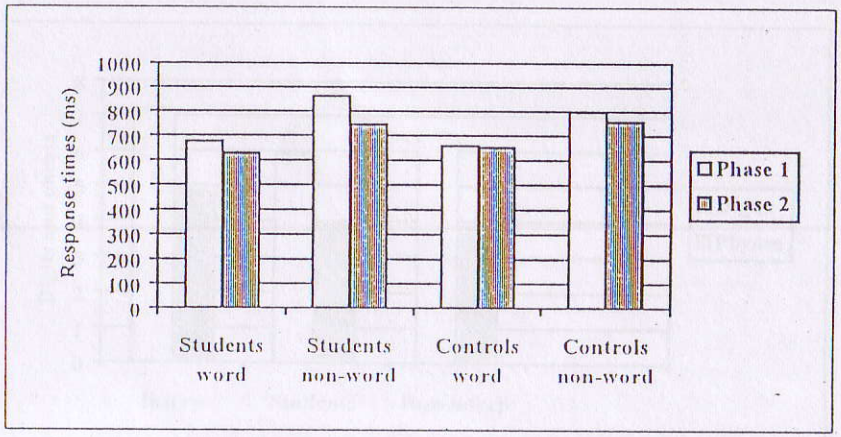

Figure 7: *Lexical decision to word and non-word (phase I and II)*

7. Comprehension and working memory

A second component involved in comprehension is short-term or working memory (Baddeley, 1990). As we know, the task of interpreting imposes a great burden on working memory, as interpreters need to simultaneously store information and perform a whole series of mental operations. Because of this, interpreters seem to show a large memory capacity (Padilla, Bajo, Cañas & Padilla 1995), and this capacity may also be the basis for their greater comprehension skills. Psycholinguistic theories like that of Kintsch and van Dijk, (1978) Kintsch (1988) and Gernsbacher (1990), assign to working memory a central role in the construction of an adequate representation of the text. Psychological research has shown that the capacity of this memory is to a great extent responsible for individual differences in the skills of reading and understanding sentences.

An important component of good comprehension skills is the capacity to compute semantic and syntactic relations between words and successive phrases so as to construct a coherent representation of the discourse. To integrate the new information with previously processed information it is necessary to have access to the results of previous processes. If temporal storage of all this information is crucial to understanding, those people who have less memory capacity will be less capable of maintaining this information in memory and therefore will be less capable of carrying out the processes necessary for comprehension (tracking references, making inferences, resolving ambiguities etc.). In the same way, people with greater memory

capacity will be more capable of carrying out these processes and will show greater reading skills.

Daró and Fabbro's research (1994) has also shown the importance of this memory when the task is performed in the conditions of simultaneity imposed by interpreting. For this reason we thought that the greater skill of interpreters in the comprehension task could be due to their greater short-term memory capacity. Therefore our next objective was to obtain data on the memory capacity of our interpreter subjects. In this second series of experiments, we omitted the group of bilinguals, since there was no particular reason to suppose that they might be superior and our previous experiments had showed that their linguistic skills were the same as those of the students.

In order to measure working memory capacity we used two tasks that have been widely used for this purpose: the digit span task and the phrase span task. In the digit span task, three sequences of four digits were presented first. Then the number of digits was gradually increased until it was impossible for the subjects to recall them in order. In the phrase span task, subjects were presented with a group of phrases and asked to recall the last word of each phrase. The number of phrases in the group was gradually increased. The size of the largest group of phrases in which all the words were recalled represented the memory span of that subject. This task was also included because it simultaneously measures the processing and storage capacities of working memory, while the digit span test is more related to the storage capacity. Daneman and Carpenter (1980) have shown that this task can predict individual differences in reading skills.

Figure 8 shows the memory span obtained by each of the groups. As can be seen, the interpreters' memory span as measured by the two tasks was higher than that of the rest. The analysis of variance computed on the digit span data showed the differences to be significant ($F(2, 27) = 3.26$, $p = 0.05$). The analysis on the phrase span data also showed the differences to be significant ($F(2,27) = 5.32$, $p < 0.01$).

In addition we calculated the correlation between the scores obtained by our subjects in these memory tasks and the reading times obtained in the previous experiments. The Kendall correlation between phrase span and reading times was significant ($K(25) = 0.24$, $p = 0.05$). These results suggest that the memory capacity of the interpreters is larger than that of non-interpreters or interpreting students, and that this larger capacity may be the basis for their efficient reading skills.

Daneman and Carpenter (1980) suggest that the greatest source of differences in reading skills is not in the passive storage of the information but in the most active part of the processing of the working memory (the central executive, in Baddeley's term). People differ in their functional capacity, that is to say, in the processes they perform in order to use the limited resources they

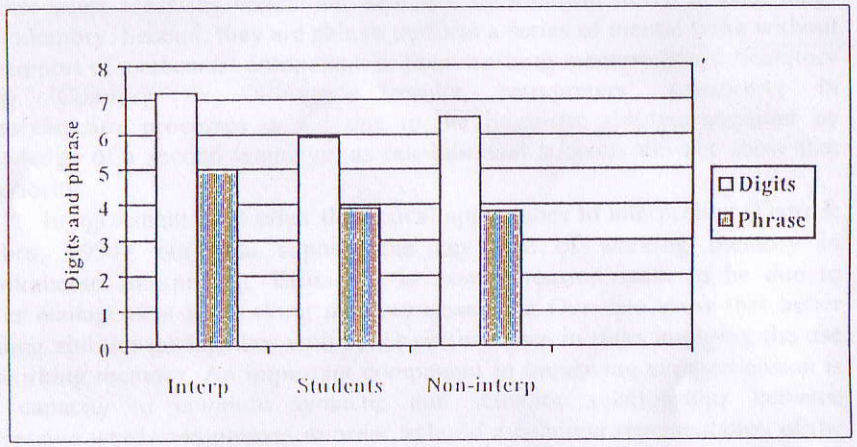

Figure 8: *Memory span tasks: digits and phrases*

possess in an optimum way. Working memory is assumed to have processing and storage
capacities. Hence, individuals may differ in their skill of dividing their resources between the two functions. Daneman and Carpenter suggest that a functionally smaller storage capacity is linked to deficits of comprehension. In the same way a functionally greater storage capacity will correlate with greater comprehension skill.

To explore this hypothesis we carried out another experiment in which we attempted to occupy the greatest storage component that the working memory has: the phonetic component (articulatory loop, in Baddeley's term). At the same time our subjects were required to process a list of words that they would later have to recall. The usual way of blocking the phonetic component is by articulatory suppression, which consists of asking the subjects to verbalize a syllable while they process other material. It is obvious that interpreters have to learn to carry out a number of processes (understanding, recalling or translating) in conditions where the phonetic component is occupied transmitting the result of these mental processes. Therefore, if their training includes other tasks, we think that they will be capable of dividing their resources of storage and processing more efficiently, so they will be less affected by articulatory suppression.

All the subjects performed a memory task (3 lists of 16 words 3 seconds each) with or without articulatory suppression. In the condition of articulatory suppression the subjects had to verbalize the syllable "bla" as they tried to memorize the words.

As illustrated in Figure 9, the interaction between group and articulatory suppression was significant ($F(2,27) = 4.58$, $p = 0.01$). Without articulatory suppression all the groups recalled approximately the same number of words ($F(2,27) = 1.91$, $p > 0.05$). However, with articulatory suppression the interpreters' performance was better than that of the other groups ($F(2,27) = 4.55$, $p < 0.01$). The students and non-interpreters performed worse when their phonetic component was occupied by verbalization of the syllable ($p < 0.01$), whereas the interpreters maintained their performance in these conditions ($p > 0.05$).

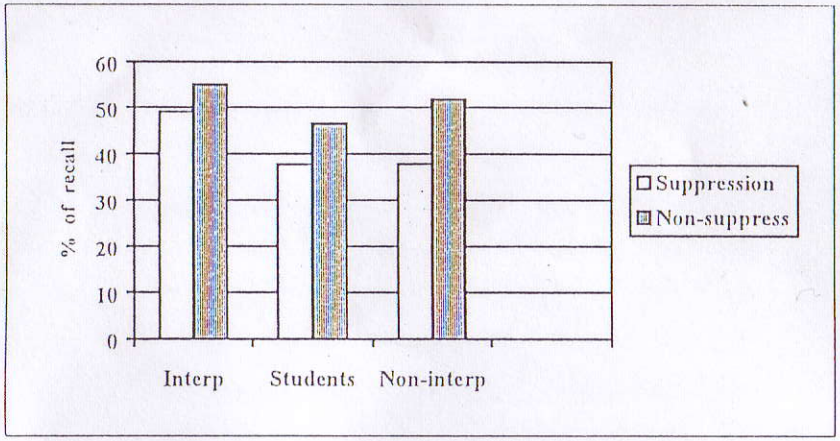

Figure 9: *Free recall with and without articlatory suppression*

It thus seems that the interpreters' superior comprehension is not only due to their greater speed in accessing semantic information, but also to their greater short-term memory capacity and to their efficient use of this memory.

8. Conclusions

The results of our experiments suggest that training and experience in interpreting develop a set of cognitive skills involved in comprehension. Thus, interpreters show fast and accurate reading abilities, faster access to lexical and semantic information, larger working memory capacity and a more efficient use of this capacity, so that the ability to understand and memorize a list of words is not impaired by suppression of the phonological component.

From a theoretical point of view, these data suggest that interpreters develop specific strategies to extend their memory capacity and efficiency. Similarly, they enhance their comprehension processes. First, they seem

quicker when accessing lexical and semantic information stored in their long-term memory. Second, they are able to perform a series of mental tasks without the support of a rehearsal component in their working memory (the articulatory loop). Contrary to Dillinger's results, interpreters' superiority in comprehension processes is not due to the linguistic abilities acquired by knowledge of a second language, as our bilingual subjects did not show that superiority.

In agreement with other theoretical approaches in interpreting (Daró & Fabbro, 1994), our data support the key role of working memory in simultaneous interpreting. Efficiency in comprehension seem to be due to better management of working memory resources. Our data show that better reading abilities go together with better performance in tasks implying the use of working memory. An important component in improving comprehension is the capacity to compute syntactic and semantic relationships between successive words and phrases in order to build a coherent representation of the discourse. For new information to be integrated with previously processed information one must have access to the results of previous processes. Storing this information temporarily is of crucial importance to understanding. Therefore, people with a larger memory capacity will be more capable of storing information and, consequently, will be better able to execute a series of sub-processes needed for comprehension (looking for referents, making inferences, solving ambiguities etc.).

According to our conclusions, the training of future interpreters must be focused, to a large extent, on an efficient use of their memory, in such a way that intensive practice in related tasks has immediate repercussions on the acquisition of the technique of interpreting.

1. Preparation of this paper was supported by Grant PB95-1180 of the DGICYT (Ministerio de Educación y Cultura) of the Spanish Government to the first author. The authors are indebted to José Cañas for his help in preparing and discussing many of the experiments presented in the paper.

References

BADDELEY, A. 1990 *Human Memory: Theory and Practice*. Hove: Lawrence Erlbaum Assoc.

DANEMAN, M & CARPENTER, P.A. 1980. "Individual differences in working memory and reading". *Journal of Verbal Learning and Verbal Behavior* 19, 450-466.

DANKS, J.H.; SHREVE, G.M.; FONTAN, S.B. & MCBEATH, M.K., eds., 1997. *Cognitive Processes in Translation and Interpreting*. London: Sage Publications.

DARÒ , V. & FABBRO, F. 1994. "Verbal memory during simultaneous interpretation: effects of phonological interference". *Applied Linguistics* 15 (4).

DILLINGER, M. 1994. "Comprehension during interpreting: What do interpreters know that bilinguals don't?". *Bridging the Gap: Empirical Research in Simultaneous Interpretation* ed. by S. LAMBERT & B. MOSER-MERCER, 155-189. Amsterdam & Philadelphia: John Benjamins.

DE VEGA, M. 1987-1990. CRONOLAB. University of La Laguna. CICYT PB86-0480 and DGICYT PB88-0425.

GERNSBACHER, M.A. 1990. *Language Comprehension as Structure Building*. Hillsdale, New Jersey: Erlbaum.

GILE, D. 1995. *Basic Concepts and Models for Interpreter and Translator Training*. Amsterdam & Philadelphia: John Benjamins.

GILE, D.1997. "Conference interpreting as a cognitive management problem". DANKS, J.H.; SHREVE, G.M.; FONTAN, S.B. & MCBEATH, M.K. eds, 196-214.

HUNT, E.B., FROST, N.& LUNNEBORG, C. 1973. "Individual differences in cognition: a new approach to intelligence". *Psychology of Learning and Motivation* ed. by G. BOWER, 87-122. New York: Academic.

KINTSCH, W. 1988. "The role of knowledge in discourse comprehension: A construction-integration model". *Psychological Review* 95 (2), 163-182.

KINTSCH, W. & VON DIJK, T.A. 1978. "Toward a Model of Text Comprehension and Production". *Psychological Review*, 85 (5) 363-394.

PADILLA, P. 1995. *Procesos de atención y memoria en interpretación de lenguas*. Unpublished Doctoral Dissertation. Universidad de Granada.

PADILLA P., BAJO M.T., CAÑAS J.J. & PADILLA F. 1995. "Cognitive processes of memory in simultaneous interpretation". *Topics in interpreting research* ed. by J. Tommola. 61-71. Turku: Centre for Translation and Interpreting.

ROSCH, E. 1975: "Cognitive representations of semantic categories". *Journal of Experimental Psychology: General* 104, 192-233.

ROSCH, E. & MERVIS, C.B. 1975. "Family resemblances. studies in the internal structure of categories". *Cognitive Psychology* 7, 575-605.