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SEMANTIC INTEGRATION IN BILINGUAL LANGUAGE PROCESSING

The University of Arizona

PH.D.

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SEMANTIC INTEGRATION IN BILINGUAL
LANGUAGE PROCESSING

by
Miguel Ángel Enríquez

A Dissertation Submitted to the Faculty of the
DEPARTMENT OF PSYCHOLOGY
In Partial Fulfillment of the Requirements
For the Degree of
DOCTOR OF PHILOSOPHY
In the Graduate College
THE UNIVERSITY OF ARIZONA

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THE UNIVERSITY OF ARIZONA
GRADUATE COLLEGE

As members of the Final Examination Committee, we certify that we have read
the dissertation prepared by Miguel Ángel Enríquez

entitled SEMANTIC INTEGRATION IN BILINGUAL
LANGUAGE PROCESSING

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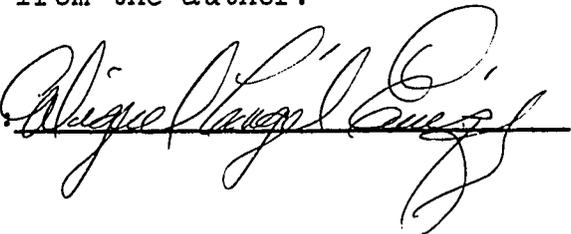
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A handwritten signature in cursive script, written in black ink, positioned over a horizontal line. The signature is highly stylized and difficult to decipher, but appears to be the name of the author.

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ABSTRACT

Two experiments using Spanish-English bilinguals from the University of Arizona and Pima Community College (Tucson, Arizona) investigated information processing and semantic integration of texts presented in Spanish and English. Using propositions (sentences) developed by Kieras (1978) and their Spanish translations, this study sought to determine how bilinguals store and retrieve information when contiguous and interleaved paragraphs are presented in both languages. It was hypothesized that bilinguals store language tags for encoded information in their memory. Storage capacity may be taxed, however, such that recall will be less effective than when information is presented coherently and in only one language. Results showed that forcing bilinguals to keep language tags did in fact result in less correct recall in some instances and greater recall in other instances. Data suggested that bilinguals having to keep language tags may have had better recall because language links between propositions provided additional retrieval routes and increased the probability of recall. In general, results were consistent with the hypothesis that bilingual subjects have only one semantic memory system that is accessed via

two different languages. The bilingual's memory performance may be affected, however, by the availability of differentiated language tags stored at the time of information encoding. An attempt was also made to determine language dominance of the 20 bilingual subjects who participated in Experiment II and to correlate this information with recall data. No reliable technique for gauging language dominance was found, nor were there any reliable correlations with recall performance.

INTRODUCTION

In recent years a growing number of researchers have begun to devote more attention to the psychological processes of bilingual subjects. In the area of human information processing, more and more journal space has been devoted to the study of bilinguals and how they process information. While this area of investigation is receiving more attention, present knowledge is still limited and sporadic. A definite need exists for further bilingual studies in semantic memory integration processes.

In the past, few researchers seemed to realize that studies of bilingual's information processing could result in a better understanding of encoding and retrieval processes more generally. More attention is now being devoted to bilingual studies, because the bilingual presents a perfect means by which some aspects of language processing can be investigated. Using the bilingual, between subject error can be zero when he is used to compare his languages. The bilingual can, and should, be used to study basic memory processes.

Rose (1975) believes that "the bilingual is the subject par excellence for investigations of cognitive processes" (p. 149). One should at least agree with Rose that even though many bilingual issues might not be particularly interesting to cognitive psychologists, bilingual subjects do provide a special opportunity for testing current theories of information processing. This is not to say, of course, that bilinguals are the best subjects for every experiment, but they are prime subjects for many information processing studies.

The majority of literature on bilinguals and bilingualism is concerned with memory and learning. A great deal of research has also been devoted to the question of language dominance where definitions of compound and coordinate bilinguals seem to be the central issues (Preston and Lambert, 1969; Goggin and Wickins, 1974; Saville and Troike, 1971). A compound bilingual is generally believed to be a person who is "balanced" in both languages. That is, he/she is equally proficient in both languages. A coordinate bilingual is generally a person who understands both languages, but seems to operate with a high-speed translation process where information received in the weaker language is translated into the stronger language. To date there has been no generally accepted definition of these terms that plague

experimenters using bilingual subjects. Most researchers who do work with bilinguals have ignored the problem of language dominance altogether, apparently by assuming that all bilingual subjects are the same. Others, for example, Kintch (1970) have employed arbitrary definitions of bilingualism. Kintsch's definition of a bilingual is anyone who has "familiarity with the basic language material employed in the experiment".

Another area of major interest in bilingual research has been attempts to develop a technique or method of language dominance assessment. Different experimenters (e. g., Macnamara, Krauthammer and Bolgar, 1968; Preston and Lambert, 1969; Ervin, 1961; Weinrich, 1953) have used different techniques to measure the degree of language dominance in bilinguals. No consistent procedure has been developed for gauging the language dominance of bilinguals, as yet. Individual researchers seem to have their own criteria and measurement techniques for determining the dominance level of each of the bilingual's languages.

Some researchers may have avoided bilingual research because of the political atmosphere of "bilingual education," which is altogether a separate issue. Fearing the quicksand pits that political controversies may present, many investigators may have decided not to get involved, thus forsaking any benefits that such studies might offer.

While the study of the bilingual may present many problems that are not of direct interest to the basic information processing researcher--segregation, socio-economic status, inadequate education--researchers should not shy away from basic studies employing the bilingual as a subject.

As late as 1975 Dornic reported "the literature on information processing in connection with bilingualism is not too extensive. There are only about 80 publications based on experimental research" (p. 2). Today the situation has not improved markedly. While an increasing number of experiments involving or studying bilinguals can be noticed in the journals, we are far from realizing the potential of this approach.

The literature in memory and learning is generally concerned with the theoretical question on the bilingual's memory and information processing structures. Does the bilingual have two memory systems that are accessible through two different languages, or does the bilingual possess only one memory structure accessed via one universal "thinking" language? There have not been too many attempts to answer this question. Those attempts that have been made have been uncoordinated and researchers have often arrived at opposing conclusions.

Kolers in 1963 postulated that bilinguals have two storage systems, one for each language and that information stored in one system is not available to the other

system, except through a high-speed translation process. The theoretical implications here are that bilinguals have two different "worlds" inside their head that makes the processing of information different from that of monolinguals. This theory has since received supporting and contradicting evidence.

Koler (1966) found evidence that contradicted his original theory. He used a simple recall task in which lists containing 20 words in English and 20 words in French were presented to bilingual subjects. The English list was a translation of the French list. In another condition all 40 words in the list were different, with half presented in English and half in French. The experimental hypothesis was that since the probability of recall of an item increases with the frequency of its occurrence in the list (e.g., Waugh 1962), translations of the same word should not affect its probability of recall since each word is stored independently. His results showed that the repetition of the item (once in English and once in French) did in fact result in improved recall and interpreted his results as showing that bilinguals store concepts rather than specific words.

In a category organization task involving bilinguals, Lambert, Ignatov, and Krauthamer (1968) found that bilinguals tended to cluster information according to categories rather than according to language as Koler's

original theory had postulated. This same study also found that when information was presented bilingually, subjects tended to recall items depending upon the categories and not upon the language of presentation.

Other studies involving similar tasks, (Nott and Lambert, 1968; Dalrymple and Aamiry, 1969; Champagnol, 1973) have resulted in similar findings. Recall items tended to be remembered according to category rather than language of presentation. These studies again support the interdependence hypothesis--that information is stored only once in the bilingual's system in some universal semantic representation. Experiments using a variety of approaches have provided further support for the interdependence hypothesis (e. g., Young and Saegert, 1966; Young and Webber, 1967; Young and Navar, 1968; Kintsch and Kintsch, 1969; Saegert, Obermayer and Kazarian, 1973; Saegert, Kazarian and Young, 1973; Lopez, Hicks and Young, 1974; Lopez and Young, 1974).

Support for the 2-storage system hypothesis is not as strong. Proponents of the independence theory suggest that bilinguals are capable of storing information in either of their systems depending upon the language of presentation and further, that these concepts can be translated at high-yet measureable-speeds if the task requires it (e.g., Tulving and Colotta, 1970; Macnamara, 1967; Macnamara and Kushnir, 1971).

Glanzer and Duarte (1971) used a free recall task containing lists of English and Spanish words. In the within-language condition words were presented in one language and were followed by a repetition of the same words. The between-language condition presented a list of words in one language, followed by its translation in the other language. Between-language repetitions gave better recall than within-language repetitions. The results supported a two-storage model of recall (Glanzer, 1972) since between-language items were recalled better than within-language items.

Experiments in which recalled words were remembered according to the language in which they were originally presented (e.g., Kolers, 1965; Nott and Lambert, 1968; Rose and Carroll, 1974) are offered as further support for the language independence theory. The rationale here has been that since bilinguals remembered in which language certain items had originally been presented, this was proof enough to support a dichotomous storage system. Anderson and Bower (1973) and Anderson (1976) have suggested that a "tagging" process can explain most of this data, thereby weakening the little evidence that independence theorists have relied upon. Anderson and Bower used the idea of a tagging process to account for subjects' ability to retain nonsemantic information about items in free recall.

In the case of retention of bilingual items, the implication is that although items are stored primarily as concepts, information about language is stored along with items, but is independent of their meaning. Thus, items are tagged with a language marker rather than stored as language-specific memories (Liepman and Saegert, 1974). Lopez and Young (1974), Saegert, Hamayan and Ahman (1975) and Rose, Rose, King and Perez (1975) have offered further support to the "tag" hypothesis. This evidence has prompted Segalwitz (1977) to conclude that bilinguals have but one memory system.

In a series of unpublished studies Enriquez (1978) investigated the issue of interdependence-independence in storage systems of Spanish-English bilinguals. The data from these studies supported the hypothesis that bilinguals process information differently depending upon mode of presentation. The results provided no strong evidence that bilinguals have separate memory systems for each language, however. Dornic (1975) has arrived at a similar conclusion.

In an attempt to better understand the bilingual and his information processing system(s), and ultimately to better understand information processing in general, the present study sought to investigate how bilinguals integrate textual information presented in two languages. Two experiments were run using a recall task to investigate

how bilinguals integrate and recall information presented in two languages. Different levels of information processing load were presented during initial reading (encoding) of textual passages. It was expected that interspersing information from several passages and presenting passages in two languages would result in a greater information processing load. It was hypothesized that as information processing load increased, that language of presentation would have less effect on recall performance. Increased processing loads should decrease the bilingual's tendency to "tag" information in memory as to original language source. Alternatively, if "language tags" are attached to stored information, this would result in less efficient semantic memory integration and lower levels of recall.

EXPERIMENT I

Anderson and Bower (1973), Kintsch (1974), Norman and Rumelhart (1975), and Anderson (1976) have offered models for the psychological representation of meaning. While these models differ significantly in important respects, their goal and basic approaches are the same. One fundamental component found in all of these models is that representation of meaning is considered to be in the form of propositions. Propositions are abstract representations of the meaning of elementary sentences.

Kintsch and Van Dyk (1975), Rumelhart (1975), Haviland and Clark (1974), and Kieras (1978) have conducted experiments in reading comprehension that have explored the organizational structure of text information. These researchers have attempted to investigate information processing by using propositional structure models.

Kieras (1978) studied semantic memory organization by investigating the integration of sentences in the context of paragraphs. By using propositions (sentences) fashioned after Bransford and Franks (1971), Kieras (1978) sought to find a relationship between passage coherence and readers' comprehension of the text materials. Paragraphs

consisted of sentences, each expressing a single proposition. Propositions could be freely reordered in the paragraph without changing the overall meaning of the passage. All passages were similar in that each contained the same number of nouns, verb forms, and expressed similar semantic relationships. By varying the order of proposition presentation, various degrees of story coherence and complexity were examined. Kieras' results enabled him to establish "good" and "bad" proposition orders. "Good" orders of presentation were those where comprehension and recall were high and a lesser amount of memory processing was required. "Bad" orders taxed memory capacity and resulted in less recall and comprehension.

In the present experiment English and Spanish sentences were used in an experimental situation very similar to that of Kintsch (1974) and Kieras (1978) to investigate semantic integration in bilinguals. Using Kieras' (1978) "best" story orders, short textual passages were presented in English and Spanish to bilingual subjects. Each passage was presented all in English, all in Spanish, or some (of the propositions) in one language and the remainder in the other. One objective was to investigate whether language of presentation affects the language of recall and/or the amount of information recalled.

Another variable investigated in Experiment I was passage (story) coherence. Four different passages were presented in either contiguous--complete story form--or in interleaved form, where each succeeding proposition presented was from a different passage. The objective was to investigate whether semantic integration in bilinguals is affected by story coherence.

METHOD

Subjects

Sixty college level male and female students volunteered for the experiment. These subjects were screened by the experimenter to select bilinguals who were proficient in reading and writing in both English and Spanish. Twenty students were selected to participate in the experiment. These students were from the University of Arizona and from Pima Community College (Tucson, Arizona). No attempt was made to measure bilingual proficiency other than the oral interview with the experimenter.

Materials

A total of 189 sentences used by Kieras (1978), 7 sentences created for this experiment, and the Spanish translations of these sentences were used. Table 1 gives a representative sample of the sentences. (A complete list of sentences is presented in Appendix A.) Direct translations cannot be assumed to produce sentences with the same meaning (Sechrest, Fay and Zaidi, 1972). Therefore, some of Kieras' sentences were modified slightly to achieve acceptable correspondence.

THE ANTS WERE HUNGRY.

LAS HORMIGAS TENIAN HAMBRE.

THE ANTS WERE IN THE KITCHEN.

LAS HORMIGAS ESTABAN EN LA COCINA.

THE JELLY WAS GRAPE.

LA JALEA ERA SABOR DE UVA.

THE JELLY WAS ON THE TABLE.

LA JALEA ESTABA EN LA MESA.

THE ANTS ATE THE JELLY.

LAS HORMIGAS SE COMIERON LA JALEA.

THE KITCHEN WAS SPOTLESS.

LA COCINA ESTABA MUY LIMPIA.

THE TABLE WAS WOODEN.

LA MESA ERA DE MADERA.

Table 1. Sample of Kieras' (1978) Sentences and Spanish Translations.

Kieras (1978) constructed sentences which each expressed a single proposition and which, when put together, formed passages. Each passage consisted of seven different sentences which could be presented in differing orders without altering the passage meaning. In the experiment reported here proposition order within each passage was always constant, using the most coherent order as reported in Kieras (1978).

A total of 28 distinct passages, each in English and in Spanish, and each consisting of 7 propositions (sentences) were available for study. Each subject saw a randomly selected set of 20 of these passages in the experiment.

After a warm-up session in which the subjects read 4 passages, each subject read 4 sets of passages. Each 4-passage set (28 propositions) represented one combination of the three basic experimental variables; contiguous vs interleaved passages, homogeneous vs heterogeneous language, and Spanish vs English.

One experimental condition, contiguous homogenous, presented all 7 propositions for every story together and in either Spanish or English. A second presentation condition, contiguous heterogeneous, presented the 7 propositions together, but some of the propositions were in Spanish and some in English. Within the 4-passage set

for this condition, 3 propositions in two passages and 4 in the other two passages were in Spanish (or English), thus subjects saw 14 English and 14 Spanish propositions. A third condition, interleaved homogeneous, presented the first proposition for each of the 4 passages, followed by the second proposition for each passage, and so on. Propositions for two of the passages were all presented in Spanish and those for the other two passages were all in English. The interleaved heterogeneous condition presented the first proposition of each passage, then the second, third, and so forth, but part of the propositions in each passage were presented in English and the rest in Spanish. The basic design, then, is a 2 x 2 x 2 factorial, with two passages (14 propositions) nested in each cell.

The rationale for these experimental conditions was to investigate whether semantic integration of reading materials depends upon surface language functions or whether semantic codings are universal in nature. It was expected that the contiguous homogeneous condition would result in the highest recall and semantic integration, and that the interleaved heterogeneous condition would result in the least amount of recall and integration. In general, the greater the information processing load at the time of reading the passages, the lower the expected recall and integration.

Procedure

Subjects participated in a group. Standardized instructions were read (in English) to the group. (See Appendix B.) They were told that the experiment was concerned with how people read and remember information. Each subject received five booklets, each consisting of a cover sheet, twenty eight small strips of paper on which sentences were typed one per strip, and a rule-lined sheet of paper.

The first booklet used the contiguous homogeneous presentation and served as a warm-up session. The four remaining booklets represented the different experimental conditions. The order of conditions and specific passages assigned to the conditions were randomized between subjects. Subjects were instructed to read the 4 passages in each booklet. They were told that some passages would be presented in Spanish, others in English, and others in both languages. Subjects were instructed that they would be required to recall the passages, and that they could recall them in any order and in any language they chose.

To begin the experiment, subjects were told to turn the cover sheet, read each sentence, and proceed until they had read all twenty eight sentences. They were instructed not to turn back to a sentence once it had been read. Immediately after reading the last

sentence in a booklet, subjects wrote down on the lined sheet of paper all that they could remember of the four stories that they had just read.

Subjects' questions concerning the procedures were answered in English and in Spanish before the experiment was run. After all of the subjects had completed recalling the information, a two-minute rest period was provided before the next booklet was begun.

Scoring

Response sheets were scored by three bilinguals who determined whether the propositions presented were recalled correctly. A correct response could be in Spanish or in English and did not have to be reported verbatim. At least two of the three scorers had to agree that a proposition was recalled.

RESULTS

Recall responses for the warm-up passages were not scored or analyzed. While subjects were allowed to recall in either language, virtually all recall responses were written in English. Less than 8% of all responses were in Spanish.

Recall responses for experimental conditions, contiguous homogeneous (CS), contiguous heterogeneous (CD), interleaved homogeneous (IS), and interleaved heterogeneous (ID), were analyzed in two forms. The first analysis was a 2(homogeneous-heterogeneous) x 2(contiguous-interleaved) x 2(Spanish-English Language of Presentation) Analysis of Variance of the number of propositions recalled per passage. More of the propositions presented in English (3.131 of 7.0 possible) were recalled than the propositions presented in Spanish (1.206), $F(1,19)=15.01$, $p<.001$. Proposition recall for the contiguous conditions (2.394) was significantly better than recall for the propositions presented in the interleaved condition (1.944), $F(1,19)=6.41$, $p<.05$. Homogeneous presentations were also significantly better (2.744) than heterogeneous presentations (1.594), $F(1,19)=23.66$, $p<.001$. No interactions were significant.

Figure 1 shows mean recall performance in each of the experimental conditions. Homogeneous-heterogeneous effects occurred in both Spanish and English. The contiguous condition resulted in better recall than the interleaved condition in both languages.

Data were also analyzed using a 2(homogeneous-heterogeneous) x 2(contiguous-interleaved) x 2(Spanish-English Language of Presentation) ANOVA for semantic integration of passage categories. The sequence of recall was tabulated for each subject according to the passage from which each proposition was recalled. A semantic integration (passage clustering) percentage was calculated by dividing the number of proposition-to-proposition transitions that were from the same passage by the total number of transitions in the subject's recall protocol minus the number of required "different passage" transitions. A high integration score indicated that the subject tended to report propositions from one passage first, followed by propositions from another passage, and so forth. The percent integration score did not reflect the total number of propositions recalled; total correct recall was analyzed previously.

Semantic integration scores for passages presented in a homogeneous condition (same language) were significantly higher than those for passages presented in the

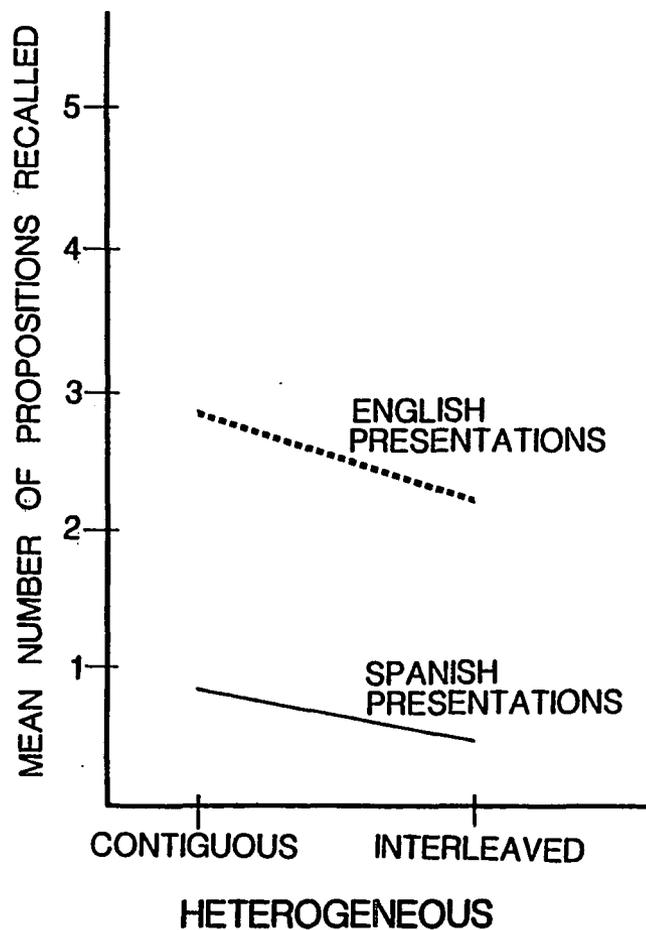
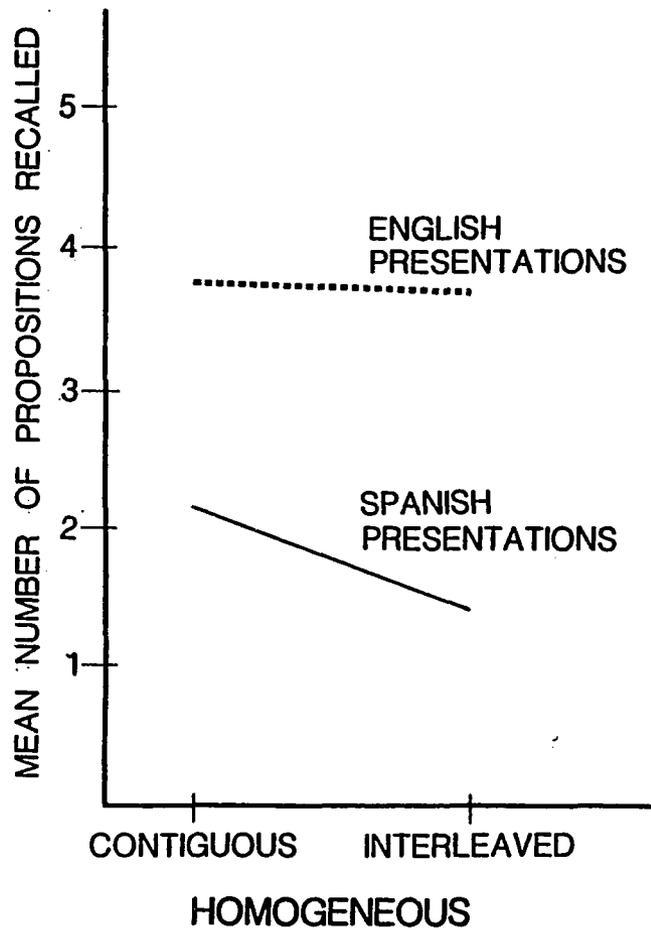
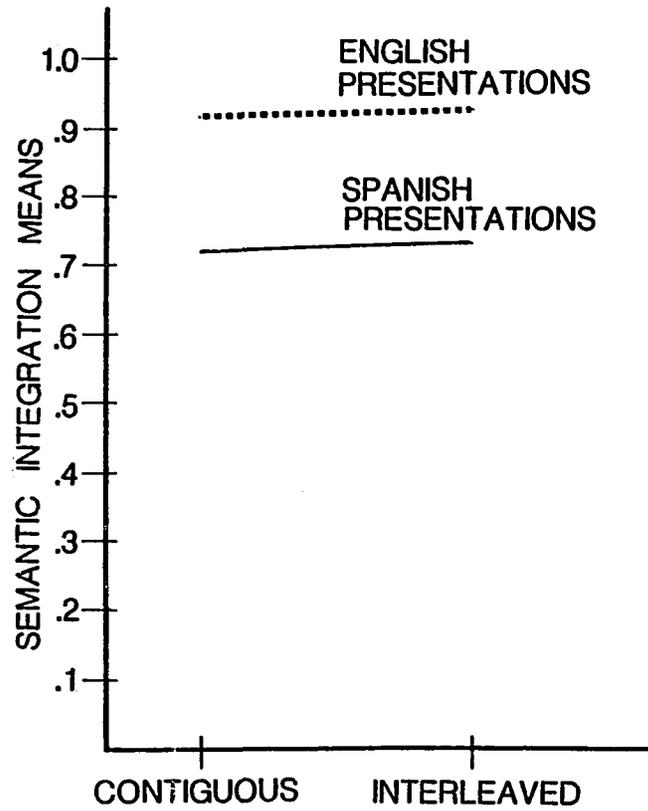


FIGURE 1 MEAN RECALL PERFORMANCE IN EXPERIMENT 1

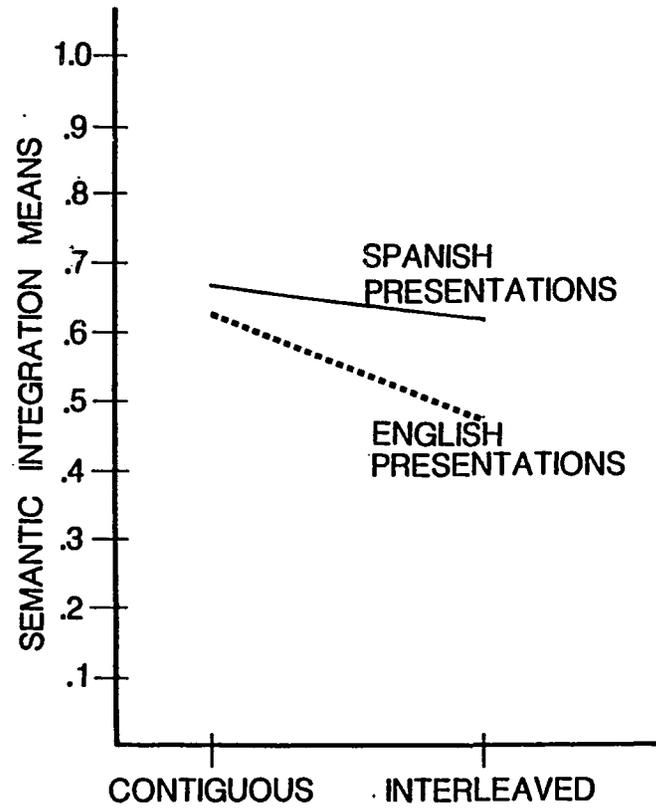
heterogeneous conditions (propositions divided between both languages), $F(1,19)=18.15$, $p<.001$. Passages presented in the homogeneous condition averaged 82.6% integration, and passages presented in the heterogeneous condition 59.8%. Notably, passages presented in the contiguous condition were not significantly better integrated than passages presented in the interleaved form (73.4% compared to 68.9%). Language of presentation (Spanish vs. English) was not significant as a main effect (68.6% for Spanish compared to 73.8% for English). The homogeneous-heterogeneous x Spanish-English Language of Presentation interaction, however, was significant, $F(1,19)=7.70$, $p<.05$.

Figure 2 shows mean semantic integration scores for all conditions. Homogeneous presentations resulted in greater integration than heterogeneous presentations. In the homogeneous language conditions, contiguous and interleaved passages were equally well integrated. In the heterogeneous language conditions, interleaved presentation lead to somewhat less integration than did contiguous. The two-way interaction, however, did not prove statistically reliable.

The most notable feature of the semantic integration results is the interaction between language of presentation and homogeneous vs. heterogeneous language within a passage. Propositions from passages presented in English



HOMOGENEOUS



HETEROGENEOUS

FIGURE 2 MEAN SEMANTIC INTEGRATION SCORES IN EXPERIMENT 1

were better integrated than those presented in Spanish in the homogeneous condition. However, in the heterogeneous condition, propositions presented in English were less well integrated into passages than were those presented in Spanish -- a complete reversal from the homogeneous presentation conditions.

DISCUSSION

Spanish-English bilinguals, given a choice as to language of recall of encoded information, used predominantly English. One possibility is that being aware that information could later be reported in either language (or both), subjects translated all sentences into the preferred language. For these subjects, the preferred language appeared to be English. Alternatively, propositions read in either language may have been encoded into a "universal" semantic representation. This semantic information was retrieved, and reported in the language of the subject's choosing at the time of recall test.

Another point of interest was that these subjects rarely recalled a single proposition in an English-Spanish combination. Only on rare occasions, where apparently subjects had trouble translating certain words, were responses in a mixed language combination.

Homogeneous-heterogeneous presentation conditions had strong effects on both the amount recalled and the degree of semantic integration. Propositions presented in English resulted in better recall and better integration than propositions presented in Spanish when all propositions for a passage were presented in one language. In the

heterogeneous condition, recall was better for English presented propositions, but Spanish presented propositions were better integrated into passages in recall. Because most responses were written in English, English would appear to have been the dominant language for this subject sample. The fact that propositions presented in English were better recalled in both homogeneous and heterogeneous conditions may simply reflect this language bias. However, the fact that Spanish presented propositions were better integrated in the heterogeneous conditions suggests some real difference in the way these propositions were encoded and/or retrieved. Perhaps the relatively few Spanish propositions recalled reflected a deeper, more semantically based encoding/retrieval process, in the context of predominantly English responses. Recall of English propositions may have relied less on semantically coded information, thus evidencing less semantic integration. These questions are investigated further in the next experiment where language or recall is specified, rather than being left to the subject's choice.

EXPERIMENT II

Experiment I indicated that textual passages presented contiguously and in one language will result in better proposition recall than when propositions from several passages are interspersed and presented in two languages. A deficiency of this experiment, however, was that subjects were given a free choice as to the language of recall. All but three subjects reported their responses in just one language, which was English. It is unclear whether subjects initially encoded all propositions in English (by translating Spanish propositions) or in some universal semantic form that subjects later chose to report in English.

Experiment II was nearly an exact replication of Experiment I. The purpose for Experiment II was to investigate whether different information processing strategies would be used if subjects were informed that either language (Spanish or English) might be required in recall. The hypothesis here was that if bilinguals do not know which language information is going to be recalled in, then different integration and/or retrieval strategies will be implemented. If subjects encode bilingual information

into a single, universal semantic representation, language of recall should have little or no effect on this encoding. Language tags, if encoded during reading of passages, might affect recall by providing (weak) retrieval links among same language propositions.

METHOD

Subjects

Twenty two bilingual male and female college students from the University of Arizona and Pima Community College (Tucson, Arizona) participated in this experiment. Two subjects were dropped from the experiment because they failed to follow instructions. Subjects for Experiment II came from the same subject population as for Experiment I, but no subject participated in both experiments. As indicated by Experiment I, subjects appeared generally to be more dominant in English than in Spanish.

Language Dominance

An attempt was made to determine language dominance of the bilingual subjects who participated. Several different assessment methods were used. One method was that of Johnson (1953) which measures language by asking bilinguals to write down as many words as they can during a five minute period, first in one language and then in the other. The relative number of words in each language is taken to be the index of language dominance. (See Appendix C.)

Another method used to assess language dominance was a questionnaire which asked subjects to rate themselves

as to degree of bilingualism, number of years of English and Spanish formal instruction, language first spoken, language spoken at home, and degree of competency in each language.

Various other techniques have been used to determine language dominance (Cattell, 1887; Nott and Lambert, 1968; Lambert, 1955; Young and Navar, 1968; Kintsch, 1970; Wickens and Millward, 1971; and Lopez and Young, 1974). At present there is no method or technique available for language dominance assessment that offers adequate reliability and validity. The Johnson (1953) technique was used in this experiment because it was easier to administer and interpret, and not because it was any better than the others.

Materials

The same 189 sentences used by Kieras (1978) and the 7 sentences created for Experiment I and their Spanish translations were used in Experiment II. Propositions (sentences) were presented exactly as they were in Experiment I, under the same experimental conditions.

Procedure

Subjects participated in a group. Standardized instructions were read (in English) to the group. They were told that the experiment was concerned with how people read and remember information. (See Appendix D.)

Subjects were told that after they had read all of the sentences in a booklet they were to turn to the instruction sheet which would tell them in what language recall responses had to be written for that booklet. They were instructed that there were three options: 1) "Report all recall in Spanish"; 2) "Report all recall in English"; 3) "Report sentences presented in Spanish in Spanish and those presented in English in English". These options were explained thoroughly before subjects began reading. Subjects' questions concerning the procedures were answered in Spanish and in English before the experiment was run.

Once subjects had read the sentences and instructions for language of recall, they wrote on the rule-lined sheet as many of the 28 propositions as they could recall. No time limit was set, but the experimenter did not allow more than 10 minutes for recall. This time was sufficient as no subject was ever stopped from writing any further. A two-minute rest period was then provided before the next booklet was presented.

The first booklet for all subjects was a warm-up session presented in the contiguous homogeneous (CS) order. All subjects received identical booklets with instruction at recall that they were to "report sentences presented in Spanish in Spanish and those presented in English in English". Data from these booklets were used as an

additional measure of Spanish-English proficiency by comparing the number of propositions recalled in each language.

The remaining four booklets, one for each of the experimental conditions, were randomly assigned to Spanish or English recall instruction such that each subject had two booklets that called for Spanish recall and two booklets that called for English recall. The order of Spanish and English recalls was random for each subject.

Scoring

Response sheets were scored by three bilinguals who determined whether propositions presented were recalled correctly. A correct response was one in which propositions were recalled in the language required by instructions. Responses did not have to be reported verbatim. At least two of the three scorers had to agree that the proposition had been recalled correctly.

RESULTS

Results of the three methods of assessing language dominance are presented in Table 2. Measures based on the Johnson (1953) method showed little correspondence with the self report questionnaire. Neither method correlated significantly with the warm-up session recall performance. There was considerable variance from subject to subject in all methods. Overall, subjects produced slightly more words in English than in Spanish. They also rated themselves as approximately equally proficient in Spanish and English. While Spanish was predominantly the first language, and the language spoken at home, the majority of formal education was in English. In the warm-up task, more Spanish propositions (a total of 108) were recalled overall than English propositions (a total of 88), which might suggest that these bilingual subjects were more Spanish proficient. However, the subjects in Experiment I, which came from the same subject population, overwhelmingly chose English when given a choice of language for recall.

Correlating the number of words generated in each language by each subject, to the number of years of schooling in that language as reported in the questionnaire,

Subject	Johnson (1953)			Questionnaire Responses					Warm-Up Session	
	Total Word Count	% Words in English	% Words in Spanish	Bilingual Self Measure 1 = Spanish 7 = English	Years of English Education	Years of Spanish Education	Home Language + = Spanish - = English	First Language Spoken + = Spanish - = English	# of Propositions Recalled in English	# of Propositions Recalled in Spanish *
1.	124	61.2	38.8	3	16	0	-	-	7	7
2.	218	53.6	46.4	3	14	14	+	+	4	7
3.	207	46.8	53.2	1	6	14	+	+	4	5
4.	153	56.8	43.2	5	9	0	-	+	4	7
5.	128	57.8	42.2	5	17	6	+	+	0	3
6.	148	54.0	46.0	4	12	5	-	+	2	8
7.	63	38.0	62.0	4	6	3	+	+	2	0
8.	118	55.9	44.1	4	20	1	-	+	4	3
9.	212	42.0	58.0	1	2	18	+	+	7	8
10.	128	64.8	35.2	3	3	9	+	+	2	6
11.	63	47.6	52.4	4	15	15	+	+	2	5
12.	123	51.2	48.8	4	8	7	-	+	4	4
13.	124	46.7	53.3	4	14	1	-	+	9	11
14.	158	59.5	40.5	5	14	2	+	+	2	3
15.	162	57.4	42.6	4	14	6	+	-	4	4
16.	174	56.3	43.7	4	13	2	-	+	8	9
17.	211	51.1	48.9	4	13	3	-	+	7	6
18.	124	64.5	35.5	4	13	4	+	+	1	2
19.	137	51.8	48.2	3	2	9	+	+	10	6
20.	135	53.3	46.7	6	20	0	+	+	5	4

Table 2. Results of Attempts to Measure Language Dominance.

*Total possible= 14 in English and 14 in Spanish.

failed to produce any significant coefficients. Correlations with other information provided in the questionnaire also failed to provide any significant relationships. Thus, language proficiency of the bilingual subjects in this experiment was not determined with any degree of consistency. It does seem clear, however, that the bilinguals who participated in these experiments were capable of reading, understanding, and writing both languages.

Data for the CS, CD, IS, and ID experimental conditions were again analyzed in two ways. An ANOVA for all recall responses in Experiment II was run. A $2 \times 2 \times 2$ within $\times 2$ between ANOVA with homogeneous-heterogeneous, contiguous-interleaved, Spanish-English Language of Presentation and Spanish-English Language of Recall, respectively was performed. Only one main effect variable was reliable. Homogeneous-heterogeneous effects were significant, $F(1,18)=6.67$, $p<.05$, with the former resulting in more recall (3.938 propositions vs. 3.3138). The three way interaction of language of presentation \times language of recall \times homogeneous-heterogeneous was significant, $F(1,18)=9.06$, $p<.01$.

Figure 3 shows mean proposition recall per passage for all experimental conditions. Homogeneous-heterogeneous effects are clearly not important when the language of presentation is different from the language of recall.

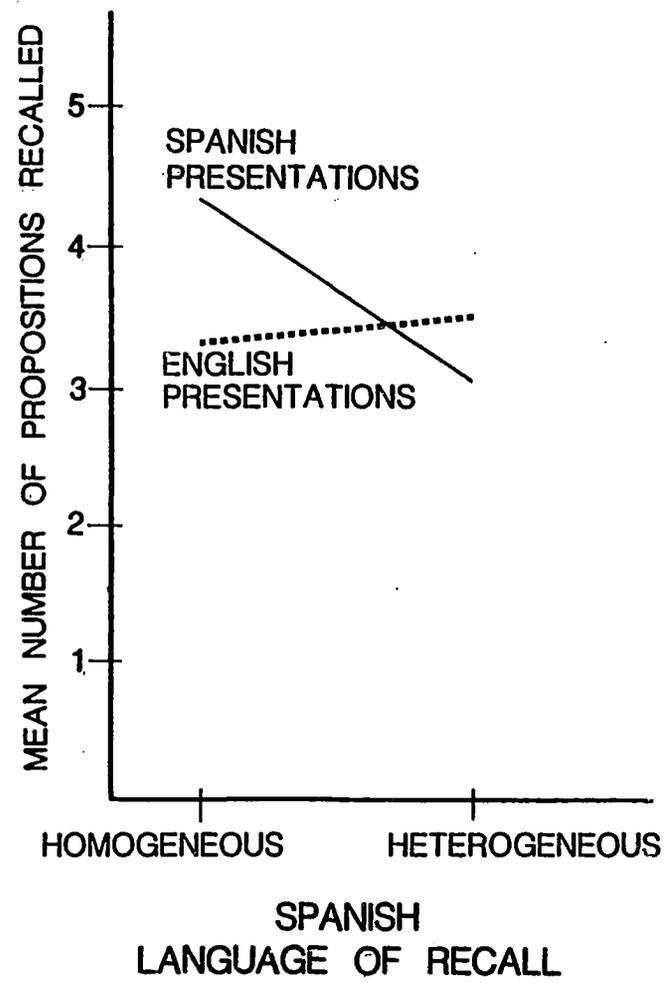
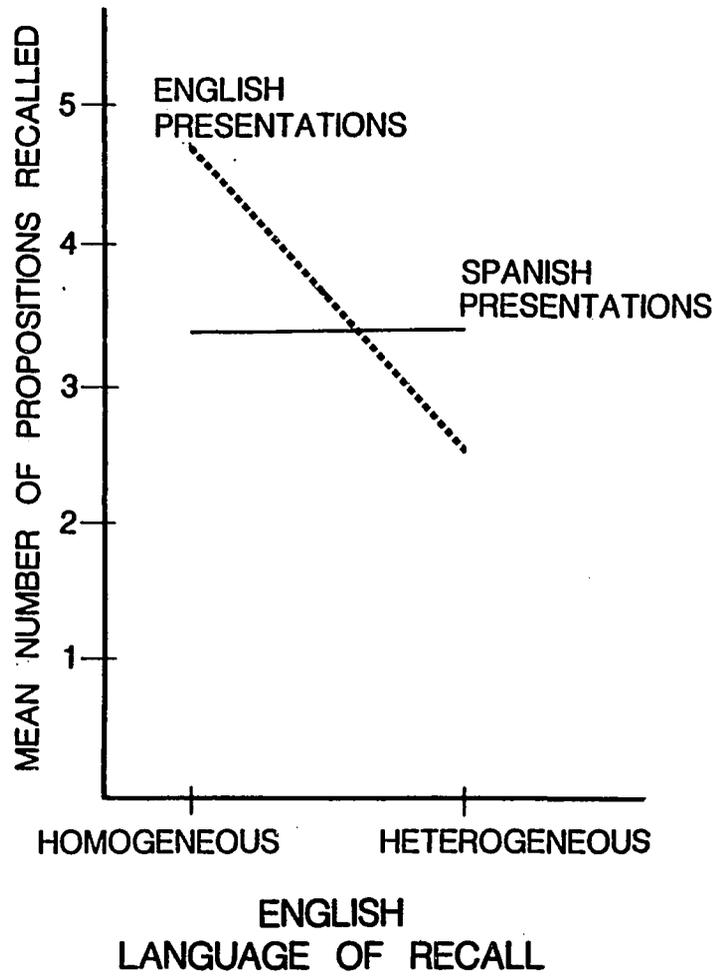


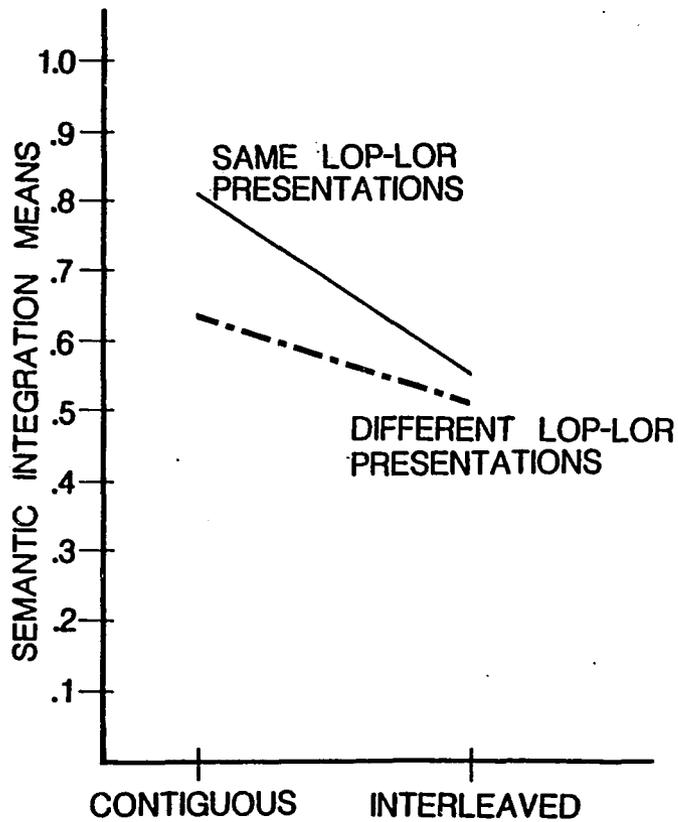
FIGURE 3. MEAN PROPOSITION RECALL PER PASSAGE IN EXPERIMENT II

It does have, however, a very significant effect in both English and Spanish when the language of recall and presentation are the same.

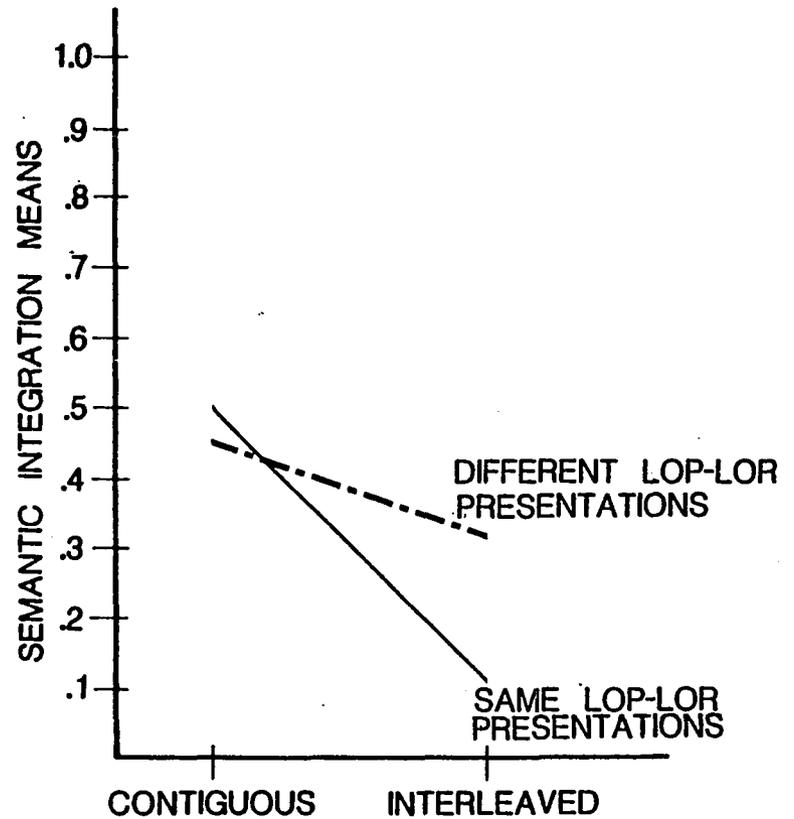
An ANOVA was also performed for semantic integration (clustering) of recall in each of the passage-order conditions. Responses were tabulated for each subject to gauge the extent to which the subject had reported propositions grouped as passages. An integration percentage score was calculated in the same way as was done in Experiment I.

A 2(homogeneous-heterogeneous) x 2(contiguous-interleaved) x 2(same-different language of presentation/language of recall) ANOVA was run for the coherence scores. Integration of passages presented in the homogeneous conditions was significantly better (62.6%) than for the heterogeneous presentations (35.4%), $F(1,19)=25.48$, $p<.001$. Contiguous presentations lead to significantly greater integration (60.0%) than interleaved presentations (38.0%), $F(1,19)=10.52$, $p<.01$. Same-different language of presentation /language of recall conditions did not differ significantly and no interactions were found to be statistically significant.

Figure 4 shows the mean semantic integration scores for the experimental conditions. In the homogeneous conditions, propositions presented and recalled in the same



HOMOGENEOUS



HETEROGENEOUS

FIGURE 4 MEAN SEMANTIC INTEGRATION SCORES IN EXPERIMENT II

LOP; LANGUAGE OF PRESENTATION
LOR; LANGUAGE OF RECALL

language had better integration than propositions presented and recalled in different languages. In the heterogeneous conditions, however, results tended in the opposite direction. Propositions presented and recalled in the same language resulted in less integration than propositions presented and recalled in different languages. This effect is primarily due to the interleaved condition, where different language propositions were substantially better integrated into passages than were same language propositions.

DISCUSSION

The various attempts to determine language dominance did not result in any clear evidence concerning the language proficiency of the bilinguals who participated in this experiment. It had been expected, because these subjects were selected from the same population as those in Experiment I, that subjects would evidence greater proficiency in English than in Spanish. The results did not confirm this expectation. The Johnson (1953) method indicated a slight dominance of English, the self rating slightly favored Spanish, and the warm-up test results favored Spanish as the dominant language. These subjects may have been relatively balanced in English and Spanish proficiency, or the tests used may have been insensitive to language dominance differences. No clear conclusions can be derived from the attempt to assess language dominance.

Results for recall responses in Experiment II were very different from Experiment I results. Experiment II resulted in better overall recall than Experiment I. This occurred in spite of what would seem to be stringent recall requirements; i.e., the language of recall was specified by the experimenter, not chosen by the subject.

The grand mean for Experiment II was 3.358 propositions as compared with a grand mean of 2.169 propositions for Experiment I. Further, the contiguous-interleaved conditions resulted in no significant differences in the number of propositions recalled, although contiguous passages were better integrated than interleaved passages. Also, homogeneous vs. heterogeneous conditions produced different recall performance only when the language of presentation was the same as the language of recall. When propositions were recalled in the opposite language from that in which they had been presented, heterogeneous passages were recalled as well as homogeneous passages. Different language recall resulted in better semantic integration in the heterogeneous interleaved condition as compared to same language recall. It should be noted that results must be attributed to factors operating at the time of recall, as encoding conditions could not have been affected -- language of recall was not specified until the time of the recall test.

GENERAL DISCUSSION

The Spanish-English bilinguals who participated in the two experiments described here were capable of performing the tasks required of them. There is no consistent evidence that they were dominant in one particular language or that a language bias might, by itself, account for the differences observed in recall and semantic integration performance.

Reading materials presented contiguously resulted in better recall than information presented with passages in the interleaved condition in Experiment I, which parallels Kieras' (1978) findings. As encoding of information presented contiguously takes place, strong semantic links are formed, as indicated by high semantic integration scores. These semantic links facilitate subsequent retrieval, and result in better recall. Semantic links for interleaved propositions are much weaker (as compared to contiguous passages), thus reducing the probability that propositions will be retrieved and recalled.

In Experiment II, contiguous and interleaved conditions resulted in equal propositional recall performance. Knowing that recall could be required in either language, or in the language of presentation, subjects may have

devoted relatively more effort to encoding the propositions and tagging them for language of recall. Thus, while semantic integration was slightly poorer in Experiment II, especially in the interleaved conditions, overall recall was better.

The homogeneous-heterogeneous conditions in this study are areas of research that have not been previously studied. It had been assumed that presenting information in one language would result in less processing load and better recall and integration than presenting information in two languages. Again, it was believed that stronger semantic links would be built during encoding of the propositions for information presented in only one language and that this would involve less processing load. This assumption was shown to be true only part of the time. When information was presented in the same language as was used in recall, homogeneous passages were recalled much better than heterogeneous. However, when information was presented in one language and recalled in the other language heterogeneous passages were recalled as well as homogeneous. This suggests that homogeneously presented information is not more efficiently encoded during reading but it may result in more retrieval cues being available during recall, if recall is in the language of presentation.

When propositions are presented contiguously and in only one language, encoding of these propositions results in both semantic and language links being built. If recall is in the same language as that of presentation, then during recall subjects can make use of both semantic and language links, resulting in high levels of recall and passage integration. Semantic and language links combine to increase the probability of a proposition being recalled during retrieval because both links provide routes for propositions from a passage to be linked in memory.

If the language of recall is different from the language of presentation, propositions will still be related by both semantic and language links. However, during retrieval subjects benefit less from the language links because they are recalling in the other language. This results in lower recall as compared with conditions where semantic and language links between propositions within a passage are redundant.

If passages are presented in two languages during encoding and then are recalled in only one language, only half of the propositions for any particular story will be recalled in the language of presentation. This condition produced much lower levels of recall and semantic integration than did any of the homogeneous language conditions.

During retrieval, subjects could make use of semantic links as well as language links. However, language links connected only half of the propositions for any passage. This condition could have resulted in better recall and integration, if subjects exploited both types of retrieval routes in recall. On the contrary, however, the availability of language links for half the propositions in same language conditions lead to reduced recall and integration compared to different language recall. Perhaps having only some of a passage's propositions connected by language links lead subjects to follow associative "blind alleys" in retrieval.

These results support the theory that information is stored not only as concepts but that language markers can be attached as well. The traditional two-model theory of structure of memory for bilinguals (one universal core vs two cores-- one for each language) is incapable of accounting for the data in this study. The one core model says that information is stored in some universal language where only concepts are stored-- free of any language labels. This model would predict that subjects would have a very difficult time responding correctly in Experiment II because subjects would not be able to carry language specificities and would not remember in which language certain propositions had been presented once

they had been encoded. The data in this study certainly does not support this model since subjects were very capable of remembering the language of presentation (as indicated by the warm-up task).

The two-core model comes closer to predicting the data in this study. That is, that information learned in Spanish is encoded into concepts stored in a Spanish core and information learned in English is stored in an English core. This model, however, has generally received less acceptance and support from researchers because it implies that two completely separate systems exist within the body. Not only is this idea intuitively incongruent (gives a notion of a Dr. Jekyll and Mr. Hyde perspective of the world) but it is also very inefficient from an information processing viewpoint. This model in effect calls for duplicity of encoding and retrieval functions which sounds rather unrealistic.

A third model is necessary. A model that allows information to be stored as concepts in a universal memory core but that allows for efficient use of language markers, tags, or whatever name language specificity labels might take, is more realistic. Anderson and Bower (1974) conducted a study where information was presented in active and passive voices and which investigated whether subjects could recall language surface structures and obtained results very similar to those in this study. Subjects

were able to recall quite well how information had been originally presented.

Results from Experiments I and II and the Anderson and Bower data support the notion that an alternative model is necessary. A model that allows for a universal semantic core that can also allow for language markers to be processed along with the information is a more realistic representation of how human information processing works. Such a model would also require that language markers be erased as time progressed from the instance of original encoding. If not, the model would predict that information is stored such that language markers are permanently attached to the information. This notion is very similar to the two-core model which has already been rejected.

Further studies should be made to investigate how long language markers attached to encoded information can be held or at which point these markers become lost for retrieval purposes. Future studies should also look at reading times and recall times to investigate how these variables affect recall rate and coherence. Also, future research should replicate this study with bilinguals who speak various language combinations to determine whether the results produced from this study are generalizable to other bilingual populations.

Regardless of what directions future information processing studies using bilingual subjects take, it is very important that they be coordinated, or at least directed, towards a common objective so that each study may be related to other studies such that together they increase our understanding of how bilinguals process information.

The results of these two experiments may also have indirect application for Bilingual Education. These results support the hypothesis that bilinguals may benefit from Bilingual Education. In Experiment II the attempt to overload the system by presenting information incoherently and in two languages resulted in more overall recall than in Experiment I where processing load was assumed to be smaller or not as difficult. It was suggested that these results were due to subjects using both semantic and language links during recall and that together these resulted in better recall. If this is indeed the case, then bilinguals having learned a concept bilingually have more retrieval possibilities than monolinguals. More research in basic information processing comparing bilinguals to monolinguals should be run to investigate information processing. Also future research should study reading times and reaction/recognition times to better understand the effectiveness and efficiency of Bilingual Education. Results from studies such as the ones suggested

here may not only provide some answers to questions involving bilinguals, but they can also help develop better methods for teaching a second language. Perhaps if more people spoke more common languages, communication would improve and this sad world would become a better place to live in.

APPENDIX A

PROPOSITIONS USED IN EXPERIMENTS I AND II
AND SPANISH TRANSLATIONS (KIERAS, 1978)

The towtruck was green.	A1	El troque de remolque era verde.
The towtruck was on the freeway.	A2	El troque de remolque estaba en la carretera.
The car was abandoned.	A3	El carro estaba abandonado.
The car was leaking water.	A4	El carro estaba tirando agua.
The towtruck towed the car.	A5	El troque de remolque jalo el carro.
The freeway was closed.	A6	La carretera estaba cerrada.
The water was rusty.	A7	El agua estaba enmohecida.
The lion tamer was sloppy.	B1	El domador de tigres era descuidado.
The lion tamer was carrying the whip.	B2	El domador de tigres traia un latigo.
The train was noisy.	B3	El tren hacia mucho ruido.
The train was pulling the dining car.	B4	El tren jalaba el carro donde se come.
The lion tamer boarder the train.	B5	El domador de tigres abordo el tren.
The whip was short.	B6	El latigo era corto.
The dining car was crowded.	B7	El carro donde se come estaba lleno.
The student was drunk.	C1	El estudiante estaba borracho.
The student was playing the guitar.	C2	El estudiante estaba tocando la guitarra.
The wine was cheap.	C3	El vino era barato.
The wine was in the bottle.	C4	El vino estaba en la botella.
The student drank the wine.	C5	El estudiante se tomo el vino.
The guitar was out of tune.	C6	La guitarra estaba desafinada.

The bottle was brown.	C7	La botella era color cafe.
The ants were hungry.	D1	Las hormigas tenian hambre.
The ants were in the kitchen.	D2	Las hormigas estaban en la cocina.
The jelly was grape.	D3	La jalea era sabor de uva.
The jelly was on the table.	D4	La jalea estaba en la mesa.
The ants ate the jelly.	D5	Las hormigas se comieron la jalea.
The kitchen was spotless.	D6	La cocina estaba muy limpia.
The table was wooden.	D7	La mesa era de madera.
The policeman was retired.	E1	El policia estaba retirado.
The policeman was aiming his revolver.	E2	El policia apuntaba su pistola.
The thief was young.	E3	El ladron era joven.
The thief was drinking in the bar.	E4	El ladron tomaba en la cantina.
The policeman arrested the thief.	E5	El policia detuvo al ladron.
The revolver was heavy.	E6	La pistola estaba pesada.
The bar was deserted.	E7	La cantina estaba sola.
The avalanche was destructive.	F1	El avelanche fue destructivo.
The avalanche was caused by a boulder.	F2	El avelanche fue causado por una piedra grande.
The inn was new.	F3	El hotel era nuevo.
The inn was near the highway.	F4	El hotel estaba cerca de la carretera.
The avalanche missed the inn.	F5	El avelanche erro al hotel.
The boulder was gigantic.	F6	La piedra era grandisima.
The highway was narrow.	F7	La carretera estaba muy angosta.
The singer was beautiful.	G1	La cantante era hermosa.
The singer was sitting on the piano.	G2	La cantante estaba sentada en el piano.
The audience was enthusiastic.	G3	El publico estaba entusiasta.
The audience was drinking beer.	G4	El publico tomaba cerveza.

The singer entertained the audience.	G5	La cantante le gusto al publico.
The piano was shiny.	G6	El piano estaba relumbroso.
The beer was cheap.	G7	La cerveza estaba barata.
The farmer was sunburned.	H1	El granjero estaba quemado por el sol.
The farmer was plowing the field.	H2	El granjero estaba arrando el campo.
The deer was jittery.	H3	El venado estaba nervioso.
The deer was in the orchard.	H4	El venado estaba en la granja.
The farmer spotted the deer.	H5	El granjero miro el venado.
The field was muddy.	H6	El campo estaba lleno de soquete.
The orchard was dense.	H7	La granja estaba tupida.
The countess was rich.	I1	La condesa era rica.
The countess was wearing the coat.	I2	La condesa traiba puesta el abrigo.
The doorman was polite.	I3	El portero fue cortez.
The doorman was in front of the hotel.	I4	El portero estaba en frente del hotel.
The countess smiled at the doorman.	I5	La condesa le sonrio al portero.
The coat was mink.	I6	El abrigo era de mink.
The hotel was exclusive.	I7	El hotel era exclusivo.
The banker was dignified.	J1	El banquero tenia dignidad.
The banker was wearing the vest.	J2	El banquero vestia un chaleco.
The invoice was yellow.	J3	La factura era amarilla.
The invoice was for the shipment.	J4	La factura era para el cargamento.
The banker inspected the invoice.	J5	El banquero inspecciono la factura.
The vest was brown.	J6	El chaleco era color cafe.
The shipment was of gold.	J7	El cargamento era oro.

The lifeguard was pale.	K1	El salvavidas estaba palido.
The lifeguard was painting the body.	K2	El salvavidas estaba pintando el cuerpo.
The dog was hairless.	K3	El perro no tenia pelo.
The dog liked the children.	K4	El perro queria a los ninos.
The lifeguard teased the dog.	K5	El salvavidas fastidio al perro.
The body was rusted.	K6	El cuerpo estaba enmohecido.
The children were noisy.	K7	Los ninos hacian mucho ruido.
The toaster was defective.	L1	El tostador de pan no servia.
The toaster was near the plant.	L2	El tostador de pan estaba cerca de la mata.
The table was wobbly.	L3	La mesa no era fuerte.
The table was by the fuse box.	L4	La mesa estaba cerca de la caja de electricidad.
The toaster scorched the table.	L5	El tostador de pan quemó la mesa.
The plant was wilted.	L6	La mata se murio.
The fuse box was smoking.	L7	La caja de electricidad estaba humeando.
The writer was profound.	M1	El escritor era profundo.
The writer was sitting on the stool.	M2	El escritor estaba sentado en el banquillo.
The announcer was bored.	M3	El anunciador estaba enfadado.
The announcer was tapping on the mike.	M4	El anunciador estaba golpeando el microfono.
The writer talked to the announcer.	M5	El escritor hablo con el anunciador.
The stool was padded.	M6	El banquillo estaba entapicado.
The mike was sensitive.	M7	El microfono era sensitivo.
The lobster was aggressive.	N1	La langosta era agresiva.
The lobster was hiding in the sand.	N2	La langosta estaba escondida en la arena.
The turtle was green.	N3	La tortuga era verde.

The turtle was under the seaweed.	N4	La tortura estaba debajo de la alga marina.
The lobster grabbed the turtle.	N5	La langosta agaro a la tortuga.
The sand was white.	N6	La arena era blanca.
The seaweed was tangled.	N7	La alga marina estaba enrredada.
The ghost was pale.	01	El espanto era palido.
The ghost was from the tomb.	02	El espanto era de la tumba.
The child was young.	03	El nino era joven.
The child was walking in the forrest.	04	El nino estaba caminando en el bosque.
The ghost terrified the child.	05	El espanto asusto al nino.
The tomb was ancient.	06	La tumba era antigua.
The forest was dark.	07	El bosque estaba obscuro.
The racketeer was arrogant.	P1	El raquetero era arrogante.
The racketeer was ignoring the lawyer.	P2	El raquetero estaba ignorando al abogado.
The judge was bald.	P3	El juez era calvo.
The judge banged the gavel.	P4	El juez golpeo la mesa con la gavela.
The racketeer angered the judge.	P5	El raquetero hizo enojar al juez.
The lawyer was dedicated.	P6	El abogado era dedicado.
The gavel was mahogany.	P7	El martillo era de caoba.
The grandmother was proud.	Q1	La abuela estaba orgullosa.
The grandmother was making a cake.	Q2	La abuela estaba haciendo un pastel.
The baby was cheerful.	Q3	El bebe estaba contento.
The baby was playing with the rattle.	Q4	El bebe jugaba con la sonaja.
The grandmother watched the baby.	Q5	La abuela cuidaba al bebe.
The cake was chocolate.	Q6	El pastel era de chocolate.

The rattle was blue.	Q7 La sonaja era azul.
The beggar was cold.	R1 El limosnero tenia frio.
The beggar was playing with the accordion.	R2 El limosnero tocaba el acordeon.
The watch was valuable.	R3 El reloj era caro.
The watch was in the guitar.	R4 El reloj estaba en la zanja.
The beggar found the watch.	R5 El limosnero hallo el reloj.
The accordion was dilapidated.	R6 El acordeon era viejo.
The gutter was filled with rubbish.	R7 La zanja estaba llena de basura.
The destroyer was fast.	S1 El destructor era rapido.
The destroyer was seeking the submarine.	S2 El destructor buscaba al submarino.
The convoy was large.	S3 El convoy era largo.
The convoy was carrying oil.	S4 El convoy llevaba petroleo.
The destroyer protected the convoy.	S5 El destructor protegia al convoy.
The submarine was german.	S6 El submarino era aleman.
The oil was vital.	S7 El petroleo era muy importante.
The detective was shrewd.	T1 El detective era astuto.
The detective was smoking a cigar.	T2 El detective estaba fumando un puro.
The corpse was unidentified.	T3 El cadaver no fue identificado.
The corpse was in the morgue.	T4 El cadaver estaba en la funeraria.
The detective examined the corpse.	T5 El detective examino el cadaver.
The cigar was imported.	T6 El puro era importado.
The morgue was quiet.	T7 La funeraria estaba silencia.
The sorceror was angry.	U1 El brujo estaba enojado.
The sorceror was carrying a wand.	U2 El brujo llevaba un palo magico.
The witch was laughing.	U3 La bruja estaba riendo.

The witch was in the tower.	U4	El brujo estaba en la torre.
The sorcerer zapped the witch.	U5	El brujo mato a la bruja.
The wand was black.	U6	El palo magico era negro.
The tower was gloomy.	U7	La torrer estaba oscura.
The bishop was tired.	V1	El obispo estaba cansado.
The bishop was wearing the cape.	V2	El obispo usaba una capa.
The school was unfinished.	V3	La escuela no se terminaba.
The school was by the river.	V4	La escuela estaba cerca del rio.
The bishop blessed the school.	V5	El obispo bendijo la escuela.
The cape was red.	V6	La capa era roja.
The river was wide.	V7	El rio era ancho.
The carpenter was sick.	W1	El carpintero estaba enfermo.
The carpenter was in the bus.	W2	El carpintero estaba en el camion.
The trumpet was tarnished.	W3	La trompeta estaba manchada.
The trumpet was in the briefcase.	W4	La trompeta estaba en un portafolio.
The carpenter played the trumpet.	W5	El carpintero toco la trompeta.
The bus was wrecked.	W6	El camion fue chocado.
The briefcase was leather.	W7	El portafolio era de cuero.
The canister was oblong.	X1	El bote era oblongo.
The canister was filled with foam.	X2	El bote estaba lleno de espuma.
The vault was hot.	X3	La boveda estaba caliente.
The vault had the time lock.	X4	La boveda tenia candado de tiempo.
The canister exploded in the vault.	X5	El bote exploto en la boveda.
The foam was toxic.	X6	La espuma era toxica.
The time lock was accurate.	X7	El candado de tiempo era presiso.
The doctor was worried.	Y1	El doctor estaba preocupado.

The doctor was using the microscope.	Y2	El doctor usaba el microscopio.
The bacteria was dangerous.	Y3	La bacteria era peligrosa.
The bacteria were in the sample.	Y4	La bacteria estaba en la muestra.
The doctor studied the bacteria.	Y5	El doctor estudio la bacteria.
The microscope was elaborate.	Y6	El microscopio era complejo.
The sample was of blood.	Y7	La muestra era de sangre.
The mechanic was skilled.	Z1	El mecanico era habil.
The mechanic was wearing coveralls.	Z2	El mecanico usaba pantalones de pecho.
The engine was heavy.	Z3	El motor era pesado.
The engine was from the truck.	Z4	El motor era de troque.
The mechanic overhauled the engine.	Z5	El mecanico re-constuyo el motor.
The coveralls were greasy.	Z6	Los pantalones de pecho estaban llenos de grasa.
The truck was large.	Z7	El troque era grande.
The maiden was kind.	AA1	La muchacha era buena.
The maiden was tending the geese.	AA2	La muchacha cuidaba los gansos.
The fox was exhausted.	AA3	La zorra estaba fatigada.
The fox was being haunted by the baron.	AA4	El baron casaba a la zorra.
The maiden rescued the fox.	AA5	La muchacha rescato a la zorra.
The geese were noisy.	AA6	Los gansos eran ruidosos.
The baron was cruel.	AA7	El baron era cruel.
The boy was ugly.	BB1	El nino era feo.
The boy was in the airplane.	BB2	El nino estaba en el avion.
The bomb was blue.	BB3	La bomba era azul.
The bomb was on the seat.	BB4	La bomba estaba en la silla.
The boy saw the bomb.	BB5	El nino miro la bomba.
The airplane was old.	BB6	El avion era viejo.
The seat was small.	BB7	La silla era chica.

APPENDIX B

INSTRUCTIONS FOR
EXPERIMENT I

This experiment is concerned with how people read and remember information in relatively simple stories under conditions where there is a lot of information to remember. You will be reading groups of four stories, one sentence at a time, and then attempting to recall the information in all four stories. We will repeat the entire process several times.

In more detail, here is what will happen: each of the five booklets in front of you presents one sentence at a time. In order to read each group of stories, you will first turn the cover page and will read each sentence in the order which it appears. After you have finished reading each sentence, you will turn to the next sentence, read it and continue until you have read all of the sentences in that booklet. Each story has seven sentences, and each group has four stories, so there are a total of 28 sentences in each group of four stories.

After you have read all 28 sentences, you are to write down on the yellow sheet all that you can remember of the four stories that you have just read. After you have done this please wait for further instructions. A rest period will be provided before the next booklet is negotiated.

So far, this does not sound particularly hard or interesting. Here's the catch: In each group of four stories, you will be reading about four separate events or situations, one for each story. As you will see, each story alone is very simple and describes a simple situation. The hard part is that you will have to discover while reading the sentences what each of the four situations are, and keep them straight, and then remember them until it is time to write them down. Sometimes this will seem easy, and you will be able to put each of the stories together without much trouble. Other times the sentences may seem mixed up and it may be hard to keep track of things. Also, the stories will vary between English and Spanish. It will always fit together, though. You will get a practice group to help you get the hang of this, but if it is not clear to you at this time what is going to be happening, please ask the experimenter now.

ANSWER QUESTIONS IN ENGLISH AND SPANISH.

Something that will make it easier is that you do not have to remember what you read perfectly; your recall does not have to be verbatim or word-for-word

exact. Do not try to remember the order in which you saw the original sentence. This is because when you recall, you should write what you remember for each story separately, so that your recall is grouped by story, so the original order is irrelevant. You must use complete sentences, but it is not necessary that they resemble the actual sentences that you read; we are only interested in your memory for the meaning of what you read. Your recall may be in either language, or both, or however you wish to retrieve the sentences.

PLEASE ASK THE EXPERIMENTER IF THESE GROUND RULES FOR RECALL ARE NOT CLEAR.

In summary, you will read and remember information from several groups of stories; each group will contain four stories each describing a simple event or situation. After you read all the sentences in a group, you will write down as much as you remember, in your own words, of the four stories. Sometimes, the information about the four stories will be hard to put together and you will have to work at keeping track of the information.

The first group will be for practice, followed by four other groups. Take as much time as you need on each sentence, but try not to take more than you really need. Also please do not go back once you have read a sentence. Also, do not go onto the next booklet until instructed to do so.

ANY QUESTIONS?

APPENDIX C

EXPERIMENT IIINSTRUCTIONS FOR LANGUAGE DOMINANTASSESSMENT MEASURE (JOHNSON, 1953)

This task involves generating English and Spanish words. When instructed, you will begin to write as many words as you can on the sheets of paper contained in the booklets in front of you. You will notice that some booklets contain instructions for Spanish words to be generated. The other booklet calls for English word responses. Half of you will provide Spanish words first, the other half will provide English words first. You will be told when to stop writing. Please cease writing as soon as you hear "stop". If you are in the middle of writing a word please do not continue.

Please keep your eyes only on your paper as you are writing. This is to prevent you from merely reporting items found in this room. The words you choose to write can be of any size or subject. We are interested in the total number of responses only.

ANY QUESTIONS?

GO!

APPENDIX D

INSTRUCTIONS FOR
EXPERIMENT II

This experiment is concerned with how people read and remember information in relatively simple stories under conditions where there is a lot of information to remember. You will be reading groups of four stories, one sentence at a time, and then attempting to recall the information in all four stories. We will repeat the entire process several times.

In more detail, here is what will happen: The folder in front of you contains five booklets. These booklets are in a special order so please work them as they are from top to bottom. Each booklet presents one sentence at a time. In order to read each group of stories, you will first turn the cover page and will read each sentence in the order which it appears. After you have finished reading each sentence, you will then turn to the next sentence, read it and continue until you have read all the sentences. You will then break the seal and read the "Recall Instruction Sheet." This will instruct you to write whatever you remember of the stories in either English, Spanish or both. You are then to write on the yellow ruled answer sheet all that you can remember of the stories that you have just read.

Each booklet contains four stories, and each story has seven sentences, so there are a total of 28 sentences in each booklet. When you are finished with the first booklet, wait for further instructions.

So far, this does not sound particularly hard or interesting. Here's the catch: In each group of four stories, you will be reading about four separate events or situations, one for each story. As you will see, each story alone is very simple and describes a simple situation. The hard part is that you will have to discover while reading the sentences what each of the four situations are, and keep them straight, and then remember them until it is time to write them down. Sometimes this will seem easy, and you will be able to put each of the stories together without much trouble. Other times the sentences may seem mixed up and it may be hard to keep track of things. Also the stories will vary between English and Spanish. It will always fit together though. You will get a practice group to help you get the hang of this; but if it is not clear at this time as to the procedures that you will follow, please ask now.

ANSWER QUESTIONS IN ENGLISH AND SPANISH.

Something that will make it easier is that you do not have to remember what you read perfectly; your recall does not have to be verbatim or word for word exact. Do not try to remember the order in which you saw the original sentence. This is because when you recall, you should write what you remember for each story separately, so that your recall is grouped by story, so the original order is inelevant. You must use complete sentences, but it is not necessary that they resemble the actual sentences that you read; we are only interested in your memory for the meaning of what you read. Sometimes you will be asked to write your responses in English only; sometimes in Spanish only; and other times in English and in Spanish.

PLEASE ASK THE EXPERIMENTER IF THESE GROUND RULES FOR RECALL ARE NOT CLEAR.

In summary, you will read and remember information from several groups of stories; each group will contain four stories, each describing a simple event or situation. After you read all the sentences in a group, you will write down as much as you remember, in your own words, of the four stories. There are five booklets in all.

The first group will be for practice, followed by four other groups. Take as much time as you need on each sentence but try not to take more than you really need. Also please do not go back once you have read a sentence. Also, do not go onto the next booklet until instructed to do so.

ANY QUESTIONS?

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