

Bilingual Memory: The Interaction of Language and Thought

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Abstract

We initiated story recall in bilingual children to analyze how specific languages affect memory for narrative. Forty 8- and 9-year-old bilingual (Greek-English) children listened to a story on tape, in either English or Greek, and were asked to retell it in either English or Greek, once from memory and a second time with the aid of a picture book. Story recall was measured in terms of number of recalled phrases. Story recall for subjects who heard the story in English and retold it in Greek (group EG) was significantly better than for groups EE, GG, and GE. Results are discussed in terms of dual coding theory and subjects' language socialization history. The implications of these findings suggest the need for dynamic, flexible bilingual education programs that are sensitive to the previous language experiences of bilingual students.

Introduction

The issue of storage, with respect to bilinguals who have two languages to cognitively contend with, has been a strongly debated topic among researchers. There are those that support the idea of language specific memory stores in bilinguals (Goggin & Wickens, 1971; Rose & Carroll, 1974; Scarborough, Gerard, & Cortese, 1984; Watkins & Peynircioglu, 1983) while others have found evidence to support the notion of a single, shared memory store, between languages (Chen & Ng, 1989; Dalrymple-Alford, 1968; Glanzer & Duarte, 1971; Lopez & Young, 1974; Macleod, 1976). Some studies have reported evidence suggesting that both alternatives are possible (Champagnol, 1975; Dyer, 1971; Durgunoglu & Roediger III, 1987; Kolers, 1963; Preston & Lambert, 1969), implying that the issue of single versus dual memory storage in bilinguals may be a matter of interpretation.

Various models of bilingual representation have been proposed, each of which attempts to explain the complex, intricate relationship between words and/or concepts and/or images in a variety of ways. One model, namely that of Paivio's (Paivio, 1986; Paivio & Desrochers, 1980; Paivio & Lambert, 1981), delineates interdependent language-specific verbal systems that are interconnected via translation equivalents and/or through a separate imagery system where perceptual information is encoded. Other more general models, similar to Paivio's, have been proposed, supporting the idea of translation equivalents between languages but not that of a special imagery system (Grainger & Beauvillain, 1988; Meyer & Ruddy, 1974).

Certain models of bilingual memory differentiate between actual words and their meanings (concepts). For example, a hierarchical model of bilingual memory claims that words have two language specific codes (surface forms) as well as a third code, which represents their semantic meaning. The former are stored independently, in separate memory systems, while the latter is stored in an amodal conceptual memory system accessible to both languages and to pictured objects (Potter, Kroll, Yachzel, Carpenter, & Sherman, 1986; Potter, So, Von Eckardt, & Feldman, 1984).

The three-code/hierarchical model appears to appease both those who advocate language specific memory stores in bilinguals as well as those who espouse the idea of shared memory stores, but at different levels of representation (Dufour & Kroll, 1995). Although words in each language may be stored independently at the lexical level, they access a common semantic system at the conceptual level. Ironically, this model has appeared to have sparked a new debate regarding the specific nature of the form of connections between languages. The question of separate versus shared memory stores appears to have been replaced by lexical versus conceptual interlanguage connections in bilinguals.

The issue of lexical versus conceptual interlanguage connections in bilinguals, more commonly referred to as the word association and concept association hypothesis, respectively, each make the presumption that the second language learned by a bilingual (L2) is weaker than the first (L1). The word association hypothesis states that when a speaker learns a second language, a direct association is set up between words in L1 and L2, such that the speaker understands and produces a word in L2 only by retrieving the word in L1. For example, translation entails recognizing the L1 word, retrieving the L2 word, and saying the L2 word. By contrast, the concept mediation hypothesis suggests that the only connection between two languages is through an underlying amodal conceptual system (Potter et al., 1984). For example, translating/picture naming entails recognizing the L1 word/image, retrieving the concept, retrieving the L2 word, and saying the L2 word.

These two hypotheses were tested via the performance of fluent and less fluent bilinguals on a picture naming and translation task in L2 (Potter et al.,

1984). It was reported that translation did resemble picture naming, for all bilinguals, regardless of level of L2 fluency. Since picture naming had already been found to require concept mediation (Potter & Faulconer, 1975), it was concluded that concept mediation was the basic form of interlanguage connection in bilinguals.

An intermediate model, which is a revised version of the hierarchical model described earlier, challenges the above-mentioned conclusion. It suggests that although some amodal concepts are shared across a bilingual's two languages, shared conceptual representation is initially not equally accessible by L1 and L2 (Kroll & Sholl, 1992; Kroll & Stewart, 1994). It argues, for bilingual adults, that early L2 acquisition entails a strong lexical reliance on L1. In other words, L1 initially serves as a lexical intermediary between L2 and conceptual meaning. As a result, lexical links from L2 to L1 are stronger than lexical links from L1 to L2, and conceptual links to L1 are initially stronger than conceptual links to L2.

The ability of L2 to directly access concepts, without the help of L1, is said to be acquired gradually, as the size of the L2 lexicon increases. As the bilingual becomes more proficient in L2, the size of the conceptual set activated by L2 will eventually be comparable to that accessed by L1. At this point in development the bilingual is said to be a concept mediator; that is, she or he will be able to use L2 to directly access meaning. Furthermore, the bilingual will also be able to mediate access from L1 to L2 through shared conceptual representations (Dufour & Kroll, 1995).

Therefore, it appears that the type of link, namely lexical and/or conceptual, between each of a bilingual's languages, as well as its strength, depends upon the degree of L2 fluency. More fluent bilinguals are said to effectively access both lexical and conceptual links, whereas less fluent bilinguals are said to rely heavily on lexical links from L2 to L1. A more recent proposal suggests that less fluent bilinguals may retrieve a restricted, well-defined set of concepts associated with L2 words but not necessarily L1 words, leaving it questionable as to whether or not they may use concepts as a link between each of their languages (Dufour & Kroll, 1995).

The point has been made that any attempt to interpret or view the representational format of bilingual memory must consider factors other than fluency, namely, individual goals, skills, and the processing requirements of retrieval tasks (Champagnol, 1978; Durgunoglu & Roediger III, 1987; Tulving & Colotla, 1970). It is possible that individuals, including bilingual individuals, have multiple codes of remembering that undergo diverse organization and reorganization, depending upon one's own personal predisposition's and one's language context of socialization. Context includes both the school and home setting. This has been termed cognitive pluralism (John-Steiner, 1991). Once less fluent bilinguals develop concept mediation of L2, through its further use, their subsequent reliance on concept and/or word associations between

L1 and L2 may be subject to a number of influences. These factors include bilinguals' language preference, language socialization history, and the nature of the memory task presented to them.

A distinction has been made in the bilingual memory literature between conceptually-driven retrieval tasks and data-driven retrieval tasks. The former, which include free recall tasks, are said to rely on stored concepts to facilitate memory and are not affected by changes in the surface form of a word, such as the language of presentation, implying a common memory store. The latter, which include list recognition or fragment completion tasks, have been found to be language dependent, supporting the theory of language specific codes in bilinguals (Ransdell & Fischler, 1987). Therefore, evidence for both a common store as well as language specific stores within the same experiment using different retrieval tasks (Durgunoglu & Roediger III, 1987) is not contradictory but rather suggests the importance of consideration of processing requirements of memory tasks of bilinguals when attempting to explain bilingual memory.

Bilingual memory representation, more specifically, the debate concerning lexical versus conceptual interlanguage associations, is of particular interest with respect to the present study due to the nature of its subjects, their language socialization history, and the actual recall task in which they are engaged. Participants of the present study were compound bilingual children, fluent in Greek and English. This is in contrast to most bilingual research, in general, and many models of bilingual memory, each of which have focused on coordinate bilingual adults. Coordinate bilinguals, commonly referred to as second language acquirers, have acquired L2 at a much later point in time from L1 (Ervin & Osgood, 1954). Using compound bilingual children, who have initially acquired both their languages simultaneously or a short time apart and who are currently using both languages on a daily basis at home and in school, may provide a cognitive window into the possible origins and subsequent development of bilingual memory structures, that has not been fully opened, as of yet, in the bilingual memory literature.

Bilingual subjects of the present study were engaged in a conceptually-driven retrieval task, namely, a story memory task. They listened to a story on audiotape with instructions to remember it in order to subsequently retell it to the experimenter. Subjects did not have access to the story in visual, written form. Bilinguals were randomly assigned to one of four language groups. Half the subjects heard the story in one language, either English (E) or Greek (G), and were subsequently instructed to retell it in their other language, groups EG and GE, respectively, while the other half were instructed to retell the story in the same language in which it was heard (groups EE and GG). Bilinguals were not initially told in what language they would be hearing the story. Furthermore, instructions, with respect to language of recall, were given to subjects after the story was heard. Previous studies of bilingual memory

have primarily used word lists as materials to be learned. Thus, most of the evidence relating to models of bilingual representation has been based on such tasks as lexical decision, categorization, object naming, translation, object decision, free recall, word fragment completion, and reaction times to monolingual and bilingual stimuli, all of which used word lists of some kind. In contrast, the present study addresses these models by using story recall, which requires subjects to remember and recall extended meaningful narrative. Such a task should be more relevant to the operation of bilingual memory in everyday life.

Different theories/models of bilingual representation make different predictions, regarding memory, with respect to the task of the present study. First, to the degree that bilinguals are conceptually mediating each of their respective languages, in accordance with the concept mediation hypothesis, it is predicted that there will be no significant differences, with respect to overall memory performance, between language groups. This follows the argument, made by supporters of a common memory store in bilinguals, that the actual surface form of a word, such as the language in which it is presented, will not affect recall. To be more specific, the semantic content of story recall for subjects who initially heard the story in English and subsequently retell the story in either English (EE) or Greek (EG) will be comparable to the semantic content of story recall for subjects who initially hear the story in Greek and retell the story in either English (GE) or Greek (GG). This prediction is also in accord with the fact that this task is a conceptually driven one.

By contrast, if bilinguals are conceptually mediating L1 but not L2—that is, L2 is weaker than L1—it is predicted, in accordance with the revised hierarchical model of bilingual representation, that there will be significant recall differences among respective language groups. For example, if English represents bilingual subjects' dominant language (L1) and Greek represents the subordinate language (L2), it is predicted that recall for subjects in group GE will be faster and more accurate, thus, better than recall for subjects in group EG. Previous findings, which lend support to this model, have shown that translation from L1 to L2 is tedious, harder, and more prone to errors, for bilinguals, as opposed to translation from L2 to L1 (Kroll & Stewart, 1990, 1994). Furthermore, bilinguals who are less fluent in their subordinate (weaker) language are said to have a greater tendency to automatically translate information into their dominant (stronger) language, i.e., from L2 to L1 (Dornic, 1978). Therefore, recall for subjects in group EE should be best, since English represents the dominant language and because it involves no translation at all.

By contrast, subjects in group GG should exhibit the poorest recall performance. If Greek is subjects' subordinate language, it stands to reason that bilinguals who hear the story in Greek should automatically translate it into English, their dominant language. When subjects are then instructed to

retell the story to the experimenter in Greek, they will be, in effect, translating that information for a second time. This second translation will be from their stronger language, English, into their weaker language, Greek. Since subjects in this group (GG) will be doing the most translating, of all four language groups, their recall performance may suffer the most. However, if Greek is the dominant language (L1), then it is predicted that bilinguals in group EG will have better recall than bilinguals in group GE, group GG should have the best recall, and group EE should exhibit the weakest memory performance, following the same argument.

A further prediction, with respect to the revised model, is that the semantic content of story recall for subjects who heard the story in English (EE and EG) will be different than that of subjects who heard the story in Greek (GG and GE). This is due to this model's assertion that L1 activates different conceptual representations, for bilinguals, as opposed to L2 (Dufour & Kroll, 1995). Such a prediction is also consistent with Kolers and Gonzales's claim (1980) that knowledge is means dependent and that "language" is a means, implying that story recall should vary depending upon language at encoding.

It is important to note that predictions made with respect to the revised hierarchical model must be made with caution, due to the fact that such a model was initially developed to account for bilingual adults with less than two years of fluency in L2, which is not the case for the subjects of the present study. However, it will be of vital interest to examine the applicability of such a model in terms of the origins, development, strength, and direction of lexical and/or conceptual interlanguage links, with respect to bilingual children whose languages are each used daily and are thus continuing to develop.

A further prediction is that bilinguals who hear and retell the story in the same language (GG and EE) will have better recall than bilinguals who hear and retell the story in two different languages (EG and GE). This prediction is consistent with the argument that while memory is fairly organized in one language, it deteriorates when language boundaries must be crossed (Tulving & Colotla, 1970). This prediction is also in accord with reported findings indicating significantly improved recall when the language at study matched the test language (Durgunoglu & Roediger III, 1987). Likewise, such a finding would support the argument that when subjects' memories are probed, if the surface form (language) of the discourse does not match that of the actual probe, that is, when the language during encoding is not consistent with the language at recall, then those contents can not be used. This necessitates the need for translation and may result in delays, each of which takes additional processing time (Guenther, 1984).

Dual coding theory may be most applicable to the second part of subjects' memory task, where they were asked to retell the story a second time with the aid of a picture book, from which the experimenter had initially generated the story. Paivio and Lambert (1981) argue for the mnemonic superiority of

nonverbal codes (pictorial or imaginal) over verbal ones. This argument suggests that story recall, in the present study, will improve for all subjects during the second retelling (T2), when they are able to use the pictures from their book to aid their memory.

It is further predicted that recall will be better, at T2, for bilinguals who previously translated stories from one language to another (EG and GE), during the first story retelling (T1), as opposed to bilinguals who previously repeated the stories back to the experimenter in the same language that they were initially heard (EE and GG). This prediction is made in accordance with the finding that the translation of concepts leads to better recall than simple repetition (Glanzer & Duarte, 1971). Paivio and Lambert (1981) claim that this is because translation entails the activation of two verbal systems as opposed to one. Such a finding is also consistent with reports of significant improvement in free recall by bilinguals who had engaged in mental operations requiring elaboration during encoding, namely a translation task (Durgunoglu & Roediger III, 1987).

Method

Participants

Forty 8- and 9-year-old children were selected from a Greek American Parochial school located in a predominately Greek American, middle-class New York community. Children were given one to two hours of instruction per day in Greek, although the rest of the school curriculum was presented in English. There were 20 boys and 20 girls, with a mean age of 8.5.

All participants of the present study had acquired both of their languages before the age of 3; that is, they were simultaneous bilinguals (Grosjean, 1982; Hamers & Blanc, 1990). In order to minimize definitional problems associated with the term bilingual, that have been identified in the research literature, the present study empirically established that all subjects were fluent in each of their respective languages, what Hakuta (1987) refers to as “balanced” bilinguals. Information was collected from each subject about their daily language experiences at home, including which language(s) they spoke at home, whether or not they liked or preferred one of their respective languages over the other, and whether or not they rated themselves more, less, or equally proficient in either language, see Appendix. This procedure was consistent with other research that has utilized bilingual subjects (Bialystok, 1997; Bochner, 1996). The language questionnaire was administered at the end of the second story retelling task. In addition, English and Greek teachers were questioned on the adeptness of each potential subject in each of her/his respective languages. Subjects that were identified as having a language difficulty in either English or Greek, in terms of verbal or written proficiency, were not included in the present study.

Materials

Two versions of the same story, one in English and the other in Greek, were used (see Appendix for this story). These stories were prototypes obtained from a preliminary study involving 12 adults bilingual in Greek and English, ages 23–27 years, half of whom were male and half of whom were female. Each participant was given a picture book without words (*Frog where are you?* by Mercer Mayer) and was asked to generate a simple story for an 8- or 9-year-old child from the pictures. This book was chosen because it has been used in cross linguistic studies of children's narratives (Slobin, 1990). The bilingual adults were asked to give two versions of the story, one in English and the other in Greek. They taped their stories on an audio recorder for subsequent transcription. Stories were compared and edited by one of the authors (C.H.) until a prototypical version in each language was obtained. Efforts were also made to ensure that, word for word, each of the respective stories was identical in meaning, as well as in length, in terms of number of phrases.

Design and Procedure

Upon receiving written consent from the participating parochial school, letters were sent to parents seeking consent for their child to be a participant in a study examining the relationship of language to memory and thought. Children were randomly assigned to one of four experimental (language) groups. Each group consisted of children bilingual in English and Greek. One group initially heard the story in English and was asked to retell it to the experimenter in English (EE). A second group, which also heard the story in English, was asked to retell it in Greek (EG). The remaining two groups each heard the story in Greek; one group was asked to retell it in Greek (GG) while the other was asked to retell it in English (GE).

Children were seen individually in a quiet space in their school. They were told to listen to a story on audiotape and try to remember it because they were going to subsequently retell it to the experimenter. The story was then played for them on the tape in the appropriate language for their group. After hearing the story twice they were asked to retell it "exactly as they heard it." Sessions were tape-recorded and later transcribed for analysis. Subjects had no knowledge of either the encoding language or the test language they would be receiving. The experimenter revealed her bilingual status to the children and explained the task to them in English. However, instructions, in terms of requested recall language, were given once the story had already been heard.

When children finished retelling the experimenter the story, they were given the story book from which the story was initially generated and instructed to retell it a second time, using the pictures from the book to aid their memory.

Analysis

Both the English and the Greek version of the story were separated into 53 phrases, comparable in terms of semantic content. For the purpose of the data analysis, phrases were coded as omitted or recalled. Phrases that were partially repeated, repeated using different words but denoting the same meaning as the original text, or repeated exactly, were all coded as recalled. Reliability (percent agreement) of two coders on all transcripts was 100% with this coding scheme.

The next step of analysis entailed classification of each of the 53 phrases of the English and Greek versions of the story into one of eight categories: opening statement, introduction of characters statement, subordinate statement, action statement, narrator's statement, reported speech, reported speaker, and closing statement. These categories are simplified ones based on those used by Bamberg and Marchman (1991). Action statements were selected and labeled as such in accordance with main actions going on during each page of the book. Subordinate statements included those statements which denoted intention of the main action statement, outcome of the main action statement, or provided the descriptive setting for the main action. Introduction of character statements introduced the three main characters of the story. Narrator statements stated what had happened to one of the main characters of the story, which did not entail any specific action. Reported speech statements involved dialogue of several supporting characters in the story. Reported speaker statements identified who specifically said the dialogue, and the opening and closing statements denoted the first phrase and last phrase of the story. Each story version, the English and the Greek, consisted of 18 action statements, 18 subordinate statements, three introduction of character statements, two narrator statements, seven reported speech statements, three reported speaker statements, one opening statement, and one closing statement.

Results

Story recall was analyzed in terms of phrases recalled for each subject in each of the four language groups (EE, EG, GG, and GE) at T1, which was without a picture book, and at T2, which was with a picture book.

A 4 (Language group) X 2 (Time) ANOVA with repeated measures on the last factor produced a Main effect for Language group [$F(3, 36) = 5.79$, $p < .05$], and a Main effect for Time, [$F(1, 36) = 28.93$, $p < .001$]. Post hoc analysis (Newman-Keuls) of the Language group effect revealed that at T1, story recall, in terms of mean number of recalled phrases, for group EG was significantly better ($M = 31.2$) than that of group EE ($M = 21.6$), GE ($M = 21$), and GG ($M = 21$), $p = .05$. Cell means (M) and standard deviations (SD) are reported in Table 1.

Table 1

Mean Number of Phrases Recalled at T1 and T2.

Language Group				
Time	EE	GE	GG	EG
Phrases Recalled (of 53)				
T1				
M	21.6	21.0	21.0	31.2
SD	(7.4)	(6.6)	(8.0)	(5.4)
T2				
M	28.6	26.7	28.7	33.3
SD	(3.8)	(5.2)	(3.8)	(7.0)

Recall of action phrases and subordinate phrases for each language group was analyzed separately and produced similar results. A 4 (Language group) X 2 (Time) ANOVA with repeated measures on Time, with respect to number of recalled action phrases, produced a Main effect of Language group [$F(3, 36) = 5.82, p < .05$], and a Main effect for Time [$F(1, 36) = 39.94, p < .001$]. Post hoc analysis (Newman-Keuls) of the Language group effect revealed, again, that at T1, story recall for EG, in terms of mean number of action phrases, was significantly better ($M = 12.9$) than EE ($M = 8.4$), GE ($M = 7.4$), and GG ($M = 7.5$), $p = .05$. A 4 (Language group) X 2 (Time) ANOVA with repeated measures on Time of subordinate phrases recalled produced a Main effect of Language group [$F(3, 36) = 4.75, p < .05$], and a Main effect of Time [$F(1, 36) = 22.10, p < .001$]. Post hoc analysis (Newman-Keuls) of the Language Group Effect revealed, again, that in terms of mean number of subordinate phrases, recall for EG was significantly better than EE, GE, and GG ($p = .05$) (see Table 2).

Table 2

Mean Number of Action and Subordinate Phrases Recalled at T1 and T2

Language Group				
Time	EE	GE	GG	EG
Phrases Recalled				
Action				
T1	8.4	7.4	7.5	12.9
T2	12.3	10.6	11.8	13.4
Subordinate				
T1	6.7	4.9	5.6	9.4
T2	8.6	7.5	8.3	10.0

Qualitative Analyses

Qualitative analyses were carried out by comparing the specific phrases recalled and omitted by pairs of language groups that shared or differed in the presentation language and shared or differed in the recall language. Within each group a particular phrase might be recalled by 0 to 10 children. There was considerable variation between groups with respect to the recall of particular phrases. Even among groups that did not differ in total amount of recall (e.g., EE, GG, and GE) an average of 20% of recalled phrases differed by as many as 4 of 10 children across the paired groups (e.g., 4 versus 8; 0 versus 4; 2 versus 6). Table 3 provides an example, comparing groups GG and GE (differing in language at recall) and groups EE and GE (differing in presentation language).

One of the questions the present study addressed was whether or not different languages engage different conceptual representations in bilinguals. Subsequent analyses of phrases repeated by children in groups EE, EG, GG, and GE indicated that only a small portion of phrases were repeated word for word (12%, 17%, 26%, and 14% respectively) at T1. These findings suggest that the language in which stories were initially heard, and the language in which subjects were subsequently instructed to retell the story, each had an impact on recall, in terms of semantic content. For example, variations of the phrase “saw that his frog wasn’t there,” included: “saw the bowl was empty”; “he looked in the jar and he didn’t see the frog”; “the boy found out the frog wasn’t in the jar”; “saw that there was no frog in the bowl”; “the frog ran away”; and “the frog left home.”

Table 3

Language Group (LG) Comparisons of Phrases Recalled at T1

Language Group Comparison	
GG vs. GE	
Phrase	(# of subjects per group [out of 10] that recalled phrase)
"and threw him off the side of a cliff"	(8 vs. 2)
"with his little frog"	(5 vs. 1)
EE vs. GE	
Phrase	(# of subjects per group [out of 10] that recalled phrase)
"he looked and he looked"	(8 vs. 3)
"there's no little frog here"	(5 vs. 9)

Discussion

The results of the present study indicate that bilingual children asked to recall a story in Greek after hearing it in English recalled more of the story than children who heard it in English and recalled it in English, or children who heard the story in Greek and recalled it in either Greek or English. Children in each of these groups tended to recall many different phrases than those in other groups.

The finding that surface form, namely the language that the story was initially heard in as well as the test language, had an effect on recall performance suggests a number of interesting possibilities with respect to bilingual memory. According to the concept mediation hypothesis, which asserts concepts as the basic interlanguage link in bilinguals, recall performance should not have varied among language groups. Although this was true with respect to groups EE, GG, and GE, in terms of amount of recalled phrases, qualitative analyses revealed that even among these said groups subjects were remembering and omitting different phrases from the story. These findings also point out the limitations of attempting to explain bilingual representation through quantitative means, namely, number of phrases recalled. It is also surprising that surface form had an effect on free recall, since it has been reported that conceptually driven tasks rely on stored concepts, not the "language" in which the material is presented (Durgunoglu & Roediger III, 1987).

However, it seems illogical to argue that conceptual links do not exist between bilinguals' languages or that subjects could not activate such links. In fact, subjects in groups EG and GE were able to hear discourse in one language, remember it, and successfully translate its conceptual contents into their other language without grammatical or semantic errors. It seems plausible that if subjects had treated this task as a simple rote memory exercise and/or one language was weaker than the other, there would have been errors among subjects in cross language groups (EG & GE), since many words do not have the same translation equivalents in other languages. It appears that subjects were quite cognizant of the respective structural and semantic rules of both their languages, suggesting both a lexical and conceptual interlanguage connection.

Furthermore, although reaction times were not actually measured, subjects in all four language groups (EE, EG, GE, GG) retold the story to the experimenter within a minute. This finding is not consistent with claims that memory organization deteriorates when language boundaries are crossed (Tulving & Colotla, 1970) or claims that the mismatch of language during encoding with language at test yields delayed recall (Guenther, 1984). There was also no evidence suggesting improved recall when the language at study matched the retrieval language (Durgunoglu & Roediger III, 1987). In fact, recall for subjects that heard and re-told the story in the same language (GG and EE) was not significantly better than recall for subjects who heard and retold the story in two different languages (EG and GE).

This finding is consistent with other studies that have reported that the central processing components involved in comprehending discourse are shared by the two languages of a bilingual individual (Guenther, 1984). What this means, with respect to bilingual representation, is that the meaning taken from any language is represented in memory in a language free symbol system.

The question still remains as to why subjects in group EG had the best recall of all four language groups. Perhaps the best approach to this dilemma is not to discuss bilingual memory in terms of common versus dual storage or lexical versus conceptual links. A more comprehensive approach would be the interpretation of bilingual representation in terms of different degrees of lexical and conceptual interlanguage connections, the activation of which and the strength of which depend upon such factors as individual's goals, skills, language socialization history, the type of memory task, and language fluency.

The language socialization history of subjects in the present study was determined by a language questionnaire that asked them about such issues as language preferences, language ability, and daily language use in school as well as at home. Teachers were also asked about subjects' language proficiency in Greek and in English. Notably, there was no indication of language preference or increased adeptness in one language as opposed to another among bilinguals. However, there was a trend of language home use that suggested that Greek was the dominant or preferred language of use in the home. It is also true that

during school, at least the instructional part of the day, subjects were instructed in Greek for approximately two hours while the rest of the daily classes were conducted in English. It is logical to assume that subjects were quite comfortable learning material in English for most of the day, and going home and conversing with their parents, grandparents, and siblings in Greek.

Although such an assumption can not be used alone to explain the results of the present study, it does give us some insight into the possible factors affecting bilingual memory performance. Subjects in group EG may have felt the most comfortable in the test condition that was somewhat similar to their daily language experiences, that is, hearing material in English and translating it into Greek. It is not beyond reason to consider that comfort or security of adeptness or skill during any test condition may effect motivation, which may, in turn, effect performance.

It is also important to consider a few limitations of the present study. The degree of balance or fluency in bilinguals is always a delicate matter. Some researchers have concluded that being equally proficient in both one's languages is more of a cognitive ideal than reality (Hakuta, Ferdman, & Diaz, 1987). Most studies on bilingual memory have used bilingual adults, who have acquired their second language in adulthood, and whose balance or degree of fluency was determined by self reports. Since there is no widely accepted method of assessing bilingual proficiency, self reports are quite common in bilingual research. In the present experiment, self reports were also used, by means of a language questionnaire that was given to subjects at the end of the second story retelling task. Although similar response times among groups and comparable recall performance do not prove balance, it is consistent with the fact that subjects were actively using both their languages at home and in school each day.

It is also important to note that while subjects did not know what language they would be hearing or retelling the story in, we can not assume what language was being engaged during encoding conditions. This would depend, in part, on the language predispositions of the subject and/or the context of the instructional procedure, which was conducted by the experimenter in English.

Many of the findings of the present study are consistent with the revised hierarchical model of memory (Dufour & Kroll, 1995), where degree of fluency is a important consideration. This model predicted differences in recall among language groups. Further examination of such differences, in accordance with this model, suggest a number of interesting possibilities, with respect to the strength and direction of conceptual and/or lexical interlanguage links in bilinguals. With respect to fluency, if Greek was the dominant language (L1) it may explain why recall for subjects in group EG was better than that of group GE. This finding is consistent with this model's claim that, for less fluent bilinguals, translation from L2 to L1, which is from English to Greek, in this case, is faster and more accurate than translation from L1 to L2, namely, Greek to English, due to stronger lexical links.

Certain findings of the present experiment, however, are not consistent with predictions made in accordance with the revised hierarchical model of bilingual memory. For example, if Greek was the subjects' dominant language, it was predicted that recall for group GG should have been the best, since it involved no translation at all. Likewise, recall for group EE should have been the poorest of the four language groups, since it involved the most translation. That is, if bilinguals tend to automatically translate information from their weaker to their stronger language, subjects who heard the story in English should have automatically translated it into Greek. When subjects were subsequently instructed, by the experimenter, to retell the story in English, they would have been translating again, but this second translation would have been into their weaker language, English. These predictions were not supported. Recall among groups EE, GG, and GE was comparable, in terms of number of remembered phrases, while group EG had the best recall performance. Furthermore, there were no real differences in reaction times among language groups. These findings indicate strong conceptual and lexical links between L1 and L2 as well as L2 and L1.

The reported variation in semantic content of recall among all four language groups, as indicated by qualitative analyses, was also predicted by the revised model. Such a finding is consistent with this model's argument that different languages engage different conceptual representations in bilinguals. The reasoning behind this argument stems from the issue of degree of fluency. It is argued that, for less fluent bilinguals, in the early stages of L2 learning, shared conceptual representations may not be equally activated by both languages. More specifically, L2 (weaker language) activates a small, restricted well-defined set of conceptual representations, relative to L1.

In the present study, although it is questionable that L2 was weaker than L1 or which language represented L1 or L2, for bilinguals, it is plausible that hearing the story in English may have triggered somewhat different concepts as opposed to hearing the story in Greek, resulting in somewhat varied semantic recall content among groups. In fact, research has reported culture specific differences in concepts and images triggered by translation equivalents (Paivio & Desrochers, 1980; Winograd, Cohen, & Baressi, 1976).

A further claim made by this model suggests that while bilinguals can use L2 in a restricted way to access concepts, this doesn't necessarily mean they can use concepts to retrieve L2 words for production. This was evident in the present study, to a small degree, for some subjects in groups EG and GE who mixed phrases. Mixing entailed saying part of a phrase in English and part of it in Greek, saying a phrase in Greek when it should have been said in English, or vice versa.

For example, consider the following response: "itan epano (Greek for "he was on") . . . he was on a deer's horns." This was said by a subject in group EG who had initially attempted to say the phrase in Greek, then, realizing

he couldn't, he quickly gave up his attempt and said it in English. Although he/she couldn't use the concept to retrieve the actual word, due to a lexical lapse, the subject was able to continue translating the story, without any further semantic/structural errors. This suggests the limitations of the applicability of the revised model, with respect to compound bilinguals as well as limitations with respect to tasks involving discourse.

The significant improvement in story recall for subjects in all groups at the second story retelling (T2) was as predicted by dual coding and Paivio & Lambert's (1981) claim of the mnemonic superiority of nonverbal codes (pictorial or imaginal) over verbal ones. Of course, the pictures also provided additional cues for recall. Their further claim that the translation of concepts will yield better recall than the simple repetition of concepts seems to be supported by the fact that recall for group EG was significantly better than EE and GG. However, recall for group GE was comparable to groups EE and GG.

The results of the present study, in totality, suggest the futility of discussing bilingual memory in terms of single versus dual storage, and further, to discuss bilingual representation in terms of lexical versus conceptual links. The revised hierarchical model is a more comprehensive approach in that it considers both types of links between each of a bilingual's respective languages. However, since this model is based on coordinate bilingual adults, many of its claims are limited, with respect to compound bilingual children that speak, think, and use both their languages everyday.

It is clear that more dynamic models of bilingual memory are needed to understand the cognitive processes underlying representation in compound bilingual children. It is plausible that the nature of interlanguage connections, that is, lexical and/or conceptual, their strength, their direction, and the degree to which such links are activated by each of a bilingual's respective languages depends upon more than just L2 fluency relative to L1. Other factors that must be considered include individual skill, motivation, the nature of the retrieval task, and language socialization history, namely, the way a bilingual has acquired and is using both languages on a daily basis. Such considerations are vital in attempting to explain the origin and subsequent development of interlanguage connections in bilingual children, whose languages are used every day and, thus, are continuing to develop, simultaneously.

The results of the present experiment have significant developmental and educational implications. The findings of this research are consistent with a wholistic approach to bilingualism (Grosjean, 1985). Developmentally speaking, bilinguals are unique listener-speakers and not simply byproducts of two or more monolinguals. In order to understand the dynamics between one's languages and one's cognitive processes, such as memory, consideration must be given to the developing relationship between the two languages of a bilingual as well as the cognitive demands of the memory task presented to them. Any potential language effects on memory are subject to change,

depending upon how each language of a bilingual is used/not used at home and in school each day.

Bilingual educators should be cognizant of such factors and design and implement dynamic, flexible instructional programs that are sensitive to the individual needs and language experiences of their students. In the present study, when the retrieval demands made on bilinguals (group EG) were consistent with their daily language experiences, subjects were at a cognitive advantage. They were able to maximize their recall performance, resulting in better overall memory. These findings are significant, considering the amount of information bilingual children must encode, understand, store, and retrieve, in both their languages, in school, and at home each day. Bilingual education must be as flexible as possible, with the overall aim being the achievement of the best social and cognitive fit possible between each bilingual student and her or his daily learning environment.

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Appendix

English version of story

Once upon a time, there was a little boy who had a little dog and a little frog. One night, while the boy and dog were sleeping, the little frog jumped out of his jar. In the morning, when the boy woke up, he looked down and saw that his frog wasn't there. The boy looked everywhere. He looked and he looked but he couldn't find his little frog. So then the boy went into the woods, with his dog, to see if he could find the frog there. The first place the little boy looked was in a hole in the ground. The frog wasn't there. Then the boy climbed up a tree, that had a big hole in it, and just as he was about to look inside the little boy fell down. At that moment a huge owl came out of the hole. "Hoo! Hoo!", said the owl, "There is no little frog here, go away!" "Hoo! Hoo!" The little boy climbed on a big rock and said "Little frog where are you ? Little frog where are you ?" The boy looked down and saw that he was leaning on the antlers of a big deer. The deer picked up the boy and threw him off the side of the cliff into a big pond. The little dog jumped into the pond after him. When they got up from the pond they heard a noise. The little boy looked behind a tree, that had fallen in the pond, and saw his little frog with another little frog and lots of baby frogs. His little frog now had a family. The little boy left his frog with his new family but he took one of the baby frogs with him. "Good-bye my little frog," said the little boy, and returned home with his little dog.

Appendix

Language Questionnaire

1. What language(s) do you speak at home?
(English/Greek/English & Greek/Other language)
2. Do you speak to your Mommy in?
(English/Greek/English & Greek/Other language)
3. Does Mommy speak to you in?
(English/Greek/English & Greek/Other language)
4. Do you speak to your Daddy in?
(English/Greek/English & Greek/Other language)
5. Does Daddy speak to you in?
(English/Greek/English & Greek/Other language)
6. Is there anyone you spend more time with at home? (Yes/No)
If yes, who? (Mommy/Daddy/Other)
7. Is there a language that you speak most of the time? (Yes/No)
If yes, which? (English/Greek/Other language)
8. Is there a language that you like to speak the most? (Yes/No)
If yes, which? (English/Greek/Other language)
9. Is there a language that you think you speak better? (Yes/No)
If yes, which? (English/Greek/Other language)
10. Is there a language that you think you understand more? (Yes/No)
If yes, which? (English/Greek/Other language)
11. Is there anyone else at home you spend time with besides Mommy and
Daddy? (Yes/No)
If yes, who and what language to you speak to her/him?