

DETERMINANTS OF BILINGUAL LEXICOSEMANTIC ORGANISATION

Annette M. B. de Groot,
University of Amsterdam

Abstract: *This article reviews studies on the representation of words and their meanings in bilingual memory. It is argued that bilingual 'lexicosemantic' organisation differs between bilinguals and develops within a bilingual. Development takes place at the level of the individual words, and the memory of every individual bilingual contains structures of various types. The roles of the following variables in bilingual memory organisation are discussed: the level of proficiency in L2; the strategy of learning L2; the interval between previous and current use of L2; the L2 learning environment; various word characteristics (e.g., word concreteness and cognate status of the translation pairs).*

1. Introduction: A person's vocabulary, or in the technical jargon of the psycholinguist, his 'mental lexicon', is a central part of his language apparatus. A child learner of a native language or an adult learner of a new language could communicate at a basic level in that language if her/his only knowledge of it consisted of a tiny set of carefully selected words. For instance, it has been argued (Nation, 1993) that a vocabulary of the 10 words with the highest frequency of occurrence in that language already provides a text coverage of 25%. Vocabularies of 100 or 1000 of the most frequent words provide coverage of 50% and 75%, respectively. In contrast, only knowing a couple of grammatical rules of a particular language system would be of little help if one is to communicate a message in that language.

This paper deals with the way the two vocabularies are organised in the memory of a bilingual. I borrow the term 'lexicosemantic' structure from Votaw (1992) to refer to this organisation. I prefer this term to the more common term 'lexical' structure to stress the fact that both the storage of the L1 and L2 words and the storage of their meanings will be considered. This article proposes that there is no such entity as *the* bilingual lexicon.

This holds in a trivial sense. In the same way that no two monolinguals share exactly the same vocabulary, every bilingual lexicon will contain a unique collection of translation word pairs, attuned to the person's personal communicative needs and interests and her/his professional experience and leisure activities. But the sense of the message intended here surpasses this obvious one, which no one would oppose. It is assumed that every individual bilingual lexicon contains a unique set of lexicosemantic structures of various types. Each structure may change over time, by use or disuse.

This latter view on how individual bilingual lexicons differ from one another is not generally accepted. For instance, numerous studies have contrasted two opposing views on the language system of a bilingual, the 'common-store' and 'separate-stores' hypotheses (see Heredia & McLaughlin, 1992, for a recent overview). According to the common-store (or 'shared-store', 'interdependence', or 'compound') hypothesis (e.g. McCormack, 1977), the two languages of a bilingual are represented in a single, language-independent, system. In such a system translation equivalents share a conceptual representation. In contrast, the separate-stores (or 'independence' or 'co-ordinate') hypothesis (e.g., Kolers, 1963) assumes two separate, language-specific, representational systems. Each of the words in a translation pair has its own conceptual representation. An implicit assumption in many of these studies appears to be that lexicosemantic organisation is the same across different bilinguals and stable within a given bilingual.

Gradually data have accumulated in the literature (e.g., Chen, 1990; de Groot, 1993; Kroll, 1993) that lead to the view that lexicosemantic organisation differs between bilinguals. It also appears that the lexicon of a bilingual reorganises itself continuously over time. Factors affecting lexicosemantic organisation and reorganisation may be: the level of proficiency a bilingual has in her/his second (meaning 'weaker' here) language (L2); specific characteristics of words (concrete or abstract; cognates or noncognates; frequent or infrequent); the strategy used when words in a new language are being learned; the context in which the two languages are used; the age at which the new language is first acquired; the time the L2 was last used; the script relation between the bilingual's two languages (e.g., both alphabetic versus one alphabetic and one logographic); the family relation between the two languages (e.g., both alphabetic and belonging to the same family of languages versus both alphabetic but from different language families). In the

sections to follow, some of these possible determinants of bilingual lexicosemantic organisation receive extensive attention. The others will only be mentioned in passing. This review of the relevant literature is by no means complete, but I believe it is representative of the more recent work in this research area. Other reviews of the factors that determine bilingual lexicosemantic organisation are by Chen (1992), Kroll (1993), and Kroll and Sholl (1992). In the final section the possible implications of this research for L2 teaching programs and CALL-programs in particular are considered. A tentative conclusion is that there may not be many.

2. L2 Proficiency: An influential study looking at the role of L2 proficiency in bilingual lexicosemantic structure was performed by Potter, So, Von Eckardt and Feldman (1984). They contrasted two hypotheses regarding bilingual lexicosemantic organisation, the 'concept-mediation' hypothesis and the 'word-association' hypothesis. The two hypotheses are depicted in Figure 1 (a and b).

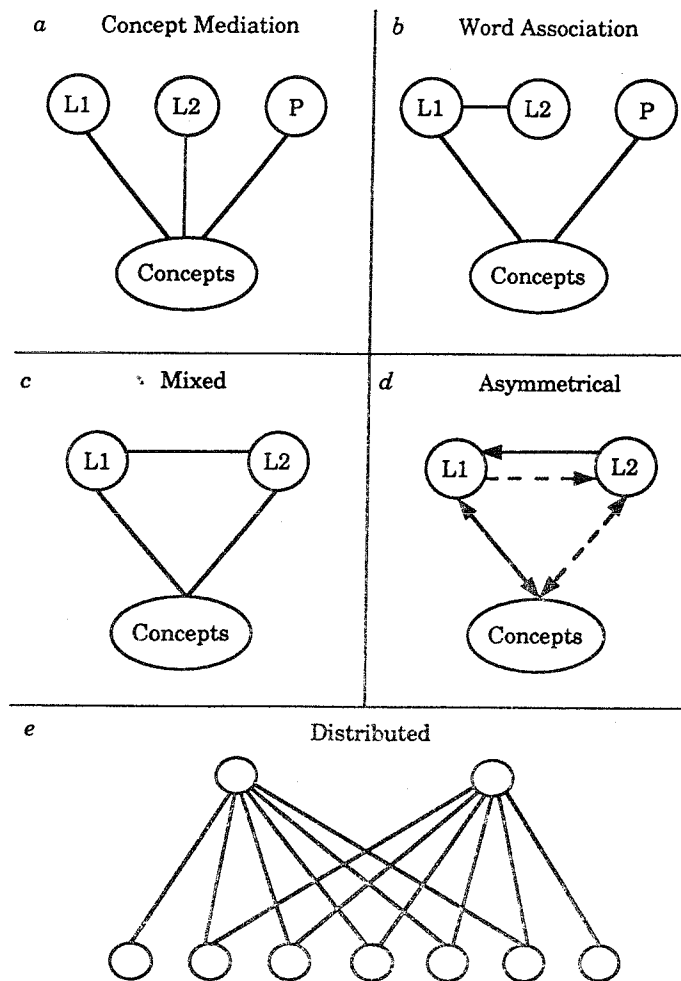


Figure 1. Models of bilingual memory.

The concept-mediation hypothesis is in fact the common-store view introduced before, and goes back at least to Weinreich (1953), who referred to it as a 'compound' structure. It assumes two layers of units in the mental lexicon. One layer represents word forms (the lexical level) and the other represents word meanings (the semantic

or conceptual level). At the word level there are two memory stores, one for each of the bilingual's two vocabularies. At the meaning level there is just one store. It contains representations that are shared by the two words in a translation pair. Each of the two word-form stores communicates directly with the shared conceptual store, through connections between the representations of the word forms on the one hand and the conceptual representations on the other.

The word-association hypothesis assumes different types of connections between the various memory stores. Consequently, the stores communicate differently. Instead of direct connections between the L2 word-form store and conceptual memory, the word-association model contains direct links between the two word-form stores. Accessing conceptual memory upon the presentation of an L2 word is thought to come about indirectly, namely, via the word-form representation of its translation in L1. Similarly, word production in L2 is thought to use this indirect route via the L1 word form. This word-association structure has also been proposed as a possible bilingual lexicosemantic organisation much earlier, again by Weinreich (1953), but under a different name ('subordinative').

Potter *et al.* (1984) argued that the word-association model might hold for bilinguals with a relatively low level of fluency in L2, whereas the concept-mediation model might apply to those with a higher L2 proficiency. This possibility implies a development from one lexicosemantic organisation to another within the same individual. This state of affairs is typically referred to as the 'developmental' hypothesis.

A comparison of response times in two tasks, picture naming in L2 and translating words from L1 to L2, provided the critical test. On every trial in the picture-naming task the subjects are shown a picture, typically of an object. They are asked to pronounce the name of the depicted object as quickly and as accurately as possible. On each trial in the word-translation task the subjects are presented with a word in one of their two languages, and they are asked to pronounce its translation in their other language. In the critical picture-naming condition in Potter *et al.*'s (1984) study the pictures had to be named in L2. In the critical word-translation condition the stimulus words were in L1 and the response words in L2.

The word-association model predicts shorter response times for word translation in L2 than for picture naming in L2. In contrast,

the concept-mediation model predicts equally long response times in the two tasks. The basis for these predictions is the length of the various routes within the memory system from initial access of the L1 word-form representation or the picture representation up to the moment the L2 word is pronounced. The longer the route (in terms of number of processing steps), the longer the response time (assuming equal strength of the various links between the memory stores). As shown in Figure 1b, the word-association model involves a shorter route for L1 to L2 word translation than for picture naming in L2. For L1 to L2 translation only the direct link between the L1 and L2 word-form stores has to be traced. Instead, picture naming in L2 first involves accessing 'picture memory' (the P-store in Figures 1a and 1b). From there conceptual memory must be accessed via the link between picture memory and conceptual memory. Subsequently, the L1 word-form store needs to be accessed via the link between this memory store and conceptual memory. Finally, the link between the two word-form stores allows access of the L2 word form. In contrast to the word-association model, the concept-mediation model implies equally long routes for the two tasks (see Figure 1a). Equally long response times were in fact obtained in the two tasks, for the high- and the low-proficiency groups alike (both consisting of adults). This finding thus supported the concept-mediation model for both bilingual groups.

Support for concept mediation in bilinguals differing in L2 proficiency was also obtained in a study recently performed by my graduate student Rik Poot and myself (unpublished). Three groups of subjects translated concrete and abstract words from L1 (Dutch) into L2 (English) and vice versa. One group consisted of pupils in their third year at secondary school (14 to 15 years old); a second group consisted of pupils in their fifth secondary-school year (16 to 17 years old); a third group were first-year university students (typically 18 to 19 years old). As expected on the basis of their L2 experience and as substantiated by their overall translation times (longest for the third-grade pupils and shortest for the university students), the L2 proficiency of each group differed significantly from that of the other two groups. We contrasted the word-association and concept-mediation models using a different procedure than the one employed by Potter *et al.* (1984). Recall that they compared word translation and picture naming in L2. That technique cannot be used when the stimulus set includes abstract words, because abstract words generally cannot be pictured.

Our approach was simply to look at the difference in processing times for concrete and abstract words in a word-translation task. This difference is termed the concreteness effect. Whenever a manipulation of a semantic variable, here concreteness, affects performance, it can be concluded that conceptual memory is implicated (see de Groot, 1992a, de Groot, Dannenburg & van Hell, 1994, and Kroll & Stewart, 1994, for arguments that substantiate this claim). If the size of the concreteness effect differs across the proficiency groups, then we can conclude that conceptual memory is differentially involved. A null-effect of concreteness (equal response times for concrete and abstract words) would indicate that task performance bypasses conceptual memory. Such a finding would thus provide support for the word-association model. It turned out the concreteness effect was about equally large in the three groups whichever the direction of translation. This suggests that the three groups employ concept mediation to the same extent.

A number of possible causes can be pointed out as to why concept mediation occurred irrespective of proficiency level. A potential problem in the study of Potter *et al.* (though not in that of Poot and myself) is the presence of a confound, namely, the script relation between the two languages of the two subject groups. The two languages of the low-proficiency group were both alphabetic, whereas those of the high-proficiency group were logographic and alphabetic. Studies by Kroll and Curley (1988) and Chen and Leung (1989), employing exactly the same technique as Potter *et al.* (1984), did not contain this confound. The subjects of both proficiency levels in Kroll and Curley's study were adults who were bilingual in two alphabetic languages (English and German). The subjects in both proficiency groups of Chen and Leung's study were, among others, adults (they also tested children; see below) who were bilingual in one logographic (Cantonese) and one alphabetic (English or French) language. The results of both studies were consistent with the notion of a word-association structure in low-proficiency adult bilinguals and a concept-mediation structure in high-proficiency adult bilinguals. In other words, the results suggest a development from one bilingual representational system (word association) to another (concept mediation) with increasing proficiency in a second language. Furthermore, they point out the above suggestion that script relation is a determinant of bilingual lexicosemantic structure, is wrong. If script relation were relevant, the development should have been different for subjects bilingual in

two alphabetic languages than for those bilingual in one alphabetic and one logographic language.

In the study of Potter *et al.* (1984) the proficiency levels may have been more similar across the subject groups than in the studies by Kroll and Curley (1988) and Chen and Leung (1989). This may constitute another reason why only in the former of these three studies no support for a development of bilingual memory was obtained. The novice bilinguals of Potter *et al.* might already have passed the developmental stage associated with the word-association structure. Indeed, this is how Kroll and Curley (1988) and Chen and Leung (1989) explained the differences in results of the three studies. The absence of a proficiency effect in the study of Poot and myself (see above) could also be explained that way. A further possibly critical difference between all these studies will be discussed in a separate section below. For now it suffices to say that evidence for a development of the structures in bilingual memory was obtained in at least two of the above studies. Furthermore, a reason could be pointed out why such support was absent in the other studies.

Chen and Leung (1989) also tested child subjects (7 years old on average). These subjects had studied French for about two years at school and were categorised as low-proficiency subjects by the authors. They showed a pattern different from both the fluent and novice adult bilingual subjects. The data suggested that, as adult novices, child novices use a 'mediator' when processing L2 words. That is, they appear to process these words indirectly, via some type of memory representation, rather than directly. But it appeared that no L1 word-form representations were used as mediators, as seems to be the case with adult novices. Instead, the child novice learners used pictorial representations (that is, the representations in the P-store of Figures 1a and 1b). A 'picture-association' model was proposed to account for these data. Chen and Leung's study thus suggests that age may also be a critical factor in bilingual lexicosemantic structure. However, they held a different view: they considered that adult and child novices used different learning strategies. This could have caused the differences in processing between these groups. A follow-up study (Chen, 1990), to be discussed in the Learning Strategy section, resolves this dispute.

Other studies investigating the relation between L2 proficiency and bilingual lexicosemantic organisation are those by Abunuwara (1992), Chen and Ho (1986), de Groot and Hoeks (submitted),

Gekoski (1980), Mägiste (1984), and Tzelgov, Henik, and Leiser (1990). Gekoski (1980) employed the 'free' word-association technique and a 'restricted' word-association technique. In the restricted task the subjects are asked to produce only response words of a particular type, for instance, only superordinates of the stimulus words (e.g., stimulus: 'knife'; response: 'utensil'). In the free task response words of any type are permitted. Gekoski's subjects were Spanish-English bilinguals. In one condition, the associative responses had to be given in the language of the stimulus. In a second condition, they had to be given in the subject's other language. The association patterns for subjects at different proficiency levels were similar. In agreement with the general view that word-association patterns reflect lexicosemantic structure (e.g., de Groot, 1989), Gekoski took this result to mean that L2 proficiency does not affect bilingual memory organisation. But he also pointed out an alternative and familiar (see above) explanation for this lack of difference: the proficiency range from which he selected his groups may have been too narrow to detect differences in response patterns between the groups.

Chen and Ho (1986), Mägiste (1984), and Tzelgov *et al.* (1990) studied the occurrence of within- and between-language Stroop-interference effects in groups of bilinguals with different levels of fluency in L2. In the common monolingual Stroop task, subjects name the ink colour of colour words presented to them. Stimulus words and responses are in the same language ('within-language'). When the ink colour and the name of the colour word match (e.g., the word 'red' printed in red ink), response time is typically shorter than when they do not match (e.g., 'red' printed in blue ink). The difference in response time between the match and mismatch conditions is what is called the 'interference' effect. In the bilingual version of the task, additional conditions are included in which the colour words are presented in one of the bilingual's languages and the responses have to be given in the other language (e.g., the word 'rouge' or 'bleu' in red ink; invited response: 'red'; this condition is referred to as a 'between-language' condition).

Between them, the studies by Mägiste (German-Swedish bilinguals), Chen and Ho (Chinese-English bilinguals), and Tzelgov *et al.* (Arabic-Hebrew bilinguals) suggest that the pattern of between- and within-language interference effects in bilinguals is determined by two factors. These are, first, the bilingual's level of proficiency in L2, and, secondly, whether or not the two languages

are orthographically similar (see Chen, 1992, for a comprehensive discussion). With low levels of L2 proficiency, between-language interference from L1 on L2 is typically larger than within-language interference. With higher levels of L2 fluency greater within- than between-language interference is obtained. The interference effect in the between-language conditions is larger when the orthographies of a bilingual's two languages are similar than when they are dissimilar. In all three of these Stroop studies the data pattern was explicitly related to bilingual lexical structure (which is why they were selected for the present discussion from a much larger set of bilingual Stroop studies). Mägiste attributed the between-language interference effects to 'associative bonds' (Mägiste, 1984, p. 306) between the L1 and L2 words: the stronger these bonds, the larger the effect. Chen and Ho, and Tzelgov *et al.* related their data to Potter *et al.*'s (1984) word-association and concept-mediation hypotheses.

Abunuwara (1992) investigated the relation between language proficiency and bilingual memory organisation in a new way. He did not manipulate proficiency in a foreign language in the usual between-subjects design, that is, by assigning subjects differing in L2 fluency to different proficiency groups. Instead, he used a within-subjects design: the subjects were (Arabic-Hebrew-English) trilinguals with a different level of fluency in their two foreign languages. An obvious advantage of using a within-subjects design is that the role of individual differences (age, family background, cultural differences, intelligence) in the results can be ruled out. All of Abunuwara's subjects had Arabic as their first and strongest language. Hebrew was stronger than English in a majority of the subjects, but a substantial number had English as the strongest non-native language. The presently relevant comparison is that between performance of one and the same trilingual in conditions that involve his L1 and the stronger of his two foreign languages on the one hand, and performance of this same individual in conditions involving L1 and his weaker foreign language on the other hand. One of the techniques employed by Abunuwara was the between-language Stroop colour-naming technique (measuring interference between each pair within the set of three languages). He also used Potter *et al.*'s (1984) technique, comparing picture naming and translation (from L1) in each of the subjects' two foreign languages. Some support for the developmental model was obtained.

De Groot and Hoeks (submitted) also investigated the role of proficiency in bilingual lexicosemantic organisation with trilingual subjects. The tasks they used were common word translation (unaccompanied by picture naming) and 'translation recognition' (see also de Groot, 1992a; Experiment 2). In common word translation ('translation production') subjects are presented with words in one of their languages and are asked to produce the translations of these words in their other language(s) out loud. This is the version of the word-translation task that has been used in the studies discussed above. In translation recognition the subjects are presented with pairs of words, one word of each pair in one language, the other in another language. For each pair they have to indicate whether or not it consists of translation equivalents.

In this study we aimed to test the development from a word-association to a concept-mediation structure with increasing proficiency in the foreign language. To be able to detect an involvement of conceptual memory in translation, the stimulus materials were manipulated on a semantic dimension: they were either concrete or abstract words (see also above). A development from a word-association structure to a concept-mediation organisation would be supported by the absence of a concreteness effect (or a relatively small effect) in the case of a low level of L2 proficiency and the presence of such an effect (or a larger effect) in the case of a higher level of L2 proficiency.

Our subjects were Dutch native speakers, with English as their strongest foreign language and French as a weaker foreign language. Each subject in the translation-production condition translated Dutch words into both English and French. Each subject in the translation-recognition condition categorised pairs of Dutch-English and of Dutch-French words. An effect of concreteness generally occurred in the Dutch-English conditions (translation time and translation-recognition time being shorter for concrete than for abstract words), but not in the Dutch-French conditions. These results suggest concept mediation in the case of a relatively high level of L2 fluency and word association in the case of a lower fluency level. In other words, the developmental model received support.

To recapitulate, a number of studies have shown a relation between L2 proficiency and bilingual lexicosemantic organisation. In a smaller number of studies no support for such a relation was

obtained. However, the results of the latter investigations may reflect the narrow range of proficiencies examined.

3. Learning Strategy: As discussed above, Chen and Leung (1989) showed that in an early stage of L2 acquisition both adults and children process L2 words indirectly. When presented with an L2 word, they first seem to access another memory structure before accessing conceptual memory. In other words, understanding L2 words seems to be 'mediated' by another type of memory structure. Adult 'beginners' (in L2 acquisition) appeared to use L1 word-form representations as 'mediators'. Child beginners appeared to pass through pictorial representations before gaining access to conceptual memory. At first sight, age may seem to be the factor determining what type of structure is accessed prior to understanding the L2 word. But in Chen and Leung's (1989) study age may have been confounded with learning strategy. Adults are typically taught (or teach themselves) the basics of their new language with the aid of L1 words. Child beginners, in contrast, '...are likely to be taught by using concrete media such as pictures or even real objects...' (Chen, 1992, p. 256). So, learning strategy rather than age may determine the type of memory structure accessed prior to understanding the L2 word.

A way to settle this issue would be to match groups of L2 learners on age while manipulating learning strategy experimentally. Chen (1990; Experiment 3) did just that. Two groups of Cantonese-speaking Chinese undergraduates learned French words from scratch. One group learned according to a picture-learning strategy. Each stimulus consisted of a word in French and the corresponding picture. The second group learned according to a word-learning strategy. Each French word was presented with its translation in Cantonese (L1). In the first session the complete set of word-picture or word-word pairs (20) was presented once; in the second session this same set was presented twice; and in the third session it was presented three times. All three study phases were immediately followed by a test phase. The test phases involved the common comparison of picture naming in L2 and translating L1 words into L2. In this design L2-proficiency was implicitly manipulated as well, because the subjects' proficiency may be expected to increase in every further session.

The results of the test phase depended on both proficiency and learning strategy. When tested after the second session (that is, after

three presentations of each of the pairs), the subjects in the picture-learning condition were faster in picture naming in L2 than in translating from L1 to L2. In contrast, the subjects in the word-learning condition showed the opposite pattern. When tested after the third session (i.e., after six presentations of the pairs), both subject groups were equally fast on the two tasks. These data suggest that during a relatively early stage of L2 word learning, the processing of the L2 words depends on the nature of the learning task. The strategy subjects adopt meets the requirements of the learning task. With further learning, all learners, irrespective of the earlier learning condition, switch to concept mediation. In sum, learning strategy rather than age is likely to have been responsible for the results obtained by Chen and Leung (1989).

Chen's (1990) study suggests that already after six learning encounters with an L2 word a concept-mediation structure has emerged. This finding and the experimental circumstances in which it was obtained are particularly noteworthy, because they hint at the relevance of *word-specific* L2 experience in the developing bilingual memory. At first sight, Chen's data may seem to conflict with those of most of the other studies on the role of L2 proficiency in bilingual lexicosemantic organisation discussed above. The subjects assigned to the low-proficiency groups in those studies typically had had about two to three years of schooling in L2. In other words, they must have had much more L2 experience than the L2 learners in Chen (1990) after only six exposures to just 20 words in L2. Yet, the data of the former subject groups evidenced a word-association (or picture-association) structure, whereas those in Chen's study showed concept mediation.

A critical difference between Chen's study on the one hand and the remaining studies on the other is that Chen tested his subjects on exactly the same 20 words they had just learned before. In the other studies the construction of the test set was independent of the particular experiences subjects had had with these selected words during their years of schooling in L2. It is possible that the total number of previous encounters with each individual test word during these years of L2 acquisition was rather restricted. Indeed there may have been less than, say, four encounters per test word. If true, Chen's data are perfectly compatible with those of the remaining studies. In conclusion, bilingual lexicosemantic structure does not seem to evolve from *general* L2 experience, but from word-specific encounters. The implication is that different words may be

represented differently in the bilingual lexicon. Within one and the same lexicon concept-mediation structures and word-association structures (as well as other structures to be discussed below) may coexist. For instance, high-frequency words, often encountered, may be represented in concept-mediation structures and low-frequency words, encountered seldom, in word-association structures. This point will be elaborated below in a separate text section (Word Type).

4. Recent Use and Disuse: In addition to L2 proficiency and learning strategy, Chen's (1990) study suggests yet another possibly critical factor: the time between the presentation of a test word and the last previous encounter of that word. Due to his specific approach, that is, learning the new language from scratch and combining learning and testing within a single 'lesson', this interval was shorter in Chen's study than in any of the other studies discussed so far. This raises an interesting question: does bilingual lexicosemantic structure only develop (from a word-association to a concept-mediation organisation) with increasing experience (proficiency) in L2, or does it also change when existing structures are out of use for some time? Conceivably it reverts to a word-association structure. If such is the case, it would classify as an instance of 'language loss', a popular research topic ever since Lambert and Freed (1982) edited a volume on this theme (see Weltens & Grendel, 1993, for a recent review of studies on the loss of vocabulary).

In fact, this possibility of a change caused by disuse suggests a different way to view the data of de Groot and Hoeks. Recall that their Dutch-English-French trilinguals showed a concept-mediation data pattern in the Dutch to English translation conditions, but a word-association pattern in the Dutch to French conditions. This word-association pattern occurred despite the fact that these subjects had had considerable (school) training in French (for about six years). But unlike English (still used practically daily by them while reading their university text books), they had not used French for some months. As a consequence, previous Dutch-French concept-mediation structures could have reverted back into word-association structures. This view of L2 experience may also explain why even the lowest proficiency group in the study by Rik Poot and myself (see L2 Proficiency), showed a concept-mediation pattern: these subjects with about 2.5 years of school training were

tested during the time they were engaged in learning English at school. As a consequence, concept-mediation structures had had no time to 'decay'.

These descriptions of how one structure develops into another as a result of frequent and recent use or prolonged disuse, should not be taken too literally. Instead of assuming that previous structures actually disappear from memory and are replaced by others, one should see the changes in terms of the strengthening and weakening of connections between memory units. For instance, when the direct connections between L2 word-form representations and L1/L2 conceptual representations have become stronger than the direct connections between L1 and L2 word-form representations, a concept-mediation data pattern may replace an earlier word-association pattern. In other words, it is assumed that the word-association links do not suddenly disappear from memory, but become dormant. They may be activated again under the appropriate circumstances (see Kroll & Sholl, 1992, and Kroll & Stewart, 1994, for similar arguments).

5. Learning Environment: The different learning strategies used by Chen (1990) led initially to different structural organisations of bilingual memory: a word-association and a picture-association organisation. With further L2 experience both these organisations evolved into a concept-mediation structure. Chen's study exemplifies the much older and more general idea of Ervin and Osgood (1954), that different learning environments or acquisition contexts lead to different memory structures. Ervin and Osgood assumed that a formal L2 learning context where L2 words are associated with L1 words (Chen's word-association learning strategy) results in a 'compound' (concept-mediation) structure. Note that this idea is substantiated by Chen's data if we assume that Ervin and Osgood referred to bilinguals past the initial stages of L2 learning. A further acquisition context that, according to Ervin and Osgood, results in a compound structure is when a child grows up in a home where the two languages are spoken interchangeably by the same people and in the same situation. In contrast, a strict separation between the use of the two languages was thought to result in a 'coordinate' structure (the separate-stores hypothesis; see Introduction). This type of structure assumes two language-specific systems.

Ervin and Osgood's ideas received support in an early experimental study by Lambert, Havelka, and Crosby (1958). They used Osgood's (1952) 'Semantic Differential' as experimental tool. French-English bilingual subjects scaled both words within each of a set of translation word pairs (e.g., 'maison' and 'house') on a standard set of meaning dimensions (like: fast-slow, and pleasant-unpleasant). A *D*-score was then computed for each pair, expressing the semantic difference between the French and English words in the pair. Lambert *et al.* expected to obtain larger *D*-scores for subjects who learned the two languages in separate contexts (assumed to result in a coordinate system) than for subjects who learned them interchangeably (resulting in a compound system). The data indeed turned out that way.

Diller (1970) severely criticised the use of Osgood's Semantic Differential as a device to study representational systems in bilinguals and how these systems relate to acquisition context. But other studies, using other experimental tools, have been performed that also point at this relation. Gekoski (1980; see also L2 Proficiency) compared within-language and between-language word-association responses to Spanish and English words in Spanish-English bilinguals. He calculated the degree of response equivalence in the two within-language and in the two between-language conditions. For instance, when a subject produced 'reina' as a response to 'rey', and 'queen' as a response to 'king', this was scored as an equivalent response. Prior to the experiment, half of the subjects were classified as compound bilinguals whereas the other half were categorised as coordinate. This categorisation was based on the subjects' acquisition histories. Gekoski argued that response equivalence should be greater in the compound than in the coordinate bilinguals. When using the 'restricted' word-association task (see L2 Proficiency), this effect was indeed obtained. However, in a second task, the 'free' word-association task (see L2 Proficiency), only a trend in the same direction was obtained.

The studies discussed in this section all point, albeit sometimes only weakly, at a relation between *acquisition* context and bilingual memory organisation. A study by Votaw (1992) also stresses the role of context in bilingual lexicosemantic structure, but from a different perspective. She notes that a bilingual may live in a basically monolingual environment, that is, among speakers of only one of the two languages (she calls this type of context 'constrained'). But s/he may also live in a bilingual environment, sharing

the two languages with the other members of the community ('unconstrained'). Votaw argues that a constrained context results in a more language-specific (coordinate) bilingual memory organisation than an unconstrained context. The reason is that in a constrained context mixing the two languages would lead to speech that would be incomprehensible to the addressee. This difference between constrained and unconstrained contexts is typically not taken into account in response-time studies that investigate the structure of bilingual memory. Consequently, it may contaminate the results of those studies. Votaw discusses the relevant literature in this light. She concludes that the distinction between constrained and unconstrained contexts is indeed a determinant of bilingual memory organisation.

6. Word Type: The alleged determinants of bilingual lexicosemantic structure discussed so far share with one another that they all distinguish between groups of *bilinguals* (e.g., low-proficient versus high-proficient bilinguals; bilinguals functioning in a constrained context versus those communicating in an unconstrained context). In the majority of the relevant studies (but see de Groot, 1993, for exceptions) the implicit assumption appears to be that all representations in one and the same bilingual are of the same type; for instance, the memories of low-fluency bilinguals may only contain word-association structures whereas those of highly fluent bilinguals may only contain concept-mediation structures. Yet another possible determining factor, however, implies a 'mixed' structure: within the lexicosemantic memory of a bilingual, structures of different types coexist. This factor is word type. It distinguishes between words, not bilinguals, and holds that different words may be represented differently within one and the same bilingual.

The idea that different words are represented differently within a bilingual memory is prompted by the finding that in bilingual processing tasks different response patterns are obtained for concrete and abstract words. Furthermore, different results are obtained for cognates (translations with a similar meaning, phonology and orthography) and noncognates (translations with a similar meaning, but dissimilar phonology and orthography). These effects can be understood by assuming different memory structures for concrete and abstract translation pairs, and, similarly, by assuming different structures for cognate and noncognate translation pairs. The rest of

this section reviews studies that point towards this conclusion (see de Groot, 1993, for more detail). First, the studies in which concreteness was manipulated will be discussed. Then follows a discussion of the studies that manipulated the cognate status of translation pairs.

Effects of *concreteness* have been obtained in studies by Kolers (1963), Taylor (1976), Jin (1990), de Groot (1992a) and de Groot *et al.* (1994). In a 'discrete' word-association study (one response word per stimulus word) Kolers (1963) observed that the responses to concrete L1 words and their equivalents in L2 were more often the same than the responses to abstract stimulus words in L1 and L2 ('same' here means referring to the same concept, irrespective of the language of the response words; so the responses 'king' to 'reina' in a between-language condition and 'rey' to 'reina' in a within-language condition would be regarded as 'same' responses). Taylor (1976) obtained a similar result in a 'continued' word-association study (in which the subjects produce as many word associations as possible to each stimulus of a set within a pre-specified time duration). She observed that the two words in concrete French-English translation pairs more often gave rise to associates that were translations of one another ('same' responses) than did the two words within abstract pairs. Furthermore, she found that the overlap between the French and English response lists was larger for concrete than for abstract words. 'Same' responses may originate from a language-independent conceptual memory, whereas 'different' responses may stem from language-specific conceptual memories. The data of Kolers (1963) and Taylor (1976) thus indicate that concrete words more often share a representation in conceptual memory than do abstract words.

Jin (1990) manipulated concreteness in a lexical-decision study where he looked at the occurrence of within- and between-language semantic-priming effects. In a lexical-decision task subjects categorise letter strings as words or nonwords. In the priming version of the task the letter strings to be categorised are preceded by 'primes', typically words. The effect of this prior stimulus on processing the test letter string is assessed. In a semantic-priming version, the semantic relation (rather than, say, the phonological relation) between primes and (word) targets is manipulated. In the within-language version of the latter type of task, primes and targets are presented in the same language. In the between-language version, primes and targets are presented in different languages. A

common finding is that a test (lexical-decision) stimulus (for instance, 'egg') preceded by a semantically related prime word in the same language (e.g., 'chicken') is responded to faster than a test stimulus preceded by an unrelated same-language word. This effect is called the 'within-language semantic-priming' effect. It is typically attributed to activation spreading in a conceptual-memory network in which the representations of related words (here, 'chicken' and 'egg') are connected with one another.

A semantic-priming effect has also been observed between-languages, with primes and targets presented in different languages. However, this effect is less robust than the within-language effect. For instance, it reliably occurs with primes in L1 and targets in L2, but not when the language of primes and targets is reversed (see Kroll & Sholl, 1992, for a review). Jin (1990), testing Korean-English adult bilinguals, obtained a reliable between-language priming effect for concrete words but not for abstract words. Again, these data point at different types of representations for different types of words. More specifically, they suggest that concrete translation-equivalent words are represented in a common, language-independent store in bilingual memory, whereas abstract words are represented in separate, language-specific stores.

Finally, a concreteness effect was obtained in two studies that attempted to identify the determinants of word translation (de Groot, 1992a; de Groot *et al.*, 1994). The former of these studies only looked at translation from Dutch, our subjects' native (and strongest) language (L1) to English, their second language (L2). In addition to this 'forward-translation' condition, the second study also investigated backward translation, from English to Dutch. Thirteen predictor variables were included. Among these variables four factors could be identified: a semantic factor, a familiarity factor, a length factor, and cognate status. Two of the variables loading on the semantic factor were the concreteness of the Dutch words and the concreteness of the English words. It turned out that concrete words were translated more rapidly and more often correctly than abstract words. These effects occurred in both translation directions. Furthermore, concrete words less often produced an omission (no response within a pre-set deadline) than abstract words, again in both directions.

As the above concreteness effects in word association and between-language semantic priming, these effects suggest that concrete words are represented more (or more often) language-

independently than abstract words. Two specific proposals for more integrated L1 and L2 representations in the case of concrete words were presented in de Groot (1992a). The first proposed 'local' conceptual representations. The second proposed 'distributed' conceptual representations. A local conceptual representation represents the meaning of a word in a single memory 'node'. In contrast, a distributed representation represents word meaning in a set of nodes, each, for instance, representing one of the word's meaning elements. A way to explain the concreteness effect in terms of local representations is to assume - for concrete words but not for abstract words - mixtures of the word-association and concept-mediation representations as presented earlier. Such a mixed representation is depicted in Figure 1c. It contains both the word-association connections of the word-association hypothesis and the direct connections between the L2 word-form representations and conceptual memory as assumed in the concept-mediation model. Thus, according to this view, concrete words share a conceptual representation. In contrast, abstract words are thought to be represented in two language-specific conceptual representations, one for each language. The consequence of these different structures for concrete and abstract words is that concrete words can be translated along two routes, through conceptual memory and along the word-association connection between the word-form representations. However, for abstract words only the latter translation route exists. The extra route for concrete words may benefit the translation of these words.

An interpretation of the concreteness effect in terms of distributed conceptual representations is that translations of concrete words share more of the individual nodes of these distributed representations than do translations of abstract words. Figure 1e depicts the distributed conceptual representations of an L1 word and its translation in L2. In this particular, hypothetical, case each of the two words in the translation pair is represented in six conceptual nodes. Five of them are shared between the languages. The proposal here is that the amount of sharing between the languages correlates positively with concreteness. The more of the nodes in the distributed representations are shared between the words in a translation pair, the easier the translation process (see de Groot, 1992b, for an elaboration of this idea).

The finding of a concreteness effect both in forward and in backward translation is particularly relevant in view of yet another

model of bilingual memory representation: the 'asymmetry' model (Kroll & Stewart, 1994; Figure 1d). The model is an instance of the 'mixed' model introduced above, which assumes both word-association and concept-mediation connections between the word-form representations of a translation pair. The model assigns directionality to the word-association links: there is a weak link from the L1 word-form representation to the L2 word-form representation, but a strong link in the reverse direction. Furthermore, the link between the L1 word-form representation and the node in conceptual memory is stronger than that between the latter node and the L2 word-form representation. As a consequence of these differences in link strength, processing from L1 to L2, for instance in a translation task, is thought to go via conceptual memory. In contrast, processing in the reverse direction, from L2 to L1, is thought to proceed along the word-association links. The present concreteness effect in backward translation suggests that a strong version of the model cannot hold. According to the strong version, forward processing *always* employs the conceptual route and backward translation *always* uses the word-association route. As argued before, whenever a concreteness effect occurs, conceptual memory must have been involved. In other words, the occurrence of a concreteness effect in backward translation suggests that also in this task the conceptual route is used. However, support for weaker asymmetrical processing in forward and backward translation was obtained in our study (de Groot *et al.*, 1994), supporting a weak version of the asymmetry model: conceptual memory is implicated *more* in forward than in backward translation. The asymmetry model also receives support from other studies, for instance, from the between-language semantic-priming studies discussed above (see Kroll & Sholl, 1992). These studies typically show larger between-language effects when the prime is in L1 and the target in L2 than vice versa.

A further noteworthy finding in a number of translation studies is an interaction between word frequency and concreteness: the effect of concreteness is larger for high-frequency words than for low-frequency words. This finding is perfectly compatible with the earlier suggestion (in the Learning Strategy section) that changes in bilingual lexicosemantic structure do occur word-specifically. Recall that a number of studies have shown that bilinguals with higher levels of L2 fluency demonstrate concept-mediation performance whereas bilinguals with a low fluency level evidence word-

association performance. In a way, highly fluent bilinguals are to less fluent bilinguals as high-frequency words are to low-frequency words: highly fluent bilinguals will in general have had more L2 practice than less fluent bilinguals, whereas high-frequency words, by definition, have been practised more by an individual bilingual than low-frequency words. If lexical change indeed takes place at the level of the individual words, this means that for high-frequency words concept mediation should occur at a time when low-frequency words are still processed via the word-association connections. In other words, word frequency should mimic within a bilingual the effect of L2 proficiency that is obtained between bilinguals. And, once more, only when translation involves processing via conceptual memory, an effect of concreteness may be expected. Low-frequency words should therefore show smaller effects of this variable, as indeed they do.

As for *cognate status*: in a continued word-association study (see above) Taylor (1976) observed that the two words in French-English cognate pairs (e.g., the French and English word 'table') more often evoked associates that are translations of one another ('chaise' and 'chair', respectively) than did the two words within noncognate pairs. She further found that the overlap between the French and English response lists was larger for cognates than for noncognates.

A large number of studies manipulated cognate status while employing the between-language 'repetition-priming' (or 'translation priming') technique (Cristoffanini, Kirsner & Milech, 1986; Davis, Sánchez-Casas & García-Albea, 1991; de Groot & Nas, 1991; Gerard & Scarborough, 1989; Kerkman, 1984; Sánchez-Casas, Davis & García-Albea, 1992). In the within-language version of the repetition-priming technique a number of words is presented twice in the same language, whereas other words are presented once only. In many studies of this type, words that already have been presented before are processed faster on their second occurrence than words presented for the first time. This is the 'repetition (priming)' effect. In the between-language version of the task, words in the repetition condition are again presented twice, but in different languages on their two occurrences. The studies that have employed this technique varied on a number of dimensions. For instance, some used a long interval between the two occurrences of a repeated word, with other words presented in between them. In other studies a word and its repetition were presented in immediate succession. In

some studies the repeated words were masked (visually degraded) on their first occurrence, whereas they were clearly visible in other studies. Despite these differences, a general pattern emerges from these studies: the translation-priming effect is larger for cognates than for noncognates (in some studies), or it occurs for cognates only (in other studies).

The word-translation task has also produced a reliable effect of cognate status (de Groot, 1992a; de Groot *et al.*, 1994; Sánchez-Casas *et al.*, 1992). Cognates are translated faster, more often (fewer omissions), and more often correctly than noncognates. Generally, cognates show the same pattern as concrete words, whereas noncognates show the same pattern as abstract words. The effects of cognate status that occur in the various tasks are consistent with the idea that the representations of cognates in bilingual memory are more language-independent than those of noncognates.

In conclusion, the effects of word type discussed in this section point out that within bilingual lexicosemantic memory different types of structure coexist: some are more segregated by language (abstract words; noncognates) than others (concrete words; cognates); some contain relatively strong word-association connections (low-frequency words), whereas others contain strong concept-mediation connections (high-frequency words). This idea that bilingual memory contains structures of various kinds is not new (see, e.g., Weinreich, 1953; Opoku, 1982), but it seems to have disappeared in much of the more recent work on bilingual memory organisation.

7. Implications?: All studies reviewed in this paper converge on the conclusion that *the* bilingual memory does not exist. The memory of every individual bilingual is likely to contain structures of various types. However, these different types of structures will occur in different proportions across bilinguals. For instance, word-association as well as concept-mediation representations will occur in the memories of both highly fluent and less fluent bilinguals, but the proportion of word-association representations will be larger in the less fluent bilinguals. L2 practice will have the effect of reducing the number of word-association structures and increasing the number of concept-mediation structures. If L2 is temporarily out of use, the opposite may happen. A strict separation of the usage of L1 and L2 may give rise to a system in which the two languages are represented in a relatively separated way (many 'coordinate'

representations). A further relevant point that was made is that the development of bilingual memory presumably takes place at the level of the individual word: the representational structure for any given pair of translations gradually develops over use or disuse of that particular translation pair. This view is more plausible than the assumption that at one point in time all memory structures, all being of one type, are miraculously replaced by structures of a different type. Another point that was mentioned was that one should not simply conceive of this, word-specific, development in terms of one structure being replaced by a different type of structure. Instead, it seems more appropriate to look at it in terms of the strengthening or weakening of the connections between the different memory units in the lexicosemantic representation of this word.

Having concluded that individual bilingual memories contain lexicosemantic structures of various types, that the different structures occur in different proportions across bilinguals, and that the individual structures change over time, what are the implications for second language learning and teaching and for CALL especially? During the process of writing this contribution (and indeed many times over the years that I was involved in this research), I often bore this question in mind. My reluctant answer at this point is that there may be disappointingly few implications.

A goal to bear in mind when considering the practical implications of this research is that an L2 learner should arrive at the structures that suits her/his communicative purposes best in as short a period of time as possible. If there are means to reach this goal, we should attempt to incorporate them in our teaching methods. Two specific questions we should pose in this context are: 1) Would for this particular L2 learner one particular type of structure, or mix of structures, be preferable? 2) Can the teaching method contribute in actualising this state and, if so, how?

There is some reason to assume that the first question must be answered affirmatively. Recall, for instance, Votaw's (1992) arguments for holding the view that language-specific (coordinate) representations are better suited for bilinguals in constrained contexts than are language-independent (e.g., compound) representations. Some support for a positive answer to the second question can also be pointed out. Chen's (1990) work demonstrated that different teaching methods (word association versus picture association) initially lead to different lexicosemantic structures in L2 learners. If it could be demonstrated that immersion learning results

in more language-specific representations than paired-associate learning with L1-L2 word pairs - a plausible assumption-, this would be another example of a role of teaching method in bilingual memory organisation. The reason why I nevertheless suspect that the impact of teaching method may be rather limited is provided, again, by Chen (1990). He demonstrated that the effect of teaching method was rather short-lived: after only a small number of learning trials, the subjects in both his groups of learners spontaneously switched to a different pattern of processing. Despite the fact that the groups were trained according to different methods, this eventual pattern was the same for both groups. In both groups the switch occurred even though the learning method had not undergone any change. Apparently, without instructional intervention the representational structures in both learner groups had changed, converging on the same type of structure for both groups. Although it would be premature to conclude at this point that *no* learning method will have a *lasting* effect on bilingual lexicosemantic organisation, this finding *does* suggest that an instructional influence on bilingual memory may be rather limited.

Maybe the most applicable outcome of the studies discussed in this paper is that words vary in processing difficulty. To the extent that ease of processing and ease of learning are correlated, this finding could have consequences for an L2 curriculum. Three of the dimensions on which words vary and that have been shown to affect processing in the studies discussed here are the concreteness of words, the frequency with which they are used, and whether they share a cognate or a noncognate relation with their translations in L2. It is plausible that cognate translations are easier to learn than noncognate translations. Indeed, this idea has already been exploited in L2 acquisition programs. Meara (1993) reviews the relevant literature (and warns the L2 teacher against a number of pitfalls when exploiting the cognate relation between translations).

More sensational is an indication that word frequency also affects L2 word acquisition. The indication comes from a study that Lorella Lotto recently performed in our laboratory. She had Dutch undergraduates learn Italian words from scratch, manipulating the stimulus materials on cognate status and word frequency. Cognate status showed the expected effect: cognates were learned faster and better than noncognates. But the most interesting outcome was an effect of word frequency: high-frequency words turned out to be easier to learn. The high-frequency words were not structurally

more similar across languages than the low-frequency words. Neither was it the case that high-frequency words structurally differed from low-frequency words within the languages. Therefore, it is likely that the frequency effect on learning was due to the fact that subjects will in general be more familiar with the referents of high-frequency words. In other words, it appears that L2 words for familiar concepts are easier to learn than L2 words for less familiar concepts. If this is indeed the case, it could be exploited in foreign-language-learning curricula. Of course, word frequency has indeed long been a factor in designing such curricula (see e.g., Nation, 1993). These methods often start out with high-frequency words, but not because, due to their familiarity, these words are relatively easy to learn. The reason is a more practical one: the learner's L2 coverage will be larger when he masters a set of high-frequency L2 words than when mastering an equally large set of low-frequency words. Consequently, if a goal of a curriculum is to provide the learner with a useful level of L2 coverage as soon as possible, initially the focus should indeed be on high-frequency words.

Finally, as for the concreteness variable, concrete words may not only be easier to process than abstract words in bilingual processing tasks (as demonstrated in many of the studies discussed in this paper), but it may also be easier to learn them (that is, their L2 names) in a foreign-language curriculum. A reason could be that concrete words are more meaningful than abstract words: they are embedded in denser semantic networks (e.g., de Groot, 1989). It is an interesting thought that the ease with which a new name can be associated with a concept would depend on how much meaning it carries.

To summarise, if the perspective of a curriculum is that easy and difficult words should be taught in a different order, the present effects of cognate status, frequency and concreteness have clear implications for L2 teaching. For instance, if a design principle of the curriculum would be that the acquisition process should start out with the easier materials (e.g., because this is motivating for the learner), high-frequency words with a cognate translation in L2 and a concrete referent should be introduced first. But note that the presently suggested implication for L2 vocabulary acquisition relates to no more than a side-issue of the central topic of this paper. In this paper the focus was not on the above word-type effects per se, but on their source: bilingual lexicosemantic structure and how this structure may differ for different types of words. It is significant that

in the design of L2 vocabulary-acquisition programs, those with and without the use of computers as a teaching medium, there seems to be little concern about the structure of the bilingual lexicon as I have discussed it here. For instance, the structuring of lexical knowledge *does* play a crucial role in the 'second-generation' computer-assisted L2 vocabulary learning programs reviewed by Goodfellow (this volume), but the structuring that he deals with seems totally L2-internal. These programs aim at building an L2 lexicon in which the units are organised according to their meaning. Inter-word relations like synonymy, hyponymy, and polysemy should become 'hardwired' in the lexical structure, as they are assumed to be within the L1 lexicon. But the way the L1 and L2 vocabularies are interconnected appears of no concern in these programs. It is as if the program builders implicitly assume a coordinate bilingual lexical structure, in which L1 and L2 are stored in totally segregated systems. As discussed here, such a coordinate system is just one of the bilingual lexicosemantic organisations that are feasible, and it is unlikely to be the optimal system for all types of bilinguals (see above). So maybe this is where the more theoretically oriented work on bilingual lexicosemantic organisation may have something to offer to the more practically oriented work on L2 vocabulary acquisition after all: it may contribute to the awareness that bilingual lexicons differ from one another. Even though it is not clear whether different instructional methods will lead to *lasting* differences in the representational structures (see above), this awareness is a point that should be taken into consideration when designing an L2 vocabulary acquisition curriculum.

References:

- Abunuwara, E. (1992) The structure of the trilingual lexicon. *European Journal of Cognitive Psychology*, 4, 311-322.
- Chen, H.-C. (1990) Lexical processing in a non-native language: Effects of language proficiency and learning strategy. *Memory & Cognition*, 18, 279-288.
- Chen, H.-C. (1992) Lexical processing in bilingual or multilingual speakers. In R. J. Harris (ed.), *Cognitive Processing in Bilinguals*. Amsterdam: Elsevier Science Publishers.
- Chen, H.-C., & Ho, C. (1986) Development of Stroop interference in Chinese-English bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 12, 397-401.

- Chen, H.-C., & Leung, Y.-S. (1989) Patterns of lexical processing in a non-native language. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 15, 316-325.
- Cristoffanini, P., Kirsner, K., & Milech, D. (1986) Bilingual lexical representation: The status of Spanish-English cognates. *Quarterly Journal of Experimental Psychology*, 38A, 367-393.
- Davis, C. W., Sánchez-Casas, R. M., & García-Albea, J. E. (1991) *Bilingual lexical representation as revealed using a masked priming procedure*. Unpublished Manuscript. St. Louis University, Madrid, Spain.
- De Groot, A. M. B. (1989) Representational aspects of word imageability and word frequency as assessed through word association. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 15, 824-845.
- De Groot, A. M. B. (1992a) Determinants of word translation. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 18, 1001-1018.
- De Groot, A. M. B. (1992b) Bilingual lexical representation: A closer look at conceptual representations. In R. Frost & L. Katz (eds), *Orthography, Phonology, Morphology, and Meaning*. Amsterdam: Elsevier Science Publishers.
- De Groot, A. M. B. (1993) Word-type effects in bilingual processing tasks: Support for a mixed representational system. In R. Schreuder & B. Weltens (eds), *The Bilingual Lexicon*. Amsterdam-Philadelphia: John Benjamins.
- De Groot, A. M. B., Dannenburg, L., & Hell, J. G. van (1994) Forward and backward word translation by bilinguals. *Journal of Memory and Language*, 33, 600-629.
- De Groot, A. M. B., & Hoeks, J. C. J. (Submitted) The development of bilingual memory: Evidence from word translation by trilinguals.
- De Groot, A. M. B., & Nas, G. L. J. (1991) Lexical representation of cognates and noncognates in compound bilinguals. *Journal of Memory and Language*, 30, 90-123.
- Diller, K. C. (1970) 'Compound' and 'coordinate' bilingualism: A conceptual artifact. *Word*, 26, 254-261.
- Ervin, S. M., & Osgood, C. E. (1954) Second language learning and bilingualism. *Journal of Abnormal Social Psychology*, Supplement, 139-146.
- Gekoski, W. L. (1980) Language acquisition context and language organization in bilinguals. *Journal of Psycholinguistic Research*, 9, 429-449.
- Gerard, L. D., & Scarborough, D. L. (1989) Language-specific lexical access of homographs by bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 15, 305-315.
- Heredia, R., & McLaughlin, B. (1992) Bilingual memory revisited. In R. J. Harris (ed.), *Cognitive Processing in Bilinguals*. Amsterdam: Elsevier Science Publishers.
- Jin, Y.-S. (1990) Effects of concreteness on cross-language priming in lexical decisions. *Perceptual and Motor Skills*, 70, 1139-1154.
- Kerkman, J. P. M. (1984) Woordherkenning in twee talen (Word recognition in two languages) In A. J. W. M. Thomassen, L. G. M. Noordman & P. A. T. M. Eling (eds), *Het Leesproces (The Reading Process)*. Lisse, The Netherlands: Swets & Zeitlinger.
- Kolers, P. A. (1963) Interlingual word associations. *Journal of Verbal Learning and Verbal Behavior*, 2, 291-300.

- Kroll, J. F. (1993) Accessing conceptual representations for words in a second language. In R. Schreuder & B. Weltens (eds), *The Bilingual Lexicon*. Amsterdam-Philadelphia: John Benjamins.
- Kroll, J. F., & Curley, J. (1988) Lexical memory in novice bilinguals: The role of concepts in retrieving second language words. In M. M. Gruneberg, P. E. Morris & R. N. Sykes (eds), *Practical Aspects of Memory: Current Research and Issues*. Chichester: John Wiley.
- Kroll, J. F., & Sholl, A. (1992) Lexical and conceptual memory in fluent and nonfluent bilinguals. In R. J. Harris (ed.), *Cognitive Processing in Bilinguals*. Amsterdam: Elsevier Science Publishers.
- Kroll, J. F., & Stewart, E. (1994) Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations. *Journal of Memory and Language*, 33, 149-174.
- Lambert, R. D., & Freed, B. F. (eds) (1982) *The loss of language skills*. Rowley, MA: Newbury House.
- Lambert, W. E., Havelka, J., & Crosby, C. (1958) The influence of language-acquisition contexts on bilingualism. *Journal of Abnormal and Social Psychology*, 56, 239-244.
- Mägiste, E. (1984) Stroop tasks and dichotic translation: The development of interference patterns in bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 10, 304-315.
- McCormack, P. D. (1977) Bilingual linguistic memory: the independence-interdependence issue revisited. In P. A. Hornby (ed.), *Bilingualism: Psychological, Social, and Educational Implications*. New York: Academic Press.
- Meara, P. (1993) The bilingual lexicon and the teaching of vocabulary. In R. Schreuder & B. Weltens (eds), *The Bilingual Lexicon*. Amsterdam-Philadelphia: John Benjamins.
- Nation, P. (1993) Vocabulary size, growth, and use. In R. Schreuder & B. Weltens (eds), *The Bilingual Lexicon*. Amsterdam-Philadelphia: John Benjamins.
- Opoku, J. Y. (1982) Bilingual representational systems and interlingual transfer of learning. *Journal of Cross-Cultural Psychology*, 13, 470-480.
- Osgood, C. E. (1952) The nature and measurement of meaning. *Psychological Bulletin*, 49, 197-237.
- Potter, M. C., So, K.-F., Von Eckardt, B., & Feldman, L. B. (1984) Lexical and conceptual representation in beginning and proficient bilinguals. *Journal of Verbal Learning and Verbal Behavior*, 23, 23-28.
- Sánchez-Casas, R. M., Davis, C. W., & García-Albea, J. E. (1992) Bilingual lexical processing: Exploring the cognate/non-cognate distinction. *European Journal of Cognitive Psychology*, 4, 293-310.
- Taylor, I. (1976) Similarity between French and English words. A factor to be considered in bilingual language behavior? *Journal of Psycholinguistic Research*, 5, 85-94.
- Tzelgov, J., Henik, A., & Leiser, D. (1990) Controlling Stroop interference: Evidence from a bilingual task. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 16, 760-771.
- Votaw, M. C. (1992) A functional view of bilingual lexicosemantic organization. In R. J. Harris (ed.), *Cognitive Processing in Bilinguals*. Amsterdam: Elsevier Science Publishers.

Weinreich, U. (1953) *Languages in Contact: Findings and Problems*. New York: Linguistic Circle of New York. Reprinted in 1974 by Mouton, The Hague.

Weltens, B. & Grendel, M. (1993) Attrition of vocabulary knowledge. In R. Schreuder & B. Weltens (eds), *The Bilingual Lexicon*. Amsterdam-Philadelphia: John Benjamins.