

This is an offprint from:

Robert Schreuder and Bert Weltens (eds)

The Bilingual Lexicon

John Benjamins Publishing Co.

Amsterdam/Philadelphia

1993

(Published as Vol. 6 of the series

STUDIES IN BILINGUALISM)

ISBN 90 272 4108 2 (Eur.)/1-55619-536-2 (US) (Hb)

ISBN 90 272 4110 4 (Eur.)/1-55619-538-9 (US) (Pb)

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Word-Type Effects in Bilingual Processing Tasks Support for a Mixed-Representational System

Annette M.B. de Groot

Three types of bilingual lexical organization are commonly distinguished: compound, coordinate, and subordinative. The compound and subordinative systems assume a single underlying conceptual system that is shared by both of the bilingual's vocabularies. In contrast, the coordinate system assumes two conceptual systems, one associated with each of the two vocabularies. The critical difference between the compound and subordinative systems is that in the former words from the L2 vocabulary access their conceptual representations directly whereas in the latter access of conceptual memory comes about via the corresponding L1 word. The main tenet of this chapter is that within the lexicon of an individual bilingual all three of these representational structures may be found, the representational format of a pair of word translations depending on particular characteristics of the word and the associated concept. Two particularly critical characteristics may be a word's concreteness and whether or not the word and its translation are cognates.

Almost four decades ago Weinreich (1953, reprinted in 1974) sketched, in Saussurian linguistic terminology, three possible organizations of word knowledge in a bilingual's mental lexicon: "compound", "coordinate", and "subordinative". The three, depicted in Figure 1, differ from one another along two dimensions: the number of underlying conceptual system(s) that the bilingual possesses (one or two) and, in the case of a single conceptual system, the way in which this system is accessed when a second-language word is input (directly or indirectly via the corresponding native language word).

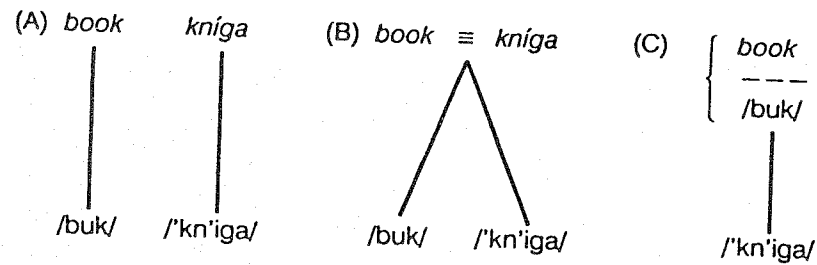


Figure 1. Three organizations of word knowledge in bilinguals. A = coordinate; B = compound; C = subordinative (from Weinreich 1953)

Coordinate bilinguals (Type A) possess one "signified" for every "signifier". In more current psycholinguistic terminology this means that a word in the bilingual's one language (L1) (e.g., English *book*) and its translation in his or her second language (L2) (the Russian *kníga*; this example is taken from Weinreich) are represented in two conceptual forms, one for the word in each language. In contrast, compound bilinguals (Type B) possess only one set of signifieds with two signifiers for each signified: *kníga* and *book* are represented by a single conceptual form in this bilingual's memory.

In distinguishing between compound and coordinate bilinguals, Weinreich does not consider the level of proficiency in the different languages of these bilinguals. When describing the third type of bilingualism, subordinative (Type C), Weinreich explicitly considers the situation in which only one language is mastered and the second is in the process of being learned. Given this state of affairs, the bilingual may link the to-be-learned word to its translation equivalent in his native language rather than directly onto a conceptual form. In the words of Weinreich:

The referents of the signs in the language being learned may then be not actual "things", but "equivalent" signs of the language already known. Thus, to an English speaker learning Russian, the signified of the form /'kn'íga/ may at first be not the object, but the English word *book*. (Weinreich 1953: 10)

Given this lexical architecture, a second-language word addresses its conceptual representation indirectly via its translation equivalent in the learner's first language. Weinreich also assumes that in most bilinguals of the subordinative type a transition will eventually take place to the coordinate type. At the

same time he acknowledges the possibility that some bilinguals of this type may acquire fluency in their new language "while continuing to interpret all its signs by reference to signs in their first language" (1974: 11). In other words, these bilinguals may permanently retain the subordinative organizational structure.

Weinreich's tripartition of the lexical memories of bilinguals—based on a review of the literature going back to the year 1888—has been around since the year of its publication (1953). During these forty years, however, mention of one or the other of the three organizations temporarily receded into the background. The first to disappear from the literature was the subordinative system, while in a number of recent publications the coordinate system has received little explicit attention. In the following sections I will initially attend to the literature concentrated on the compound *versus* coordinate systems (Section 1). Subsequently (Section 2) some of the studies contrasting the compound and subordinative organizations will be considered. In a further section (Section 3) I will consider the possibility of a mixed-structure within the bilingual memory. In a mixed-system different types of representational structures coexist (e.g., coordinate and compound structures, but other hybrids are also possible). In the main section (Section 4), word-type effects in bilingual processing tasks will be reviewed and their implications for bilingual word representation discussed. Section 4.1 is concentrated on the effects of word concreteness while Section 4.2 highlights the effects of the cognate status of translation equivalents. It will be argued that these effects strongly indicate a mixture of different representational forms. The final section (Section 5) will present some general conclusions.

The labels "compound", "coordinate", and "subordinative" are not the only labels that have been applied to the bilingual lexical organizations distinguished here. The distinction between compound and coordinate bilingual language systems has, *mutatis mutandis*, also been referred to as the "common storage" or "shared storage" *versus* "separate storage" hypotheses (e.g., Kolers 1963; Kolers and Gonzalez 1980), as the "interdependence" *versus* "independence" hypotheses (e.g., Jin 1990; McCormack 1977; Vaid 1988), or as the "single-code" *versus* "dual-code" hypotheses (Durgunoglu and Roediger 1987).¹ The compound and subordinative systems remind us strongly of the "concept mediation" model *versus* the "word association" model as contrasted by Potter, So, Von Eckardt and Feldman (1984) and others. Unlike the compound and subordinative systems, however, the latter assume explicitly the representations found in the common system to be abstract and amodal. In the following I will mainly use Weinreich's (1953) terminology, but if the authors being discussed use other labels, these will be indicated in parentheses.

1 Compound *versus* Coordinate Representation

In addition to pointing out the structural differences between the compound and coordinate bilingual language systems, Ervin and Osgood (1954) stated the relationship between particulars of the learning environment, on the one hand, and the emerging representational structure, on the other hand. *Compound bilingualism* was, for instance, thought to emerge from a common foreign-language-learning practice in school settings, in which signs from an L2 are associated with the corresponding signs and their meanings in L1.² A second learning situation that was thought to result in a compound system is when a child grows up in a home where two languages are spoken interchangeably by the same people and in the same situations. In contrast, *coordinate bilingualism* was regarded to be the consequence of a strict separation between the use of the two languages, for instance, language A being used exclusively at home and language B exclusively outside the home, in school or at work. Alternatively, coordinate bilingualism emerges when the bilingual's two languages are acquired in two totally distinct national or cultural settings. Lambert, Havelka and Crosby (1958) illustrated this with the English-French translation pair *church-église*. For a French-English bilingual who lived in France for many years before coming to America the association between the symbol *église* and the corresponding "environmental events" may differ radically from that between the symbol *church* and the corresponding environmental events because these associations were formed in totally distinct settings. For this bilingual, *église* could mean a gothic cathedral while *church* could mean a tall wooden building used on Sundays (Lambert *et al.* 1958: 240-241). In their study, Lambert *et al.* indeed obtained support for the assumption that different language-acquisition contexts can lead to different representational systems.

In other words, different L1 and L2 learning histories may lead to different bilingual lexical structures and there is little need to reject a particular view of bilingual representation when the data from an experiment testing only one particular type of subjects appear to favour a different view. The views of compound and coordinate bilingual representational systems may coexist in perfect harmony, one applying to one type of bilingual, the other to a different type. But what is more, compound and coordinate structures may coexist within a single individual's lexicon (see Section 3). Nevertheless, many a paper on bilingual word representation starts by posing the question in strict *either-or* terms and concludes by opting in favour of one or the other structural possibility (*e.g.*, McCormack 1977, who opted for the compound (interdependent) view, or Kolers 1963, who favoured the coordinate (separate-storage) system).

Durgunoglu and Roediger (1987) warned against the precocious dismissal of either the compound or the coordinate view for a different reason. Based on studies of episodic memory, they conclude that the type of task at test can drastically influence the outcomes of these studies. Following a study task, subjects are tested for their retention of the study materials. The language of the study and the test materials is systematically varied. Retention may be measured in an explicit memory task, for instance, free recall or task; old-new recognition. It may also be measured in an implicit memory task, for instance, lexical decision or fragment completion. When performance at test is found to be independent of the language of the study materials, this is seen as support for a compound (*i.e.*, interdependent; see Note 1) system; when performance at test is found to depend on the language of the study materials, this is seen as support for a coordinate (*i.e.*, independent) system.

Durgunoglu and Roediger note that studies in which subjects were asked to perform conceptually-driven tests (*e.g.*, free recall) have typically produced a pattern of results suggestive of compound (single-code) representation. Surprisingly, the authors of some of the studies who cite Durgunoglu and Roediger to support their argument regard their *own* free-recall data as support for the coordinate view (Kolers and Gonzalez 1980; Paivio, Clark, and Lambert 1988). In contrast, when test tasks were primarily data-driven (*e.g.*, lexical decision), the data supported the coordinate (dual-code) view of bilingual representation (Kirsner, Brown, Abrol, Chadha and Sharma 1980; Kirsner, Smith, Lockhart, King and Jain 1984; Scarborough, Gerard and Cortese 1984). Durgunoglu and Roediger go on to experimentally demonstrate the plausibility of their analysis. Following identical study tasks, they assigned the bilinguals randomly to different tasks at test. The subjects performing a conceptually-driven test task (free recall) showed a language-independent pattern of results, consistent with the compound view. Those performing a data-driven test task (fragment completion) showed a language-dependent pattern of results, consistent with the coordinate view. Durgunoglu and Roediger conclude:

The issue of whether bilinguals store information in one or two codes seems indeterminable, because the varying retrieval demands of different tasks produce different patterns of results and lead to opposite conclusions. (1987: 377)

In sum, there are empirical and theoretical grounds to uphold both the compound and coordinate organizations as feasible bilingual lexical structures. As will be seen in the next section, the same appears to hold for the compound-subordinative distinction.

2 Compound *versus* Subordinative Representation

The compound and subordinative systems (but labelled the "concept mediation model" and "word association model", respectively) are the main focus of an article by Potter *et al.* (1984) and in studies that elaborate on the research reported there (Cheng and Leung 1989; Kroll and Curley 1988; Kroll and Stewart 1992). In these studies two levels of representation are distinguished explicitly in bilingual memory, one lexical (storing word forms) and one conceptual (storing word meanings), and they assume the existence of two separate lexicons, one for each of the bilingual's two languages.³ To rephrase the compound-subordinative distinction in Potter *et al.*'s terminology: the concept-mediation model proposes that the only connection between a bilingual's two lexicons is via the underlying, amodal, conceptual system to which pictured objects also have access. The word association model assumes direct associations between the lexical representations of equivalent words in a bilingual's two languages. These associations are used to understand and produce words in the second language. Support for either model is derived from a comparison of response times (RTs) in two semantic-memory tasks: translating words from the native to the second language (L2) and picture naming in L2. The concept-mediation model predicts equal RTs in both conditions, because in both cases responding comes about via access to the conceptual system. The word association model predicts shorter RTs for translation than for picture naming in L2 because the route to the response is shorter in the translation task; only the direct link between the lexical representations of the words has to be traced whereas in picture naming access to the conceptual system is necessary.

A central question in these studies mirrors the assumption by Weinreich (1953; see introductory section) that during learning a second language bilinguals of the subordinative type gradually develop a coordinate structure. One of the questions posed in the studies reviewed in this section is whether with accumulating proficiency in the second language bilingual representation switches from the subordinative type (the word association model) not to the coordinate, but to the compound type (the concept mediation model). In Potter *et al.*'s original study both groups of subjects—nonfluent and proficient bilinguals—were equally fast in translating words to L2 and picture naming in L2. The authors concluded that their study did not support the occurrence of a transition from one to another representational structure; rather, the concept-mediation model could account for the data from both groups of subjects. However, the results of later investigations suggested that this null-effect of proficiency level could have been due to the fact that the novice bilinguals in Potter *et al.*'s study had already passed the stage associated with a subordinative representational structure.

Kroll and Curley (1988) compared the performance of novice bilinguals who were less proficient in their second language than the novices tested by Potter *et al.* with that of more expert bilinguals. For novice bilinguals translating words from L1 (in this case English) to L2 (German) was significantly faster than picture naming in L2. In contrast, expert bilinguals produced equal RTs in these two tasks. The authors concluded that their data were consistent with the hypothesis that bilinguals switch from word association to concept mediation, or in the present terminology, from a subordinative to a compound system (see Kroll, this volume, for further detailed discussion). Similar data from Chen and Leung (1989) also suggest such a transition, but at the same time provide reason to qualify the assumption: whereas novice *adult* beginners appear to access the conceptual system via corresponding words in the subjects' native language, novice *child* beginners also appear to access the conceptual system indirectly but via pictorial representations and not via the native-language words, as implied by the original subordinative system. Note that for Snodgrass (this volume) this difference between adult and child beginners is one of the reasons to doubt the validity of the present approach (*i.e.*, comparing picture naming and translating in L2) to reveal the structure of bilingual memories.

In conclusion, there is some empirical support for the view that both the subordinative and compound bilingual lexical organizations occur, but that they hold for different levels of bilingual proficiency.

3 Mixed Representation

The discussion up until this point suggests a pure structural organization within the lexical memory of individual bilinguals: within a single bilingual mental lexicon, words and their translations are either all represented in a compounded fashion, all in a coordinate fashion, or all in a subordinative fashion. This, in fact, reflects the tenor of the majority of the publications on bilingual representational structure. Only occasionally is the possibility of a mixed structure put forward. For instance, Weinreich (1953: 10), after having discussed the coordinate and compound systems, briefly remarks: "It would appear offhand that a person's or group's bilingualism need not be entirely of type A (coordinate) or type B (compound), since some signs of the languages may be compounded while others are not" (information between brackets added, AdG). Weinreich then presents free word association as an experimental technique to determine the extent to which a given bilingual has stored his lexical knowledge of the two languages in a compounded or coordinated manner. Imagine an experimental situation in which bilingual subjects are asked to produce verbal re-

actions to a series of words from the subjects' two languages presented at random. Responses in both languages are permitted, regardless of the language of the stimulus word. Weinreich discusses the results of a study of this type, in which a special type of answer turned out to be the "translation response". In such cases, the subject responded with the translation for the stimulus word. Such responses suggest a compound bilingual representation. The proportion of this response type would thus suggest the degree of compounding for the two language systems.

Opoku (1985) also acknowledged the possibility of a mixed bilingual lexicon. In line with Weinreich's suggestion, he used the word association task as a means to assess the degree of overlap between the bilingual's two language systems, but he used the task in conjunction with the word translation task. His subjects first had to provide word associations in L2 (English) to words presented in L2. Three months later they were presented the English words that they had produced in the word association test and were asked to translate them into their native language (Yoruba, one of the languages spoken in Nigeria). Subjects were categorized as 'low-separation' and 'high-separation' bilinguals on the basis of the proportion of correct translations into L1 of the word associations that they had provided earlier in L2. This proportion was relatively high for the low-separation group and relatively low for the high-separation group. The assumption underlying this categorization is that if a subject produces an L2 association (to an L2 stimulus word) that he subsequently cannot translate into L1, then this association must have come from a representational system that is unique to L2—that is separate from the L1 representational system. Opoku (1982) used a slightly different version of this procedure but with the same underlying rationale. His classification procedure turned out to be successful: In both studies the subjects classified as 'low-separation' showed more transfer of word learning in their one language to subsequent learning of these same words in their other language than those subjects categorized as 'high-separation'. Such between-language transfer is generally regarded as support for shared storage in bilingual memory (e.g., López and Young 1974; MacLeod 1976; Young and Saegert 1966).

Ervin and Osgood suggested that bilinguals "distribute themselves along a continuum from a pure compound system to a pure coordinate system" (1954: 141), and argued that Osgood's (1952) semantic differential (D) could be used to locate individual bilinguals along this continuum. The D-technique involves the scaling of stimulus words on a standard set of meaning dimensions. For instance, subjects are asked to rate a set of words along two (but generally more meaning dimensions are involved) seven-point scales with 'fast' and 'pleasant' appearing at one end of the scales, and 'slow' and 'unpleasant' appearing at the

other ends. Applied in a bilingual research setting, the stimulus words are presented in both of the bilinguals' languages (e.g., *house* and *maison*) and both words of a translation pair are scaled on the same set of dimensions. The differences between the ratings for a word in the two languages (e.g., *house* is given a 3 on the fast-slow dimension while *maison* is given a 5) are then transformed into a D score. The larger the D score, the larger the semantic difference between the translation equivalents. Ervin and Osgood (1954) take the view that the average D scores thus obtained should vary directly with the degree of 'coordinateness' of the bilingual's language systems (see Lambert *et al.* 1958, for an application of this technique in bilingual research).

An alternative to a mixed structure in which some words are represented one way (e.g., compoundly) and others are represented in another way (e.g., coordinately) is one in which it is acknowledged explicitly that formal translation "equivalents" (words that are listed as translations in a dictionary) seldom, if ever, share all aspects of their meaning. This insight was, in fact, the starting point for the application of Osgood's semantic differential to research on bilingual lexical representation (see above). The different contexts (linguistic, cultural, and social) within which translation words are acquired may have the effect that they only have partly similar meanings. Rees (1979) distinguishes between bilingual subjects who have a relatively low degree of similarity in the meanings assigned to formal translation equivalents ('dissimilar' subjects) and those who have a relatively high degree of overlap in the meanings of formal translation equivalents ('similar' subjects). He assumes that in dissimilar subjects "the formally equivalent sets of attributes, referents and selectional restrictions are expected to show lower degrees of overlap" (Rees 1979: 217). In other words, one can conceive of a word meaning as a composite of various elements only some of which are shared between a pair of translated words.

The primary stress in Rees' (1979) article is on categorizing *bilinguals* according to the extent to which translation equivalents in their lexical memories have overlapping meanings. An implication of his view, however, is that within the mental lexicon of a single bilingual, both of the 'similar' and of the 'dissimilar' type, *words* may vary in the extent to which they share representational elements with their translations. This is another way in which a single bilingual lexicon may have a mixed structure. This idea has also been developed by Taylor and Taylor (1990) and myself (De Groot 1992a; De Groot 1992b). In this work, the conceptual representations in question (consisting of a collection of memory nodes for each word, with each node representing a single meaning element) have been labelled "distributed", contrasting them with "local" conceptual representations (consisting of a single memory node). Other authors, in the domain of the monolingual mental lexicon (Bierwisch and Schreuder 1992), have used

the labels "decompositional" *versus* "holistic" to refer to this contrast. The notion of decomposing conceptual representations into more elementary informational units each of which is shared by a number of words (see also Poulisse, this volume; De Bot and Schreuder, this volume), has been proposed by several other researchers of the monolingual lexicon (Masson 1991; Schreuder and Flores d'Arcais 1989).

An interesting question in this context is whether there are classes of words that are particularly good candidates for sharing relatively many (or relatively few) representational elements across languages. For example, there are reasons to believe (see Section 4.1 below) that the translations of concrete words have more similar meanings than the translations of abstract words. It is plausible that this difference will be reflected in the way in which these words are internally represented in the bilingual lexicon, or at least in the lexicon of *some* bilinguals (for instance, those who are very proficient in L2 with detailed L2-vocabulary knowledge). This situation is depicted in Figure 2. In this example, the concrete words in the Dutch-English translation pair *vader* - *father* share all of their conceptual representational elements whereas the abstract words in the translation pair *idee* - *idea* share only a subset of the elements found in their conceptual representations. In addition to the shared elements each of the words in the pair *idee* - *idea* has a few unique elements.

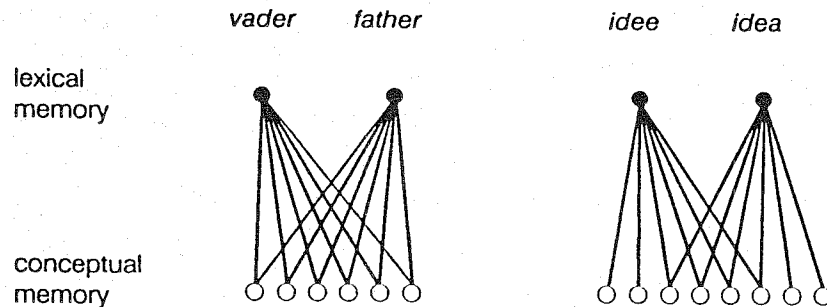


Figure 2. Decompositional conceptual representations in bilingual memory (from De Groot 1992a, 1992b)

There are very few bilingualism studies in which word-type effects are considered. The few that exist will be reviewed in the following. Section 4.1 will be

devoted to concreteness effects in bilingual processing tasks. Section 4.2 is concerned with the effect of the "cognate status" of translation equivalents.

4 Word-Type Effects

4.1 Word Concreteness

Semantic-memory studies dealing with the effect of word concreteness on bilingual representation and processing are those by Kolers (1963), Taylor (1976), Jin (1990), and De Groot (1992b). Kolers collected discrete (one response per stimulus) word-association responses within and between languages. His subjects all had English as a second language with German, Spanish, or Thai as a native language. Each subject produced word associations in each of the four within- and between-language conditions (stimulus word in native or second language; response word in native or second language). Among the stimulus words, which were all nouns, there were concrete words, abstract words, and words referring to emotions. Kolers was particularly interested in finding out how often the native-language word and the second-language word produced in response to the same stimulus would be translations of each other (he called these "same" responses). For example, for the L2 stimulus word *king* the L1 and L2 responses *reina* and *queen* would be produced. In the case of a compound ("shared" in his terms) bilingual system, many "same" responses should occur. In the case of a coordinate ("separate") system, relatively few "same" responses should occur. Note that this is the third way in which word association has been used as a means to disclose the structure of bilingual memory. The other two (Weinreich 1953; Opoku 1985) were described in Section 3. Kolers' main finding was that, within all three groups of bilinguals, over half of all of the responses in the between-language conditions were unique (not "same" responses). On the basis of this finding, he concluded that the separate-storage hypothesis must be correct. As he himself later admitted (Kolers and Gonzalez 1980), however, this conclusion seems too strong given that about one third of the between-language responses were in fact "same" responses. It appears, rather, that a mixed-storage system might account for his data, with the relatively large proportion of unique responses indicating a largely, but not exclusively, separate system for Kolers' subjects.⁴

A further finding of Kolers, which is of particular interest in the present context, was that the different *word types* produced different patterns of responding. Concrete words generated same responses within and between lan-

guages more often than abstract words and emotion words did. This finding suggests that in the bilingual lexicon concrete words share more of their meaning representations between languages than abstract words and emotion words. (It should be noted that Kolers interpreted this word-type effect in terms of separate language systems solely; see Kolers 1963: 298). One way this could be effectuated is implied in Section 3: a mixture of Weinreich's A and B types of representations may exist within the bilingual lexicon, with more type B (compound) representations for concrete words than for abstract words. Alternatively, the system may consist of distributed (decompositional) representations (see Figure 2), that are not only shared partly or entirely between words that translate each other, but also partly between word associations, both within and between languages. In comparison with abstract words, concrete words and their word associations share relatively many conceptual elements both within and between languages (see De Groot 1992a, for further details).

Taylor (1976) also manipulated word type in a bilingual word association task. Rather than the discrete association task used by Kolers (1963), she used the continued version of the task, in which the subjects generate as many word associates to a stimulus word as possible within a prespecified amount of time (60 sec. in this study). Subjects were French-English bilinguals, one group of children and one group of adults. All subjects associated in French to French stimulus words and in English to the English translations of the French stimulus words. No between-language conditions were included. Taylor was primarily interested in whether, and how, orthographic and phonological similarities between translation equivalents might affect the speech behaviour and the representational structures of bilinguals. In manipulating the form variable, Taylor also matched the stimulus groups for the number of "concrete" and "abstract words" they contained. Her data, thus, also pertain to the question of whether word concreteness affects bilingual word representation. Taylor found, among other things, that (1) a "concrete" word and its translation equivalent produced primary associates (the most frequent response word to a stimulus) that were translations of each other more often than abstract words, and that (2) the overlap between the French and the English response lists was larger for concrete words than for abstract words. These results are compatible with Kolers' (1963) data and with the present view that the translations of concrete words share more (or larger parts) of their representations than those of abstract words.

A task not mentioned yet but nevertheless quite popular in the study of bilingual memory representation is lexical decision on semantically primed words. The lexical decision task involves the categorization of letter strings as words or nonwords. In the priming variant of this task the letter strings to be categorized, the targets, are preceded by a context stimulus, the 'prime', and the effect of the

prime on target processing is assessed. In *semantic* priming experiments, the semantic relation between prime and target is manipulated. A typical experiment includes, in addition to the stimuli with a nonword as target, prime-target pairs consisting of semantically related words, prime-target pairs consisting of words that are not related in any obvious sense, and, occasionally, pairs consisting of some 'neutral' prime and a target. The standard finding in monolingual semantic-priming experiments, where the prime and target are presented in the same language, is that a lexical decision to a word preceded by a semantically related word (e.g., *war* preceded by *peace*) is made faster than one to a word preceded by an unrelated word or by some neutral context stimulus (*war* preceded by *peach* or by *XXXXX*). This finding is known as the 'semantic-priming effect'. A number of processes have been proposed to account for this effect. The one of interest in the present context is activation spreading via the links that connect memory nodes (see Neely 1991, for a review).

Several studies have demonstrated that the semantic-priming effect also occurs across languages; that is, when the prime is presented in a bilingual's one language and the target in his other language response times are shorter for semantically related than for nonrelated targets. (Chen and Ng 1989; De Groot and Nas 1991; Jin 1990; Kerkman 1984; Kirsner *et al.* 1984; Meyer and Ruddy 1974; Schwanenflugel and Rey 1986; Tzelgov and Eben-Ezra 1992). In some of these studies the interlingual effect turned out to be equally large as the intralingual effect (however, see Keatley and De Gelder 1992, for an exception). Interlingual semantic-priming effects support the view of a compound bilingual lexicon, with the relative size of the effect in comparison with the intralingual effect indicative of the degree of compounding. For instance, equally large effects within and between languages would suggest that the conceptual representations are fully shared between languages. The absence of an interlingual effect would support the notion of a coordinate system.

Jin (1990) manipulated target concreteness in a cross-language priming experiment testing Korean-English adult bilinguals. A reliable interlingual semantic-priming effect was obtained for concrete targets but not for abstract targets. Jin interpreted this finding in terms of Paivio's dual coding theory applied to bilingual memory (Paivio 1991; Paivio and Desrochers 1980; Paivio, Clark and Lambert 1988; Vaid 1988). In the theory a coordinate bilingual memory system is assumed; that is, two independent, though connected, verbal representational systems are assumed to exist. In addition a third system, the "imagery system", is assumed, to which the verbal systems are partially connected. Concrete words are represented in both verbal systems and in the imagery system whereas abstract words are only represented in the verbal systems. A representation in the imagery system is shared by a corresponding pair of concrete translation equi-

valents in the verbal systems. This shared representation is seen as the source of interdependent processing and interlingual effects, here: the semantic-priming effect for concrete words. Abstract words do not show the effect because an abstract word and its translation have no representation in the imagery system. But, as admitted by Jin (1990), his concreteness effect can also be accounted for with representational systems that do not assume the existence of a special-purpose imagery system. In his words:

The greater interdependence for concepts involved in "concrete" words could be realized at a semantic or propositional level with no involvement of visual analog representations ... it may make more sense to think of the present concreteness effect as more conceptually rather than as visually based. (Jin 1990: 1150)

But whatever interpretation is selected ultimately, the present data correspond to those of the word association studies discussed above in that they also suggest that the translations of concrete words share more of their representations than the translations of abstract words.

In a final semantic-memory study concerned with word-type effects on bilingual performance, the word-translation task was used (De Groot 1992b). Word concreteness was one of the variables manipulated in three versions of this task, dubbed "normal translation", "cued translation", and "translation recognition". In the normal translation task subjects were presented with words in their native language (Dutch) and asked to translate them into their second language (English). The cued task was the same as the normal task, except that in addition to the Dutch stimulus word the first letter of the English translation was presented. In the translation recognition task the subjects were shown Dutch-English word pairs and asked to decide whether the words within a pair were translations of one another. All subjects were university students and advanced learners of English. In all three versions of the task, effects of concreteness were obtained. In the normal and cued tasks concrete words were translated faster, more often, and more often correctly than abstract words. In the recognition task decisions were faster and fewer errors were made on positive (requiring a "yes" response) concrete word pairs than on positive abstract pairs. Again, these data are compatible with the view that concrete words share more of their representations between languages than abstract words (De Groot 1992a).

It is unlikely that concreteness *per se* causes words that differ on this dimension to be represented differently in bilingual memory. A more plausible cause is the degree of meaning overlap between a pair of word translations, this overlap presumably being larger for concrete words than for abstract words. The rea-

son to assume this to be the case (De Groot 1992a; *cf.* Kolers 1963: 298) is that concrete words refer to entities whose function is likely to be the same across languages. The outward appearance of these entities and the behaviours that they elicit are also likely to be similar across language communities because these relate directly to their function. As a consequence, the conceptual representations for the translations of concrete words will have very similar contents. This may become reflected in the sharing of their conceptual representations. On the other hand, abstract words have no external referents that can be looked at, handled, utilized, and thus no guarantee for a large degree of cross-language similarity in the content of their conceptual representations. Their meanings must be learned by looking their definitions up in a dictionary, having others provide them, or — more importantly — inferring them from the contexts in which these words are encountered. To the extent that these contexts differ across languages (cultures), the meanings of these words may also differ. In sum, there are reasons to assume that translation pairs of concrete words have very similar meanings whereas translations of abstract words do not. A possible consequence of this, supported by the above data, is that abstract words are frequently represented language-dependently (coordinate), while concrete words are frequently represented by a conceptual representation common to the bilingual's two languages (compound).

However, this suggestion may have to be qualified in that such representational differences between concrete and abstract words may only hold for certain types of bilinguals, for instance, those with a near-native proficiency in their L2 or beginners immersed in the L2 culture. In contrast, beginners confronted with a new language in a typical L2-L1 paired-associate learning paradigm may assume pure meaning equivalence of the two terms in an associated pair (whether concrete or abstract). As a consequence, they may simply link all new words onto the existing conceptual representations for the corresponding L1 words either directly (*i.e.*, compounding) or indirectly via the L1 words (*i.e.*, subordinatively; see Section 2).

4.2 Cognate Status

A second word characteristic attended to in some bilingual studies is the cognate status of translation equivalents. The question is whether the translations are similar in sound and/or spelling (similar for cognates, dissimilar for noncognates) and what effects this factor may have (Cristoffanini, Kirsner and Milech 1986; Davis, Sánchez-Casas and García-Albea 1991; Gerard and Scarborough 1989; De Groot 1992b; De Groot and Nas 1991; Kerkman 1984; Sánchez-

Casas, Davis, and García-Albea 1992; Taylor 1976). Details of the studies by Taylor (1976, continued word association) and myself (De Groot 1992b, word translation) have already been provided (see Section 4.1 above). In addition to the manipulation of word concreteness discussed there, the cognate status of the words was also manipulated in these studies. Taylor observed (1) that cognate translations (e.g., English *carrot* and French *carotte*) evoked common primary associates (that is, primary associates that are translations of one another; *vegetable* and *legume*) more often than noncognate translations, and (2) that the overlap between the French and the English response lists was larger for cognate translations than for noncognate translations.

Using the normal translation task (see Section 4.1), I found that cognates were translated faster, more often, and more often correctly than noncognates (De Groot 1992b). The translation direction in my study was from the native language (Dutch) to the subjects' second language (English). Sánchez-Casas *et al.* (Experiment 3) observed these same effects of cognate status in cued (see Section 4.1) word translation. Their subjects, Spanish university students and teachers all reasonably proficient in their L2, English, translated between Spanish and English in both directions. Translation times for cognates turned out to be the same in both directions, but noncognates were translated faster from the second to the first language (English to Spanish) than in the reverse direction (*cf.* Kroll and Stewart 1992).

The studies by Cristoffanini *et al.* (1986), Gerard and Scarborough (1989), and Kerkman (1984) all used the between-language variant of what De Groot and Nas (1991) referred to as the "classical repetition priming technique". The technique in fact instantiates the episodic memory paradigm briefly described in Section 1; a study task is followed by a test task in which retention of the information provided in the study episode is assessed. More specifically, repetition priming involves the repeated presentation of a set of words within an experiment with usually several minutes to half an hour passing between the two occurrences of a repeated word. This interval is filled with the presentation of other words. The experiment may, but need not, involve the presentation of two clearly separated lists of stimuli, each of them containing the critical (repeated) words at least once. If there are indeed two lists of stimuli with a clear caesura between the two, the subjects may be asked to perform the same task with the stimuli from both lists (for instance, lexical decision) or they may be asked to respond differently to the two lists (for instance, read the stimuli in List 1 aloud and perform lexical decision on those in List 2). A common (but by no means ubiquitous) finding in these studies is that words encountered for a second time and in the same language as on their first occurrence are responded to faster than words presented only once in the experiment. This effect is known as the

"repetition (priming) effect". The first occurrence of a word serves to prime the second.

In the between-language version of this repetition priming paradigm, the words are presented in two different languages on their two occurrences. The relevant studies have shown that the between-language repetition effect depends on the cognate status of the translations. Scarborough *et al.* (1984) first presented a block of lexical decision trials in Spanish, followed by a block in English. Half of the words in the second block were new; the remainder were translations of the Spanish words in the first block. The translations were all noncognates. Not a hint of a between-language repetition effect (also known as the "translation-priming effect") was obtained. The same null-effect was obtained in studies with English-Hindi bilinguals (Kirsner *et al.* 1980) and French-English bilinguals (Kirsner *et al.* 1984), where the cross-language repetitions also involved noncognates (see De Groot and Nas 1991, for more detailed discussion). In contrast, if the between-language repetition concerned *cognates*, a translation priming effect came out (Cristoffanini *et al.* 1986; Kerkman 1984). In addition to (identical) cognates (translations with exactly the same form and meaning across languages) and noncognate translations, Gerard and Scarborough (1989) also included a group of stimuli they called "homographic noncognates", but which more appropriately would have been called "false friends" (words spelled identically in the two languages but with totally different meanings; for instance, *four* in English and *four*, meaning *oven*, in French). Again, for cognates but not for noncognates a between-language repetition effect materialized. However, their most interesting finding was that for false friends an effect occurred as large as the effect for cognates (see, however, Kerkman 1984). This suggests that the source of the between-language repetition effect for cognates is the facilitated encoding on a word's second occurrence and, thus, that the favoured interpretation of the effect in terms of shared language-independent representations for cognates is flawed. Gerard and Scarborough (1989), indeed, conclude that their data are consistent with a language-specific (coordinate) bilingual representational structure.

How can this conclusion, derived from the classical repetition priming studies, be reconciled with the fact that reliable effects of cognate status were obtained in the above studies in which semantic memory tasks were used (word translation and word association). Basing their arguments on the outcome of a number of monolingual lexical decision studies (Forster and Davis 1984; Olliphant 1983), Davis *et al.* (1991), De Groot and Nas (1991), and Sánchez-Casas *et al.* (1992) reasoned that the within- and between-language repetition priming effects obtained with the classical repetition paradigm are episodically rather than lexically based. As such, they cannot contribute to our understanding of lexical

organization in either monolingual or bilingual subjects. In order for lexically-based repetition effects to come about, the interval between the two occurrences of a word (or between a word and its translation) should be considerably shorter than the interval in the classical experiment. Rather than minutes, the interval should be no longer than several hundreds of milliseconds.

Using intervals of 60 to 1000 msec between a word and its translation, Altarriba (1992), Chen and Ng (1989), Davis *et al.* (1991), De Groot and Nas (1991), Jin (1990), and Sánchez-Casas *et al.* (1992) all obtained translation priming effects. In all of these studies except one, the subjects performed lexical decisions on the targets. Sánchez-Casas *et al.* had their subjects semantically categorize the targets (is it an instance of the category named by the prime?). The priming effect occurred not only when the prime was clearly visible (Altarriba 1992; Chen and Ng 1989; Jin 1990), but also when it was masked so that it could not be identified by the subjects (Davis *et al.* 1991; De Groot and Nas 1991; Sánchez-Casas *et al.* 1992; see these studies for the rationale behind the masking manipulation). In the latter three studies the cognate status of the translation equivalents was varied. In the masked-prime condition of De Groot and Nas (1991), the translation priming effect was always larger for cognates than for noncognates although statistically the effect was equally large for the two types of words. However, Davis *et al.* (1991) and Sánchez-Casas *et al.* (1992) obtained significantly larger effects for cognates than for noncognates. In conclusion, it appears that a lexically-based translation priming effect *does* occur and that the effect is larger for cognates than for noncognates. The possibility that the cognate effects were due to facilitated encoding (*cf.* Gerard and Scarborough's 1989, interpretation) was elegantly ruled out by Sánchez-Casas *et al.* (1992). They included a control condition in which the target was preceded by a nonword prime showing the same form overlap with the target as the prime with the target in the cognate translation condition (*e.g.*, cognate translation condition: *rich* - *rico*; control condition: *rict* - *rico*). The targets in the control pairs were responded to significantly slower than those in the cognate translation condition.

De Groot and Nas (1991) not only looked at the effect of cognate status on repetition priming but also at its effect on semantic priming. Their data from the masked-prime condition showed an interlingual semantic priming effect for cognates but not for noncognates; the effect for cognates was as large as the intralingual semantic priming effect for both cognates and noncognates. Nas and I concluded from these data (1) that in bilingual memory cognate translations share a conceptual representation and that these shared representations are connected to the conceptual representations of semantically related words; (2) that noncognate translations are represented in language-specific conceptual

nodes and that these nodes only have connections to those of semantically related words of the same language. An interpretation in terms of distributed (decompositional) conceptual representations is provided in De Groot (1992a).

In the previous section (4.1) it was suggested that concrete words are represented more compoundly than abstract words because the translations of concrete words overlap more in meaning than the translations of abstract words. An obvious question then is whether differential degree of meaning similarity might also underlie any differences in the representation of cognate and noncognate translations. Is there reason to believe that cognate translations have more similar meanings than noncognate translations? A reason could be the different origin of these translations: cognate translations derive from the same root in a common parent language whereas noncognate translations generally derive from different roots. Another reason may be that L2 learners, noticing the orthographic and phonological similarity between cognate translations, simply assume the two have the same or very similar meanings. As a consequence they will link the new L2 word onto the conceptual representation of the corresponding L1 word in such cases. In the case of noncognate translations, the learners may be more aware of possible meaning differences between the words in a translation pair and *not* blindly assign the new L2 word to the conceptual representation of its translation in L1.

In sum, a plausible interpretation of the results of a number of studies manipulating word concreteness and/or the cognate status of translation equivalents is that *concrete* and *abstract words* are represented differently in the lexical memory of (some types of) bilinguals and that the storage format for *cognates* also differs from that of *noncognates*. More fine-grained analyses of the stimulus materials used in these studies and new studies focusing on word-type effects in bilingual processing tasks should allow us to ascertain the validity of this conclusion. An interesting question is what the representational status of concrete words that are *not* cognates or abstract words that *are* cognates might be. In particular, does it require an intersection of the two stimulus characteristics concreteness and cognate status for a pair of translations to be represented in a compound fashion? Another potentially relevant issue is whether the variables critical for the representational format are indeed concreteness and cognate status *per se* rather than some other variable(s) with which they correlate (*e.g.*, 'context availability', which correlates highly with concreteness; see Schwanenflugel, Harnishfeger and Stowe 1988).

5 Conclusion

Even though Weinreich (1953) observed that the word memories of individual bilinguals need not contain just one type of representational structure (either a strictly compound, strictly coordinate, or strictly subordinative structure), many recent investigations on bilingual lexical representation set out assuming one or the other pure bilingual representational system. The studies assuming a mixed structure appear to be in the minority although there are a few that explicitly acknowledge the possibility of an entire range of systems, from purely compound to purely coordinate (Ervin and Osgood 1954; Opoku 1982, 1985; Rees 1979). An individual bilingual's lexicon may be located anywhere on this continuum, with his L2-learning history and maybe his level of proficiency in L2 partially determining his position on this scale.

The studies reviewed in Sections 4.1 and 4.2 support the view that the lexical memories of individual bilinguals may contain a mixture of different representational forms. More specifically, they suggest that in addition to other possible determinants of representational form (e.g., L2-learning history, see Lambert *et al.* 1958), the storage format may also depend on word type. It appears that concrete words and cognates (or some intersection of these two word types) are relatively often stored in a compound fashion while abstract words and noncognates are more likely to be stored in a coordinate form. Also, a set of words (e.g., L2 words that are still in an early stage of being acquired) may be represented in a subordinate form. Although the present review has focused on word concreteness and the cognate status of translation equivalents as possible determinants of bilingual representational structure, other word characteristics may also influence the storage format (for instance, word frequency and whether or not a word's meaning is culturally distinct; see De Groot 1992a; Taylor and Taylor 1990: 358-359).

It was suggested that concreteness and cognate status *per se* are not the determinants of the representational form. Rather, the degree of meaning similarity between the words within a translation pair may ultimately determine the bilingual representational form. The more similar the meanings of the translations, the more likely they are to be stored compoundly in the mental lexicons of some types of bilinguals or—in the case of distributed conceptual representations—the larger the number of conceptual elements that the translation pair is likely to share. Surely such a system makes sense. It is parsimonious where it is justified to be so; representational space is not wasted by storing the same meaning twice, once for the word in each language. At the same time, the system recognizes that for many words in one language a truly equivalent term does not exist in the other language. If a pair of nonequivalent translations

would be stored in a fully compounded form, say, attaching a new L2 word to the conceptual representation of the corresponding L1 word, the L2 word would be assigned a meaning that is both too broad (the L1-specific part of the original L1-conceptual representation would be unjustly included) and too narrow (the L2-specific part of the meaning would be unjustly excluded). Similarly, if corresponding but nonequivalent L1 and L2 words were acquired simultaneously and only the overlapping parts of their meanings stored in a compound conceptual representation, the unique parts of their meanings would be lost. In conclusion, a hypothetical bilingual with a fully compounded lexical structure might never be optimally proficient in both of his languages because he lacks the language-specific shades of meaning of either his L2 words or of both his L1 and L2 words.

Notes

1. The use of the labels "interdependence" and "independence" is somewhat unfortunate given the fact that language-*independent* effects are generally taken as supporting the common representation (*interdependence*) model whereas language-*dependent* effects are regarded as support for the *independence* model.
2. It is likely that this learning practice first results in a subordinative structure (the word association model proposed by Potter *et al.* 1984) and that the direct links between the "signifiers" eventually pass into disuse with the formation of direct links between the signifiers of the new language and the corresponding signifieds.
3. Note the restricted use of the term "lexical" that is implied here. It concerns just one aspect of all we know about words. More commonly the term "lexical" implies *all* of our knowledge about words, including their acoustic and orthographic form, grammatical class, and meaning. This broader sense is implied in the present chapter when talking about, for instance, "the bilingual lexicon" and "bilingual lexical organization".
4. Kolers' conclusion that his data support the separate-storage view is too strong for another reason as well. When stimulus words are repeatedly presented in the same language, the response words will also often not be the same. Indeed, Kolers and Gonzalez (1980), contemplating on Kolers earlier (1963) investigation, say:

The hypothesis was that if knowledge were stored in some common, abstracted representation and if the word association tests tapped into that knowledge, then bilinguals would give similar associations to words that translated each other, *at least to the degree that repeated stimulus words elicit similar associations.* (Kolers and Gonzalez 1980: 53, italics added)

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