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## CHAPTER SIX

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## Lexical and Conceptual Memory in the Bilingual: Mapping Form to Meaning in Two Languages

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A central issue in theories of bilingual language representation concerns the mapping of form to meaning. Past research on this topic sought to determine whether word forms and concepts in two languages are represented independently or integrated within unitary lexical and conceptual memory systems. Although an indeterminate conclusion concerning this question initially led some to argue that it was not possible to resolve the issue empirically (e.g., Glucksberg, 1984), recent work suggests that the earlier claims of representational indeterminacy failed to take into account distinctions between levels of representation. If one assumes that lexical-level representations are functionally independent for words in two languages (an assumption that seems to be required for languages in which word form is not similar) but that conceptual representations are shared (as they appear to be for words in the first language and pictured objects), it is possible to interpret the earlier contradictory evidence for the two alternative positions (Potter, 1979; Snodgrass, 1984). In general, evidence gathered from tasks that focus on lexical-level processing tends to support the independence view (e.g., Gerard & Scarborough, 1989), whereas evidence gathered from tasks that require semantic-level processing tends to support the integrated view (Durgunoglu & Roediger, 1987). However, although the assumption of two levels that correspond to form and meaning provides an initial framework for thinking about bilingual representation, it does not determine the specific nature of the mappings between form and meaning within or across languages.

In this chapter, we review current research on the representation of words and concepts in bilingual memory. Because a number of tutorial chapters on this topic have appeared recently (e.g., Chen, 1992; De Groot, 1993, 1995; Kroll, 1993; Kroll & Sholl, 1992), the present chapter focuses on research that we believe has significant implications for ultimately resolving the issue of how word forms are mapped to meaning in two languages. Because the architecture of the bilingual's mind may be a reflection of the level of expertise in the second language and the context in which the second language was acquired, we examine the cognitive processes that are engaged in bilingual tasks by individuals at early stages of second language acquisition, by individuals who are relatively fluent bilinguals, and by individuals who are relatively fluent in a second language and are attempting to acquire a third language. What should be clear from this brief description is that we do not restrict the discussion to the performance of *balanced* bilinguals (who are, in fact, extremely rare) but, instead, define bilingualism in the broadest possible terms, including all individuals who actively use, or attempt to use, more than one language, even if they have not achieved fluency in the second language (L2). Bilingual groups are distinguished on the basis of their L2 proficiency. A further caveat is that we focus primarily on adult second language learners and bilinguals. Because lexical and conceptual development co-occur in early childhood, and because there may be critical period effects that influence the course of language acquisition (e.g., Johnson & Newport, 1989), the topic of childhood bilingualism raises issues beyond the scope of the present tutorial. (See chapters 1 and 2 in this volume for a discussion of the impact of the age and context of acquisition on L2.)

#### LEVELS OF REPRESENTATION FOR WORDS AND CONCEPTS

Linguists and psycholinguists often distinguish two levels of meaning. One level consists of the semantic specifications that are taken to be part of the lexical representation. This level of representation constrains the way in which the meanings of words are accessed for the purpose of comprehending and producing syntactically well-formed utterances. The other level represents the conceptual information that includes real world knowledge and the meanings of the objects and events to which words refer. Research on the representation of words and concepts in the bilingual departs from this traditional dichotomy by making the assumption that lexical representations do not include meaning but only aspects of word form. According to this perspective, all meaning is grouped within the conceptual representation (e.g., Potter, So, Von Eckardt, & Feldman, 1984) or a third level of representation is proposed to handle some specific lexical-semantic functions (e.g., the lemma level in Levelt's, 1989,

model; see Poulisse, chapter 7, this volume, for a discussion of this issue in the context of bilingual speech production). The proposal of a lexical representation devoid of meaning may be, in part, a reflection of the emphasis in research on this topic to use bilingual word and picture tasks that are performed outside of sentence context. However, the general assumption that there are independent levels of representation for word form and meaning is not restricted to bilingual research. Recent monolingual work on word and picture recognition (e.g., Besner, Smith, & MacLeod, 1990; Glaser, 1992; Vitkovitch & Humphreys, 1991, and see Smith, chapter 5, this volume, for a review of this evidence), language production (e.g., Levelt et al., 1991), and neuropsychology (Anderson et al., 1992, and see Paradis, chapter 12, this volume, for a related discussion) make similar claims.

#### WORD ASSOCIATION VERSUS CONCEPT MEDIATION: THE DEVELOPMENTAL HYPOTHESIS

The first explicit test of alternative hypotheses for mapping first and second language words to concepts was reported by Potter et al. (1984). The two models they contrasted are shown in Fig. 6.1. They are both *hierarchical* models in the sense that they distinguish between word representations and concept representations. According to the word association model, words in the second language (L2) access concepts via words in the first language (L1). In contrast, the concept mediation model allows direct access to concepts for words in both languages. Potter et al. (1984) tested these alternatives by comparing more and less fluent bilinguals on word translation and picture-naming tasks. A great deal of research on picture naming suggests that it is accomplished via concept mediation; lexical entries for the names of pictures only appear to be available subsequent to conceptual access (e.g., Potter & Faulconer, 1975). If bilingual translation is also accomplished conceptually, translation and picture-naming tasks should take equally long to perform. However, if translation can take advantage of a word association mechanism that by-passes the necessity for retrieving the concept, translation should be faster than picture naming. Potter et al. found that the two tasks were performed in approximately the same amount of time, supporting the concept mediation alternative. Furthermore, they found that both more and less fluent bilinguals appeared to conceptually mediate L2.

Subsequent research on translation and picture naming extended the logic of Potter et al.'s (1984) study to show that second language learners who are at earlier stages of acquisition than the less fluent group in that study perform in accord with the predictions of the word association model. Less fluent individuals are faster to translate words than to name pictures in the second language (Chen & Leung, 1989; Kroll & Curley, 1988). Lexical mediation through L1 appears to characterize the performance of nonfluent

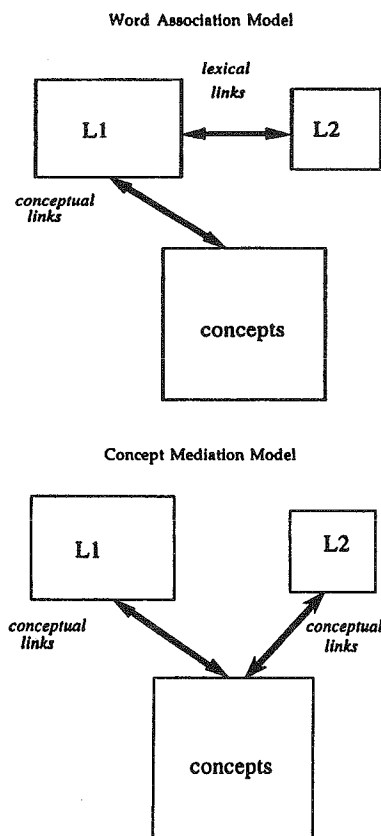


FIG. 6.1. The word association and concept mediation models (adapted from Potter et al., 1984). In the word association model, second language words are associated to their translation equivalents in the first language. In the concept mediation model, each language accesses the same shared concepts.

bilinguals, whereas concept mediation appears to characterize the performance of more fluent bilinguals. Results of Stroop studies, examining interference within and across languages, also support a developmental process from lexical to conceptual processing with increasing expertise in L2 (Chen & Ho, 1986; Mägiste, 1984; Tzelgov, Henik, & Leiser, 1990).

### Evidence for the Developmental Hypothesis

If there is a developmental shift from lexical to conceptual mappings for L2 words with increasing fluency, it should be possible to observe differential involvement of lexical and conceptual processes in the performance of more

and less fluent bilinguals. In general, studies using a wide variety of methods to test this hypothesis have found converging support for it.

One source of evidence that suggests that less fluent bilinguals rely on lexical mediation to understand second language words comes from research on cross-language transfer concerning the role of cognates in second language learning. Although cognate status has been defined in a variety of ways in the literature on bilingual language processing, cognates are generally taken to be words that share aspects of both form and meaning across languages (e.g., *tomato* in English and *tomaat* in Dutch). Because cognates are relatively transparent at the lexical level, they provide a means for less fluent bilinguals to use the second language prior to the ability to conceptually access the meanings of L2 words. Hancin-Bhatt and Govindjee (in press) have shown that the degree of transfer from L1 to L2 depends on the similarity of phonology in the bilingual's two languages with languages that share phonology supporting the greatest transfer.

Although a cognate strategy during early stages of second language acquisition (or when acquiring difficult new vocabulary during later stages) may facilitate the acquisition of some kinds of linguistic knowledge in L2 (for example, see Hancin-Bhatt & Nagy, 1994, concerning the acquisition of derivational morphology), it may be a strategy that has only short-term benefits (see also Meara, 1993, for a discussion of the implications of the presence of cognates for L2 learning). For one thing, languages that share aspects of word form are likely to include false as well as true cognates (e.g., the word *red* in Spanish means *net* in English, not *red*). A cognate strategy, although lexically efficient, may not be reliable. Dufour, Kroll, and Sholl (1996) examined the role of cognate status in the translation performance of less and more fluent English-French bilinguals. The results showed that all bilinguals translated cognates more rapidly than noncognates, replicating previous reports of a cognate advantage in translation (e.g., De Groot, 1992a; De Groot, Dannenburg, & Van Hell, 1994; Kroll & Stewart, 1994; Sánchez-Casas, Davis, & García-Albea, 1992), but the advantage for cognates was greater for the less than for the more fluent bilinguals, suggesting that less fluent bilinguals were more reliant on a lexical translation strategy.

To examine the lexical mediation hypothesis more directly, Talamas, Kroll, and Dufour (1995) asked more and less fluent English-Spanish bilinguals to perform a translation recognition task (De Groot, 1992a) in which they had to decide whether two words, one in each language, were translation equivalents. The conditions of interest in this study were the trials on which the two words were not translation equivalents. These *no* trials included cases in which the incorrect translation was similar in form to the correct translation (e.g., *hambre* vs. *hombre* in Spanish), similar in meaning (e.g., *mujer* vs. *bombre* in Spanish), or unrelated. Talamas et al. found evidence for interference (i.e., longer response latencies) for both form-related and meaning-

related trials relative to unrelated controls. However, the magnitude of the form and meaning interference was a function of fluency in L2. Less fluent bilinguals produced a large form interference effect but a small meaning interference effect. The opposite was true for more fluent bilinguals, whose performance was more disrupted by similarity in meaning than in form. The results supported the hypothesis that bilinguals shift from reliance on lexical form to reliance on meaning with increasing fluency in the second language. Furthermore, they are consistent with the classroom observation that students at beginning levels of L2 study are more likely to make form-based errors in translation than students at more advanced levels (Talamas et al.). Related studies by Cziko (1980) and McLeod and McLaughlin (1986) also provide support for the claim that increasing fluency in the second language is associated with a reduction in reliance on form and an increase in reliance on meaning.

Two approaches have been taken to determine whether second language learners are conceptually mediating their second language. One approach is to ask individuals to perform a task that, by its very nature, requires conceptual processing. If they are conceptually mediating L2, it should be possible for them to perform the task. If they are not able to conceptually mediate, and, if the conditions of the experiment do not allow participants to resort to translation strategies, then performance should be generally poor. However, the way in which a second language learner or less fluent bilingual solves the problem of accessing the required information in such a task may also reveal the manner in which the conceptual connections are eventually established. A second approach is to manipulate a variable that is believed to reflect access to semantic or conceptual memory and to determine whether performance in both languages is sensitive to that factor.

One way to require conceptual access is to ask participants to categorize exemplars as members of specified semantic categories (e.g., to decide whether *apples* are a type of fruit). Past studies that have examined within- and across-language categorization have shown that fluent bilinguals can categorize as rapidly and accurately within as across their two languages (Caramazza & Brones, 1980; Potter et al., 1984; Shanon, 1982). This result has been interpreted as support for the view that the fluent bilingual's two languages are conceptually mediated by a common semantic representation. However, many of these studies used a paradigm in which the interval between the presentation of the category name and the exemplar was relatively long, thus permitting or encouraging a translation strategy.

More recently, Dufour and Kroll (1995) replicated the concept mediation results for fluent English–French bilinguals in a categorization task in which the interval between the category name and exemplar was brief, providing more compelling evidence for the concept mediation hypothesis. Dufour and Kroll included a less fluent comparison in this experiment and predicted

that less fluent bilinguals, who would presumably have to rely on a lexical translation strategy, would have particular difficulty in the categorization task when the exemplar followed the category name by only a brief interval. If less fluent bilinguals must resort to a translation strategy, then the conditions that require the most translation, when both category name and target word appear in L2, should produce the longest categorization latencies. Contrary to the predictions based on a translation strategy, they found that less fluent English–French bilinguals were able to categorize under short SOA conditions and under conditions in which both the category name and the target word appeared in L2 (French). However, the pattern of categorization for the less fluent bilinguals differed from the one produced by the more fluent bilinguals, such that they were slower to categorize when the language of the target mismatched the language of the category name. This pattern of categorization latencies held, even when the category names were presented in L1, a condition in which all participants were presumably able to comprehend the presented information. On the basis of this result, Dufour and Kroll argued that L1 may activate conceptual memory to the point where a less fluent bilingual's relatively weak L2 may not be able to provide the necessary lexical support. Having concepts active, for which no readily available word is known in L2, may serve to inhibit access to those concepts for which L2 words exist. Thus, it may be possible for the less fluent bilingual to direct conceptual access on the basis of a limited L2 but, at the same time, not be able to use conceptual information to retrieve L2 words. Because it is the latter process of L2 lexicalization that is required in production tasks, such as translation and picture naming, it may be possible for individuals at this level of L2 acquisition to use conceptual information in comprehension and recognition tasks, whereas the very same information may not be used if production is required. (See McLeod & McLaughlin, 1986, for a similar argument concerning the degree to which proficiency generalizes across tasks.) Overall, these findings support the claim that the nature of conceptual processing changes with increasing L2 proficiency.

Additional evidence to support the claim that fluent bilinguals are able to conceptually mediate their second language comes from semantic priming tasks in which the languages of the prime and target are manipulated. If bilinguals are able to access concepts for L2 words, and, if concepts are shared across their two languages, then semantic priming should be observed within both L1 and L2 and also across languages. The results of a large number of cross-language semantic priming studies generally support the conclusion that fluent or relatively fluent bilinguals are able to conceptually mediate L2 because priming is typically observed both within and between languages (e.g., Altarriba, 1990; Chen & Ng, 1989; De Groot & Nas, 1991; Frenck & Pynte, 1987; Kirsner, Smith, Lockhart, King, & Jain, 1984; Meyer & Ruddy, 1974; Schwanenflugel & Rey, 1986; Tzelgov & Henik, 1989). How-

ever, recent studies that have attempted to carefully control methodological aspects of the semantic priming paradigm have reported some limits to the extent of cross-language priming, even when bilinguals are highly proficient in L2 (e.g., De Groot & Nas, 1991; Keatley & De Gelder, 1992; Keatley, Spinks, & De Gelder, 1994). We return to these exceptions at a later point. For now, the point of these semantic priming studies is to demonstrate that fluent bilinguals are able to take advantage of semantic context, even when it appears in the other language. Few of these studies have examined less fluent bilinguals, making it impossible to assess the prediction that less fluent individuals will fail to demonstrate cross-language priming.<sup>1</sup>

De Groot and Hoeks (1995) used the concreteness effect in translation (De Groot, 1992a; De Groot et al., 1994) as an index of conceptual mediation in Dutch trilinguals who speak English as a relatively fluent second language and French as a nonfluent third language. De Groot (1992a) had previously demonstrated that fluent bilinguals translate concrete words more quickly than abstract words and suggested that the difference in translation performance for concrete and abstract words reflects a difference in the degree of conceptual feature overlap, with concrete translation equivalents sharing a larger number of conceptual features than abstract translation equivalents (see also Taylor, 1976). If access to shared conceptual features and subsequent retrieval of the translation in L2 occurs only when individuals are relatively fluent in both languages, then it should be possible to demonstrate conceptual mediation for the stronger of a trilingual's nonnative languages, but not for the weaker. That is, it should be possible to observe fluency differences within as well as across individuals. This is precisely the result that De Groot and Hoeks (1995) reported: Dutch-English-French trilinguals produced the standard concreteness effect in translation when translating from Dutch to English (L1 to L2) but not when translating from Dutch to French (L1 to L3).

A final source of evidence regarding changes in representation and processing as a function of increasing L2 proficiency comes from training studies that have sought to simulate aspects of L2 learning in the laboratory over a few relatively brief sessions with a small set of materials. Chen (1990) trained a group of native Chinese speakers on a set of French words either by having them learn the translation of the French word in Chinese or by associating the new French word with a picture of the object to which it referred. The study showed that, early in acquisition, the conditions of training produced different results, with superior performance when the modality at test matched the

<sup>1</sup>An exception is a sentence priming study by Kroll and Boring (1987) in which sentence fragments in English were completed by target words in English or Spanish that rendered the sentences meaningful or not. Fluent English-Spanish bilinguals were faster to make lexical decisions for related than for unrelated target words, regardless of the language of the target. Less fluent bilinguals showed effects of target relatedness only for English targets, suggesting that they were unable to conceptually mediate Spanish.

modality at study. Later in training, there were few differences between the groups, the data patterns suggesting concept mediation for both. Concept mediation thus appears possible, at least for a very limited vocabulary, after even short term exposure to second language words.

Kroll and Sankaranarayanan (1996) recently extended Chen's (1990) study by showing that the dependency on modality during early stages of acquisition can be overcome if new second language vocabulary is associated to unique cues, similar to those that might be encountered in an immersion environment. Unusual orientations of objects were used to provide such a cue. Past research (e.g., Palmer, Rosch, & Chase, 1981) has shown that pictures of objects are named more slowly when they are oriented in a noncanonical presentation. If the noncanonical orientation slows not only recognition of the object but also the retrieval of the corresponding concept and name (in L1), then associating a noncanonical view with a new L2 word might effectively inhibit the first language's *claim* to conceptual memory. A group of native English-speaking participants was taught 40 new words in Dutch. Half of the participants learned the Dutch words by associating them to their English translations, and the remaining participants associated the Dutch words to pictures of the objects to which they referred. Half of the pictures were presented in canonical orientation, and half were presented in noncanonical orientation. There were two important results. First, the participants who were trained with pictures were better able to later name the pictures in Dutch and translate words from English to Dutch than the individuals trained with words. The fact that the superiority of picture study held, even when participants were tested on word translation, suggests that the advantage conferred by picture study occurred at a conceptual level. Second, and most interesting, was that learning new Dutch words, by associating them to noncanonical views of objects, produced superior performance in a later test of picture naming and word translation relative to Dutch words learned by association to normally oriented objects. The fact that the advantage for Dutch words associated to noncanonical objects during study was observed in translation (where the perceptual cues were absent) as well as in picture naming provides additional support for Chen's (1990) conclusion that, under some circumstances, it is possible to observe concept mediation early in learning.

The findings we have reviewed suggest that there are changes in bilingual representation and/or processing with increasing expertise and that these different states may simultaneously exist within the very same individual, as the trilingual data suggest. In the next section, we discuss two alternative proposals for the ultimate form of representation in the fluent bilingual. The two proposals, although not mutually exclusive, focus on different aspects of lexical and semantic processing in the bilingual. One, the revised hierarchical model (Kroll & Stewart, 1990, 1994), examines the consequences of

the developmental sequence described previously. The other, the distributed conceptual feature model (De Groot, 1992a, 1992b, 1993), focuses on the characteristics of words that may constrain the form of lexical and conceptual representation across languages.

### THE REVISED HIERARCHICAL MODEL

The research reviewed earlier suggests that second language learners initially access meaning for second language words through the first language and only later become able to conceptually mediate L2 directly (Chen & Leung, 1989; Kroll & Curley, 1988). The shift from reliance on L1 to direct conceptual processing of L2 with increasing fluency may also have the consequence of creating an asymmetry in the strength of lexical-to-conceptual connections between the first and second languages (Kroll, 1993; Kroll & Sholl, 1992; Kroll & Stewart, 1994). Because the second language depends initially on the first language for access to meaning, the lexical-level connections from L2 to L1 will be stronger than the corresponding lexical-level connections from L1 to L2. Because L1 initially holds privileged access to meaning, the strength of the conceptual connections will be stronger for L1 than for L2.

To accommodate these differences in lexical and conceptual representation for a bilingual's two languages, Kroll and Stewart (1990, 1994) proposed a revised hierarchical memory model. The model, shown in Fig. 6.2, depicts the asymmetries described earlier. The model assumes that both lexical and conceptual links are active in bilingual memory but that the strength of those links differs as a function of fluency in L2 and the relative dominance of L1 to

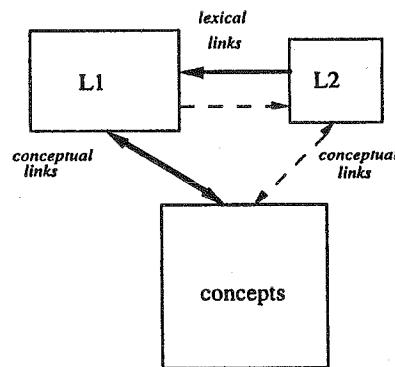


FIG. 6.2. The revised hierarchical model (adapted from Kroll & Stewart, 1994). Words in each language (L1 and L2) are interconnected via lexical-level links and conceptual links. The lexical-level links are stronger from L2 to L1 (solid line) than from L1 to L2 (dashed line), but the conceptual links are stronger for L1 (solid line) than for L2 (dashed line).

L2. As shown in the figure, L1 is represented as larger than L2 because the model assumes that, for most bilinguals, even those who are relatively fluent, more words are known in the native language than in the second language. Lexical associations between L2 and L1 are stronger than those from L1 to L2 because that is the direction in which second language learners first acquire the translations of new L2 words. The link between words and concepts, however, is stronger for L1 than for L2. When a person acquires a second language beyond a stage of very early childhood, there is already a very strong link between the first language lexicon and conceptual memory. During early stages of second language learning, second language words are attached to this system primarily by lexical links with the first language. As the individual becomes more proficient in the second language, direct conceptual links are also acquired. However, the lexical connections do not disappear when the conceptual links are established; they appear to remain as viable connections (De Groot, 1992a).

Kroll and Stewart (1994) and Sholl, Sankaranarayanan, and Kroll (1995) tested predictions of the revised model for bilingual translation performance. According to the model, translation from L1 to L2 should be more likely to engage conceptual processing than translation from L2 to L1 because L1 can more readily activate concepts than L2 can. Likewise, L2, by virtue of its initial lexical-level connections to L1, should allow rapid lexical-level translation from L2 to L1 without recourse to meaning. Thus, L2 to L1 translation should be faster than L1 to L2 translation and also less sensitive to the effects of semantic factors. Kroll and Stewart reported support for each of these predictions in an experiment in which fluent Dutch-English bilinguals performed each direction of translation for words in semantically categorized or randomly mixed lists. Words were translated more rapidly and accurately from L2 to L1 than from L1 to L2, and only the L1 to L2 translation task was affected by the semantic context of the list. Other translation studies have reported a similar asymmetry (e.g., Keatley, Spinks, & De Gelder, 1992; Roufca, 1992; Sánchez-Casas et al., 1992).

Sholl et al. (1995) tested the further prediction that only translation from L1 to L2, the direction of translation hypothesized to be conceptually mediated, would resemble picture naming, a task also believed to require conceptual access (Glaser, 1992; Levelt et al., 1991; Potter & Faulconer, 1975; Vitkovitch & Humphreys, 1991; Wheeldon & Monsell, 1992). Bilingual subjects named pictures in each of their languages during study and translated words in each direction of translation at test. Some of the words at test were repeated concepts that had been named as pictures during study. The results showed that at test L1 to L2 translation was primed by the prior picture-naming task, but L2 to L1 translation was not. These findings lend strong support to the claim that connections between words in a bilingual's two languages and concepts are asymmetric and, in particular, that L2 processing is less likely to

engage meaning than L1. The pattern of results also suggests that the translation asymmetry cannot be due entirely to production difficulties in L2. Naming a picture in L1 at study produced significant facilitation in later translation from L1 to L2, despite the absence of a common production at study and test (see also Snodgrass, 1993, for a discussion of this issue).

### Other Evidence for the Revised Hierarchical Model

A source of converging evidence for the revised hierarchical model comes from the exceptions to the general cross-language semantic priming results described earlier. Many of the past studies of cross-language semantic priming can be criticized on methodological grounds because they included a high proportion of related trials and a long interstimulus interval between prime and target words that may have encouraged subjects to develop expectations for the upcoming targets. The use of long prime-to-target intervals in the bilingual experiments is particularly problematic because, in some of these experiments, participants may have been encouraged to translate the prime and/or target into the same language (see Neely, 1991, for a general discussion of the factors that may exaggerate the magnitude of priming). In a bilingual semantic priming task, if participants can translate, on even a small proportion of trials, then the observed cross-language priming may reflect only the presence of within-language priming in the cross-language conditions.

Recent studies that have carefully controlled the characteristics of the priming paradigm to optimize automatic aspects of processing and minimize the contribution of expectation and strategy have not found cross-language priming under all conditions. For example, using a masked priming paradigm, in which participants are not even necessarily aware of the bilingual nature of the task, De Groot and Nas (1991) found evidence for cross-language semantic priming in Dutch and English only when translation equivalents in the two languages were cognates, sharing lexical form as well as meaning. A cross-language translation priming effect materialized for both cognates and noncognates, although it tended to be smaller for the latter type of words. A recent study by Gollan, Forster, and Frost (1996) showed that masked cross-language translation priming was not restricted to languages that share the same script; for Hebrew and English, there was significant masked priming for both cognate and noncognate translations, but the effect was much larger and more reliable from L1 to L2 than the reverse.

Using the standard priming paradigm but carefully controlling the conditions of presentation, Keatley et al. (1994) reported that, even when bilingual participants are highly fluent in both languages, there are asymmetries in the magnitude of semantic priming. Keatley et al. found priming only from L1 to L2, but not from L2 to L1. Similar asymmetric priming results have been described by Altarriba (1990), Kroll et al. (1992), and Tzelgov and Eben-Ezra (1992).

The observed asymmetries in priming are consistent with the predictions of the revised hierarchical model because L1 words are more likely to activate their respective meanings than L2 words and are thus more effective primes. However, Keatley and De Gelder (1992) have also shown that the cross-language priming effect from L1 to L2 can be eliminated when fluent bilingual participants are forced to speed their responses in a lexical decision task. Under these speeded conditions, Keatley and De Gelder observed semantic priming for within-language conditions only. Cross-language priming occurred only in a condition in which the prime and target were translation equivalents. (See Keatley et al., 1994, for the description of a lexical network model in which conceptual representations are not assumed. This model, like Paivio's, 1971, 1986, dual code model, assumes that cross-language interactions are restricted to lexical associations.)

In a related negative priming paradigm, in which the effects of unattended semantically related flanking words were examined, Fox (1996) found that only L1 words produced cross-language semantic effects on the processing of L2 target words; cross-language semantic effects were not obtained in the L2 to L1 direction. These results are consistent with the predictions of the revised hierarchical model and formally similar to the asymmetries reported earlier in the semantic priming paradigm. However, a further result in the Fox study did not support the predictions of the model. When the unattended words were translations of the target rather than words semantically related to the targets, there were significant effects for both cross-language directions, but they were still larger from L1 to L2 than from L2 to L1. According to the model, L2 words should be *more* likely to activate their respective translations than L1 words, thus, the effect observed with semantically related words should have been reversed for translation equivalents. Similar results have been reported in studies of translation priming (e.g., Altarriba, 1992; Chen & Ng, 1989; Jin, 1990; Keatley et al., 1992): L1 words produce larger translation priming for L2 words than the reverse, although significant translation priming is also found in the L2 to L1 direction.

The problem in interpreting the priming results is that, for bilinguals who are dominant in L1 (which is most of the bilingual population), there will be more information available from an L1 prime than from an L2 prime. Taken together with the fact that, on average, an L1 target will also be recognized more rapidly than an L2 target, it makes sense to expect that L1 will be more effective as a prime but less influenced as a target. That is, L1 words are functionally more frequent than their L2 translation equivalents. Because recognition will be slower for L2 than for L1, it is also more likely that meaning will have been activated by the time the L2 word is identified. The observed asymmetries in priming, with larger effects from L1 to L2 than from L2 to L1, although consistent with the predictions of the revised hierarchical model, may also reflect the limitations of the primed lexical decision paradigm for investigating this issue.

### Challenges to the Revised Hierarchical Model

A number of recent papers have challenged the view that translation from L2 to L1 (backward translation) is accomplished via a lexical route. De Groot et al. (1994) used regression methods to determine whether predictor variables related to a word's meaning (e.g., concreteness, context availability, definition accuracy) could account for translation performance in both directions of translation. Their results showed that, indeed, both directions of translation were affected by meaning variables, apparently providing evidence against the strong claim that translation from L2 to L1 is always accomplished lexically. However, some of the correlations between the meaning variables and translation performance were higher for forward translation (from L1 to L2) than for backward translation. The opposite pattern, higher such correlations for backward translation, never occurred. A similar finding was obtained in two recent studies whose primary purpose was to disentangle the effects of word concreteness and context availability in bilingual processing, more specifically, in word translation (Van Hell & De Groot, 1996; cf. the monolingual study of Schwanenflugel, Harnishfeger, & Stowe, 1988). A concreteness effect occurred in both translation directions but was slightly larger in forward translation. These findings support a weak version of the revised hierarchical model, holding that processing the first language is more likely to engage meaning than does processing the second language.<sup>2</sup>

Evidence that might be seen as more damaging to the revised hierarchical model comes from a recent study by La Heij, Kerling, and van der Velden (1996) who, contrary to the predictions of the model, observed semantic context effects in both directions of translation and, if anything, evidence for more semantic involvement in backward than in forward translation. La Heij et al. presented pictures as context along with target words to be translated. In one condition, the pictures depicted an entity belonging to the same category as the referent of the word to be translated (e.g., the word *shark* accompanied by a picture of a whale). In a second condition, the entity depicted by the picture was unrelated to the word's referent. The authors found that both directions of translation were facilitated by the presence of a semantically related context. Furthermore, no translation asymmetry was observed in the size of the context effect, and, in one experiment (Experiment 3), translation from L1 to L2 was faster than translation from L2 to L1. In another

<sup>2</sup>In the De Groot et al. (1994) study, the direction of translation was manipulated between participants, whereas, in the Kroll and Stewart (1994) study, it was manipulated within participants. Because studies of bilingual language processing suggest that mixing languages sometimes incurs a processing cost, particularly for the weaker language, it may be that backward translation is more likely to be conceptually mediated in the absence of forward translation trials. It is unlikely that this is the only factor accounting for the observed differences, however, because a recent study by De Groot and Poot (in press) found concreteness effects in both directions of translation, even though direction was manipulated within participants.

experiment (Experiment 4), there was also a hint of this effect, but it did not generalize over subjects.

Because the revised hierarchical model was designed to account for out-of-context translation performance, the La Heij et al. (1996) data are not problematic if one assumes that context provides the semantic support to allow an otherwise weaker L2 to access meaning.<sup>3</sup> The bilinguals who participated in La Heij et al., as, in fact, those in De Groot et al. (1994) and Kroll and Stewart (1994), were drawn from a population of relatively fluent Dutch-English bilinguals capable of reading and speaking at high levels in their L2. The minimal context used in the La Heij et al. study, in the form of a pictured object, might suffice to boost the process of accessing meaning from L2 and, thus, eliminate the asymmetry. The translation asymmetry and the corresponding evidence for lexically mediated processing from L2 to L1 may, therefore, occur only in the absence of context. If this were not the case, then these apparently fluent bilinguals would have great difficulty using their second language under normal conditions that are more contextually rich than most experiments.

Some support for this view comes from Stroop-type translation experiments in which an L2 word is presented for translation, followed after a brief SOA by an L1 distractor word (La Heij et al., 1990; Mazibuko, 1991). According to the revised hierarchical model, no Stroop interference should result from a semantically related L1 distractor word if L2 to L1 translation is lexically mediated. However, both of these studies reported significant semantic interference for semantically related words, suggesting that, in the presence of the L1 context, backward translation is conceptually mediated.

A number of other recent translation studies, however, suggest that not all of the inconsistencies in the results concerning translation direction can be resolved this way. De Groot and Poot (in press) had three groups of Dutch-English bilinguals translate words from Dutch (their L1) to English (their L2) and vice versa. The groups differed in their level of proficiency in English (and in age): One group consisted of university students, drawn from the same population as the participants tested in La Heij et al. (1996), Kroll and Stewart (1994), and De Groot et al. (1994); the second and third groups consisted of secondary-school pupils in the 5th and 3rd years, respectively. The results of that study were, in fact, very similar to those of La Heij et al., even though translation occurred out of context. In the group

<sup>3</sup>This explanation is analogous to the context availability account of concreteness effects offered by Schwanenflugel and Shoben (1983) and Schwanenflugel, Harnishfeger, and Stowe (1988). According to the context availability model, abstract words have a conceptual representation that is more diffuse and, therefore, more dependent on context. In comparison, concrete words are hypothesized to have a more unitary representation that is less dependent on the presence of context. The empirical support for this proposal comes from the demonstration (Schwanenflugel et al., 1988; Schwanenflugel & Shoben, 1983) that concreteness effects disappear following context.



comparable to those tested in La Heij et al., Kroll and Stewart (1994), and De Groot et al. (1994), no translation asymmetries occurred: Statistically, translation was as fast in the forward direction as in the backward direction (as in De Groot et al., 1994, Experiment 1, and in Van Hell & De Groot, 1996), although, in absolute terms, a nonsignificant benefit was observed for *forward* translation (cf. La Heij et al., Experiment 4). Furthermore, equally large effects of a semantic variable, word concreteness, were obtained in both translation directions. This pattern held for various types of words, for instance, for both cognates and noncognates.

The data patterns for the lower proficiency groups in the study by De Groot and Poot (in press) are even more problematic for the revised hierarchical model. In both groups, the concreteness effect was, statistically, as large in backward translation as in forward translation (and tended to be larger in backward translation). This pattern again held for various types of words, cognates as well as noncognates. Furthermore, now a clear directional asymmetry in RT, opposite to that predicted by the revised hierarchical model, was obtained. For both participant groups, translation RT was considerably slower for backward translation. This latter is not an isolated finding. It has also been reported before for this population of Dutch university students (De Groot et al., 1994, Experiment 2; La Heij et al., 1996, Experiment 3; Swaak, 1992).

Further support for the idea that effects of meaning variables are often immune to translation direction was obtained in a correlational study that included a number of these variables as predictor variables and that employed translation recognition as the test task (De Groot & Comijs, 1995). In this study, the first word of a test stimulus always preceded the second by some hundreds of milliseconds, and the language of the first and second words within the stimuli was varied. The translation-direction manipulation of the common translation (production) task was, thus, mimicked to a certain extent. The meaning variables affected translation-recognition performance in both directions, and to the same extent.

From the effects of semantic manipulations in this latter set of studies, it appears that, at least for Dutch-English bilinguals beyond the very initial stages of English training, translation processes are often, qualitatively, the same in both translation directions: Conceptual memory appears implicated in both directions and to the same extent. At present, it is not at all clear why the data of the studies already discussed, dealing with conceptually very similar issues, do not converge more closely. Of course, albeit conceptually very similar, the studies differ from each other in the ways in which the theoretical questions have been implemented, in terms of the participants, the stimulus materials, the experimental procedure, or a particular combination of these three. The choices made on each of these three dimensions may interact in complex ways, the details of which are not yet understood. That such factors affect

performance is, of course, widely known, and, indeed, some indications that they have played a role in the data patterns obtained in the present research area are already available. It will be particularly critical in future research to determine the relations between the conceptual variables that have been examined in these bilingual studies. It may be the case that the semantic organization of a list (the conceptual variable in the Kroll & Stewart, 1994, study), word concreteness (the conceptual variable in many of De Groot and her colleagues' experiments), and semantic context (the conceptual variable in the La Heij et al., 1996, study and in experiments on bilingual semantic priming), though all legitimate semantic variables, may influence different processing loci during translation.

An analysis of the La Heij et al. (1996) study illustrates the manner in which seemingly small methodological differences may have important consequences. La Heij et al. used a procedure in which bilingual participants were first familiarized with the set of pictures to be used as context and with the words to be translated. In addition, the to-be-translated words appeared a number of times during the course of the experiment in different conditions. It is well known that there are repetition priming effects that may affect performance under these conditions (e.g., Scarborough, Cortese, & Scarborough, 1977), at the least producing very fast response latencies. And indeed, the translation RTs in the La Heij et al. study were noticeably fast, relative to other translation studies. However, Sholl et al. (1995) and Kroll, Elsinger, and Tokowicz (1994) have also shown that a single repetition of a concept prior to translation will reverse the translation asymmetry. In these studies, participants named pictures or translated words during a study phase. In a later test phase, they translated words in both directions of translation that included some words that had previously been named during study. It is, therefore, possible that the failure to observe differential effects for the two directions of translation in the La Heij et al. study is due to the effects of repeating concepts across conditions. The absence of an out-of-context condition in that study also makes it impossible to know whether the high frequency words used in those experiments would have produced a translation asymmetry.

As to the choice of participants and the role of choice in translation performance, a study by Janine Swaak, performed in part in the laboratories of both of the present authors, is informative (Swaak, 1993). In one of our laboratories, she tested Spanish-English bilinguals; in the other, she tested Dutch-English bilinguals. The task she used in both experiments of the study was translation recognition, in both directions, and with a clear interval (500 milliseconds) between the first and second word in each translation pair. The procedural details of the experiment that she performed first (Spanish-English) and the characteristics of its stimulus materials were imitated as closely as possible in the second experiment. An attempt was made to match the L2 proficiency levels of the participants in the two experiments, but the data (both

RT and percent errors) clearly suggested that this attempt had failed. The L2 proficiency level of the Dutch–English bilinguals turned out to be higher than that of the Spanish–English bilinguals. Particularly interesting for our present purposes is that the data patterns of the two groups were qualitatively different. To mention a few differences: The lower proficiency group showed the regular concreteness effect in forward translation but the reverse effect (faster responses to abstract words) in backward translation, whereas the higher proficiency group showed equally large concreteness effects in both translation directions (with, in both cases, the concrete words producing the fastest responses); the main effect of concreteness was not reliable in the lower proficiency group, but it was in the higher proficiency group; there were some signs that the concreteness effect in forward direction in the lower proficiency group depended on word type (cognates showed a much smaller effect than noncognates), whereas the effect in the higher proficiency group was much more even across the various word types.

Swaak's (1993) data thus suggest that the choice of participants may influence the pattern of results in these studies. But other factors, for instance those just mentioned, are likely to play a role, too. Perhaps the strongest argument that other factors must be relevant as well is that Kroll and Stewart (1994), in the study that gave rise to the revision of the original hierarchical model, tested subjects from the same population of Dutch–English bilinguals used by La Heij et al. (1996), De Groot et al. (1994), and De Groot and Poot (in press; their highest proficiency group). Yet, even though Kroll and Stewart obtained support for the strong version of the model (only involvement of conceptual memory in forward translation), De Groot et al.'s (1994) data suggest a slightly larger involvement of conceptual memory in forward than in backward translation, and the remaining two studies obtained support for the idea of qualitatively similar translation in the two directions, that is, for a *symmetrical* model.<sup>4</sup>

Although the evidence reviewed raises a question as to whether the asymmetry at the center of the revised hierarchical model can be generalized

<sup>4</sup>Support for the view that the particular choice of stimulus materials can also affect the data pattern is provided by a reanalysis of a subset of the data of De Groot et al. (1994), the study that provided support for a weak version of the asymmetry model (a slightly larger influence of meaning variables in forward than in backward translation). All stimulus words of De Groot and Poot (in press), the study that showed no trace of an asymmetry, had been among the much larger set of stimulus materials in the study by De Groot et al. It would be revealing to see whether the data associated with exactly this stimulus set, extracted from the larger data set of De Groot et al., would show a pattern of results similar to that of De Groot and Poot, that is, no asymmetry. If so, the small asymmetries observed in De Groot et al. would have to have been due to specific characteristics of the remaining stimulus materials, whatever these characteristics may be. Indeed, the relevant reanalysis of the subset of the earlier data set showed no trace of the asymmetries predicted by the revised hierarchical model: Forward translation was not slower than backward translation (in fact, it was faster), and the concreteness effect was equally large in forward and backward translation.

beyond limited conditions, some very recent neuroimaging evidence (Klein, Milner, Zatorre, Meyer, & Evans, 1995) supports the findings of an asymmetry in the direction predicted by model. It will remain to be determined which conditions constrain the form and direction of the asymmetries predicted by the revised hierarchical model for bilinguals at different stages of L2 proficiency. If bilinguals are capable of accessing conceptual memory equally well for both of their languages, once they are beyond an early stage of L2 acquisition, or for some subset of materials, as some of the evidence just reviewed suggests, then an important focus in this area of research will concern the form of concepts and modeling of activation of meaning for words in different languages. The next model we consider, the conceptual feature model, addresses this issue.

#### THE CONCEPTUAL FEATURE MODEL

An alternative approach to modeling the representation of words and concepts in bilingual memory is to focus on those aspects of words that appear to be associated with lexical or conceptual processing. De Groot (1992a, 1992b, 1993; De Groot et al., 1994) has developed this approach by examining the effects of a host of variables thought to reflect lexical and conceptual levels of processing in bilingual performance in translation production and translation recognition (see also Jin, 1990, and Sánchez-Casas et al., 1992, for related studies). Two central findings in this work are that concrete words and cognates are translated faster than abstract words and noncognates. To accommodate these effects, De Groot (1992b) proposed a conceptual feature model in which words in each of the bilingual's two languages activate conceptual features that are assumed to be distributed, such that particular concepts correspond to sets of activated features (see Taylor & Taylor, 1990, and Poulisse, chapter 7, this volume, for similar views on bilingual memory representation, and Masson, 1991, for a similar view on monolingual memory representation). The model, shown in Fig. 6.3, provides an account for the observed concreteness effects in translation and other bilingual processing tasks. Because concrete words refer to perceptual referents that are, for the most part, shared across languages, they will access similar or identical subsets of conceptual features, regardless of the language in which they are presented. Concrete words can be thought to possess true, or close, translation equivalents across languages. In contrast, abstract words that may be more dependent on context for their interpretation (Schwanenflugel et al., 1988; Schwanenflugel & Shoben, 1983) are more likely to differ across languages in that they share fewer conceptual features than do concrete words. In this respect, abstract words may not possess close translation equivalents across languages, but translations that are only roughly similar. If the process of translation is

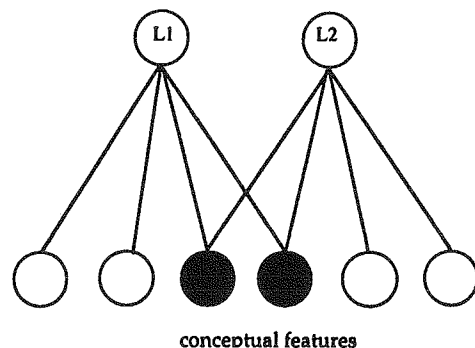


FIG. 6.3. The distributed conceptual feature model (adapted from De Groot, 1992b).

conceptually mediated (e.g., De Groot & Poot, in press; La Heij et al., 1996; Potter et al., 1984), then access to shared conceptual information will be more available for concrete than for abstract words. Additional support for the view that conceptual overlap is the basis of shared meaning across languages comes from a recent study that demonstrated that semantic similarity was more critical than association value in producing cross-language priming under masked conditions (Williams, 1994).

De Groot (1992a, 1992b, 1993) proposed a similar explanation to account for the advantage of cognates in translation. Superficially, it might seem that cognate words would be translated more rapidly than noncognate words because translation might be able to occur at a lexical level. Some evidence for this claim is provided by a translation recognition study that showed that the degree of meaning overlap between translation equivalents affected performance for noncognates but not for cognates (Sánchez-Casas, Suárez-Buratti, & Igoa, 1992). Indeed, it does make sense to think that the translation of cognates might be influenced more by lexical than by conceptual factors. However, in the studies by De Groot and her colleagues described previously, cognate translations were still shown to be influenced by the concreteness of the target words, a variable thought to reflect conceptual rather than lexical processing. And in the Kroll and Stewart (1994) study, cognates were translated more quickly than noncognates, but a translation asymmetry was observed in both cases, and category interference, a reflection of semantic processing, was present for cognates as well as noncognates in forward translation. These results suggest that cognates engage conceptual processes and that some part of the facilitation for cognate translation may be attributable to a higher level of conceptual feature overlap across translation equivalents for cognates than for noncognates. In some languages, cognates tend to be words that are borrows or loans from the other language, in which case the translations would share very close conceptual as well as lexical form.

### Extensions of the Conceptual Feature Model

At present, the proposed conceptual feature model is neutral on the issue of whether, in addition to facilitating access to translation equivalents, the overlapping features assume special importance in bilingual language processing. It is unclear as to whether the conceptual features represent units whose joint activation determines conceptual overlap in a purely quantitative sense or whether, within the conceptual representation, there are differences in the weights assigned to particular features and corresponding assumptions made about the degree of intercorrelation between features. For example, if one were to distinguish defining and characteristic features, as others have, in modeling semantic memory (e.g., Smith, Shoben, & Rips, 1974), the impact of which particular features overlap for a given translation pair might be significant. Similarly, the observed differences in translation for concrete and abstract words may be understood in terms of differential representation of perceptual features for concrete and abstract words. A recent neuropsychological study by Breedin, Saffran, and Coslett (1994) described a patient who showed a reversal of the normal concreteness effect, such that his performance was superior for abstract concepts. Breedin et al. argued that a specific impairment to concrete concepts reflected damage to a distinctly perceptual component of the semantic representation. If concrete translation equivalents across languages activate a large pool of shared semantic features, it is possible that overlapping perceptual features are the source of their meaning similarity.

A similar idea was described by McRae, De Sa, and Seidenberg (1993), who proposed that the conceptual features of exemplars of animate categories are more highly correlated or densely represented than the features of exemplars of inanimate categories. Sholl (1995) tested the McRae et al. proposal by examining animacy effects in bilingual picture naming and translation tasks. The interesting result, for the purpose of the present discussion, is that animacy had a clear effect on translation: Animate concepts were translated more rapidly than inanimate concepts. Because both the animate and inanimate concepts were concrete nouns, this result might suggest that concreteness alone does not determine the degree of conceptual overlap across languages. However, it is also possible that any variable that reflects access to conceptual memory will produce a corresponding effect in translation. Although reports by bilinguals that it is often difficult to come up with an exact translation for a given word are consistent with the idea of degrees of overlap among conceptual features, the available empirical results do not yet allow us to readily distinguish between alternative models.

A related focus in the current literature on bilingual word recognition concerns the issue of whether shared lexical-level units are distributed in a manner analogous to the conceptual features of the De Groot (1992a, 1992b),

1993) model. Recent work by Grainger (1993; Grainger & Dijkstra, 1992) suggests that, for languages that share aspects of lexical form, there may be parallel activation of shared lexical units (see Smith, chapter 5, this volume, for a discussion of this work). Up to this point in the discussion, we have assumed that word forms in a bilingual's two languages are stored separately because a fair amount of research on the bilingual lexicon supports that assumption (Brown, Sharma, & Kirsner, 1984; Gerard & Scarborough, 1989; Kirsner et al., 1984; Scarborough, Gerard, & Cortese, 1984, and see Smith, chapter 5, this volume). However, it may be useful to consider how a model might incorporate distributed features at both the lexical and conceptual levels. The model shown in Fig. 6.4 extends the notion of distributed conceptual features to a lexical level of distributed features. The general architecture of this model resembles models proposed by Dell and O'Seaghdha (1992) and Levelt et al. (1991) for speech production. (Note that only one layer of lexical features is depicted, but one could easily assume a multi-layered arrangement corresponding to different aspects of lexical form.) In addition to the language-independent (shared) lexical- and conceptual-feature levels, a language-specific lemma level is proposed. We assume that a lemma-type representation (e.g., Bock & Levelt, 1994; Kempen & Huijbers, 1983; Levelt, 1989; Roelofs, 1992) includes the lexical entry itself and mediates between activation of lexical and conceptual features and higher level language processes. Although there is some disagreement about the exact nature of the lemma representation, we will make only the general assumption that the lemma includes some syntactic and semantic information.

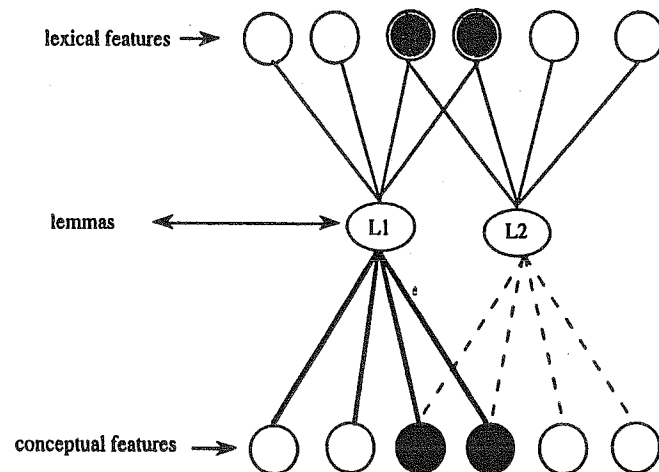


FIG. 6.4. The distributed lexical/conceptual feature model. Words in each language can share aspects of word form (lexical features) and/or aspects of meaning (conceptual features). Language-specific lemmas form the interconnection between the lexical-conceptual mappings to and from syntax.

As we noted at the beginning of this chapter, much of the research on bilingual representation (other than the work on bilingual speech production) has ignored the debate on lemma-level representation, presumably because the out-of-context nature of the tasks that have been used to test these models has not required a commitment to the semantic and syntactic constraints that operate during actual sentence processing. However, bilingual models also have an additional problem that complicates these issues beyond the monolingual case. In addition to all of the lexical, semantic, and syntactic factors that must be specified, the bilingual's language mode varies, such that, at any given moment, he or she may speak and comprehend sentences in one, or the other, or both languages. The interactive models that have been proposed for bilingual language processing (e.g., the Bilingual Interactive Activation model (BIA) of Grainger & Dijkstra, 1992, and also see Grosjean, chapter 8, this volume, for a description of the BIMOLA model for spoken word recognition) solve this problem in different ways, with or without the inclusion of language-specific language nodes (see also Poulisse, 1993, and chapter 7, this volume, and De Bot & Schreuder, 1993, for models of bilingual production that differ in the level at which language is specified).

In the present scheme, we assume that lemmas are not necessarily a form of symbolic representation that function as an interface between the lexical and conceptual features on one hand, and semantic or syntactic constraints on the other, but rather a means to represent the patterns of activation between word forms and meanings. In the absence of context, the lemma level may reflect only these form/meaning mappings. In the presence of context, the lemma may also reflect syntactic-level processes that selectively weight the activation of lexical and conceptual features. The assumption of a language-specific lemma level in the present model may allow the bilingual's two languages to be influenced by one another and to share access to a common pool of lexical and conceptual features but, at the same time, enable functional autonomy when only one language is active. Furthermore, this arrangement can distinguish the situation in which an individual is acquiring new vocabulary in L1 from the case in which the new vocabulary is associated with a new language; the same set of lexical and conceptual features may be activated in each case, but the mapping between these levels and the lemma level will differ, and, hence, the conditions under which they are activated will differ.

According to the model shown in Fig. 6.4, the level of facilitation and/or interference observed across languages will be a function of not only the degree of feature overlap, as the earlier distributed models assumed, but, more importantly, a function of the degree to which there are consistent mappings from word forms to meanings within and across languages. There is some support for this view in the literature on bilingual word recognition and lexical access. For example, Grainger and Beauvillain (1987) reported

that in tasks such as bilingual lexical decision, there are costs associated with language mixtures, reflected by increased processing time. However, these costs are not observed when the words in each language are orthographically unique to that language. A similar result has been reported by Li (1996) for spoken word recognition in code-switched sentences. These findings show that it is not the language mixture per se that incurs a processing cost, but the extent to which word forms activate both languages simultaneously. When lexical forms uniquely specify one language or the other, it is possible to consistently map lexical units to meaning via one language alone.

The model may also be able to explain some previously puzzling results concerning the apparent language specificity of lexical representations between languages. Data from tasks such as cross-language repetition (= translation) priming have, for the most part, failed to observe cross-language priming (see Smith, chapter 5, this volume, for a review of these studies). The reasonable conclusion, on the basis of these results, is that the two languages are represented separately at the lexical level. However, other studies (e.g., Altenberg & Cairns, 1983; Grainger & Dijkstra, 1992; Nas, 1983) have demonstrated lexical-level influences from one language to the other, creating difficulty for this claim. By distinguishing a level of lexical features from the lemma level, we can account for these apparently discrepant results. Because the lemma level is sensitive to syntactic constraints as well as to the mapping between lexical and conceptual features, it will necessarily be language specific. Tasks in which only a single language is presented at a time (as in most of the repetition priming studies that have failed to find cross-language priming), or in which the dominant language is the focus of attention, will likely be associated with relatively high levels of activation for the lemma associated with that language. Tasks in which both languages are simultaneously active, or in which the weaker of the two languages is emphasized, will give rise to activation of both lemmas and corresponding activation of lexical features across languages. In addition, when tasks require conceptual processing, the resulting lexicalization processes will typically favor L1, producing an increase in the likelihood of cross-language influence from L1 to L2. (See Grosjean, chapter 8, this volume, for a related discussion of the effects of the level of activation associated with each language in code switching and language mixing.)

Additional evidence for the importance of consistent mapping of lexical and conceptual features comes from a study in which fluent Spanish-English bilinguals read high and low constraint English sentences that contained a high or low frequency target word in English or Spanish (Altarriba, Kroll, Sholl, & Rayner, 1996). In one experiment, Altarriba et al. monitored eye movements while bilinguals read the sentences, and, in another experiment, they measured naming latencies for the English and Spanish target words.

When the sentence and the target word appeared in the same language, they found the standard pattern of results associated with sentence constraint and word frequency: Eye fixations were briefer and naming latencies shorter for highly constrained sentences and high frequency targets. However, when a Spanish target appeared in an English sentence, the pattern of results was quite different, such that high frequency target words were more difficult to process than low frequency target words in highly constrained sentences. Although the conceptual features per se may have been similar for the Spanish and English target words (they were all concrete nouns), the combination of high constraint, coupled with the priming of lexical features associated with the predicted English word in an otherwise English sentence, may have served to interfere with recognition of the Spanish word. Interestingly, the same effect did not hold when the Spanish word was low frequency, suggesting, again, that what is critical is the mapping process and not simply activation of each level independently.

How can the distributed lexical/conceptual feature model shown in Fig. 6.4 account for the asymmetries handled within the revised hierarchical model? We assume that the weaker mappings from form to meanings in L2 in early stages of second language acquisition, together with less developed knowledge of L2 syntax, will create a pattern of processing that will functionally mirror the asymmetry described by the revised hierarchical model. Studies of transfer at the lexical and syntactic levels suggest that, initially, L2 is processed as if it were L1, to the extent that there are some shared cues in the two languages (Durgunoglu & Hancin, 1992, and see MacWhinney, chapter 4, this volume, for a description of the competition model's account of syntactic transfer across languages). Like the competition model, the distributed feature model predicts that performance should be best when it is possible to form consistent mappings between levels for a given language. An interesting implication of this view is that it provides a theoretical basis on which to consider the effects of context of acquisition. Immersion learning, widely held to provide a superior context for L2 acquisition, may provide the unique cues for L2 that allow consistent mappings to form. In contrast, classroom learning may foster continued reliance on L1.

## CONCLUSIONS

In this chapter, we reviewed recent evidence concerning the relations between lexical and conceptual memory in the second language learner and the more fluent bilingual. Although theory development on this topic is still at an early stage, we believe that recent efforts toward conceptualizing the mapping of word forms to meanings in two languages as a distributed architecture will provide a productive way to understand the mapping prob-

lem itself and the dynamic changes it undergoes with increasing proficiency in the second language. It holds the additional promise of providing a framework within which performance on out-of-context bilingual tasks, such as translation, picture naming, and single word priming, may be related to bilingual performance in contexts that are linguistically complex and more representative of second language use. In future research, we hope to explore the implications of this perspective.

### ACKNOWLEDGMENTS

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