

Chapter 8

Bilingual Memory

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The word “memory” has a number of different senses: It is used to refer to the place where memory information is kept, to the stored information itself, and to the processing involved in storing new information in memory and retrieving it when needed later. A distinction is made between “long-term memory” and “working memory.” Long-term memory stores information for long periods of time (and perhaps permanently) while working memory retrieves information from long-term memory and holds (and manipulates) it for the duration it is needed to perform some mental operation.

Long-term memory is divided into two subsystems called “declarative memory” and “non-declarative memory.” Declarative memory contains knowledge that is explicit, accessible to consciousness. In contrast, knowledge contained by non-declarative memory (also called “procedural memory”) is implicit, unavailable to consciousness. It is expressed in behavior rather than by conscious recollection and can be acquired without the individual being aware of what is being learned. Two common forms of memory information contained by non-declarative memory are skills and habits (see Squire, Knowlton, & Musen, 1993 for further details).

This chapter deals exclusively with long-term declarative knowledge. Declarative memory contains both general, factual knowledge that we share with other people, and personal knowledge that reflects our individual past experiences. These two types of knowledge are usually called “semantic” and “episodic” or “autobiographical” respectively, and the systems that hold them are called “semantic” and “episodic” memory. Our mental lexicon – that is, the words we know, their form and meaning – constitutes a major component of semantic memory, but also general facts like *the longest river on earth is the Nile*, and *Prince Willem Alexander is married to Maxíma Zorreguieta* are part of semantic memory. In contrast, episodic or autobiographical memory stores our memories of specific events that happened to us in our past lives. I may, for instance, remember talking to Princess Maxíma about her

daughters' bilingualism at a reception held in the administrative building of the University of Amsterdam on the occasion of the university's foundation day.

Semantic and episodic knowledge are closely interrelated. On the one hand, semantic knowledge is built up from a process of generalization and abstraction from personal experiences and the memory traces left by them. For instance, our knowledge of what the word "dog" means is based on our personal experiences with individual dogs and summarizes the core of those experiences. On the other hand, what we experience is given meaning by information in semantic memory.

The aim of this chapter is to familiarize the reader with methods and outcomes of research on bilingual declarative memory, both semantic and episodic/autobiographical. The part of bilingual semantic memory that will be focused on is the bilingual's mental lexicon. Section 8.1 discusses various views on how the mental representations of (1) the form of an L1 word, (2) the form of its translation in L2, and (3) the meaning associated with these word forms are connected with each other and how the connections develop with increasing fluency in L2. In addition, it introduces the notion of meaning "nonequivalence" of translation pairs and its consequences for the representation of meaning. In the relevant literature the meaning representations of words are usually called "conceptual representations" or, simply, "concepts," and all of the mental lexicon's conceptual representations together constitute "conceptual memory." In this literature the word-form representations are often called "lexical representations" and all of these lexical representations together constitute "lexical memory." This latter nomenclature can be confusing at times because the adjective "lexical" can also refer to the mental lexicon as a whole, containing the representations of both the forms *and* meanings of words. For clarity's sake, in Section 8.1 of this chapter I will consistently use the term "conceptual representation" and "form representation" to refer to the representation of word meaning and word form, respectively.

Following the presentation of the various models of the organization of words' form and conceptual representations in the bilingual mental lexicon in Section 8.1, Section 8.2 then looks more closely at conceptual representations. From here on these are simply called "concepts" (because they are no longer discussed in relation to the form representations). Section 8.2 presents studies that examine whether, how, and why the L1 and L2 concepts in bilinguals differ from one another and from the corresponding concepts in monolingual native speakers of the languages concerned. Finally, Section 8.3 deals with bilingual episodic/autobiographical memory, specifically posing the question whether the language spoken at the time of a past event is encoded in the memory trace of that event and what this means for retrieving the memory at some later point in time.

8.1 The Organization of the Bilingual Mental Lexicon

Exactly 60 years ago Weinreich (1953/1968) described three organizations of word knowledge in a bilingual's mental lexicon: "coordinative," "compound," and

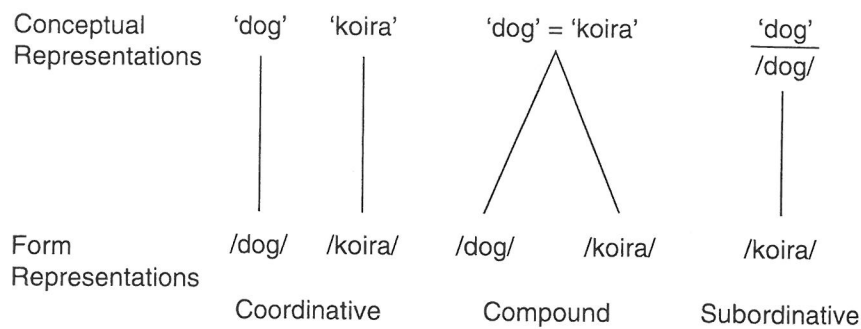


Figure 8.1: Three organizations of vocabulary knowledge in bilingual memory as proposed by Weinreich (1953/1968).

“subordinative” (see Chapter 1, Section 1.6). They are illustrated in Figure 8.1. In bilinguals of the coordinative type a word in L1 and its translation in L2 not only have separate form representations in memory but also separate conceptual representations. In contrast, in compound bilinguals an L1 word and its translation in L2 have separate form representations but share one and the same conceptual representation. Finally, in subordinative bilinguals the form representation of an L2 word does not map directly onto a conceptual representation. Instead, it maps onto the corresponding L1 form representation and exploits the latter’s conceptual representation. In other words, in subordinative bilingualism access from an L2 word to conceptual memory is indirect, proceeding via the form representation of the corresponding L1 word. Weinreich suggested that this type of representation might hold during an early stage of L2 learning and that with increased learning a transition takes place from subordinative to coordinative bilingualism.

Weinreich’s compound and subordinative memory systems are equivalent to the “Concept Mediation Model” and the “Word Association Model” examined by Potter, So, Von Eckardt, and Feldman (1984) in a study that set the stage for many studies on bilingual memory organization in the years that followed. Common illustrations of these two models are shown in Figure 8.2. Instead of showing the concept-mediation and word-association organizations for individual translation pairs (as Weinreich did), in agreement with common convention these two organizations are now shown for the bilingual mental lexicon as a whole. The different sizes of the L1 and L2 form stores reflect the fact that in (unbalanced) bilinguals the L1 vocabulary is usually larger than the L2 vocabulary.

An unfortunate consequence of illustrating the concept-mediation and word-association organizations for the system as a whole is that it can easily lead to the misguided inference that all structures within a bilingual’s mental lexicon are necessarily of one and the same kind. Although few authors explicate whether or not this is the stance they take, such an assumption would be unjust in at least a number of cases. The possibility that different types of structures coexist within a bilingual’s memory was already suggested by Weinreich (1953/1968) and is explicit in some of the more recent work as well (e.g., De Groot, 1993; Dufour & Kroll, 1995).

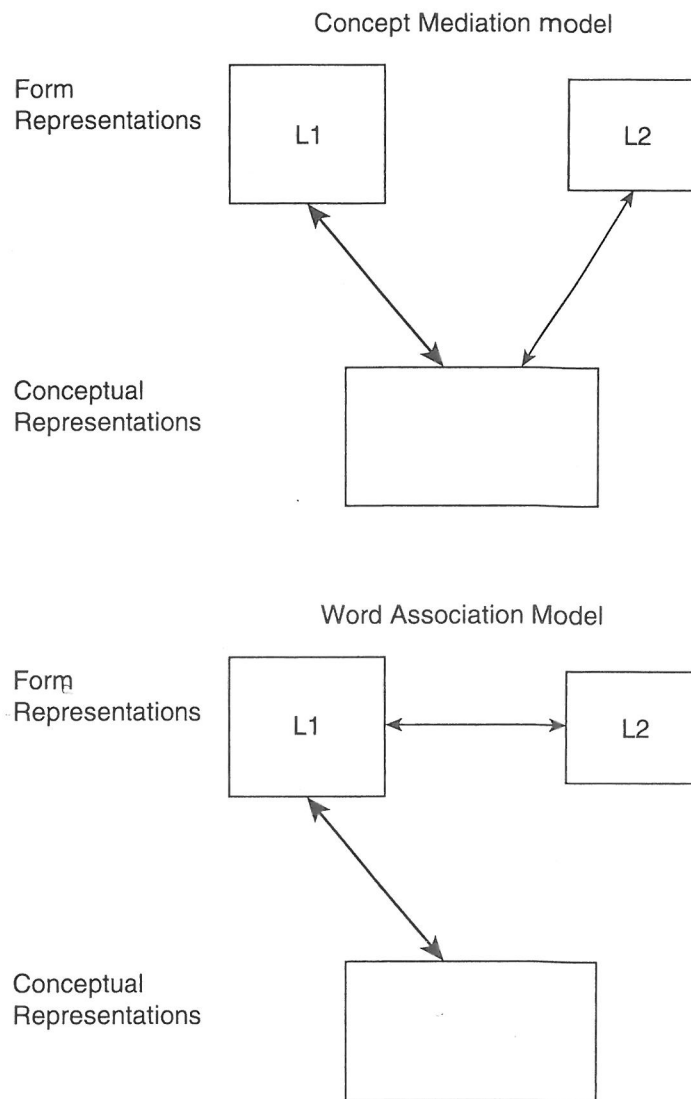


Figure 8.2: The Concept Mediation Model and Word Association Model (Potter *et al.*, 1984).

In their seminal study, Potter *et al.* examined the possibility that the form representations of new L2 words first get directly connected to those of the corresponding L1 words and that “this association is used in understanding and speaking the second language” (p. 23). So, just like Weinreich, they hypothesized that during an early stage of L2 learning the memory structures are of the word-association type (called “subordinative” by Weinreich). They furthermore hypothesized that with increased L2 learning, direct links between the L2 form representations and the conceptual representations (shared between L1 and L2) develop, replacing the word-association connections. In other words, whereas Weinreich assumed a development from word-association structures to coordinative structures, Potter *et al.* hypothesized a development from word-association to compound structures.

They tested this hypothesis by comparing the performance of two groups of L2 speakers on two tasks. One group consisted of L1-Chinese speakers relatively proficient in L2 English. The second group consisted of L1-English speakers with a

relatively poor mastery of L2 French. The critical comparison was between each group's performance on a task that required the participants to translate L1 words into L2 and a second task in which they had to name pictures in L2. On the basis of a careful analysis of the type and number of mental processing steps involved in both tasks – in terms of either the Word Association Model or the Concept Mediation Model – the authors argued that response times should be equally long in both tasks if the Concept Mediation Model held, whereas they should be shorter for translation than for picture naming if the Word Association Model applied. In both groups translating from L1 to L2 and picture naming in L2 took equally long. Based on this finding the authors concluded that concept mediation holds not only for bilinguals with a relatively high level of L2 proficiency but also for less proficient bilinguals. In other words, the direct connections between L2 form representations and the conceptual representations that enable concept mediation already seem to be in place early on during L2 acquisition.

However, a small set of subsequent studies (e.g., Chen & Leung, 1989; Kroll & Curley, 1988) indicated that this conclusion does not apply to L2 speakers with an even lower level of L2 proficiency than the less fluent group in Potter *et al.* (1984). These less fluent L2 speakers showed the data patterns predicted by the Word Association Model. The combined studies thus suggest that increases in L2 fluency are accompanied by changes in the linkage patterns between the form and conceptual representations in the bilingual mental lexicon. The time it takes for these changes to take place is likely to be a function of frequency of word use: The more often an L2 word will be used, the sooner a direct link between its form and conceptual representation will be in place. This claim implies that within a bilingual's memory, different types of structures may coexist: At a given stage of L2 fluency a bilingual has developed more direct connections between the form representations of frequently used L2 words and the corresponding conceptual representations than between the form representations of infrequently used L2 words and their conceptual representations (De Groot, 1993). In other words, at this stage of L2 learning concept-mediation and word-association processing will take place for relatively many frequent and infrequent L2 words, respectively.

The "Revised Hierarchical Model" (e.g., Kroll, 1993; Kroll & Stewart, 1994) integrates these views on the development of bilingual memory representations into a single model that combines the Word Association and Concept Mediation Models and extends the integrated model with some new features. The model, as shown in Figure 8.3, assumes both direct links between the form representations of a translation pair (as in the Word Association Model) as well as direct connections between each of the form representations and a shared conceptual representation (as in the Concept Mediation Model). The extension of this combined model concerns two modifications: Two unidirectional instead of one bidirectional link between the L1 and L2 form representations are hypothesized, and the various connections are assumed to differ in strength. Specifically, the direct link from the L2 form representation to the L1 form representation is stronger than the one in the reverse direction, and the direct link between the L1 form representation and the shared

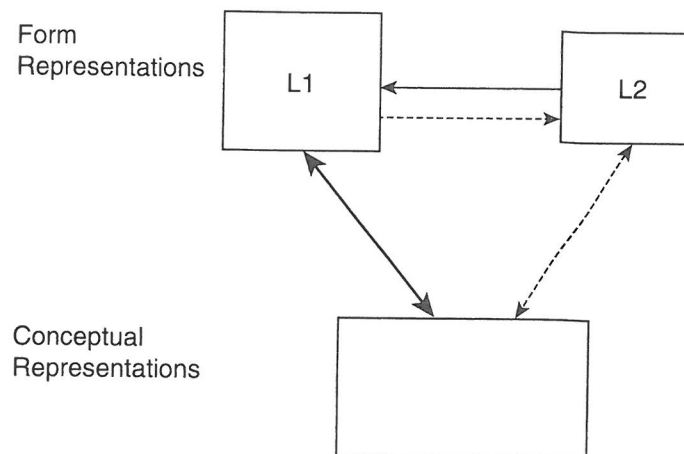


Figure 8.3: The Revised Hierarchical Model (Kroll & Stewart, 1994).

conceptual representation is stronger than the direct link from the L2 form representation to this shared representation. Note that in Figure 8.3 solid and dashed lines represent strong and weak links, respectively.

An important reason for developing this model was the authors' observation that translating L1 words into L2 often takes longer than translating L2 words into L1. After excluding the possibility that this translation asymmetry results from a difference between L1 and L2 words in pronunciation difficulty, they hypothesized that it reflects the use of two different translation routes: L2 to L1 translation comes about by tracing the strong direct connection between the L2 and L1 form representations whereas L1 to L2 translation uses the indirect route from the L1 form representation, via the shared conceptual representation, to the corresponding L2 form representation. The latter route takes more time to complete because it is the longer of the two. As suggested by the authors, a reason why the direct link from the L2 form representation to the L1 form representation is relatively strong may be that "second language words are frequently taught by associating them to first language words [. . .] but not vice versa" (Kroll, 1993, p. 70). With increasing L2 use, the direct connections between the L2 form representations and the common conceptual representations gradually become stronger so that ultimately they are strong enough to enable direct access to the conceptual representations from the L2 form representations (in comprehension) and direct retrieval of the L2 form representations following the activation of a conceptual representation (in production). The consequence of these developmental changes is that the above translation asymmetry should only hold for the earlier stages of L2 acquisition.

The Revised Hierarchical Model is supported by various sets of data (e.g., Kroll & Stewart, 1994; Sholl, Sankaranarayanan, & Kroll, 1995). For instance, Kroll and Stewart replicated the above translation asymmetry but provided another source of evidence as well: Clustering the words to be translated into semantic categories (e.g., clothing, body parts, musical instruments) as opposed to presenting them in random order slowed down L1-to-L2 translation but not L2-to-L1 translation. This effect

presumably results from fierce competition between the conceptual representations of semantically related words caused by semantic clustering. The fact that the effect only occurred in L1-to-L2 translation thus suggests the involvement of conceptual representations in L1-to-L2 translation but not in L2-to-L1 translation.

But counterevidence has also been gathered, such as the finding that the predicted difference in translation time for the two translation directions does not always materialize. This finding is unproblematic for the model if the participants in the pertinent studies are equally proficient in both languages. In fact, equally long translation times for both translation directions are expected under those circumstances. It *is* problematic, however, in cases where the participants' L2 is clearly much weaker than their L1. Similarly, the opposite pattern of *shorter* L1-to-L2 translation times, even in bilinguals nonfluent in L2, cannot be accounted for in terms of the model. Yet both these findings have been obtained (De Groot & Poot, 1997; La Heij, Hooglander, Kerling, & Van der Velden, 1996). Obviously then, the model requires revision (see Brysbaert & Duyck, 2010, and Kroll, Van Hell, Tokowicz, & Green, 2010, for discussions).

Excepting Weinreich's coordinative model, an unrealistic suggestion of the models of the bilingual mental lexicon presented so far is that the L1 and L2 terms of a translation pair are implicitly assumed to have exactly the same meaning. Contrary to this suggestion, it is well known that complete meaning equivalence of a pair of translations rarely exists. Instead, in addition to the shared meaning aspects, each member of a translation pair typically has meaning aspects specific to the language it belongs to. Furthermore, different types of words (e.g., concrete vs. abstract words; cognates vs. noncognates) may differ in the amount of meaning they share with their translations. Further noteworthy characteristics of word meanings are that they are not static but change over time and differ between individuals (Pavlenko, 1999). The Distributed Conceptual Feature Model (De Groot, 1992, 1993; Van Hell & De Groot, 1998) explicitly acknowledges that a pair of translations may not share meaning completely and that the degree of meaning nonequivalence may vary across word types (see Figure 8.4). This model does not represent a word's meaning in a single memory unit (models that do so are called "localist" models) but assumes "distributed" representations, where the word's meaning is spread out over a number of more elementary conceptual units. The two terms in a translation pair may share many or fewer of these conceptual units between them. This idea is illustrated in the figure, which shows the fictitious memory structure for a pair of translations that share all conceptual elements and another structure for a pair that shares fewer, while each member of the pair contains language-specific conceptual elements as well.

The Distributed Conceptual Feature Model is supported by the fact that the response patterns to different types of words (e.g., concrete vs. abstract words; cognates vs. noncognates) systematically differ in various bilingual research paradigms, such as word translation, between-language semantic priming, and bilingual word association (see De Groot, 1992; Van Hell & De Groot, 1998 for reviews). In particular, the results obtained by means of the bilingual word-association

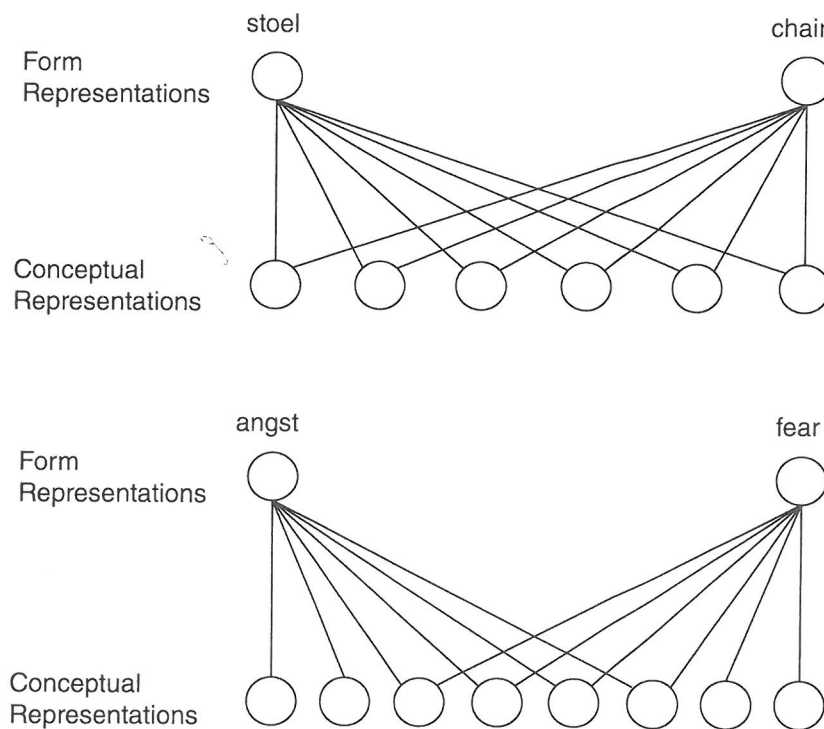


Figure 8.4: The Distributed Conceptual Feature Model (De Groot, 1992).

paradigm strongly support the model, because it is known that the generation of word associations generally exploits the words' conceptual representations (not the form representations) in memory. The bilingual participants in these studies (e.g., Van Hell & De Groot, 1998) are presented with a series of words and have to give a single word association to each of them. In a within-language condition, the responses must be in the language of the presented words; in a between-language condition, the responses must be in the other language. The critical dependent variable is the response equivalence of the responses to one and the same word in the within- and between-language conditions. If, for instance, a Dutch-English participant is shown the word "skirt" and responds with "dress" in the within-language English condition and with "jurk" in the between-language condition, this counts as an equivalent response ("jurk" is Dutch for *dress*). If, instead, he responds with "dress" in the within-language English condition but with "vrouw" (*woman*) in the between-language condition, this counts as a nonequivalent response. The crucial finding is that the responses in the within- and between-language conditions are more often equivalent for concrete words and cognates than for abstract words and noncognates, respectively. This finding suggests that the conceptual representations of concrete and cognate translation pairs share more conceptual units in bilingual memory than those of abstract and noncognate translation pairs. By implication, this indicates that full meaning equivalence does not hold for all translation pairs (and, in fact, it may never hold).

More recent models similarly acknowledge that translation pairs generally do not share meaning completely. One of these, the Shared Distributed Asymmetrical

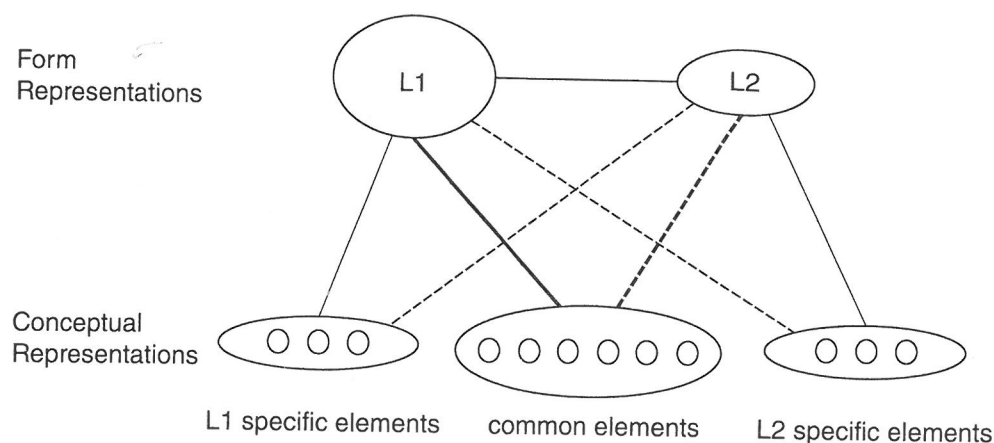


Figure 8.5: The Shared Distributed Asymmetrical Model. (Based on Dong *et al.*, 2005, with permission from Cambridge University Press.)

Model (Dong, Gui, & MacWhinney, 2005) incorporates the assumptions of the Distributed Conceptual Feature Model that (1) the representation of word meaning is distributed over a set of elementary conceptual units, (2) the two members of a translation pair minimally share a subset of these units, and (3) each member of a translation pair is associated with a number of language-specific conceptual units as well (see Figure 8.5). To this set of assumptions the authors add a fourth: The connections between the L2 form representations and the conceptual representations are assumed to be weaker than the connections between the L1 form representations and the conceptual representations (cf. the Revised Hierarchical Model). During the advancement of L2 learning these strength differences will gradually become smaller. A fifth assumption of the model is that during the early stages of L2 learning the L2 form representations are not only connected to the conceptual units they share with L1, but also to the L1-specific conceptual units and that with increasing levels of L2 proficiency the latter type of connections gradually weaken (while the links between L2 form representations and L2-specific conceptual units gradually strengthen). Figure 8.5 illustrates these assumptions for one level of L2 proficiency (so it ignores the model's developmental assumptions).

Dong *et al.* (2005) obtained support for the latter characteristics of the model in an experiment wherein Chinese learners of L2 English produced semantic-similarity ratings to word sets. Four groups of L2 learners were tested, two consisting of first-year English majors, the remaining two of third-year English majors. One of the two groups at each of these levels of English rated sets of English words; the second rated the closest Chinese translations of the words in the English sets. In addition, groups of English and Chinese monolinguals (one of each) performed the task on the English sets and the Chinese sets, respectively. Each word set consisted of a "head word" and seven words that were all semantically related to the head word but in different ways and to different degrees. The participants were asked to rank the closeness of the head word to each of the other words in the set. Similarity analyses

were then performed between the ratings of all six groups of participants. These analyses showed, first, that the ratings of the two monolingual groups differed significantly from one another, thus substantiating the present general claim that translation equivalents do not share meaning completely. Secondly, the L2 English learners' ratings on the English sets deviated from those of the English monolinguals and the more advanced learners produced ratings that were closer to those of the English monolinguals than the less advanced learners. These findings suggest that the learners' L2 gradually becomes more native-like. In terms of the model, they suggest the gradual weakening of the links between the L2 form representations and the L1-specific conceptual units. Thirdly, the ratings that the L2 English learners produced on the L1 Chinese sets deviated from the corresponding ratings of the Chinese monolinguals on these sets, and the deviance was relatively large for the more advanced learners. This finding supports the model's assumption that during L2 learning connections between the L1 form representations and the L2-specific conceptual units are formed.

A final model to present here is Pavlenko's (2009) Modified Hierarchical Model. Like the Shared Distributed Asymmetrical Model and the Distributed Conceptual Feature Model it assumes that conceptual representations do not have to be fully shared between a bilingual's two languages but may be partially shared as well. This implies distributed instead of unitary, localist conceptual representations. But a unique feature of this new model is that it explicitly posits the existence of conceptual representations that are *completely* language specific, thus acknowledging that not all words in one of the bilingual's languages can be translated by means of a single word in the other language (but require a circumlocution instead). Another way of saying this is that these words are not "lexicalized" in the other language. Examples of such words are *frustration* and *privacy*, which have no equivalent in Russian (Pavlenko's examples).

A further central feature of Pavlenko's (2009) model is that it tries to account for the phenomenon of "conceptual transfer," where the complete conceptual content associated with an L1 word is assigned to ("transferred to") a translation "equivalent" word in L2, including meaning aspects not typically associated with the L2 word. For instance, an L1 English speaker of L2 Russian may call a cup-shaped drinking container made of paper and without a handle a *chaska* despite the fact that this Russian word for cup never refers to containers of this type (in Russian, paper cups without a handle are named with the Russian word for little glasses: *stakanchiki*). This naming flaw suggests that this learner has transferred the complete concept of English *cup* to Russian *chaska*, including *cup*'s L1-specific conceptual elements (e.g., the fact that cups can be made of paper and do not necessarily have handles). Notice that this idea rephrases the assumption in Dong *et al.*'s (2005) model above, that L1-specific meaning units are linked to L2 word forms. L2 learning involves chipping off the L1-specific parts of the L2 conceptual representations (and adding the L2-specific parts). This process of redefining L2 *chaska* implicates the redefinition of other words as well (in this case, of *stakanchiki*). In other words, learning the exact reference of a word requires "conceptual restructuring" in the L2

lexicon. A third main feature of Pavlenko's model is that it implements the idea that a main goal of L2 vocabulary learning is conceptual restructuring such that the L2 conceptual representations will ultimately be as native-like as possible.

To summarize, the various models of the bilingual mental lexicon presented in this section differ from one another in the type of conceptual representations that they assume, unitary or distributed. A correlated difference between the models is whether or not they assume the presence of language-specific elements in the conceptual representations. In addition, they differ in the way the form and conceptual representations are connected. Finally, some of the models explicate how the conceptual representations and the links between the form and conceptual representations change when a bilingual gradually becomes more fluent in the L2 whereas others do not say anything about this.

8.2 Bilingual Concepts

We have just seen that the two terms in a translation pair may not refer to exactly the same set of things (the *cup-chaska* example). Another way of saying this is that the concepts associated with a pair of word translations differ from one another. (Recall that from here on we will no longer talk about "conceptual representations" but about "concepts.") This does not only hold for concrete words like *cup*, but even more so for abstract words (Van Hell & De Groot, 1998; see also Section 8.1). We have also seen that not all words have a close lexical equivalent in the other language at all because this language may lack the associated concepts altogether. These facts about cross-language conceptual nonequivalence raise the question of what information bilinguals' concepts contain exactly. This question has been examined both for late bilinguals, who started to learn an L2 when the L1 was already (largely) in place, and for simultaneous bilinguals, exposed to two languages from birth or soon after. In these studies the bilinguals' L2 concepts were compared with the corresponding concepts of monolingual native speakers of that language and/or with the corresponding L1 concepts in these very same bilinguals.

Major questions posed in these studies are whether or not an L2 speaker will ever attain native-like L2 concepts and, if not, what causes the L2 concepts to remain nonnative-like. One possible reason is that during L2 learning, the meaning associated with an L2 word's closest translation equivalent in L1 is transferred completely to the L2 word, a process called "conceptual transfer" in Section 8.1 (e.g., Pavlenko, 2009, where the meaning of L1 English *cup* was transferred to L2 Russian *chaska*). The consequence of this process is that bilinguals' L2 word use exhibits a "semantic accent": A particular L2 word might be used where a native speaker would not use it and, conversely, the word might not be used where a native speaker *would* use it. While conceptual transfer from L1 would lead to nonnative-like L2 word use, bilinguals' L1 word use should remain native-like, indistinguishable from word use in monolingual speakers of this language. Nonnative-like concepts may also result from a process during which the L1 and L2 concepts are merged into one concept

that is used for both languages (e.g., Pavlenko, 2005). Because this one concept contains both L1- and L2-specific meaning nuances, bilinguals' word use in *both* L1 and L2 will be semantically accented. These issues have been examined for various types of concepts, including object concepts, color concepts, and the concepts of time, space, and motion. Due to space limits I will confine my discussion to object concepts (see Pavlenko, 2005, for a more complete discussion).

8.2.1 Object concepts and word naming

The term "object concepts" refers to the concepts associated with common artifacts such as combs, keys, and cups. In one of the studies examining these concepts (Malt & Sloman, 2003), three groups of L2 speakers of American English were tested. The groups differed between them with respect to the number of years they had been immersed in an American English language environment (from 2.3 years to 13.5 years on average for the least experienced and most experienced group, respectively). The participants were asked to give the English names for 60 photographed containers (the "bottles set") and for 60 photographed household objects for preparing and serving food (the "dishes set"). An earlier study had shown that native speakers of American English most commonly used the words *bottle*, *jar*, or *container* to describe the objects in the bottles set and *dish*, *plate*, or *bowl* to describe those in the dishes set. Following the naming session, the participants were asked to judge each object's typicality as an instance of these subclasses. They were, for instance, first presented with a photograph from the bottles set together with the word *bottle* and had to indicate the typicality of the depicted object as a bottle on a scale ranging from 0 (not a member of the bottle subclass) to 7 (very typical of the bottle subclass). Next, they were presented with the same photograph again, now with the word *jar*, and had to indicate the object's degree of "jarness," again on a 7-point scale. Finally, the same photograph was presented with the word *container* and the subjects rated how typical a container the object was. An earlier set of data obtained from American native speakers of English was used for comparison with the L2 speakers' data.

Following data gathering the researchers calculated the overlap between the native speakers' naming scores and the naming scores of each group of L2 speakers. In addition, they correlated the typicality judgments provided by the native speakers with those given by the groups of L2 speakers. The naming- and typicality-judgment patterns observed for the least experienced L2 speakers differed substantially from the native speakers' patterns. The analyses furthermore showed that the response patterns of the L2 speakers were more native-like the larger their L2 experience. But interestingly, even in the most experienced L2 speakers, deviations from the native speakers' response patterns remained. These findings indicate that L2 concepts differ from the corresponding concepts in native speakers and that this still holds after a long period of immersion in the L2 environment. Because the participants

did not perform the tasks in their L1, it is impossible to tell whether their L1 might have developed an accent as a result of acquiring an L2.

A similar study (Ameel, Storms, Malt, & Sloman, 2005) tested balanced simultaneous bilinguals instead of late L2 speakers. The participants had all grown up with two languages, Dutch and French, from birth. The materials and procedure were largely similar to those used by Malt and Sloman (2003), except that the participants now named the objects twice, once in each language. Their naming performance in both language conditions was compared to the performance of Dutch and French monolingual control groups. Whereas the monolingual control groups showed language-specific naming patterns, the French and Dutch naming patterns of the bilinguals converged toward a common pattern, suggesting merged concepts. The authors concluded that "through the mutual influence of the two languages, the category boundaries in each language move toward one another and hence diverge from the boundaries used by the native speakers of either language" (Ameel *et al.*, 2005, p. 60).

The likely source of these cross-language differences between object concepts is a rather trivial one: For no other reason than mere habit, native speakers of a particular language refer to this specific object by this specific name and this habitual naming pattern just happens to differ between languages. If a particular object is usually called *bottle* by speakers of English whereas speakers of Dutch most often call it *flacon* (which is closer to English *flask*), the *bottle* concept in native speakers of English will come to differ, however slightly, from the *fles* concept in Dutch native speakers (*fles* is the closest Dutch translation equivalent of *bottle*). Grammatical differences between languages constitute a further, more interesting, source of cross-language differences between object concepts. One of these concerns a difference between languages in their use of grammatical gender. A second is a difference in the way they mark grammatical number.

8.2.2 Grammatical gender and object concepts

"Grammatical gender" refers to a grammatical distinction that marks common nouns as "masculine," "feminine," and "neuter." Contrary to the suggestion conveyed by these adjectives, in many languages that exploit grammatical gender the relation between grammatical and biological gender is largely arbitrary. This follows clearly from the fact that the word for one and the same object may be feminine in one language and masculine in another (and neuter in a third). For instance, the word for a key is masculine in German (*der Schlüssel*, where *der* indicates grammatical masculinity) but feminine in Spanish (*la llave*, where *la* indicates grammatical femininity). Of course, it also follows from the fact that inanimate objects such as keys are, by their very nature, all sexless.

Boroditsky, Schmidt, and Phillips (2003) wondered whether talking about inanimate objects such as keys as if they were masculine or feminine might mislead

people into thinking that inanimate objects have a gender. If so, in the process of acquiring the associated concepts, native-language learners may look for specific object properties that match the object name's gender. For example, for an L1 German learner the hardness of the key's material may be especially noticeable (hardness having a masculine connotation), while an L1 Spanish learner may notice the key's smallness (a feminine connotation). The properties noticed this way will likely be included in the developing concept while those that go unnoticed will not be included. In other words, if two languages denote a particular inanimate object by different grammatical genders, the associated concepts will differ between the languages (e.g., hardness and smallness will be included in the L1 German and L1 Spanish concepts of a key, respectively). If comparisons of monolingual speakers of such languages would show this to be the case, a next question is what information is contained in an L2 speaker's concepts for common nouns to which the L2 does not assign gender while this L2 speaker's L1 does do so.

To answer this question, Boroditsky *et al.* (2003) examined the L2 English concepts for inanimate objects in German-English and Spanish-English bilinguals. The participants, all highly proficient in L2 English, were presented with a set of English common nouns and were asked to name for each of them, in English, the first three adjectives that came to mind. All nouns referred to inanimate objects and their translations in German and Spanish had opposite genders (but they were all non-gendered in English; after all, English does not use gender marking on nouns). The question of interest was whether the grammatical gender of the objects' names in L1 influenced adjective naming in non-gendered L2 English: Would English object names with a feminine translation equivalent in L1 evoke relatively many adjectives with a feminine connotation whereas those with a masculine L1 translation equivalent would evoke relatively many with a masculine connotation? The data showed this to be the case. For example, to English *key* (with a masculine translation in German and a feminine translation in Spanish), the L2 speakers with German as L1 produced, among others, *hard*, *heavy*, and *metal*, while the L2 speakers with Spanish as L1 generated the adjectives *little*, *lovely*, and *shiny*. These findings suggest that (1) the grammatical gender system of L1 influences the content of the L1 object concepts, and that (2) conceptual transfer occurs from L1 to L2.

Whereas Boroditsky *et al.* looked at the effect of a gendered L1 (German or Spanish) on the content of object concepts in a non-gendered L2 (English), in an Italian-German study Bassetti (2007) examined the consequences for the content of bilingual concepts of mastering two languages that both exploit grammatical gender but that assign opposite genders to particular object nouns. While the participants in Boroditsky *et al.*'s study were adult late bilinguals, Bassetti tested balanced-bilingual 9-year-olds that had either been exposed to both Italian and German from birth or exclusively to Italian at first but subsequently (before age 4) also to German. In addition, a group of monolingual Italian 9-year-olds was included for comparison. The experimental materials were drawings of familiar objects. Half of these had masculine names in Italian and feminine names in

German whereas for the other half the opposite held. An experimental procedure suitable for 9-year-olds was developed: The participants saw the object while hearing a sentence spoken by a male and then saw the object a second time accompanied by the same sentence but now spoken by a female, or vice versa. The participants were asked to imagine the object could talk and to choose the voice that belonged to the object, male or female. All testing was done in Italian. The results showed that the Italian monolingual children tended to attribute sex to the objects consistent with the grammatical gender of the objects' Italian names. This tendency was considerably weaker in the bilingual children, and detailed analyses indicated that their responses were influenced by the objects' German names. Apparently, the contrasting grammatical gender of the objects' names in Italian and German had given rise to object concepts that differ from the corresponding concepts in monolingual children.

8.2.3 Grammatical number and object concepts

A second grammatical difference between languages that appears to influence the content of object concepts concerns the way languages mark grammatical number. In English and many other languages, both nouns that refer to living beings ("animate" nouns) and nouns referring to inanimate objects take an obligatory plural marker when more than one of their referents is implied (e.g., *three dogs*, *two bottles*). In contrast, nouns that have an inanimate, non-countable referent ("mass nouns") cannot take a plural marker and require some unit of measurement (a "unitizer") to be quantified (*two bags of flour*). In other languages, for instance in Japanese, nouns referring to inanimate objects cannot take a plural marker and, just like English mass nouns, are quantified by means of a unitizer. In other words, these languages talk about inanimate objects as if they were substances (Boroditsky, 2003). In these languages plural marking of animate nouns is optional rather than obligatory.

To acquire the grammatical-number system of the ambient language, learners of different languages must attend to different aspects of the living beings, things, and substances that surround them. On the assumption that what is attended to will become part of the developing concepts, the consequence of language-dependent attention allocation is that the ensuing concepts will differ between speakers of different languages. If so, the question of present interest is what information is contained by the analogous concepts of bilinguals whose two languages have different number systems. Athanasopoulos and Kasai (2008) examined this question in a Japanese-English study in which they compared object categorization by intermediate and advanced Japanese learners of L2 English with that by Japanese and English monolinguals. Adopting a theoretical analysis by Lucy and Gaskins (2001), Athanasopoulos and Kasai hypothesized that a focus on the shape of a noun's referent in particular is conducive to developing the English grammatical-number system (because shape is a marker of individuation, and individuation is required

for using plural marking properly), while this strategy is not particularly suitable for learning the Japanese system (see the original studies for details). If learners of English indeed rely strongly on the referent's shape, with a growth in L2 English, shape should become a more prominent feature in the object concepts of Japanese L1 speakers who are learning L2 English.

On each trial, the participants in Athanasopoulos and Kasai (2008) were presented with a picture that showed three artificial objects (drawings of irregular shapes), one object being the target, the other two the "alternates." One of the alternates was identical to the target in shape but printed in a different color; the second was identical to the target in color but had a different shape. The participants were asked to indicate which of the two alternates they thought was "the same as" the target. The advanced Japanese learners of L2 English behaved like the English monolinguals, selecting the shape match in the vast majority of cases (about 90% of the time). In contrast, the intermediate Japanese learners of L2 English behaved like the Japanese monolinguals, selecting the shape match less often than the other two groups (about 65% of the time). In other words, the advanced Japanese learners of L2 English, but not yet the intermediate ones, had learned to categorize objects the way English monolinguals do, namely, predominantly on the basis of shape. This difference in categorization behavior between the two groups of L2 English learners confirmed the hypothesis that, with a growth in L2 English, shape had become a more prominent feature in the learners' object concepts.

To summarize, the studies by Boroditsky *et al.* (2003) and Malt and Sloman (2003) suggest that late L2 speakers transfer L1 object concepts to the L2 with the effect that L2 speakers exhibit a semantic accent when speaking about the concerned objects in L2. In contrast, the study by Athanasopoulos and Kasai (2008) indicates that with extensive L2 use the L2 object concepts of late L2 speakers can become native-like, suggesting that cognitive restructuring has taken place. Furthermore, the studies that tested simultaneous bilinguals (Ameel *et al.*, 2005; Bassetti, 2007) indicate that bilinguals of this type develop object concepts that merge the concepts specific to their two languages. The result of this process of merging is that the object concepts in these bilinguals, in both languages, differ from the corresponding native speakers' concepts. The joint results of the above studies also indicate that both arbitrary naming conventions and systematic grammatical differences between languages influence concept formation and that the grammatical cross-language differences in question exert their effect on concept formation by having language learners allocate their attention to specific aspects of the environment.

8.3 Bilingual Autobiographical Memory

So far we discussed one type of declarative knowledge, namely, semantic knowledge. Recall that this concerns general knowledge such as knowing what the word *cup* means and that Maxima Zorreguieta is the wife of Prince Willem Alexander. In the previous sections we have dealt with the former of these two types of general semantic

knowledge, that is, vocabulary knowledge, focusing on the special case of the bilingual who knows two sets of words.

As mentioned in the introduction, a second type of declarative knowledge is “episodic” knowledge. This concerns personal memories of events that happened to us in our past lives. These episodic memories typically contain information on the time the event took place, where it took place, and perceptual details of the event. Because such memories are autobiographical records of our own experiences they are called “autobiographical memories” as well. The study of autobiographical memory tries to answer such questions as:

- (1) What types of encoding processes are going on when a person experiences some event?
- (2) Which aspects of the event get stored in the memory trace of this event?
- (3) How can this memory trace be accessed and the information on it retrieved when we try to recall the event at some later moment in time?

Tulving and Thompson (1973) posited an influential theory that addressed these questions. A central component of the theory is the Encoding Specificity Principle (ESP). It states that an event can only be recalled successfully if the information contained by the retrieval cue (the prompt that is presented to trigger recall of the event) is actually encoded in the memory trace of that event. If it is not, retrieval fails. If ESP is correct, the content of memory traces can be charted by varying the type of retrieval cues presented to the participants in memory experiments and seeing which ones are effective and which ones are not. Using this procedure it has, for instance, been discovered that information about the physical environment in which an event took place and the mood of the person experiencing the event are encoded in the event’s memory trace (e.g., Godden & Baddeley, 1975).

If language is involved in an event, this aspect of the event might also be imprinted in the memory trace. If so, bilinguals’ autobiographical memory may contain a subset of memories with their one language encoded onto them and a subset with their other language imprinted on them (in addition to memories with both languages encoded on them, plausibly resulting from events that involved frequent language switching). ESP then predicts that in cuing autobiographical memories in bilinguals by means of words, different memories will pop up depending on the language of the cues. A specific prediction regarding immigrant late bilinguals is that when a word from their L1 serves as the retrieval cue, relatively many memories from the remote past will be retrieved because during their younger years this was the only language they experienced and, thus, the only language to become imprinted in the memory traces.

Several researchers have tested these ideas and the collective data suggest that language is indeed encoded in the memory trace of an event and that immigrant late bilinguals’ two languages trigger memories from different life periods. The participants in one of the relevant studies (Schrauf & Rubin, 2000) were older L1 Spanish/L2 English bilinguals who had immigrated to the United States around the

age of 28 and had lived there for 38 years on average. The researchers used a common word-prompt technique, in an English session and then in a Spanish session (or vice versa) that were held on two separate days. In each language session the participant was first given a set of prompt words in the language of that session and was asked to come up with a specific event from his personal past for each of them and to write a few words about that memory in the language of that session. Immediately after completing the description of the event, the participant was asked to determine whether the memory had seemed to come in no language, in Spanish, in English, or in both languages. With this procedure the researchers could, among other things, distinguish between "congruent" and "crossover" memories. A congruent memory was defined as one that had come to the participant in the same language as the prompt word (that is, in the language of the session) whereas in a crossover memory the language of the prompt word and that of the memory differed from one another. In addition, the participants were asked to date their memories, that is, to indicate what age they were when they experienced the event. A similar earlier study by these same researchers (Schrauf & Rubin, 1998) used a somewhat different procedure in which only the occurrence of crossover memories was determined.

In the vast majority of cases (about 80%) the participants in Schrauf and Rubin (2000) indicated that the memory had come to them in one or more languages. This finding per se supports the idea that language is encoded in the memory trace of an event. But of particular interest was the finding that in both studies the crossover memories that were recalled internally in Spanish dated back to events that happened earlier in life (on average 30 and 27 years in the 1998 and 2000 studies, respectively) than those recalled in English (47 and 53 years, respectively). The same held for the congruent memories in the 2000 study: The average age at which the remembered event occurred was 29 years for congruent Spanish memories and 48 years for congruent English memories. Both these findings confirm the hypothesis that language is encoded in the memory trace of an event.

Schrauf and Rubin (1998) had also predicted that Spanish and English prompts would trigger relatively many older and more recent memories, respectively (specifically, from before and after the age at immigration, respectively). This hypothesis was not confirmed: The mean age of the participants at the time of the recalled event was around 40 for both English and Spanish prompts. Marian and Neisser (2000) suggested this result may have been due to the fact that the participants in Schrauf and Rubin's (1998) study were relatively old and had lived in the United States the larger part of their lives, possibly using *both* languages frequently after immigration. Because of the large number of post-immigration years at the moment of testing, not only events from the pre-immigration period will then have been encoded in L1 Spanish, but also relatively many post-immigration events. This may be the reason why Spanish prompts did not trigger relatively more Spanish memories from early in life.

To circumvent this problem, in an L1-Russian/L2-English study, Marian and Neisser (2000) used a slightly different methodology and tested subjects with a

lower chronological and immigration age (on average 22 and 14 years, respectively). After collecting two sets of memories by means of the usual word-prompt procedure, one set in an all-Russian interview and a second in an all-English interview, the subjects were asked to indicate “the language they had spoken, had been spoken to in, or were surrounded by, at the time when each recalled event took place and to estimate their age at the time” (Marian & Neisser, 2000, p. 364). The participants reported more “Russian memories” (i.e., memories of events in which the language used at the time was Russian) when prompted with Russian words (in the Russian interview) while they reported more English memories when prompted with English words (in the English interview). Importantly, in the Russian interview more memories from an earlier age were reported (13 years on average) than in the English interview (16 years on average).

In conclusion, the joint findings of the above studies confirm the hypotheses that language is encoded in the memory trace of an event, that bilinguals’ autobiographical memory therefore contains a subset of memories with their one language encoded into them and a second set that encodes their other language, and that immigrant late bilinguals’ two languages trigger memories from different life periods.

Research Questions

1. According to the Revised Hierarchical Model, L1-to-L2 word translation is slower than L2-to-L1 translation because the two translation directions use different translation routes. Try to think of other reasons why L1-to-L2 translation is relatively slow.
2. The conceptual representations of an abstract word and its closest translation in another language generally differ more than the conceptual representations of a concrete pair of translations. Try to think of a reason why this is the case.
3. Bilinguals often report that speaking two languages is accompanied by the feeling of living in two different worlds. How can the studies on bilingual autobiographical memory account for this phenomenon?

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