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Language and cognition in bilinguals

Annette M. B. de Groot

A couple of years ago Benedetta Bassetti and I accepted an invitation from the *American Journal of Psychology* to review each other's books: *Language and Bilingual Cognition* (Cook and Bassetti 2011) and *Language and Cognition in Bilinguals and Multilinguals* (De Groot 2011). Given the close resemblance of the two titles, the book review editor of the journal had naturally assumed that these volumes cover the same content and thought that a cross-review of both by the respective authors might be particularly informative for the journal's readership, revealing both the established knowledge and the controversies in their common subject of enquiry. Initially I similarly assumed a largely overlapping content, but while carrying out my part of the commitment I soon noticed that the two volumes clearly complement one another, their titles emphasizing different senses of the component words. To avoid a similar misunderstanding in the readers of this chapter and to put them on track right away, I will start out demarcating and organizing the field of research covered by its title, by explaining a few of the field's key terms and sketching the various lines of enquiry it comprises and the monolingual work it is grounded on. The remainder of this chapter will centre, from various angles, on lexical concepts, because these appear to constitute a clear interface between language and cognition and, as such, provide a link between the field's diverse sub-areas of study.

12.1 Demarcating and organizing the field

Although the meanings of *language* and *cognition* are usually taken for granted, like most other words they cover different senses. On the one hand, *language* refers to the language system, the structural characteristics of its components and their inter-relations. On the other hand it refers to language use, that is, to verbal behaviour in its various forms

(e.g. reading and speaking) and the mental processes and knowledge structures involved in such behaviour. It is harder to describe the coverage of *cognition* in a few broad strokes. I just searched the first pages of a dozen textbooks on cognitive psychology or cognitive science for a common definition of cognition. Most of them start out with a concise characterization of their subject, such as the statement that cognitive psychology 'concerns itself with the science of mental life' (Kellogg 1995, p. 3) or that it 'concerns itself with the structure and functions of the mind' (Hampson and Morris 1996, p. 1), but in the paragraphs to follow it soon becomes clear that these crisp descriptions cover numerous areas of study and that it is obscure where cognitive psychology ends and other areas of psychological science start, or where the demarcation between cognition and language lies. Eysenck and Kean (1995, p. 1) state that cognitive psychology 'deals with a bewildering diversity of phenomena ... thus, it is concerned with topics like perception, learning, memory, language, emotion, concept formation, and thinking'. It is particularly noteworthy that *language* is among this list, indicating that language is not separate from cognition but one of its ingredients. This is presumably why a distinction is often made between verbal cognition (language) and non-verbal cognition, though, as clarified below, even this distinction is a fuzzy one.

Like the meanings of *language* and *cognition*, we usually assume the meaning of *bilingualism* to be self-evident, the term referring to an individual's ability (and actual practice) of communicating in two languages and to the linguistic knowledge base that enables this ability (notice that I use the term to refer to *individual* bilingualism, not a community's bilingualism). At the same time we realize that this description is seriously wanting, if only because it does not specify whether a particular minimal degree of expertise in both languages is required for a certain individual to be called bilingual (instead of an L2 learner). Furthermore, there are multiple routes towards this ability of using two languages (cf. simultaneous, early sequential, and late sequential bilingualism, or L2 learning in a natural environment or at school). The route taken and the degree of expertise in both languages may impact on the depth of knowledge of the two languages, the way this knowledge is stored in memory, and the nature of bilinguals' linguistic expressions. In other words, *bilingualism* is an umbrella term that covers much heterogeneity in both language representation and language use. Still, the available evidence suggests that one phenomenon is true of all bilinguals, including L2 learners: cross-talk between the two language subsystems is common, so that using either language is influenced by the other and the linguistic expressions of bilinguals will typically differ from the corresponding expressions of monolinguals. This is the main tenet in much of François Grosjean's influential work (e.g. Grosjean 1989, 'Neurolinguists beware! the bilingual is not two monolinguals in one person') and, indeed, it is the core of the multi-competence idea as

conceived initially (e.g. Cook 2003), before it was extended to its much broader current coverage.

The collected research covered by the title of this chapter examines the effects of bilingualism on verbal and non-verbal cognition. One main line of study has its roots in cross-language research on *linguistic relativity*, the idea that the specific way in which a language system has encoded aspects of the environment affects the thought of its speakers, with the effect that speakers of different languages think differently. The bilingual research that builds on this work addresses the question of how linguistic relativity plays out in bilinguals, whose two languages may contain different structural solutions for representing the surrounding world. That is, it deals with the question of how the opposing features of the two language systems of bilinguals affect their *non-verbal* cognition. A second main research line in the study of bilingual cognition centres on *verbal* cognition, specifically, on how mastering two languages affects language use, the mental processing it involves and the knowledge structures it exploits, and on how the linguistic expressions of bilinguals compare to those of monolingual language users. The first of these two research lines constitutes the core of Cook and Bassetti's (2011) volume mentioned above; the second is the most central theme in De Groot (2011).

Bassetti and Cook (2011) present some further distinctions that greatly help in structuring this field of research. One is the contrast between *micro-level* and *macro-level* effects of bilingualism on cognition. Micro-level effects are the effects caused by specific structural contrasts between a bilingual's two languages, for instance, the different ways in which French and English encode motion, Chinese and English encode time, or Greek and English encode the colour blue. Other examples of micro-level effects and their specific effects on cognition will be given in the final sections of this chapter. Macro-level effects are those due to bilingualism *per se*, irrespective of the specific structural contrasts that exist between the two concerned languages. For instance, using two languages daily may have a beneficial effect on general 'executive control' (an umbrella term for various mental processes involved in the planning and execution of behaviours, such as attending to relevant sources of information, inhibiting irrelevant information, monitoring behaviour and correcting it when it goes astray). Bilingualism may be advantageous for executive control because outputting the selected language at any moment in time, while preventing intrusions from the other language, requires the involvement of the mental executive-control system (e.g. Bialystok 2009; but see Paap and Greenberg 2013); bilinguals' unilingual language use thus trains this system. Another macro-level effect of bilingualism might be that knowing two languages may enhance metalinguistic awareness and, consequently, be advantageous for *Theory of Mind* (TOM), the ability to assess what goes on in the mind of others (e.g. Siegal, Frank, Surian and Hjelmquist 2011). A third is that it may boost divergent thinking, the ability to quickly generate

many alternative responses to a problem (e.g. Kharkhurin 2007; but see Hommel, Colzato, Fischer and Christoffels 2011 for a qualification). The first two of these examples of macro-level effects comprise a further potentially relevant distinction presented by Bassetti and Cook: the effect on cognition of *using* versus *knowing* two languages (with effects on executive control and TOM, respectively).

A final relevant contrast concerns two different versions of linguistic-relativity theory. One version, first advanced by Slobin (e.g. 1987) and dubbed *thinking for speaking* by him, concerns the idea that speakers of different languages think differently from each other when they are actually using language (e.g. speaking) but not necessarily when they are not involved in language use. This version of linguistic-relativity theory appears to be generally accepted for the simple reason that conceptualization during language use (a type of thinking) must be shaped to fit onto the grammatical and lexical structures that are available in the target language. The other, challenged, version holds that the thought of speakers of different languages, or the content of their thought processes, also differs when they are not using language but are exercising some form of non-verbal cognition. This second version also comes in two versions, succinctly defined by Athanasopoulos (2009, p. 83) as the ideas that our language constrains our thought or that it guides our attention to specific perceptual aspects of the surrounding world, respectively.

To detect an effect of language structure on thought in general (beyond thinking for speaking), linguistic-relativity researchers often design experiments wherein the stimulus materials are completely non-verbal and no overt language responses are invited from the participants, thus trying to minimize the involvement of language during task performance as much as possible. The subjects may, for instance, be asked to memorize pictured objects or scenes, rate the degree of similarity of pairs of pictures that depict motion events (Czechowska and Ewert 2011) or colours (Athanasopoulos 2009), or to select the object out of two that is most similar to a third object, the three objects differing from each other in the materials they are made of or in form (Athanasopoulos and Kasai 2008). Though overt verbal stimulation and overt verbal responses may be successfully expelled from such tasks, it is quite plausible that many of them still involve language processing. For instance, tasks that require memorizing or perceiving familiar objects or colours likely involve covert naming of the presented objects or colours. As illustrated below, the covertly generated names may be used to perform the task, deliberately or unintentionally.

There is another reason for assuming that language is still involved in tasks that are intended to be non-verbal, namely, that many of the building blocks of thought, *concepts*, can be argued to belong to the realm of language as much as they belong to the realm of general cognition. Armies of researchers have tried to elucidate the relation between word meaning,

semantics, on the one hand, and concepts on the other hand, defined by Murphy (1991, p. 11) as, respectively, 'the semantic component of words . . . the component of linguistic elements that gives them significance' and 'mental representations of coherent classes of entities. Concepts are our notions of what kinds of objects and events make up the world.' Based on sound reasoning and experimentation, Murphy reaches the conclusion that, one way or the other, word meanings – components of the mental lexicon and, thus, of the language system – are built out of concepts. Francis (2005, p. 251) suggests a specification of this view by first proposing a conceptual system that is shared across languages and cultures and that is a 'possibly hardwired aspect of human cognition', a 'universe of possible ideas or concepts that a human can learn or understand'. She then suggests that all possible concepts have the potential to be expressed in language, but that languages, and individual speakers of one and the same language, differ between them with respect to which ones out of this endless variety of possible concepts are actually instantiated in language. 'Semantic representations may be those concepts that are referred to by particular words or sentences . . . Word meanings, or semantic representations of words, would be a particular type of concept' (p. 252), namely a lexicalized concept (or *lexical concept*), a concept that is linked with a word and that is referred to by this word and that, as such, is part of the language system. It is not unreasonable to assume that lexical concepts constitute a major portion of the concepts recruited during thinking in general, for the very reason that they are encoded in language and, therefore, readily available mentally. If true, performance in so-called non-verbal tasks involves language processing as well. This idea that lexical concepts are central in both language and thought in general was the reason to characterize them as the interface between language and cognition above.

The study of lexical concepts (henceforth used interchangeably with *word meanings* and often abbreviated to *concepts*) is tightly anchored in the study of language and cognition from a monolingual perspective. One of the major insights from that work is that word meanings are neither clear-cut nor stable but vary across contexts, time, and individuals (e.g. Aitchison 1987; Barsalou 1982; Barsalou and Medin 1986; Labov 1973; Rosch 1975). More recent evidence of the variability of word meaning derives from the study of bilingualism and L2 learning, which shows that lexical concepts differ between bilinguals/L2 learners and monolinguals, and between L2 learners at different stages of L2 development. These claims are substantiated in the next sections, which deal with different aspects of the lexical concepts of bilinguals/L2 learners: how they develop with growth in L2 proficiency and differ from monolinguals' lexical concepts; how they are connected to the associated words in memory and what this implies for processing either language. In this discussion, the terms *bilingualism* and *bilinguals* will be used in their neutral sense of referring to the ability to communicate in two languages and to people

possessing this ability, respectively, irrespective of the degree of expertise in the languages.

12.2 Forms of bilingualism and determinants of bilingual lexicosemantic organization

The idea that lexical concepts in bilinguals may differ from the corresponding lexical concepts in monolinguals can be inferred from the collected knowledge in a subfield of bilingualism research that tries to determine how words connect onto their meanings in bilingual memory. This subfield of study goes back a long time, at least as far as Weinreich (1953), who distinguished between three types of word-to-meaning mapping, suggesting three forms of bilingualism: 'coordinate', 'compound' and 'subordinative'. In coordinate bilingualism a word in one language and its translation in the other language are connected to separate meanings (in psychological terms: the *representation* of a word in one language and the *representation* of its translation in the other language are connected to separate meaning *representations*; henceforth I will often sacrifice precision for brevity, leaving out *the representation of* from such phrases). So an English–French bilingual would have a representation for the English word *dog* stored in memory, a second for the French word *chien*, a third for the meaning of English *dog*, and a fourth for the meaning of French *chien* (notice that I use *word* to refer to just the form of a word, not to the combination of form and meaning). In contrast, in compound bilingualism both words of a translation pair (e.g. *dog* and *chien*) map onto one and the same meaning ('dog/chien'). Finally, in subordinative bilingualism words from a new language that is learned do not map onto meanings directly but indirectly, via the L1 words.

Compound bilingualism implies the existence of lexical concepts (equated with word meanings above) that differ from the corresponding lexical concepts (henceforth often abbreviated to *concepts*) in monolingual speakers of the two languages for the simple reason that the two terms in a translation pair seldom have exactly the same meaning. Instead, in addition to sharing meaning elements, each term of a translation pair is also associated with language-specific meaning components. To illustrate, this is what I encountered in a special edition on World War I of today's newspaper: 'If English people talk about war, they mean: mud, bombardments, trenches, Word War I. Dutch people associate war with a winter of starvation, occupation, holocaust: World War II' (NRC, 26–27 April 2014, translated from Dutch). Mapping both elements of a translation pair onto one and the same meaning ignores such language-specific differences in word meaning (so that, for instance, the common concept contains the language-specific meaning components of both languages, or it only contains the meaning elements that are the same for both languages). The

inevitable effect of such mapping is what I previously called 'semantically accented' word use in both languages (De Groot 2011, 2012, 2014). For similar reasons, the concepts that subordinative bilinguals use for their L2 differ from the corresponding concepts of native speakers of that language so that these bilinguals' L2 (but not their L1) is inevitably semantically accented.

Ervin and Osgood (1954) and Lambert, Havelka and Crosby (1958) proposed that different forms of bilingualism result from different contexts in which a person can become bilingual. Specifically, they suggested that compound bilingualism emerges from 'fused' language contexts, as in foreign language learning in a formal school setting that exploits L1 as a medium of instruction or when a child grows up in a home where both languages are spoken interchangeably by both parents. They thought that, in contrast, coordinate bilingualism emerges from acquisition contexts in which the two languages are used separately from one another, the first in one type of context (e.g. at home or in one linguistic community), the second in another type of context (e.g. at work or in another linguistic community). Ervin and Osgood (1954) call bilinguals of the coordinate type 'true' bilinguals, perhaps because of the above-mentioned consequence of compound bilingualism that it implies semantically accented word use. Lambert and his colleagues (1958) provided some empirical evidence in support of the assumed relation between acquisition context and form of bilingualism, at the same time offering an important qualification of the relation: of the participants who had acquired their two languages in separate contexts, only those who had learned them in geographically distinct cultures ('bicultural bilinguals'), not those who had acquired them in separate contexts within one and the same geographical area ('unicultural bilinguals'), showed a pattern of results that differed from the pattern observed for participants who acquired their languages in a fused context. Specifically, in bicultural bilinguals the meanings of the two terms in translation pairs differed more than in all other participants. Other authors (e.g. Gekoski 1980) provided some additional evidence supporting a relation between acquisition context and type of bilingualism, at the same time noticing that the effects, if they occur at all, are modest in size and in fact 'not of sufficient magnitude to support the usefulness of making a theoretical distinction between compound and coordinate bilingualism' (Gekoski 1980, p. 444).

A likely reason why the relation between acquisition context and type of bilingualism is weak is that acquisition context is only one of a larger number of variables that determines bilingual *lexicosemantic organization* (as the representation of words and their meanings and how they are connected is sometimes called). In addition to acquisition context, I previously identified four such variables on the basis of the empirical evidence existing at the time (De Groot 1995): level of L2 proficiency, L2 learning strategy, word type, and the time delay between current and previous L2 usage.

The joint effect of these variables is that pure subordinative, compound, or coordinate bilingualism is highly unlikely but that different types of word-to-meaning mappings coexist within the mental lexicon of one and the same bilingual; in other words, bilinguals' lexicosemantic memory is a 'mixed-representational system' (De Groot 1993) containing, for instance, both structures of the compound type and structures of the coordinate type. Interestingly, this idea had already been suggested by Weinreich (1953) and Ervin and Osgood (1954), the former stating that 'It would appear offhand that a person's or a group's bilingualism need not be entirely of type A or type B, since some signs of the language may be compounded while others are not' (p. 10), and the latter suggesting that 'we would expect speakers of more than one language to distribute themselves along a continuum from a pure compound system to a pure coordinate system' (p. 141).

The word-type effects that are consistently obtained when bilinguals are asked to process words constitute perhaps the most convincing evidence for a mixed bilingual lexicosemantic system. The word-type variables that have been examined most are *word concreteness*, *cognate status*, and *word frequency*. Across a variety of tasks (e.g. within- and between-language word association, within- and between-language semantic priming, and translation) different response patterns are typically observed for concrete and abstract words, for words with a cognate translation in the other language and those with a non-cognate translation (see Van Hell and De Groot 1998 for some of the evidence and references to relevant studies), and for frequently and infrequently used words. The observed effects are often explained in terms of different memory representations for different types of words. Specifically, it is suggested that translation pairs for concrete words and cognates more often share a meaning representation in bilingual memory (or share a larger part of a 'distributed' meaning representation in memory; see below) than translation pairs for abstract words and non-cognates. For example, in an English–Dutch bilingual the translation pair *bottle–fles* (concrete) more likely shares a meaning representation than the translation pair *despair–wanhoop* (abstract), and the translation pair *elephant–olifant* (cognate) more likely shares a meaning representation than the translation pair *squirrel–eekhoorn* (non-cognate). In terms of the compound–coordinate distinction: translation pairs for concrete words and cognates appear to be represented in compound structures relatively often whereas those for abstract words and non-cognates more often seem to be represented in coordinate structures. On the assumption that lexicosemantic representations develop with increases in L2 use (see Section 12.3), low-frequency words may relatively often be represented in subordinative structures and high-frequency words in compound or coordinate structures. Irrespective of the validity of these assertions, the very fact that different types of words give rise to different response patterns across a variety of experimental tasks *per se*

suggests that different types of words exhibit different patterns of word-to-meaning mapping (in other words, are represented differently) in bilingual memory.

12.3 The development of bilingual lexicosemantic representations

The way (the representations of) words are connected to (the representations of) their meanings is not stable but changes with growth in L2 proficiency. A number of researchers examined this development, a study by Potter, So, Von Eckardt and Feldman (1984) providing the theoretical basis for much of this enquiry. In line with the earlier view that the linkage patterns may differ between groups of bilinguals, Potter and her colleagues distinguished between two bilingual lexicosemantic organizations, assuming that the first applied to L2 learners in an early stage of learning and the second to proficient bilinguals. The two types of word-to-meaning mapping they assumed appear to be identical to Weinreich's (1953) subordinative and compound organizations, but the names they gave to these mapping patterns emphasize their consequences for the way bilinguals *process* words. The *word-association model* assumes a direct connection between the L1 and L2 words of a translation pair and between the L1 word and its meaning. As in Weinreich's subordinative bilingualism, the L2 word is not directly connected to meaning. The consequence of this linkage pattern is that comprehension and production of L2 words come about indirectly, via the corresponding L1 words. The *concept-mediation model* instead assumes that the L1 and L2 words of a translation pair are both directly connected to a meaning representation that is shared between the two words and that there is no direct connection between the latter two (cf. Weinreich's compound bilingualism). The consequence of this connection pattern is that comprehension and production take place in the same, direct, way in both languages.

As mentioned, Potter et al. (1984) hypothesized that the word-association and concept-mediation models apply to beginning L2 learners and proficient bilinguals, respectively, direct connections between the L2 words and meanings gradually developing with increases in L2 experience. But when they compared two groups of bilinguals with different levels of L2 proficiency on picture naming in L2 and word translation from L1 to L2 (predicting faster translation than picture naming for the group of beginners but equally long response times on both tasks for the proficient group; see the original study for details), no difference between the performance of the two groups was obtained, the observed response patterns suggesting that concept mediation held for both. However, in subsequent studies wherein the rationale and methodology of Potter et al.'s study were adopted but L2 learners at an even lower level of L2 fluency than those in

the original study were selected as beginners (Chen and Leung 1989; Kroll and Curley 1988), performance differences between the groups of beginners and the advanced L2 learners were obtained. In agreement with Potter et al.'s initial hypothesis, the results observed for the non-fluent and proficient groups were consistent with the word-association model and the concept-mediation model, respectively. It thus appears that with increased L2 experience direct connections develop between L2 words and their meanings, which they share with L1 words. A candidate learning mechanism underlying the development of such direct connections is Hebbian learning, which implies that memory units that are activated simultaneously get connected (e.g. Li, in press; Li and Farkas 2002). During L2 learning this requirement is fulfilled for the memory representations of L2 words and their meanings.

Other researchers built on these views by constructing more elaborate models of bilingual lexicosemantic representation and development. The plausibly most widely known of these, the Revised Hierarchical Model of Kroll and her colleagues (e.g. Kroll, Michael, Tokowicz and Dufour 2002; Kroll and Stewart 1994; see Brysbaert and Duyck 2010 and Kroll, van Hell, Tokowicz and Green 2010 for recent evaluations of the model), integrated the word-association and concept-mediation models, assuming both direct links between the two words of a translation pair and direct connections from both words to a meaning representation shared by the two (see Figure 12.1). But instead of the one, bidirectional, connection between the L1 and L2 words assumed in the word-association model, the Revised Hierarchical Model postulates two unidirectional ones, the connection from L2 to L1 being stronger than the one from L1 to L2. Furthermore, the two connections from the L1 and L2 words to the shared

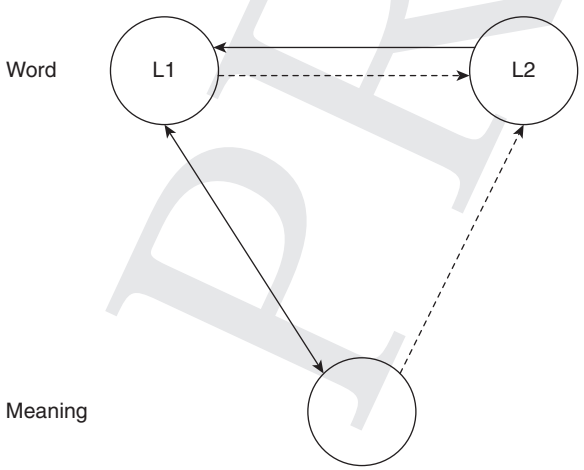

Figure 12.1 The Revised Hierarchical Model (adapted from Kroll and Stewart 1994). Solid and dashed lines represent stronger and weaker connections, respectively

meaning differ in strength, the one from the L2 word being the weaker of the two.

The differences in strength of the various connections within these memory structures likely results from unequal use of the two languages, the assumption being that L1 is the previously and currently more frequently used language. Connection strength determines the speed with which activation spreads along the links connecting word and meaning, so that, during the initial stages of L2 development, access of an L2 word from an L1/L2 meaning (in production) and vice versa (in comprehension) relatively often takes place indirectly, via the L1 word. With growth in L2 use (and, thus, in L2 *word* use) and the concomitant gradual strengthening of the direct connections between the L2 words and the L1/L2 meanings this entails (e.g. through the mechanism of Hebbian learning described above), lexical access increasingly often exploits the latter.

The Revised Hierarchical Model emphasizes the strength differences between the various connections in bilinguals' lexicosemantic representations and the effects of these strength differences on the way bilinguals at different levels of L2 proficiency process words in their L1 and L2. Jiang (2000) has, instead, proposed a developmental model that, in addition to paying attention to processing, focuses more on the evolving content of the memory representations, because 'representation and processes cannot be studied independently of each other' (Jiang 2000, p. 47). He described L2 development in three stages, in each of which a particular processing pattern is associated with a specific type of content in the L2 lexical entry. In the first 'formal' stage, involving word-association processing, the L2 lexical entry only stores form information (phonological and/or orthographic). In the second stage, where processing takes place through concept mediation, semantic and syntactic information from L1 words is copied in or attached to the corresponding L2 lexical entries. In the third stage the L2 lexical entry contains formal, semantic, syntactical, and morphological specifications. In the processing structures Jiang postulated for this stage, Weinreich's (1953) coordinate bilingualism can be recognized. Jiang argued that without extensive contextualized exposure to the L2, many L2 representations fossilize in the second stage, lacking morphological specifications and with weak connections between forms and meanings.

In other developmental models attention specifically centred on the semantic component of the bilingual lexicosemantic representations. One of these models is the Shared Distributed Asymmetrical Model by Dong, Gui and MacWhinney (2005, Figure 12.2; but see also the Sense Model proposed by Finkbeiner, Forster and Nakamura 2004, and the Modified Hierarchical Model by Pavlenko (2009). In agreement with other authors (e.g. De Groot 1992; Taylor and Taylor 1990; Van Hell and De Groot 1998), Dong and her collaborators assumed that the meaning of a word consists of a collection of more elementary meaning elements

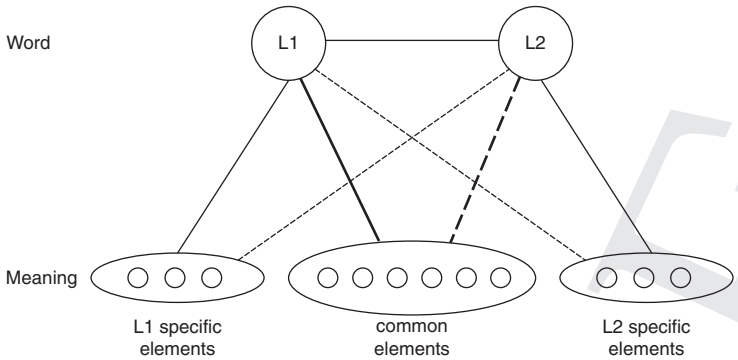

Figure 12.2 The Shared Distributed Asymmetrical Model (adapted from Dong et al. 2005). Solid and dashed lines represent stronger and weaker connections, respectively

(meaning is said to be *distributed* over a set of conceptual elements; see De Groot 1992, 406–408, for a discussion about the possible nature of these conceptual elements). The exact set of meaning elements associated with a word and the strength of the connections between the word and these meaning elements changes with increasing L2 proficiency. During an early stage of L2 learning, the L2 words are connected to both the meaning elements common to the L2 words and their L1 translations and to L1-specific meaning elements. In other words, at this stage of learning the L2 words adopt the meanings of the corresponding L1 words. As explained earlier, L2 word use will consequently be semantically accented. In agreement with the Revised Hierarchical Model, in this stage of L2 learning the strength of the connections between the L2 words and the meaning elements are weaker than those between the L1 words and the meaning units. Advancement in L2 learning involves (i) the strengthening of the links between the L2 words and the meaning elements common to L1 and L2, (ii) the weakening of the links between the L2 words and the L1-specific meanings elements, and (iii) the development of L2-specific meaning elements and the formation and gradual strengthening of connections between these and the L2 words (with the effect that L2 word use will gradually become less semantically accented). Interestingly, the authors furthermore assumed that, during L2 learning, the emerging L2-specific meaning elements also become weakly connected to the L1 words, so that L1 word use may come to exhibit a semantic accent as well (for example, during comprehension, L2 learners would assign a different meaning to their L1 words than monolingual L1 users would). Dong et al. obtained support for this developmental trajectory in a study in which L1 Chinese speakers at two levels of proficiency in L2 English and monolingual English and Chinese comparison groups provided semantic-similarity ratings on word sets consisting of Chinese words or their closest English translations.

I ended the first main section of this chapter highlighting an important conclusion drawn from earlier monolingual research on the nature of

word meanings – that they vary over contexts, time and individuals – and claimed that the study of bilingualism substantiates this conclusion. When positing that claim I had in mind the models of bilingual lexicosemantic development presented in this section, and especially those that focus on the meaning components of the lexicosemantic representations. Dong et al.'s (2005) model (but also the other ones that pay special attention to the meaning components of these representations but were only mentioned in passing) clearly implements the notion that word meanings in bilinguals are variable over time and differ between individual bilinguals. But I also had the findings of another type of bilingual studies in mind: those that concentrate entirely on bilinguals' lexical concepts (which I equated with word meanings earlier on in this chapter), ignoring the larger lexicosemantic structures they are part of. Many of these studies were inspired by the notion of linguistic relativity and how this plays out in bilingualism.

12.4 Linguistic diversity, linguistic relativity and lexical concepts

The studies discussed in the previous two sections clearly suggest that the lexical concepts of bilinguals differ from those of monolinguals and change with growth in L2 proficiency, but they do not reveal the actual content of these concepts. A separate research field is primarily aimed at discovering what information bilinguals' lexical concepts contain and how these concepts might differ from the corresponding concepts of monolinguals and develop in tandem with changes in linguistic experience and expertise. This area of study relates to, on the one hand, the study of word-to-concept mapping in bilinguals presented above and with, on the other hand, research on *linguistic relativity*: the idea (in tribute to its originators called the *Sapir–Whorf hypothesis*) that the language we speak influences our way of thinking and that, consequently, speakers of different languages think differently.

This linguistic-relativity hypothesis builds on linguistic diversity, the fact that languages differ between them in the linguistic means they use to represent the environment. This shows from their vocabularies, which vary greatly in size and the aspects of the world they capture. An illustration provided by Whorf (but disputed by Martin 1986) is the distinctions made in Eskimo for snow, where for instance the concepts of snow falling down, snow that has touched the ground, and snow hard like ice are named differently (Carroll 1956, p. 216). Another illustration concerns the vocabulary of basic colour terms, which in a seminal study examining just twenty out of the thousands of languages spoken on the planet was claimed to already vary between two and eleven (Berlin and Kay 1969; see Anderson 2010 for reasons why an exact count of the world's languages cannot be given). A final example is the rich vocabulary in Pintupi, an

Australian aboriginal language, to distinguish between various types of holes, with separate words for, for instance, a hole in the ground, a hole in an object, a hole formed by a rock shelf, a special hole in a spear and a rabbit burrow (Crystal 1987, p. 15). Linguistic diversity also shows from morphological variability: across languages, verbs and other word categories may or may not be marked for gender, number, tense, person, aspect, for instance, and even for eye-witness testimony (there are languages, such as Turkish and Iranian, that include verb inflections to indicate whether the event expressed by a verb was witnessed or heard about by the speaker, a phenomenon called 'evidentiality': Johanson and Utas 2000).

Linguistic diversity implies that learners of different languages must attend to different aspects of the world to correctly learn their language. For example, a learner of Pintupi must find out what it is that distinguishes something called *yarla* (a hole in an object) from something called *mutara* (a special hole in a spear) whereas a learner of English must find out why they are both called *hole*. During this learning process, learners of different languages develop different inventories of lexical concepts: if one and the same colour spectrum is lexicalized in, say, six basic colour words in one language but in eight in another, it follows that the meaning coverage of (at least some of) the separate colour words differs between these two languages (i.e. the smaller the number of colour words a language has, the broader the coverage of each of these). But even if the same set of words describes a particular conceptual domain in two languages, the coverage of each single word may differ between languages, because the boundaries between the lexical concepts may differ between the languages. For instance, a particular object to hold food may usually be called a *dish* in one language but a *plate* in the other, even if both languages have one word for dishes and one for plates. Similarly, a particular colour may usually be called *red* in one language and *brown* in the other, even if both languages have one word for red and one for brown.

There is evidence to suggest that grammatical diversity between languages also causes particular lexical concepts to differ between speakers of different languages. For instance, in languages with a grammatical number system that (from the perspective of native speakers of English) treats inanimate objects as if they were substances rather than countable entities (this concerns, for instance, Yucatec and Japanese), the material property of objects appears to be more prominently represented in the associated concepts than their shape. The opposite applies to languages like English, which uses the same grammatical number marking for inanimate objects and animate beings, treating both as countable (e.g. Lucy and Gaskins 2001). (In the former type of languages, nouns for inanimate objects do not get a plural marker when referring to more than one of these objects and the nouns cannot be directly preceded by a numeral to quantify the objects; instead, like substances in English, they are quantified by means

of a classifier. So instead of *three chairs* it would be something like *three pieces of chair*.) Again, the likely reason for these between-language differences in the content of concepts is that, to learn the distinctions encoded in the language, the language learner must attend to specific aspects of the world (for example, learners of English must direct their attention to the shapes of objects because the shapes signal how many of these same objects there are). Once learned, the encoded distinctions will be evoked in language use time after time and, thereby, strengthened each time. In the words of the master:

> users of markedly different grammars are pointed by their grammars towards different types of observation and different evaluations of externally similar acts of observation, and hence are not equivalent as observers but must arrive at somewhat different views of the world.
>
> *(Whorf 1940/1956, p. 211; quoted in Slobin 1987, p. 435)*

One further example of how between-language grammatical diversity may differentially affect the content of lexical concepts concerns grammatical gender, a linguistic construct that designates nouns as masculine, feminine, and neuter, often on the basis of their forms. For instance, in Italian, in which all nouns are either masculine or feminine, almost all nouns ending with an *-a* are feminine and those ending with an *-o* are masculine. In many languages a noun's gender governs the choice and form of other words with which it occurs. For example, in Italian noun phrases the forms of adjectives and the choice of articles co-vary with the noun's gender (*la terra nuova* versus *il parco nuovo*). Languages differ greatly in the grammatical gender distinctions they make and the degree in which they use specific word markings to index gender, but the relation between grammatical gender and biological gender is generally largely arbitrary. This is perhaps best illustrated by the fact that one and the same object, and even one and the same living creature, can be named with a feminine word in one language, a masculine word in a second, and a neuter word in a third.

Even though the relation between grammatical and biological gender is generally weak, there is evidence to suggest that in languages that distinguish between grammatically feminine and masculine words and use grammatical-gender marking profusely, the concepts for inanimate objects contain biological-gender information in agreement with the grammatical gender of the objects' names (Boroditsky, Schmidt and Phillips 2003). In other words, in these languages inanimate objects, evidently sexless, appear to be assigned biological gender with the effect that, for instance, native speakers of German may think about bridges as things that are elegant, whereas native speakers of Spanish may regard bridges to be sturdy (*bridge* translates into a feminine word in German and into a masculine one in Spanish). As pointed out by Boroditsky and her colleagues, the reason why biological-gender information might come to be stored in the concepts for

inanimate objects, even though the grammatical gender of their names does not systematically relate to any perceivable feminine or masculine feature of their referents, is that 'children learning to speak a language with a grammatical gender system have no *a priori* reason to believe that grammatical gender doesn't indicate a meaningful distinction between types of objects' (Boroditsky et al. 2003, p. 64). After all, other grammatical distinctions (e.g. grammatical number) *do* point at observable distinctions in the world. Therefore, learners of a grammatically gendered language apply their common language-learning strategy of searching the perceived objects for the presence of perceptual features that correlate with the critical grammatical feature, for instance noticing the elegance of the bridge when the language to be learned is German but its sturdiness when it is Spanish.

In short, learners of different languages develop different collections of lexical concepts and the lexical concepts that *are* shared between a set of languages do not cover exactly the same content across these languages (thus substantiating the earlier claim that true translation equivalents are rare). On the assumption that lexical concepts are the main vehicles of thought, these facts suggest that speakers of different languages think differently, perhaps not only in the non-disputed sense of *thinking-for-speaking* (Slobin 1987, 1996), but also in the more dramatic sense that Whorf had in mind: they develop different views of the world that are also manifest in non-verbal cognition (see Slobin's quotation from Whorf above).

12.5 Linguistic relativity and bilingual lexical concepts

Until around 2000 the Sapir–Whorf hypothesis had predominantly been tested in cross-linguistic studies comparing monolingual speakers of pairs of languages that differ in how they encode a particular aspect of the world (e.g. space, time, motion, or colour). Since then bilingualism has been discovered as a useful test case for linguistic relativity because 'it is quite possible that bilinguals are the only ones to experience directly the effects of linguistic relativity' (Pavlenko 2005, p. 437). The experience of bicultural bilinguals that switching to another language feels like switching to another life (Wierzbicka 1985, in Pavlenko 2005; see also Pavlenko 2006) indeed suggests that bilinguals' thinking may depend on the language spoken at the moment.

Bilingual research into linguistic relativity is as diverse as its monolingual cross-language counterpart (see the rich variety of studies reported in Cook and Bassetti 2011), but a common goal in a substantial portion of this work is to discover whether the lexical concepts of bilinguals differ from the corresponding concepts of monolingual users of their languages. In a way, an affirmative answer to this question was already implied by the research on bilingual lexicosemantic organization presented above:

Weinreich's (1953) subordinative bilingualism (or, in terms of processing, the word-association model of Potter et al. 1984) implies the use of concepts in L2 that differ from the analogous concepts in monolingual speakers of that language and his compound bilingualism (Potter et al.'s concept-mediation model) implies the use of concepts that deviate from those in monolingual speakers of both languages. But the bilingual studies that build on linguistic-relativity research address this question in a specific way, looking at the effect of a particular lexical or grammatical contrast between bilinguals' two languages on the emerging concepts. In other words, these studies examine *micro-level effects* of bilingualism on cognition, more precisely, on what I am assuming to be main ingredients of thought: lexical concepts.

The assembled studies in this research area consider a varied set of ways in which bilingual concepts may differ from monolingual concepts (see Bassetti and Cook 2011). In addition, they explicate the processes that may give rise to the various types of bilingual concepts, such as transfer, shift or convergence (see e.g. Pavlenko 2005 for details). The separate studies often compare the performance of monolinguals and bilinguals on a verbal or non-verbal task, using stimulus materials that capture a specific grammatical or lexical contrast between the participants' two languages (for example, a difference in the use of grammatical number, tense, or gender, or in the way the colour spectrum is lexicalized). A number of them investigated how task performance develops with increasing levels of L2 proficiency (e.g. Athanasopoulos 2006; Athanasopoulos and Kasai 2008; Cook et al. 2006; Malt and Sloman 2003) or depends on other variables such as amount of L2 use or length of stay in the L2 country (Athanasopoulos, Damjanovic, Krajciova and Sasaki 2011). Furthermore, some studies (e.g. Bassetti 2007; Boroditsky et al. 2003) were designed to rule out the possibility that the critical effect was due to differential cultural (rather than linguistic) experience of the bilingual and monolingual participants. Crucially, the performance differences between monolinguals and bilinguals and between various types of bilinguals shown in these tasks often seem to be attributed to differences in their lexical concepts (*seem*, because the authors often use terms that are less specific than *lexical concepts*, talking for instance about differences between monolinguals and bilinguals in *cognition*, or in *cognitive representation*).

On the basis of the assembled evidence, it can be concluded beyond doubt that speakers of different languages produce different response patterns on a large variety of tasks, verbal and non-verbal, and that the observed behavioural differences reflect an influence of the different ways in which specific aspects of reality are encoded across languages (see e.g. the studies on colour discrimination by Roberson, Pak and Hanley 2008, and Winawer et al. 2007). Furthermore, the data unmistakably legitimate the conclusion that the response patterns obtained for bilinguals generally differ from those exhibited by monolingual speakers of their languages

(e.g. Ameel, Storms, Malt and Sloman 2005; Athanasopoulos 2009; Bassetti 2007; Malt and Sloman 2003). However, this last conclusion may not always warrant the more far-reaching one that bilinguals' concepts differ from those of monolinguals and that this is the reason why the behavioural patterns differ between them.

The reason for this cautionary note is that, at least in verbal tasks (with linguistic stimulus materials and/or actual language as output), different response patterns for bilinguals and monolinguals can also result from the well-established phenomenon that, when instructed to perform a task in one language, bilinguals cannot simply mentally switch off (de-activate) the other language. When, for instance, bilinguals are asked to name pictured objects in one of their languages, the objects' names in both languages are activated (e.g. Costa, Caramazza and Sebastian-Galles 2000; Starreveld, De Groot, Rossmark and Van Hell 2014). So when a Spanish–Catalan bilingual is presented with a picture of a table and asked to produce the corresponding name in Catalan, both the Catalan and the Spanish words for table (*taula* and *mesa*) will be activated in memory. In their turn, both activated names likely activate their translations in the other language, that is, they activate each other (cf. the direct connection between the representations of the two words in a translation pair that is assumed in some of the models of bilingual lexicosemantic representation described above) as well as other translations each of them may have in the other language. The effect of this parallel activation in both languages is that even if a particular bilingual possesses two perfectly native-like sets of lexical concepts, the response pattern she exhibits in either language will differ from the one shown by a monolingual speaker of her languages. In other words (and as illustrated below), different behavioural patterns are not reliable indicators of differences in concept representation.

12.6 Verbal tasks

This idea that behavioural differences between monolinguals and bilinguals in verbal tasks like picture naming do not unequivocally indicate that their concepts differ, but may be caused by parallel activation of word representations in their two language subsystems, can already be found in Ervin's (1961) seminal study on colour naming in Navajo–English bilinguals. She wrote:

> If a bilingual is asked to name colours in a particular language, he must suppress intrusions from the wrong language. If implicit responses occur in the suppressed language, response probabilities in the overt language will be altered ... if an implicit response occurs in the suppressed language, it mediates a response in the overt language.
>
> *(Ervin 1961, p. 234)*

And perhaps most revealing, she talks about a 'semantic shift *in terms*' (p. 234, my italicization), as if suggesting that bilinguals' verbal responses, not necessarily their colour concepts, differ from those of monolinguals. In sum, contrary to the suggestion conveyed by the title of her article ('Semantic shift in bilingualism'), Ervin appears to hold the view that the different colour-naming patterns she obtained for monolinguals and bilinguals reflect response variability due to lexical competition in the bilingual language system, *not* necessarily that the colour concepts of bilinguals differ from those of monolingual speakers of their languages (let alone that the data patterns suggest that bilinguals and monolinguals *perceive* colours differently, as if their physiology for colour vision differs).

In De Groot (2014) I attempted to explain the results of a varied set of studies this way. In all these studies verbal tasks were used. The working hypothesis in that paper was that phonological, grammatical, and semantic *accents* (defined earlier as differences between the linguistic expressions of monolinguals and bilinguals) may have two causes. First, becoming bilingual may result in memory representations for specific linguistic units (e.g. phones, lexical concepts) that differ qualitatively from the related representations in monolingual memory (through processes of, for instance, shift, convergence, or restructuring). To illustrate, the representation of a particular L2 phone may differ from the corresponding representation in a monolingual speaker of that language because during L2 learning it has been assimilated with the representation of a closely similar but not exactly identical L1 phone (e.g. Flege 1987, 2002). Second, automatic parallel activation in the two mental language subsystems may cause accented language even if the critical linguistic units stored there (e.g. phones, lexical concepts, knowledge structures that enable parsing) are perfectly native-like. From an examination of the selected studies with these two options in mind, it appeared that an interpretation of bilinguals' accented language in terms of parallel, language-independent, activation was a plausible alternative to one in terms of qualitatively different memory representations of bilinguals and monolinguals, even in cases where the original authors opted for the latter.

Consider, for instance, the study by Boroditsky et al. (2003) introduced above, which examined the influence of the grammatical gender of the names for inanimate objects on the corresponding concept representations. In one of their experiments highly proficient bilinguals with Spanish or German as L1 and English as L2 were asked to produce English adjectives to English names for inanimate objects with a feminine name in German and a masculine name in Spanish or vice versa. The responses reflected the grammatical gender of the stimulus words in the participants' L1. For example, among the adjectives the Spanish–English bilinguals produced for the word *bridge* (masculine in Spanish; feminine in German) were *big, dangerous, strong*, and *sturdy*; among those the German–English bilinguals gave to *bridge* were *elegant, fragile*, and *pretty*. As mentioned earlier, this

finding indicates that L1 learners of grammatically gendered languages assign biological gender to the referents of words and build concepts that contain biological-gender information in agreement with the associated words' grammatical gender. But of particular relevance here is that, at first sight, it also suggests that, during L2 learning, conceptual transfer occurs from L1 to L2 and that even the L2 concepts of proficient bilinguals differ qualitatively from those of native speakers of that language.

But an alternative explanation of the results of Boroditsky et al. (2003) to consider is that the stimulus words' translations in L1 mediated the L2 responses. So the stimulus word *bridge* may have activated its Spanish translation *puente* which, in turn, activated the Spanish concept for *puente*. Next, the latter's content was 'read out' in complying with the instruction to produce adjectives. In other words, even if Boroditsky et al.'s participants possessed perfectly native-like L2-English concepts, their responses would differ from those of native English speakers performing the same task. It appeared that the findings of a number of other studies on bilingual concepts, all using (partly) verbal tasks, could similarly be explained, among them one in which the participants were asked to point out the focal area and range for a set of colour names on a colour chart (Caskey-Sirmons and Hickerson 1977), a few that examined the naming of pictured objects (Ameel et al. 2005; Malt and Sloman 2003), and Ervin's (1961) study on colour naming in Navajo–English bilinguals discussed above.

This alternative account of the results of earlier studies presupposes the existence of direct memory connections between the two word terms in translation pairs (also in bilinguals of the coordinate type, with a separate store of concepts for each language) along which activation can be transmitted. Such connections may be formed by Hebbian learning, the learning mechanism introduced before. As mentioned there, this mechanism implies that simultaneously activated memory units get connected and could thus explain how direct connections between words and their meanings are formed and gradually strengthened. The parallel activation of both names for a concept during bilingual speech production (as examined, for instance, by means of picture naming; see above) fulfils this requirement of simultaneous activation of the two elements in translation pairs.

12.7 Non-verbal tasks

Earlier in this chapter I claimed that so-called non-verbal tasks may still involve language processing, something researchers using such tasks are well aware of (e.g. Athanasopoulos et al. 2011, p. 16; Boroditsky et al. 2003, p. 76; Winawer et al. 2007). Indeed, given the facts that (i) memory connections exist between (the representations of) words and their meanings and between (the representations of) the two words within translation

pairs, and that (ii) the transmission of activation along these connections proceeds automatically, tasks that are completely non-verbal but use stimuli whose mental representations are linked with word representations (e.g. pictures of familiar objects or colour patches) involve the activation of word representations and, thus, language processing. In bilinguals word representations in both language subsystems are activated in this way (see above). If activation in a word representation exceeds a critical threshold, the associated word becomes available to consciousness, that is, internal verbalization occurs. The observed critical effect might then result from strategic or unintentional use of the available verbal code(s) rather than from some fascinating difference in (real) non-verbal cognition in speakers of different languages or in bilinguals as compared with monolinguals.

Consider for instance a study by Athanasopoulos and colleagues (2011) that exploited a difference in the way the *blue*-area of the colour spectrum is lexicalized across languages. More precisely, this study made use of the fact that some languages like English have just one single word to denote all shades of blue whereas other languages (e.g. Greek, Japanese, and Russian) have two different single words for blue, one denoting its lighter shades, the other its darker shades. In each trial two blue colour chips were shown to the participants, who were asked to judge the degree of similarity of the two on a 10-point scale. The participants were Japanese and English monolinguals and Japanese–English bilinguals. In some trials the two stimuli crossed the Japanese boundary between the two categories of blue (for example, one would be called *ao*, dark blue in Japanese, the other *mizuiro*, a lighter blue). In other trials the two stimuli were instances of the same category (for example, both would be considered instances of *ao*). Crucially, the actual physical distance between the two types of blue presented in a trial did not differ between these two conditions.

The similarity ratings of the Japanese monolinguals depended on whether or not the two types of blue presented in a trial crossed the boundary between the two categories. Specifically, the two types of blue were regarded as less similar if they belonged to different categories. In contrast, English monolinguals (for which the critical category distinction does not exist) produced equal similarity ratings to within- and across-category colour pairs. The results of the Japanese–English bilinguals differed from those of both monolingual groups but resembled those of the English group most. The results of an earlier Greek–English study showed similar results (Athanasopoulos 2009).

It is tempting to conclude that perceptual discrimination of colour pairs depends on whether or not the perceiver's native language has lexically encoded the distinction in question. But a more down-to-earth explanation of the results is that they ensue from automatic verbalization of the colour stimuli that affects the Japanese and English monolinguals differently. Specifically, in Japanese speakers two stimuli that cross the boundary between the lighter and darker shades of blue will internally generate

two different names (*ao* and *mizuiro*), whereas two stimuli from the same category will generate the same name twice (*ao* or *mizuiro*). The monolingual Japanese participants may strategically use this information in producing the requested similarity rating, assigning lower similarity ratings to stimulus pairs that generate different names than to pairs generating the same name twice. Because *all* stimuli give rise to the verbal response *blue* in monolingual English speakers, this strategy cannot be sensibly used by them. The data pattern observed for the Japanese–English bilinguals may result from cross-trial differences in the moment in time the Japanese and English colour names (activated in parallel; see above) are available. The reason why the data resemble the English monolinguals' data more than the Japanese data may be that the task instruction was in English (the participants were asked 'how different or similar these two colours are'; Athanasopoulos et al. 2011, p. 13) and were tested in the United Kingdom. We know that such aspects of an experiment affect the activation level of bilinguals' two language subsystems (e.g. Grosjean 1998). The instruction and test location of the present study have likely boosted the activation in the English subsystem with the effect that the one English colour term was more available than the two Greek terms.

Though it may seem contrived, this interpretation of the data in terms of the strategic use of internally generated verbal codes receives support from a similar study that examined within- and cross-category discrimination of various shades of blue by Russian and English native speakers (Winawer et al. 2007; no bilingual group was included). Like Japanese, Russian splits up the *blue* part of the colour spectrum into two categories, *goluboy* and *siniy*. Instead of the subjective-judgment task used by Athanasopoulos and colleagues (2011), the researchers used an objective, perceptual task (speeded colour discrimination with response time measurement), arguing that especially subjective tasks like the one used in Athanasopoulos' studies foster the strategic use of verbal codes. But the presently most interesting manipulation was one that enabled verbalization of the colour chips in one condition but frustrated it in a second, the 'verbal-interference' condition (in which the participants were asked to rehearse a series of eight digits while performing the colour-discrimination task). In the no-interference condition the Russian native speakers, but not the English native speakers, discriminated between the blue chips faster when they crossed the category boundary than when they were instances of the same category, but this effect disappeared in the verbal-interference condition. This finding suggests the ubiquity of verbalization: it even occurs when the task used was carefully designed to prevent it, except when it is frustrated by a secondary task.

But the most important suggestion arising from Winawer et al.'s study (2007) is that, although speakers of languages that split up the colour spectrum differently clearly have different stocks of lexical colour concepts, this specific cross-language difference does not seem to affect perceptual

discrimination of colours. After all, if it did, the Russian native speakers should also have shown the critical effect in the verbal-interference condition. Instead, as suggested by Rosch Heider (1972), colour discrimination may depend on the physiology of primate vision and thus be universal.

12.8 Conclusions

In this chapter I have looked at lexical concepts in the same way Joni Mitchell (1969) eyed clouds: from multiple angles. I chose to focus on lexical concepts because they can be argued to belong to the realms of both language and cognition, both of which I was supposed to cover in this chapter, from a bilingual perspective. Without a common theme that assignment would have been utterly impossible. Although the job did not lead to the kind of illusory observations evoked by Mitchell's clouds, like flows of angel hair, ice cream castles, and feather canyons, one specific research area was identified that may be creating an illusion, namely, that differences in the way different languages lexicalize the colour spectrum cause their speakers to perceive colours differently. An alternative, more mundane, interpretation of the critical empirical data was suggested, namely, that strategic or unintentional use of the output of (apparently unavoidable) internal verbalization caused the patterns of results to differ between conditions.

A more general point to make here is that the data pattern obtained in a particular study may be ambiguous, allowing more than one interpretation. Indeed, data indeterminacy was also the reason why differences in the response patterns observed for monolinguals and bilinguals in verbal tasks like picture naming and colour naming were not regarded as unequivocal evidence that the implicated lexical concepts differed between monolinguals and bilinguals. Instead, it was suggested that parallel activation in bilinguals' two language subsystems and ensuing differences in response probabilities between bilinguals and monolinguals might be one cause of the different response patterns observed for them (possible differences in lexical concepts being a second).

Notwithstanding these cautionary notes, one conclusion can safely be drawn on the basis of the above discussion: language cannot easily be banned from non-verbal tasks. In fact, that it cannot was a starting point in this chapter, which I began by assuming that lexical concepts, elements of the language system, are a main ingredient of all thought processes. But the final section of this chapter suggested a stronger presence of language in non-verbal tasks: the word forms associated with the lexical concepts may also be recruited during task performance. In fact, this being the case fully agrees with the structure and processing assumptions contained by the models of lexicosemantic representation presented in the earlier sections of this chapter.

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