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ABSTRACT

A study of the organization of the bilingual's mental lexicon is reported. First, three major hypotheses are examined: (1) Shared Semantic Store or interdependence hypothesis, suggesting a single conceptual memory system; (2) Separate Semantic Store hypothesis, that words and meanings are stored separately; and (3) Shared-&-Separate Semantic Store hypothesis, which posits two separate lexicons linked by a common semantic conceptual representation. Other factors influencing organization of information are also considered, including degree of difference between the two languages, degree of language dominance, and the demands imposed by linguistic tasks. An experiment with bilinguals is then described, involving a lexical decision task with repetition priming. Subjects were 45 native Spanish speakers with intermediate to advanced knowledge of English. Four independent variables were considered: task language (Spanish or English); second language proficiency (low-intermediate and advanced); degree of cognates (same and different); and repetition (repetition within languages, repetition between languages, no repetition). Results indicate the subjects had different reaction times depending on language used, proficiency, and repetition condition when considered separately; there was no interaction of variables found. It is concluded that current theories about the organization of bilingual lexicon are oversimplified, and further research is needed. Contains 48 references. (MSE)

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LEXICAL PROCESSING IN UNEVEN BILINGUALS: AN EXPLORATION OF SPANISH-ENGLISH ACTIVATION OF FORM AND MEANING

Carmen Santos Maldonado (DAL)

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LEXICAL PROCESSING IN UNEVEN BILINGUALS: AN EXPLORATION OF SPANISH-ENGLISH ACTIVATION OF FORM AND MEANING

Carmen Santos Maldonado (DAL)

Abstract

This article looks at the organisation of the bilingual mental lexicon. The first half briefly reviews relevant literature in bilingual research in relation to whether semantic information is language-specific or language-independent. Three major hypotheses are examined: the Shared Semantic Store, the Separate Semantic Store and the Shared-&-Separate Semantic Store. Other factors having an influence on the organisation of the bilingual lexicon are the degree of topological difference between two languages, the degree of dominance of one language over another and the demands imposed by the experimental tasks. In the second part, I report on a lexical decision experiment with repetition priming carried out with Spanish-English bilinguals. Four independent variables were looked at: language (Spanish and English), L2 proficiency (low intermediate and advanced), degree of cognates (same and different) and repetition (repetition within languages, repetition between languages, and no repetition). Significant differences in reaction times were observed for all variables except cognates. Results are discussed in the context of recent studies. A line of research is proposed to examine activation of bilingual lexical items as a function of form and meaning combined.

1. Introduction

The importance of lexical research derives from the simple fact that understanding 'words' is the key to human communication. In child language learning, the acquisition of words precedes the acquisition of grammar. Moreover, of the three pillars on which every language system rests – grammar, vocabulary and phonology– vocabulary is the only one that continues to develop throughout a life span, even when grammar and phonology have reached a state of 'maturity'. This is true not only of first language competence but also tends to be the case in second language learning.

For the psycholinguist, a general but crucial theoretical issue in bilingualism is whether the knowledge represented in the lexicon of both languages is stored in a single semantic memory system or in two separate systems. In particular, we need to explore such issues as: to what extent lexical activation processes in the second language (L2) are similar to or shared by the lexical processes of the first language (L1); and whether it is possible for the bilingual mind to operate in a completely monolingual mode once it has become bilingual. A more specific question is how the bilingual learner structures and integrates the new lexical items of the second language into the lexical knowledge already stored in his or her mind. Ideal comprehensive models of lexical learning and lexical processing should, therefore, be able to incorporate a description of bilingual processes, especially if we accept the argument that a bilingual mind is different from the simple addition of two monolingual minds (Meara 1983).

Let us start by clarifying some points of terminology. Firstly, for most people a 'bilingual' speaker is someone who is able to speak two languages equally fluently, preferably if both were acquired during the early years of life. Clearly, not many people can claim that privilege in absolute terms. Even if both languages were acquired before adolescence, innumerable social and personal variables make a true balance highly unlikely (Harris and McGhee Nelson 1992). However, in the context of second language acquisition (SLA) research, 'bilingual' usually includes someone who has first learned their mother tongue to full command and has then learned a second language to a greater or a lesser degree mpetence. This is how the term bilingual will be used in this article. Secondly, I will employ the

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term 'even' bilingual to refer to a speaker who is equally competent in both languages; I will use the term 'uneven'[1] bilingual to refer to the second or foreign language learner with a clearly dominant first language. In this connection, the term 'second language', or L2, will be used to refer to the language that came second in the speaker's life, in other words, in contrast with 'first' rather than with 'foreign' language.

As stated above, the first half of this article briefly reviews relevant literature in bilingual research. In the second half I report on a lexical decision experiment with repetition priming carried out with Spanish-English bilinguals, I then analyse the results and propose the line of research which I intend to pursue in the near future.

2. Models for the organisation of the bilingual mental lexicon

Studies in bilingual lexical research by no means present a unified picture. Over the years researchers have put forward various 'theories', 'paradigms', 'models' and 'hypotheses', which quite often are not comparable. Two possible reasons for this lack of comparability are, first, that assumptions are not always clearly stated and, second, that terminology is often not clearly defined. For example, it is difficult to know if authors mean exactly the same when they talk about 'unified language processing system' (Altenberg and Smith Cairns 1983), 'integrated semantic memory system' (Schwanenflugel and Rey 1986), 'single language-independent store' (De Groot and Nas 1991) or 'integrated network' (Kirsner, Smith, Lockhart, King and Jain 1984). In addition, many experiments are not easily comparable either. This state of affairs makes any meaningful evaluation of the research literature problematic.

In her historical analysis of cognitive bilingual research, Keatley (1992) suggests that studies can be grouped into three blocks. Each block asks one of the following questions:

- Are the meanings of the lexical items in a bilingual's two languages represented in a shared memory system or in a separate one?
- Does the 'inactive' language influence processing in the 'active' language?
- Assuming the semantic memory system is shared, how do words in the bilingual's lexicons access conceptual representation?

The largest group of studies revolves around the question of the shared or separate semantic store. In this connection, Snodgrass and Tsivkin (1995) suggest that views cluster around three basic theoretical positions. For the purposes of this article the positions will be referred to as follows:

1. The Shared Semantic Store Hypothesis.
2. The Separate Semantic Store Hypothesis.
3. The Shared-&-Separate Semantic Store Hypothesis.

2.1 The Shared Semantic Store Hypothesis

The view that the bilingual lexicon is a single store of semantic information shared by both languages (McLaughlin 1985) is sometimes referred to in the literature as the Interdependency Hypothesis. It assumes that shared semantic information feeds both languages, and that only linguistic labels, or 'tags', are language-specific.

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Early support for the notion of a single conceptual memory system came from experiments on transfer and interference of learning across languages (Young and Webber 1967; Preston and Lambert 1969). More recently, work done in the field of semantic facilitation is often quoted in relation to the Shared-Store Hypothesis. It is accepted that words are recognised more quickly if they appear in the context of other semantically related words. For example, the word *brother* will be processed in a shorter time if it occurs in the context of *sister* or *family*. Meyer and Ruddy (1974, cited by Kirsner, Smith, Lockhart, King and Jain 1984) found that, for bilingual speakers, cross-linguistic semantic facilitation was as important as semantic facilitation in a monolingual task. Similarly, Schwanenflugel and Rey (1986) arrived at the same conclusions when they tested cross-language priming effects on lexical decisions in Spanish-English bilinguals. They observed that priming within the same language was not greater than priming between languages.

Nas (1983) also provides some evidence for the shared semantic store hypothesis when he asked Dutch-English bilinguals to make lexical decisions on English-like non-words, which were actually real words in Dutch – i.e. pseudo non-words. He found that reaction times were slower for the pseudo non-words than for ordinary English non-words. On the basis of this, Nas concluded that the semantic store was common for both languages. Altenberg and Cairns (1983), however, on achieving similar results, were much more cautious and did not feel that conclusions could be drawn about whether there are one or two processing systems. They simply proposed that bilinguals have knowledge of two sets of phonotactic constraints, and that both sets are simultaneously available during lexical processing.

Despite the evidence that has been gathered over the years, there are some problems associated with the Shared Semantic Store Hypothesis, at least with its strong version. De Groot and Nas (1991) have found some restrictions necessary for bilingual priming to occur: the translation equivalents have to be 'cognates', i.e. similar in form and meaning, not only similar in meaning, and they have to be presented almost immediately one after the other.

2.2 The Separate Semantic Store Hypothesis

The view that words and their meanings in the bilingual's two languages are stored separately in two independent memory systems is sometimes referred to as the Independency Hypothesis. Researchers like McCormack (1977), Kolers and González (1980), Paivio and Desrochers (1980), Paivio and Lambert (1981), Scarborough, Gerard and Cortese (1984) and Paivio, Clark and Lambert (1988) have followed this line of work. Paivio and his collaborators developed a Dual-Coding Model for images and words, claiming that the actual code – i.e. language – determines the organisation of mental representations into two separate memory systems.

Kolers and González (1980) researched into word-associations in two languages, and concluded that, very often, the associations of a particular word differ from the associations conjured up by the translation of that word into another language[2]. This could be interpreted as there being, at least to a certain extent, two separate sets of associative relations. However, they hedge their conclusions by suggesting that the nature of the relation between both lexicons (i.e. whether they are independent or interdependent) can be largely influenced by the nature of the encoding or retrieving tasks that bilinguals are asked to perform. Thus, the shared-separate dichotomy could be an empty question. This methodological point would later be taken up by Durgunoglu and Roediger (1987), who concluded that the dichotomy is a completely meaningless issue. Other researchers, however, think the debate is a perfectly legitimate one. Scarborourgh and his collaborators (1984), for example, powerfully maintain that bilingual speakers "are able to process the words of a language in a language-specific manner, without any influence of their knowledge of the surface (e.g., spelling) or conceptual representations of words in the other language" (Scarborourgh *et al.* 1984: 84). They found that the practice of words from one language helped improve times needed for the recognition of those words, but it did not do anything to speed up reaction times in the recognition of the

translations of those words. They also found that when bilinguals were instructed to respond only to true words in a particular language, they reacted to words of the non-target language as if they were non-words. A few years later, Gerard and Scarborough (1989) repeated the basic experiment and found the same results.

The Separate Semantic Store view can presumably account for the fact that homographs, like *red* in Spanish (meaning 'net') and *red* in English (meaning the 'colour red'), are semantically processed only within the relevant language, while the non-target meaning seems to remain untapped. This approach could also explain the fact that bilinguals can switch between languages, as required by the context, and are still able to limit themselves to the use of one language only, without having to constantly suppress the interference from non-target vocabulary. However, the view of two, totally independent lexicons is not without problems. For example, how can it account for successful fast code-switching of speakers in bilingual settings? And what about the problems of interference that many non-fluent speakers experience when functioning in the second language?

In her review of bilingual memory research, Keatley (1992) concludes that more recent views either reject the dichotomy as meaningless and irrelevant, or they propose a picture of bilingual lexical processing with structures connected at different levels. Some of these structures are shared and some are separate, which leads us to the analysis of the third position.

2.3 The Shared-&-Separate Semantic Store Hypothesis

The Shared-&-Separate Semantic Store Hypothesis redefines 'lexicon' as a somewhat narrower construct: lexicon is interpreted as containing only morphological and phonological specifications for words, and, maybe, specifications for the syntactical distribution of words. This view advocates the existence of one such lexicon for each language. The two lexicons would be linked to each other via a common semantic store which houses the conceptual representation of all lexical items (see figure 1).

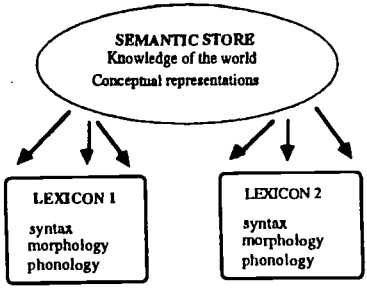

Figure 1. The Shared-&-Separate Semantic Store Hypothesis: the two separate lexicons are connected via a common semantic store.

The attraction of this mixed model lies in the fact that it softens the sharp dividing lines postulated by the other two positions already discussed, in that it combines the best arguments of both: the cost-effectiveness of a fully integrated semantic memory store, and the autonomy of two separate syntactic, morphological and phonological systems. This hybrid model encompasses the most recent developments in the literature of bilingualism (De Bot, Cox, Ralston, Schaufeli and Weltens 1995; De Bot 1992; De Groot 1993, 1992; Green 1993; Kroll and Sholl 1992; Kroll and Stewart 1994) and is also compatible with more general frameworks put forward to account for monolingual lexical processing. Particularly relevant are Levelt's Speaking Model (Levelt 1989, 1992) and the Spreading

Activation Theory of semantic memory (Collins and Loftus 1975; Dell 1986, 1988). The theoretical and experimental implications of these models provide the framework for the lexical decision experiment reported later in this article.

2.3.1 Levelt's Speaking Model

Levelt's model of linguistic production almost exclusively accounts for monolingual speech. According to Levelt (1989, 1992), from the point of view of speech production, the specifications contained in every lexical entry can be grouped into two parts, lemma and lexeme. The lemma encompasses the meaning and syntax of the entry, whereas the lexeme agglutinates the form properties, morphology and phonology. Grammatical encoding is geared by lemma retrieval: once the meaning of the lemma has satisfied the conditions stipulated by the propositional message, a set of syntactic specifications (syntactic category, selection and categorisation rules, thematic role assignments, etc.) has to be met. At this stage lexical items are still unspecified for morpho-phonological form. For a phonetic plan to be executed by the articulatory system we have to move to the second phase of lexical access, phonological encoding. Lexical items, then, are activated in two successive stages: first, lemma activation (or semantic activation), in the form of semantic representations, pragmatic and syntactic information; and second, lexeme activation (or form activation), by way of morpho-phonological rules. We will come back to the notion of activation in the next section.

It is tricky to pin down what proportion of a concept is actually linguistic/semantic knowledge and what proportion is part of our wider knowledge of the world. It is generally accepted that the world-knowledge store is language-independent and therefore one store would be enough for both languages. Levelt assumes that the conceptualizer, on the other hand, is language-specific and he argues his case by discussing the example of spatial reference in Spanish and English: English uses only one spatial distinction (*here/there*), while Spanish uses two distinctions (*aquí/ahí/allí*). In Levelt's view, these distinctions should already be present in the preverbal messages. De Bot (1992), however, suggests that this conception would be anti-economical and proposes that the first of the two operations taking place in the conceptualizer (macroplanning) be language-independent, and the second operation (microplanning) be language-specific. What is indeed clear is the fact that the internal structure of lexical items is crucial for the understanding of lexical retrieval processes.

The bilingual version of Levelt's model must account for the fact that, with no apparent problems, many bilinguals can use both languages separately as well as in 'code-switching' mode. It should also account for the fact that unwanted cross-linguistic influence is relatively common in bilingual speech.

2.3.2 Spreading Activation Theory

Semantic Activation models (Collins and Loftus 1975; Dell 1986 1988; Dell and O'Seaghdha 1992) are based on assumptions of spreading activation, which 'postulates a network of linguistic rules and units in which decisions of what unit or rule to choose are based on the activation levels of the nodes representing those rules or units' (Dell 1986: 283). In a spreading activation model, lexical processing would take place in a way very similar to the synaptic connections in nervous transmission (see figure 2). There are three processes involved: spreading, summation and decay.

- Spreading happens when a node is activated and sends out some activation to other nodes connected to it.
- Summation operates when the activation reaching a particular node is added to whatever level of activation was previously present in the node.
- Decay is the passive decrease of activation after a period of no activation reaching the node.

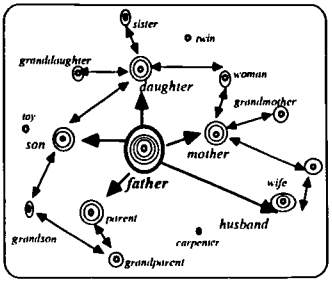

Figure 2. Illustration of how Semantic Activation models work: when a linguistic node is activated (e.g. 'father'), activation spreads out to other nodes connected to it. The level of activation becomes weaker as it reaches nodes further removed from the central one (e.g. 'daughter', 'sister').

Spreading activation closely relates to the notion of the Subset Principle (Paradis 1987, cited by De Bot 1992). The appeal of this hypothesis lies in the suggestion that, if connections are made often enough, subsets can be formed, not only among elements (nodes) of a single language, but also among elements of different languages. A further characteristic of subsets is that they can comprise not only words as such but also groups of semantic or syntactic features. An example of a within-language subset is any semantic field. A subset across languages would be formed by lexical entries frequently used by bilinguals who code-switch very often. Another fundamental feature of this model is that all the connections are two-way and activation can circulate in both directions between two activated nodes. This theoretical aspect, which is of crucial relevance for the organisation of the bilingual lexicon, poses an important problem for Semantic Activation models, in general, and for the Subset Principle, in particular: if information can flow backwards and forwards between lexical entries for both languages, why is it that translation from L1 into L2 is generally much more difficult and slow than translation from L2 into L1? The Concept Mediation Hypothesis, in the next section, addresses this issue.

2.3.3 The Concept Mediation Hypothesis

A variation of the Shared-&-Separate Semantic Store Hypothesis, the 'Three-Code' Hierarchical Model, was put forward by Potter, So, Von Eckardt and Felman (1984). It suggests that there are different levels of lexical processing. Whether the lexicons in a bilingual's two languages operate independently or in a shared fashion depends on how deep the level of processing is: there is a first level, the level of the word forms, which is language-specific (separate); and there is a conceptual memory level, which is language-general (shared). Furthermore, the store of conceptual representations is amodal (non-linguistic) and therefore other forms of information, like pictorial information, can also have access to it.

Potter *et al.* (1984) tested their model by looking at retrieval of translation equivalents. They proposed two types of hypotheses about how translation equivalents could be searched for in the other language:

- The Word Association Hypothesis: A word in one language makes a direct contact to its translation equivalent in the other language.

- The Concept Mediation Hypothesis: Lexical items contact translation equivalents in the other language via conceptual representations in the memory. It is assumed that translation by word association is faster than by concept mediation, because the route is more direct.

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The Three-Code Hierarchical Model has been progressively revised and extended to address the question of asymmetry in translation. Kroll and Sholl (1992), Kroll (1993) and Kroll and Stewart (1994) have proposed the Asymmetry Model of bilingual representation. This model includes both lexical and conceptual connections between the L1 and the L2 and different connection strengths depending on the direction of the connection (see figure 3).

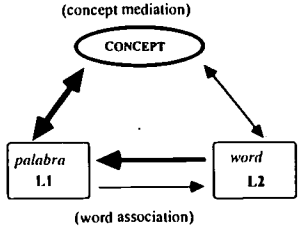

Figure 3. Illustration of the Asymmetry Model. Translation from L1 to L2 is more difficult because lexical connections in the L2 direction are weaker.

The authors hypothesise that translations from L2 to L1 are less difficult and faster than translations from L1 to L2, because word-to-word links between L2 and L1 are stronger than word-to-word links between L1 and L2. Translation from L1 to L2, on the other hand, is likely to be conceptually mediated, and this mediation is impaired by the fact that conceptual links for L2 are not as strong as conceptual links for L1. As the speaker becomes more fluent, connections between L2 and conceptual representations become stronger, but the lexical connections are still active. This would explain why translation into L1 usually remains easier. The Asymmetry Model is, however, more descriptive than explanatory: it tells what happens in translation, but not why that happens. For example, lexical connections in the L1—>L2 direction are weaker. But, if information flows both ways, according to theories of Spreading Activation, why then should information in one particular direction be impaired?

3. Factors affecting the organisation of the bilingual lexicon

We have seen so far that looking at lexical knowledge as a monolithic construct, and asking whether this knowledge is shared in a common system or is stored in two separate systems, is probably too simplistic. There are several factors that may play an important role in how the bilingual lexicon is organised, mainly the degree of topological difference between the two languages, the degree of dominance of one language over another and the demands imposed by the experimental tasks.

3.1 Linguistic distance between the two languages

To establish a relationship between the linguistic distance separating two languages and the likelihood of a joint or independent semantic store, Paradis (1985) formulated a hypothesis of a language pair-distance continuum. The continuum would range from the great dissimilarity between two unrelated languages (e.g. Spanish *vs.* Basque), through only relative similarity in somewhat related languages (e.g. Spanish *vs.* English, Spanish *vs.* Italian), to the great similarity between two different registers of the same language (e.g. colloquial Spanish vs. formal Spanish). What this implies is that a bilingual speaker of two closely related languages is more likely to enjoy shared

semantic information for both languages, while the bilingual speaker of two completely unrelated languages probably makes greater use of language-specific lexical knowledge.

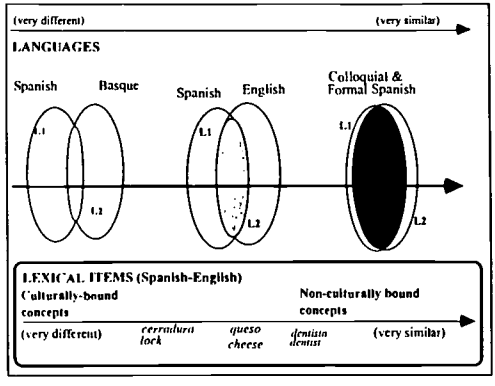

Figure 4. Illustration of Paradis (1985) hypothesis for the language pair-distance continuum. The hypothesis could be extended to cross-language pairs of lexical items (e.g. Spanish-English).

Now, I would like to suggest that the hypothesis of linguistic distance could be applied not only to languages as whole systems, but also to individual lexical items. Take Spanish and English as an instance (see figure 4). For translation equivalents, not formally related in any obvious way, like *cerradura* and *lock*, the bilingual speaker would rely more on language-specific knowledge. For two more obviously related items, like *queso* and *cheese* the overlapping semantic knowledge would be greater. Finally, for two true cognates (i.e. lexical items with same meaning and very similar phonology) like *dentista* and *dentist*, the Spanish-English speaker would largely make use of the same procedural and lexical knowledge. An extreme example of lexical distance comes with culturally-bound concepts. For example, English words related to cricket and Spanish words related to bullfighting are extraordinarily difficult to translate, because the concepts as such do not exist in the target language. In a more domestic domain, the word *kettle* has no satisfactory translation into Spanish, quite simply because there are no 'kettles' in Spain. *Kettle* is sometimes translated as 'hervidora de agua', which is only half adequate, as it is a translated paraphrase of the function of the object.

The notion of lexical distance, or degree of 'cognates', closely relates to one of the independent variables in the lexical decision experiment reported later in this article (see section 4.1. on hypotheses and variables). In this connection, we drew up a list of very similar pairs of words in both languages, or 'sames', (e.g. *mapa* and *map*) and a list of very dissimilar pairs of words, or 'differents', (e.g. *pantalla* and *screen*). Our aim was to explore if, across languages, reaction times for 'same' words were shorter than reaction times for 'different' words. If this is the case, it could then be hypothesised that cognates share some procedural and lexical knowledge – hence the priming effect, and that translation equivalents are processed in a more language-specific way – hence less or no priming effect.

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3.2. Level of proficiency in the second language

One theoretical problem which Levelt's Speaking Model (1989, 1992) presents in relation to the bilingual lexicon is that it is a 'steady-state' model (De Bot 1992:3), and, therefore, it leaves us with the question of how relevant the processes described by Levelt are for the basic L2 lexicon of a very uneven bilingual speaker. As De Bot points out, since the model is mostly appropriate to account for full or total command of the language, the extent to which the speaker is more or less competent in both languages should affect the organization of the lexicon and the relationships between its components.

It could be argued that very uneven bilinguals have a much more shared semantic store than more balanced bilinguals. Thus, as experience in the second language increases, speakers would move towards a more language-specific lexicon. Some experiments seem to confirm this idea. For example, Preston and Lambert (1969) and Mägiste (1985), in their experiments with Stroop techniques, found that uneven bilinguals experienced greater interference between languages. For more balanced bilinguals, on the other hand, their cross-linguistic interference was comparable to the interference in the monolingual version of the task. Furthermore, Potter *et al.* (1984), in their studies with proficient Chinese-English bilinguals and non-fluent English-French bilinguals, reached the conclusion that fluent and non-fluent subjects both retrieved translation equivalents in a way consistent with the concept mediation hypothesis. Surprisingly, they found no confirmation of the intuitively appealing notion that non-fluent bilinguals translate by word-to-word association.

But the nature of these conclusions needs to be revised. Kroll and Sholl (1992) present evidence suggesting that individuals in their early stages of L2 learning do make use of direct word connections in translation. They suggest that this may be the case because their subjects were probably more true beginners than those of Potter *et al.*'s, and, presumably, as speakers progress in their L2 competence, they would shift towards a concept mediation mode in L2 word processing. They further argue that the more direct lexical connections remain available to the more fluent speaker.

3.3. Methodological variables

The importance of the influence of experimental variables on the results of the different experiments has been highlighted by De Groot (1996):

> For the word level, two separate stores are assumed, one for each of the two languages of the bilingual; the representations at the meaning level are thought to be shared by the two languages. Different experimental tasks exploit the two different layers in the system, which is why they produce results that are 'seemingly' contradictory.
>
> (De Groot 1996: 339-340).

Indeed, a number of researchers have drawn attention to the crucial influence of the nature of tasks on the kind of results obtained in experiments. Durgunoglu and Roediger (1987), for example, stress that it is the processing demands of the retrieving tasks that is revealed in these experiments, rather than the organisation of the bilingual memory. According to these authors there are two basic types of experimental tasks:

- Conceptually driven tasks require subjects to focus on the conceptual representations lying behind the stumuli. Free recall and categorisation of lexical items are examples of this type of task.

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- Data-driven tasks make subjects concentrate on the physical characteristics of the stimuli. Word-fragment completion and lexical decision techniques are examples of data-driven tasks.

Tasks demanding attention at the level of the word form tend to yield results consistent with the Separate Semantic Store view, whereas tasks concentrating on the level of word meaning tend to produce results in agreement with the Shared Semantic Store view. In numerous studies on translation task, De Groot has shown that the nature of the experimental linguistic stimuli plays a crucial role in bilingual lexical processing (De Groot and Nas 1991; De Groot 1992, 1993; De Groot, Dannenburg and Van Hell 1994). In particular, she looked at imageability, context availability, familiarity, word frequency, length of word and cognate status. She found that all these experimental factors correlate with the subjects' performance and warns against hidden effects produced by different characteristics in the stimuli. For example, concrete nouns are generally preferred to abstract nouns, verbs or adjectives because of their higher degree of 'imageability'; however, not all concrete nouns are equally 'imageable'. In using cognates, both members of the cognate pair may not be used with the same frequency in their respective languages. In fact, that will almost certainly be the case. An added problem is the fact that very frequent words are quite often polysemous words, not least of all in English. A word like *letter* can be translated into Spanish as *carta* (what you put inside an envelope), or as *letra* (every unit of the alphabet). Words like *bank* and *bench* both translate into Spanish as *banco*. The question is, when the word *banco* is activated in the speaker's mind, which meaning is being tapped? The more frequently used? And also, are the various meanings accessed simultaneously or successively?

4. Report on preliminary research study[1]

This section briefly reports on a cross-language lexical decision experiment with repetition priming with Spanish(L1)-English(L2) bilinguals, carried out in the Department of Applied Linguistics at the University of Edinburgh in the summer of 1995. The study was initially intended as a replication of a study published by De Bot and his collaborators (De Bot, Cox, Ralston, Schaufeli and Weltens 1995). They report on two different lexical decision tasks, one based on written data and one on auditory data. In the present study, I used the experimental design of their auditory task but presented visual (written) stimuli. What follows is only a short description; a full account of the study can be found in Sanitise Midland (1995).

A lexical decision task typically requires subjects to respond as quickly and as accurately as possible to whether a string of letters in a language constitutes a real word or a non-word in that particular language. Stimuli can be visual or auditory, and they can be presented once or more than once in the course of the experiment. If they are presented more than once, we then have a lexical decision task with priming. It is now accepted that, in monolingual versions of the task, the second presentation of the stimulus triggers shorter reaction times. In cross-linguistic lexical decision tasks, when there is a shortening in reaction times on the presentation of the translation equivalent, this is taken as support for a shared model of semantic representation. Conversely, no influence on reaction times is taken as support for the separate model. Priming can be obtained in two different ways: by repetition priming or by semantic priming. In repetition priming, the same stimulus is repeated, either in its identical form (same word, same language), or in a translated version. In semantic priming, the prime is a word related in meaning to the target word, whether within a language (*doctor-nurse*), or across languages (*médico-nurse*). As monolingual semantic priming has been shown to occur, the aim in bilingual research is to analyze if semantic priming also operates across languages.

4.1. Hypotheses and variables

In line with De Bot *et al.* (1995) this study tested four hypotheses, formulated as follows:

1. There will be a within-language repetition priming effect for both Spanish and English.

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2. There will be a between-language repetition priming effect for cognates, but no effect for translation equivalents.

3. The between-language repetition priming effect for cognates will be present in low proficiency bilinguals, but not in high proficiency bilinguals.

4. For low proficiency bilinguals the repetition priming effects will be stronger in the L1 —>L2 (Spanish—>English) condition than in the L2—>L1 condition. No such difference will be expected with high proficiency bilinguals.

To test these hypotheses, four independent categorial variables were selected (see table 1): language, level of L2 proficiency, level of cognates and how the items were repeated.

VARIABLES	CATEGORIES
1. LANGUAGE	•Spanish •English
2. L2 PROFICIENCY	•Low intermediate •Advanced
3. COGNATES	•'Sames' •'Differents'
4. REPETITION	•Repeated •Within-language •Between-language •Non repeated

Table 1. Four independent categorical variables and their respective categories.

Cognates refers to the degree of similarity in form (written and spoken) between items with the same meaning in both languages. I was primarily interested in two types of items:

- Real cognates or 'sames': These are items which have the same meaning and whose form is also very similar; for example, teléfono and telephone, or pistola and pistol.

- Translation equivalents or 'differents': These are items which have the same meaning but whose form is very dissimilar; for example, cazador and hunter, or asa and handle.

The dependent variable was reaction times in the lexical decision task, measured in milliseconds.

4.2 Method

A set of 640 items, which comprised 320 words and 320 pseudo words was required to satisfy the experimental design. As one of the variables was degree of cognates, it was important for item validity that expert judgements of similarity and dissimilarity should be obtained.

4.2.1 Native judges and rating materials

An initial list of 270 pairs of Spanish-English words was drawn. Then, eight 'naive' native speakers of Spanish, with advanced knowledge of English, rated every pair for 'degree of similarity'. These judges were instructed, in writing, that words in every pair were similar in meaning but different in pronunciation and spelling, and that the degree of difference varied from pair to pair. In some pairs the words looked and sounded very different – for example, *armario / wardrobe* –, or very similar – for example, *acción / action*. In other pairs the words looked and sounded only relatively similar – or example, *botella / bottle* and *diamante / diamond*. Using a 7-point scale (see table 2), judges had to rate whether the words in each pair were 'totally different' (1 point), 'virtually identical' (7 points) or 'somewhere in between' (2 to 6 points). The judges' decisions were highly consistent (α = .9751). For y pair of words I had eight ratings, on which mean (perceived 'degree of difference / similarity')

and standard deviation (degree of agreement among judges) were calculated. Table 3 shows a selection of these data. These calculations allowed confident allocation of items to the different lexical categories required for the experiment: 'sames', 'differents' and fillers.

ESPAÑOL-INGLES	ESCALA	ESPAÑOL-INGLES	ESCALA
tijeras/scissors	1234567	camisa/shirt	1234567
venda/bandage	1234567	nube/cloud	1234567
naranja/orange	1234567	tormenta/storm	1234567
escalera/stairs	1234567	cebolla/onion	1234567
ducha/shower	1234567	mariposa/butterfly	1234567
padre/father	1234567	nariz/nose	1234567

Table 2. Selection of rating task for the judges. For every L1/L2 pair, judges had to rate the level of difference.

WORDS	JUDGES' RATINGS								MEAN	DEVIATION
1. cerradura/lock	1	1	1	1	1	1	1	1	1.000	0.00000
2. serpiente/snake	3	3	1	1	1	1	1	3	1.750	1.03510
3. bolsillo/pocket	1	2	1	1	1	1	1	2	1.250	0.46291
4. maleta/suitcase	1	1	1	1	1	1	1	1	1.000	0.00000
5. ola/wave	1	6	1	1	1	1	1	2	1.750	1.75255
6. periódico/newspaper	1	3	5	4	1	5	2	4	3.125	1.64208
7. lluvia/rain	2	3	1	1	1	3	1	3	1.875	0.99103
8. gato/cat	1	4	1	1	1	1	1	1	1.375	1.06066
9. cortina/curtain	5	7	5	4	5	5	5	6	5.250	0.88641
10. queso/cheese	1	4	1	3	2	3	4	4	2.750	1.28174

Table 3. Selection of judges' ratings. Mean and standard deviation for every pair of words yielded 'degree of similarity' and 'degree of agreement among judges', respectively.

4.2.2. Stimuli

From the initial list of stimuli (270 pairs), the experimental items were selected: 'sames' (40 pairs with the highest mean) and 'differents' (40 pairs with the lowest mean). From the middle of the list 160 pairs were selected as fillers, to act as distractors in the lexical decision task. The remaining 30 pairs were discarded. The number of items allocated to every category can be seen in table 4.

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	SPANISH	ENGLISH	Total
'SAMES'	40	40	80
'DIFFERENTS'	40	40	80
FILLERS	80	80	160
PSEUDO WORDS	160	160	320
TOTAL			640

Table 4. Number of words and pseudo words and its distribution in the different categories.

- The experimental items in Spanish are 40 'sames' and 40 'differents'. The experimental items in English are the corresponding translations of the 80 Spanish items.
- The fillers were the 160 middle-ground pairs (80 items for each language). For every pair, only the Spanish word or the English word formed part of the filler bank.
- The number of pseudo words matches the number of experimental items and fillers, i.e. 320 (160 for each language). I understand 'pseudo words' in Groot and Nas' terms: "letter strings that conform to the orthography and phonology of the experimental language, but that carry no meaning" (Groot and Nas 1991: 95). My pseudo words were created by an English native speaker by changing, adding or deleting one letter in every one of the real words. There is a selection of these items in table 5.

	SPANISH		ENGLISH	
	WORDS	PSEUDO WORDS	WORDS	PSEUDO WORDS
'SAMES'	estatua	espatua	statue	satue
	pistola	pitola	pistol	pristol
	té	tém	tea	tean
	capitán	sapitán	captain	captaine
	guitarra	guiarra	guitar	gitar
'DIFFERENTS'	cerradura	cerradua	lock	loock
	maleta	laleta	suitcase	sitcase
	sombrero	sombero	hat	hap
	bandera	bamdera	flag	flug
	cazador	carzador	hunter	thunter
FILLERS	cuello	cuellio	road	troad
	mano	manoz	drum	brum
	bigote	bilgote	farm	fam
	pastel	pascel	arm	larm
	ajo	zajo	sheet	cheet

Table 5. Selection of 'SAMES', 'DIFFERENTS' and FILLERS for both languages, and their corresponding pseudo words.

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The 640 items were presented in four separate single language 'blocks': two blocks were in Spanish and the other two in English. It was decided to alternate language in presentation to ensure that presentation of the repeated items was not delayed by more than ten minutes (ten minutes was the duration of every block). All subjects in the experiment were presented with the same material but in a different random sequence, to avoid any effect due to the order of presentation of the stimuli.

4.2.3 Subjects

Forty-five native speakers of Spanish did the experiment. For experimental reasons only 40 of them were selected for the study. They were all unpaid volunteers whose level of proficiency in English was either low intermediate or advanced. There were 20 subjects in each level. All subjects were briefly interviewed about language background and current usage of English. Most of the advanced subjects were recruited from postgraduate courses at Edinburgh University and had lived in Scotland between one and five years. Most people in the low group had come to Scotland to do a three-week English language course for low intermediate students at the Institute for Applied Language Studies, also at Edinburgh University.

4.2.4 Procedure

Subjects were tested individually in a single session of about 45 minutes. They sat in front of an LCIII Apple Macintosh computer and, were in full control of the experiment (run using the PsyScope programme). All the necessary instructions appeared on the screen, in Spanish. Subjects were informed that they were going to see a number of letter-strings on the screen, either in Spanish or in English, and that they could be true words or pseudo words. Using a two-button box, subjects had to decide as quickly and as accurately as possible whether the letter string was a real word or not. A bleep after every response informed the subject whether he or she had answered correctly. However, feedback on speed was not provided. The experiment started with a small two-block practice session to allow familiarisation with the task.

4.2.5. Analysis and results

The data was filtered to remove incorrect responses and reaction times longer than 1400 milliseconds to avoid spurious effects of exceptionally long latencies, due, for example, to distraction or interruption of the task. Incorrect responses were also discarded. The analysis was thus carried out on a total of 2975 responses, with latencies ranging from 320 to 1395 milliseconds and a mean of 654.1 milliseconds for the whole experiment. Figure 5 presents the marginal means and standard deviations for both levels of the four variables in the study. Figure 6 presents mean reaction times for all the categories, together with baseline conditions. A factorial ANOVA yielded three significant main factor effects (proficiency, language and within/between repetition), no first order interaction effects, and one significant second order interaction effect (proficiency x language x repetition).

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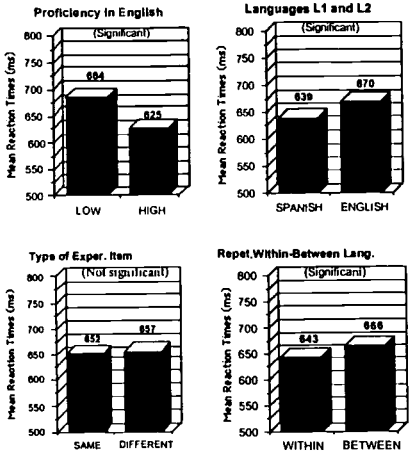

Figure 5. Marginal mean reaction times to lexical decision task for the two levels of the four variables: level of proficiency, languages (L1 and L2), degree of similarity in the two words of every experimental pair, and mode of repetition in relation to language. For every variable, except type of experimental item, the difference between both means is significant.

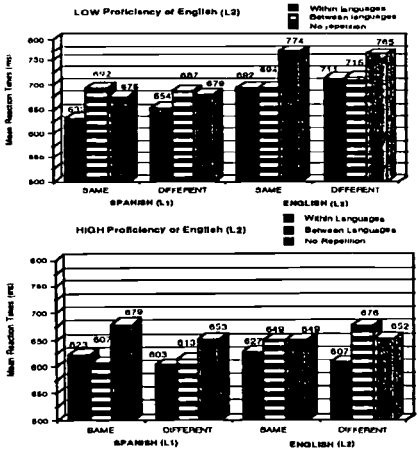

Figure 6. Mean reaction times for the LOW group and the HIGH group, for no repetition (baseline condition), within-language repetition and between-language repetition, crossed with languages and item type.

The results of the factorial analysis for the four hypotheses mentioned at the beginning of this report are as follows:

1. 'There will be a within-language repetition priming effect for both Spanish and English'. The results support this hypothesis [F (1.2959)= 11.28, p < .05].

2. 'There will be a between-language repetition priming effect for cognates but no effect for translation equivalents'. There is no interaction effect between repetition and type of item [F (1.2959)= 0.78, p > .05]. This hypothesis is not supported.

3. 'The between-language repetition priming effect for cognates will be present in low proficiency bilinguals, but not in high proficiency bilinguals'. There is no interaction effect between proficiency and repetition [F (1.2959)= 0.07, p > .05]. The outcome does not support the hypothesis.

4. 'For low proficiency bilinguals the repetition priming effects will be stronger in the L1 —>L2 (Spanish—>English) condition than in the L2—>L1 condition. No such difference will be expected with high proficiency bilinguals'. There is no interaction between proficiency and type of item [F (1.2959)= 1.34, p > .05]. The hypothesis is not confirmed.

Hardly surprising are the significant results that refer to two of the main effects:

- The low proficiency group showed significantly slower reaction times (by 60 ms) than the high proficiency group [F (1.2959)= 73.63, p < .05].

- The reaction time for Spanish was significantly shorter (on average 30 ms quicker) than English [F (1.2959)= 22.27, p < .05]. Again, this is hardly surprising, since Spanish is the subjects' native language.

More important is the significant second order effect proficiency x language x repetition [F (1.2959)= 11.21, p < .05], which is the only interaction effect in the study (see figure 7).

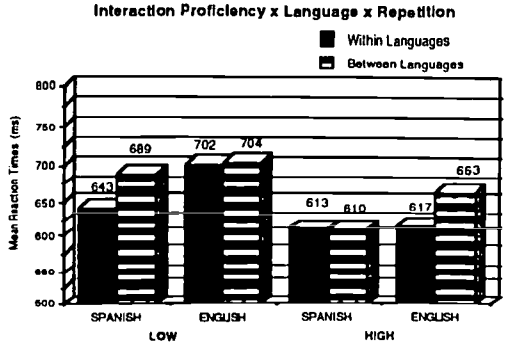

Figure 7. Mean reaction times for within/between repetition across proficiency and language.

The main results of the experiment can then be summarised as follows. There are differences in reaction times for language, proficiency and repetition condition taken as main factors. There is also an interaction effect between these three factors. Most importantly, no differences have been observed between cognates and translation equivalents. We examine these results in the next section.

4.4 Discussion

As indicated at the beginning of this report, the aim was to explore four variables: type of priming, degree of cognates, level of proficiency and language. In line with the results of the study that we aimed to replicate, we found no significant patterns in relation to degree of cognates. As regards type of priming and the relationship with level of language proficiency, I find that these results (within-language effect) are in line with those of other studies: Kerkman (1984, cited by De Bot *et al.* 1995), De Bot *et al.* (1995) and Woutersen, Cox and De Bot (1994), to mention but a few. Generally, in connection with cognates, findings are very often conflicting. Kerkman (1984), Monsell, Matthews and Miller (1992), and Gerard and Scarborough (1989) found cross-language priming for cognates and semi-cognates, but no priming for translation equivalents. On the other hand, De Bot *et al.* (1995) and Woutersen *et al.* (1994) found no differences for cognates and translation equivalents.

At this point it is relevant to discuss Monsell *et al.*'s work (1992) briefly. They worked with Welsh-English bilinguals who had to name pictures in Welsh. Half the stimuli had been primed by words in Welsh, given in response to Welsh definitions, or by words in English, given in response to English definitions. They found considerable amount of within-language facilitation. Crucially, they did not find facilitation between languages when the equivalents differed in their phonological form. As there is no priming, they argued, from repeated activation of meaning alone or from repeated activation of phonological form alone, they hypothesised that the locus of cross-language priming lies between the word's meaning and the word's form.

A further point to bear in mind is the nature of words used in the present experiment. In her review of word-type effect on bilingual processing, De Groot (1993) writes in favour of a mixed representation of the bilingual lexicon, arguing that concrete nouns and cognates are more likely to be stored in a common memory system than are abstract nouns. This may be true, but distinguishing between concrete and abstract nouns might not be enough. Within concrete nouns, the degree of 'imageability' can also play a role. All our nouns were concrete nouns, but we cannot be sure that they all had the same degree of imageability. It could be hypothesised that highly 'imageable' words could in fact conjure up a mental picture much more readily, and could prime their corresponding translation equivalents regardless of their surface similarity, i.e. regardless of whether they are true cognates or not. As one of our judges put it: "I know that *manzana* and *apple* are different, but to me they are the same thing, I picture a *manzana-apple* very readily in my mind". It could be argued, then, that if a word and its translation have a high degree of imageability, they could prime one another more than two items with a low degree of imageability, whether or not they look and sound the same.

5. Where do we go from here?

I would now like to explore two possible avenues for research. The first line of work follows directly from the preliminary study and it involves the use of auditory material. One of the reasons why I did not obtain the expected cross-language repetition effect may have been the influence of the phonological form of the stimuli. It could well be that my 'sames' were not as similar as I thought they were. The phonological systems in Spanish and English are really very different. Some of the 'same' pairs, like *cocodrilo* and *crocodile, plato* and *plate,* or *bebé* and *baby,* may have not been perceived as very similar by our experimental subjects. If one reads these words mentally, they may not 'sound' as similar as they 'look'. To put it very simply, to the non-linguist, some English items have some diphthongs that the Spanish items do not have, which may, in fact, make the pairs sound very rent. The rating instructions given to the native judges encouraged them to look for similarities

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both in spelling and pronunciation. But maybe we were mixing two aspects, overly different, under the single term 'similarity'. Certainly, Monsell *et al.*'s work (1992) appears to confirm this possibility. It therefore looks as if a similar study with auditory stimuli, or a combination of auditory and visual stimuli, could perhaps shed some light on the problem of how important the interference of 'mental pronunciation' is in processing cross-linguistic visual (written) material. It may be the case that interference from 'mental pronunciation' in reading-type tasks is more likely than the interference of 'mental spelling' in auditory-type tasks. As yet, we simply do not know.

The second line of research that I would like to explore relates to the relationship between form and meaning in the activation of cognates. Gerard and Scarborough (1989) looked at Spanish-English cognates, non-cognates and homographic non-cognates (words spelt identically but with different meaning, e.g. *quince*). As they had hypothesized, they found cross-language facilitation for cognates, but not for translation equivalents. They further found cross-language facilitation for homographic non-cognates. This may be indicative that 'form' is much more likely to trigger cross-language facilitation than 'meaning'. One possible explanation for this could be that lexical entries are connected interlingually primarily through form. Since not many researchers have worked with homographic non-cognates we still do not know exactly how much of cross-language cognate facilitation is due to form-similarity and how much is due to meaning-similarity.

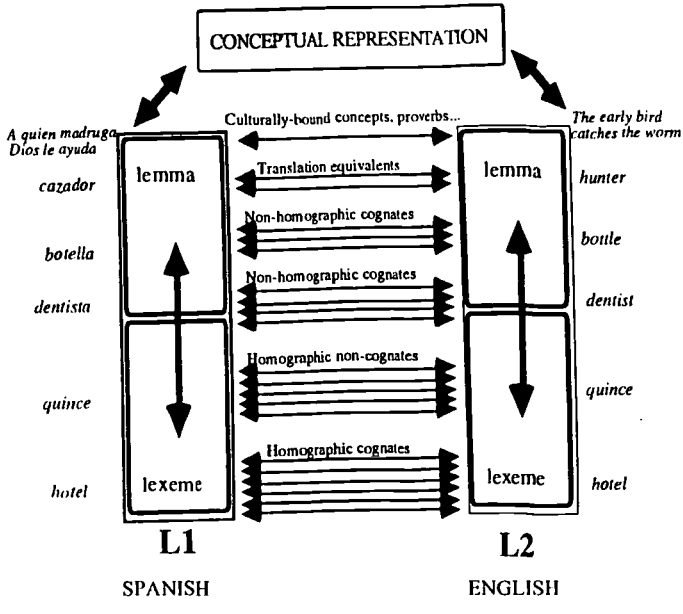

Figure 8. Possible degrees of cross-language activation for different degrees of 'cognates' and 'homographicness' combined. The number of arrows illustrates the hypothesis that activation is a function of form and meaning combined.

The hypothesis presented in figure 8 suggests that there is a continuum in which activation is a function of form and meaning combined. Form on its own is more 'activation-generating' than meaning on its own, but effects are accumulative. So, the greatest activation would take place when form and meaning are identical, as in the case of homographic cognates (e.g. hotel, for Spanish and

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English) and the smallest activation would occur when only meaning is shared, as in translation equivalents or culturally-bound concepts.

There are a number of methodological issues, though, which need to be taken into consideration. One problem is whether cognates share the same relative frequency of use in their respective languages. For example, the Spanish word *quince* ('fifteen') is relatively frequent, however, the English word *quince* is extremely infrequent. A second methodological hurdle is to actually find enough experimental items which fit into the categories of the proposed hypothesis. Finally, another important aspect refers to the actual presentation of stimuli: if activation effects of cross-linguistic priming were highly transient, then the time lag between presentation of primes and presentation of targets must be carefully controlled for.

6. Conclusion

I hope to have shown that the question of whether the bilingual lexicon is organized in one or two semantic stores is an over-simplification. To address the issue in a more realistic way we need to investigate under what circumstances the semantic knowledge of both languages can be separated and under what circumstances this knowledge operates in a combined way. The literature review shows that, more and more, researchers are moving towards models of mixed-representation of bilingual lexical knowledge. It certainly fits the evidence better to think of the bilingual lexicon in terms of a dynamic structure comprising various subsets. The number and defining criteria of these subsets are not yet fully understood, nor are the relationships between them. Thus, more research would be welcome to look into specific questions like, to name just a few, the asymmetry in the lexical connections between languages, the notion of lexical proficiency, the influence of the cognitive nature of the experimental tasks and the comparison between visual and auditory bilingual lexical processing.

Notes

[1] I am aware that in SLA literature 'uneven' bilinguals are normally referred to as 'unbalanced' bilinguals, but given the unfortunate connotations of the word 'unbalanced' when applied to the mind, I have decided to favour the use of the much more neutral term 'uneven'.

[2] For example, for a Spanish-English bilingual, a word like *cementerio* brings a set of associations completely different from the word *cemetery*. For Spanish speakers cemeteries are morbid places, to be kept away from people's lives, and physically far from the centre of the town. In Britain, on the other hand, cemeteries are much more integrated in the city landscape, e.g. frequently they are part of a public park.

[3] Thanks are due to the people that made this study possible: Dr. Dan Robertson from the Department of Applied Linguistics, for his invaluable help; the Department of Linguistics, for allowing me to use their computer laboratories; and the forty-five participants in the experiment, who so generously lent me an hour of their time.

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