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Semantic Representation and Surface Forms: A Look at Across-Language Priming in Bilinguals

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The question of whether words in one language versus their translations in another access the same conceptual representation was addressed in the present experiment. English-French bilinguals were tested in a lexical decision task, the target words being primed by semantically related words in either the same language or across languages. The results show significant priming facilitation in both conditions; response latencies were notably shorter when the target was preceded by a semantically related word than when presented alone, whether or not the two words were presented in the same language. While these results seem to substantiate the hypothesis of a common semantic store for the two languages, close inspection reveals that facilitation was more likely due to the strategic use of primes than to automatic processing.

To what degree does the physical presentation of a concept determine its semantic representation? Do there exist in memory several distinct representational systems, each specific to a particular surface form, or do all possible physical and/or perceptive forms of a concept ultimately converge into a single amodal representation? This question has indeed been the subject of heated debate in cognitive psychology for the last 20 years.

In monolinguals, it has generally been examined in the framework of studies on imagery; the question is posed, for example, whether the word *chair* and the picture of a chair give rise to the same underlying

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representation (Paivio, 1971; Pylyshyn, 1973; Anderson & Paulson, 1978).

This question has also been studied in reference to bilinguals. Here, the debate is raised as to whether the two verbal systems available to the bilingual are distinguishable at the lexical level alone or at a conceptual level as well. In general, two extreme positions are opposed. The independence model argues in favor of multiple symbolic systems, with contact being mainly established through translation processes, though some overlap would exist (Kolers & Gonzales, 1980; Paivio & Desrochers, 1980; Paivio & Lambert, 1981; Kolers & Brison, 1984). Opposing this view, the interdependence model argues for different levels of processing, whereby the two lexical systems of the bilingual would ultimately converge at a unique supralinguistic system of knowledge (McCormack, 1977; Potter, So, Von Eckardt, & Feldman, 1984).

The idea of various levels of processing seems indeed to be the key to this debate, especially inasmuch as bilinguals are concerned. Indeed, several studies have provided experimental evidence that at certain levels of analysis the two linguistic codes are relatively independent. It has been shown, for example, that a bilingual can activate one phonological system without experiencing interference from the other (Carmazza, Yeni-Komshian, & Zurif, 1974; Altenberg & Cairns, 1983). The level of treatment seems as well to be determined by the task, whether such be imposed upon, or decided upon by, the subject. Kintsch (1970) demonstrated this with a recognition task. He showed that, when shown a continuous list of words, these being presented either twice in one language (i.e., DOG, DOG) or once in two languages (i.e., DOG, HUND), bilingual subjects could base recognition either upon the physical presentation or upon the meaning of a word, in accordance with instructions.

This fact is important to keep in mind when interpretating the results of experimental studies on semantic representation in bilinguals. We believe that in many cases, what has been taken as evidence for independent representational systems is in reality the reflection of independence at a lower level of processing. It has been shown that certain experimental tasks, in particular those that require the learning of lists of isolated words, lead the subject to pay more attention to the physical than to the semantic aspects of a word (Saegert, Hamayan, & Ahmar 1975). Thus, such tasks as free recall or recognition of mixed language lists, while providing information about the criteria used in coding words during learning, would seem to be less appropriate for the study of the semantic representation of these words.

A task that is often used to investigate the organization of semantic memory is that of lexical decision. It has long since been proven in monolinguals that word recognition is facilitated by the prior presentation of an associated (Meyer & Schvaneveldt, 1971) or semantically related word (Neely, 1977). That this facilitation, classically known as the priming effect, is due to the processing of the meaning of the first word, or prime, has been shown by Fischler (1977) as well as by Franklin and Okada (1982).

Provided that the facilitation observed in lexical decision tasks is indeed due to the semantic treatment of the prime, this paradigm appears to be propitious for the study of semantic representation in bilinguals. By testing the facilitating effect of primes across languages, it should be possible to determine whether or not the two lexical systems do indeed converge at the semantic level.

Various authors have already employed this technique in bilingual situations, i.e., where the prime and target word were presented in either the same or different languages (Kirsner, Brown, Abrol, Chadha, & Sharma, 1980; Scarborough, Gerard, & Cortese, 1984; Kirsner, Smith, Lockhart, King, & Jain, 1984, experiment 1). In these studies, facilitation was observed only in within-language conditions, thus appearing to provide evidence that the two langauges of the bilingual are indeed stored in distinct semantic systems. It must be noted, however, that in the studies just cited, the prime consisted not of a word either semantically related or associated to the target but rather either the same exact word or a translation thereof (i.e., DOG–dog or PERRO–dog). The aim of these studies was to test for the "repetition effect," long since demonstrated in monolinguals, whereby the recognition of a word is faster following its repetition as compared to its first presentation. Here again, however, we are confronted with the problem of levels of processing. The conclusion that the lack of a repetition effect across languages reflects the absence of semantic overlap between these languages is based on the belief that said effect is itself due to processing at the semantic level, a belief that is far from being accepted unanimously. It has beeen shown, for example, in monolinguals that changing the format of a word upon its second presentation (auditory to visual) can reduce the amount of facilitation due to repetition (Kirsner & Smith, 1974; Scarborough, Gerard, & Cortese, 1979; Kirsner, Milech, & Standen, 1983). This result lends support to the contrary belief that the repetition effect is, if not purely a product of, at least strongly linked to, perceptual processing. We ourselves lean towards this belief, and agree with Scarborough et al. (1984) in saying that the repetition effect depends to a much greater extent upon the

physical similarity of stimuli than to processing at a conceptual level. As such, the absence of a repetition effect across languages does not necessarily reflect the absence of a common underlying concept for two surface level presentations of a word.

Quite to the contrary, experimental evidence has shown that facilitatory effects can be produced across languages, provided that the prime bear a semantic relationship to the target word. Meyer and Ruddy (1974) demonstrated a between-language priming effect, using words associated to the target as primes (i.e., the lexical decision latency to an L1 target, DOG, was shorter when preceded by an associated L2 prime, GATO, then when preceded by a nonassociated L2 prime, SIETE. Kirsner et al. (1984, experiment 4) also demonstrated facilitatory effects of primes across languages; however, these authors chose to use category names as primes.

The use of category names as primes rather than first associates seems to us in general to be more appropriate to the study of semantic representation, and especially in the case of bilinguals. Experiments on free association in bilinguals have shown that often these subjects give varying associations for the same word when presented in two different languages (Kolers, 1963; Dalrymple-Alford & Aamiry, 1970). While this result may at first sight appear to substantiate the hypothesis of seperate semantic networks, it should be emphasized that we are dealing here with often observed associations, most likely linked to cultural factors, whose relationship to the semantic organization of the lexicon is yet to be explored.

The experiment presented here was realized in order to study the semantic organization of the bilingual's two languages. In this aim, and for the reasons outlined above, we chose to use the lexical decision paradigm, while employing category names as primes. It was hypothesized that in the instance of a common semantic network, response latencies to target words would be faster following the prior presentation of a related prime than when presented alone. This reduction in response latencies would indicate that the semantic processing of the prime did indeed facilitate the subject's lexical decision to the target. This prediction, of course, essentially concerned conditions of across-language priming; however, the two within-language conditions were also included in the experiment as controls. We thus predicted a reduction in responce latencies in across-language priming conditions.

To the contrary, if semantic representation is language-specific, response latencies to target words should not be affected by prime processing when primes and targets are presented in different languages.

Priming effects should be observed in within-language, but not across-language, conditions.

METHOD

Subjects

Twenty-four adult English-French bilinguals, all being English-speaking natives having learned French formally as adults, participated on a volunteer basis. They were divided into two subgroups of 12, as a function of the number of years they had resided in France. The first group, which we shall call "skilled bilinguals," had lived in France for a mean of 14 years, while the second, or "less-skilled bilinguals," had lived in the country for an average of 3 years.

Materials

Target sequences consisted of 72 English nouns and their French equivalents, taken from six categories (parts of a building, parts of the body, birds, clothing, furniture, and vegetables). Categories were chosen that did not ressemble each other in the two languages (for example BIRD in English and OISEAU in French), in order that they might be used as across-language primes (i.e., categories such as FRUIT, which are spelled identically in both languages, were avoided). The items were chosen with the following constraints: (1) They appeared among the first 20 words cited in Rosch (1975) and Dubois (1983) category tables; (2) they ranged in length from three to nine letters; (3) their spelling and pronunciation differed considerably in the two languages. Thirty-six additional nouns (18 French and 18 English), taken from six other categories, were used as distractor items. A total of 180 nonwords were constructed by matching a word (in length and number of syllables) to each of the 72 English and French target sequences, as well as to the 36 distractor items, and changing one or two letters while observing the phonological and orthgraphic constraints of either French or English accordingly.

Target words were presented in two conditions. In the first condition they were presented alone, without being primed. In this condition the 72 target words were presented without the presence of distractor items, along with 72 nonwords. In the second condition, targets were preceded by their corresponding prime. The combination of factors Target Lan-

guage × Prime Language defined the four possible presentations of a target word in this condition (OISEAU–moineau; OISEAU–sparrow; BIRD–moineau; BIRD–sparrow). To avoid the subjects immediately becoming aware of the relationship between primes and targets, 36 distractor items were presented in this condition. They were preceded by the same primes as target words (for example BIRD–scooter), and like targets were divided into four groups according to the combination of factors Distractor Language × Prime Language. An equal number of nonwords (108) were presented, these as well being preceded by one of the 6 possible primes.

All target words were seen in both languages. A given subject saw 36 targets presented in French and 36 in English under each condition, with language of targets being counterbalanced across subjects and conditions. Thus, a given subject never saw the same word twice in the same language.

Apparatus

The experiment was controlled by a microcomputer. Stimuli were presented in white lower-case letters against a dark background, with French words being normally accented. Responses and response times were recorded by the computer.

Procedure

The experiment was divided into two sessions, in accordance with the conditions outlined above. In both sessions, subjects were to make a lexical decision, indicating their responses manually, and were instructed to respond affirmatively whenever the stimulus presented was indeed a word, independent of language. In the first session, stimuli were presented individually and remained on the screen until the subject had responded, with a 3-sec delay between subject's response and the presentation of the following stimulus. The second session differed from the first in two aspects: (1) Stimuli were preceded by the presentation of a prime. The prime was presented for 250 ms and disappeared automatically. The stimulus was then presented, following a delay of 250 ms without masking; (2) stimuli were presented in two blocks, according to prime language. In one block, primes were always presented in English (stimuli being either words in English, words in French, or nonwords), while in the other they were presented in French. Sessions took place on seperate days with a 3-day interval.

Table I. Mean Response Latencies and Percentage of Errors (in Parentheses) for Skilled and Less-Skilled bilinguals as a Function of Prime Condition, Prime Language, and Target Language

Condition:	Unprimed		English-primed		French-primed	
Target language:	English	French	English	French	English	French
Bilingual						
Skilled	760 (2)	797 (2)	679 (2)	734 (2)	709 (2)	776 (5)
Less-skilled	685 (3)	834 (7)	621 (1)	693 (3)	619 (2)	718 (3)

RESULTS

Table I presents a summary of results, as a function of Condition, Prime Language, Target Language, and Level of Bilingual. A 2(condition) × 2(prime language) × 2(target language) × 2(bilingual) × 6(category) × 3(item) ANOVA revealed the following significant main effects: Condition ($F(1, 22) = 7.85, p < .025$); Target language ($F(1, 22) = 31.49, p < .001$); Category ($F(5, 55) = 9.10, p < .001$). Subjects were quicker to decide that the sequence presented was indeed a word (1) when it was primed (693 ms) than when presented alone (769 ms), (2) when the word was presented in English (690 ms) than when presented in French (773 ms). Finally, subjects responded faster to certain categories of words.

A significant one-way interaction was observed between the factors Target Language × Level of Bilingual ($F(1, 22) = 5.38, p < .05$). This interaction reveals the fact that skilled bilinguals differed to a much lesser extent in their performances for the two languages (RT = 727 ms for English and 776 ms for French targets; difference = 49 ms) than did less-skilled bilinguals (RT = 652 ms and 770 ms, respectively; difference = 118 ms).

There was as well a significant two-way interaction between Target Language, Level of Bilingual, and Condition ($F(1, 22) = 4.75, p < .05$). Facilitation due to priming was less pronounced in the skilled than in the less-skilled group of bilinguals, and in the latter group facilitation was greater for target words presented in French than for those presented in English ($F(1, 22) = 4.95, p < .05$).

The difference in response patterns for the two levels of bilinguals led us to perform separate analyses for the two groups. When considered independently, the skilled bilingual group did not show a significant

Table II. Mean Response Latencies and Percentage of Errors (in Parentheses) for the Less-Skilled Group of Bilinguals as a Function of Prime Condition and Semantic Category

	Condition	
	Unprimed	Primed
Category		
Bird	855 (10)	673 (1)
Clothing	757 (6)	638 (0)
Body	711 (8)	614 (5)
Vegetable	789 (2)	707 (1)
Building	694 (1)	632 (1)
Furniture	750 (3)	714 (3)

effect of priming ($F(1, 11) = 2.25$, n.s.); mean response latencies in this group were not significantly shorter in the condition where target words were preceded by related primes than in the condition where presented without primes (as can be seen in Table I, however, the observed effects were in the right direction). To the contrary, there was a significant effect of priming in the less-skilled bilingual group ($F(1, 11) = 5.88, p < .05$). Moreover, there was a significant one-way interaction in this group between the factors Condition × Category ($F(5, 55) = 2.38, p < .05$). Priming facilitation was greater for certain categories of words than for others, and was greatest for the category BIRDS, which itself was the category with the highest mean response time in the condition where targets were presented alone, without being preceded by primes ($F(5, 55) = 2.51, p < .05$). A summary of these results is presented in Table II.

The factor Prime Language was not significant in any instance, neither as a main effect, nor when considered in interactions with other factors, nor when considered for independent groups of bilinguals ($F < 1$ in all cases.)

Error data are presented in parantheses in Table I. Globally, we observed the same pattern of results as that observed for response times. The overall error rate was 3%.

DISCUSSION

In general terms, the results provide evidence for the hypothesis that the bilingual's two languages converge at the semantic level. Our

bilingual subjects demonstrated higher performances, in terms of both speed and accuracy, when the target word was preceded by a semantically related word than when it was presented alone, whether or not the two words were presented in the same language.

However, while facilitation due to priming was observed both across and within languages, it was not observed equally for the two levels of bilinguals, nor for all words. First, priming facilitation was observed mainly in the group of less-skilled bilinguals. Second, it is interesting to note that, in this group, facilitation was greatest for words that were identified the most slowly in the condition of isolated presentation—i.e., certain categories of words, and words presented in French in general. Taken together, these results suggest that the priming facilitation we observed may not have been the result of effortless, automatic processing. Rather, it would appear as though facilitation was due to the conscious, strategic use of primes.

This distinction between "automatic activation" and "conscious attention," first introduced by Posner and Snyder (1975a, 1975b), is now a well-documented question. According to this two-component theory, context would act upon word identification through two independent mechanisms. Automatic mechanisms are operationally defined as processes that occur without intention, without giving rise to conscious awareness, and without producing interference with other ongoing mental activity. Said mechanisms would intervene rapidly and, owing to their nonintentional character, would be irrepressible in the sense that the subject could not avoid their ocurrence. Attentional mechanisms, on the other hand, would take place later in processing and would be under the subject's strategic control. Contrary to automatic mechanisms, attentional mechanisms are defined as being capacity-limited: Once a subject has invested his attention in the processing of a particular stimulus, the benefits due to automatic treatment would be augmented but simultaneously accompanied by a temporary incapacity to treat other stimuli.

The notion of automatic and attentional mechanisms in priming facilitation is of particular importance to the present study. Indeed, in order to truly substantiate the hypothesis of a common semantic network, it is necessary to show that across-language priming facilitation is the result of noncontrolled, automatic processing. This result not only would give proof of the existence of a semantic link between two words of two different languages of the same nature as that existing between two words of the same language but would as well invalidate all arguments that attribute across-language context effects to subject strategies, such as translation. Our results cannot, however, be taken as evidence for such.

First, as noted, facilitation was greater for those words that were identified more slowly. Numerous studies have equally demonstrated this relation between word identification latency and context effect. In general, these studies have compared the effect of context upon word identification in skilled and less-skilled readers. There is now considerable empirical evidence that less-skilled readers show larger context benefits than do skilled readers (Samuels, Begy, & Chen, 1975–1976; Schvaneveldt, Ackerman, & Semlear, 1977; West & Stanovich, 1978; Perfetti, Goldman, & Hogaboam, 1979; Stanovitch & West, 1979, 1981), the former as well being slower to identify words than the latter (Mackworth & Mackworth, 1974; Perfetti & Hogaboam, 1975; Perfetti, Finger, & Hogaboam, 1978). Moreover, Stanovich and West (1979) demonstrated that contextual facilitation is positively related to the time interval between presentation of the context and the target word, and that even for skilled readers the amount of benefit is greater for "difficult" words (long and rare, thus more slowly identified) than for "easy" ones (short and frequent, thus rapidly identified).

These results can be explained in terms of attentional processes. For Stanovich and West (1981), whereas the contextual benefit observed in skilled readers would result exclusively from automatic activation, in less-skilled readers word identification would be sufficiently slow for attentional processes to have time to intervene, thus augmenting the facilitation due to automatic mechanisms. Perfetti et al. (1979) also suggest that attentional mechanisms come into play in word identification to a much greater extent in less-skilled than in skilled readers. They suggest that the former, due to their difficulty in decoding, are led to actively use context. In a word-identification task, for example, they would employ the context to limit the possible lexical candidates. Skilled readers, on the other hand, would not use context in the same manner (see Carr, 1981) and in this type of task would benefit relatively little from it since their decoding abilities would most likely be based upon automatic, context-free mechanisms.

The results obtained in our experiment are compatible with the view that less-skilled readers—in the present case less-skilled bilinguals—actively employ context, or primes. As concerns response latencies, the group of less-skilled bilinguals performed in much the same manner as did less-skilled readers in the above-cited studies. Although error rate was not considered as a dependent variable in these studies, it is nevertheless worth noting that in our study the results obtained for responses corresponded to those obtained for response latencies. According to our results, attentional mechanisms played a role essentially in the treatment

of those words that took longer to identify. However, while longer identification latency enables or incites the use of attentional mechanisms, it is not the proof of such. Indeed, in order to claim that the subject actively deployed attention, one must be able to demonstrate the presence of inhibition effects, without which treatment is considered to be purely automatic (Posner & Snyder, 1975a, 1975b; Schneider & Shiffrin, 1977). Unfortunately, our results do not provide evidence either for or against the presence of inhibitory mechanisms. Inhibition is said to exist if the response latency to a target word is longer when the target is preceded by an incongruous context (i.e., FURNITURE–brother) than when preceded by a neutral context (XXXXX–brother). In our experiment, targets were seen in only two conditions, either preceded by a congruous context or presented alone. Thus, while we can provide evidence for facilitation effects, through the comparison of neutral and congruous priming conditions, we have no basis of comparison for the demonstration of inhibition effects.

A recent experiment conducted by Favreau and Segalowitz (1983), however, provided results that corroborate our interpretation. These authors employed a lexical decision task that incorporated an incongruous context condition. The study was aimed at testing for within-language priming effects in the bilingual's first and second language. Priming facilitation was demonstrated in both languages; however, it was shown that the type of facilitation differed according to the bilingual's level of skill in the two languages. In a first group of subjects, classified as being equally proficient in the two languages (according to scores of comprehension and rapidity on a reading test), automatic facilitation was shown in both the first and the second language. However, in the group classified as being less skilled in their second language, automatic facilitation was shown in the maternal language alone, facilitation in the second language being attributed to the active employment of primes.

In summary, while the results of the present experiment indeed provide evidence for across-language facilitation, it is necessary to proceed with caution before concluding in favor of a unique semantic system. Further experimentation, demonstrating automatic facilitation between languages, is in order before firm conclusions can be drawn.

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