JOURNAL OF VERBAL LEARNING AND VERBAL BEHAVIOR, 8, 559–566 (1969)

Semantic Generalization in Bilinguals[1]

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Bilinguals were trained to press a reaction-time button to those words in a mixed-language (English and French) list which were not exemplars of a certain general concept while learning to recognize which words were. They were then tested on a new mixed-language list containing English and French synonyms of the concept, unrelated words, as well as the original training exemplars of the concept. Reaction latencies were used as indices of within- and between-language semantic generalization. It was found that: (*a*) all *S*s generalized their responses significantly to both within-language and other-language synonyms; (*b*) in screening words for membership in the special category, *S*s found that the semantic properties of each test word provided a more important clue than did the language of the test word; and (*c*) the semantic properties of test words played a more important role for coordinate than for compound bilinguals.

Many psychological studies of bilingualism have been concerned with the ways language acquisition histories may affect the ultimate nature and form of bilingualism. Ervin and Osgood (1954) advanced the notion that two distinctive forms of bilingualism would likely result if, in one case, the two languages are acquired at the same time and in the same context, or, in the other case, separately, at different times, and in different contexts. The compound form of bilingualism is presumed to develop through experience in overlapping or fused acquisition contexts; i.e., contexts where referents are the same for the translation equivalents of words in the two languages, while the coordinate form presumably results from experiences in distinctive or separated acquisition contexts where referents are not necessarily the same for concepts developed in each language. Certain implications of this notion have already been discussed (e.g., Lambert, Havelka, & Crosby, 1958; Macnamara, 1967; Lambert, in press) and various models have been proposed to portray how such acquisition histories could produce different structures and cognitive organizations (e.g., Diebold, 1966; Jakobovits, 1967).

A selection of several of the empirical studies derived from this line of reasoning will provide the context for the present investigation. Jakobovits and Lambert (1961) attempted to show compound-coordinate differences in a semantic satiation task. As predicted, compounds, who presumably have a common mediator for a given word and its translation equivalent, showed transfer effects from the satiated word to its translation. In contrast, coordinates, who are presumed to have distinctive mediators for concepts in each language, did not show transfer. With similar purposes in mind, Lambert, Havelka, and Crosby (1958) found that coordinates showed more semantic independence than did compounds. These studies are typical of a larger set (see Lambert, in press) that lend support to the idea that the histories of bilingual development can basically influence the semantic structures characterizing the two languages.

Other experiments by Olton (1960), however, ran counter to theoretical expectations.

[1] The research reported here was supported by grants from Canada Council and the Defence Research Board (Grant 9401-10) to the Language Research Group at McGill.

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Olton expected to find that compounds would show a greater tendency than coordinates to generalize along semantic dimensions to other-language, translation equivalents. Subjects were required to press a lever to avoid shock which was administered after the presentation of certain words. The responses to translation equivalents were used as indicators of between-language generalization. Contrary to expectations, no compound-coordinate differences were found.

In a second experiment, Olton asked French-English bilinguals to learn a mixed list of both English and French words. Later, *S*s were given a recognition test where they had to select original-list words from a longer list containing as well some translations of the original items. According to theory, compounds should have been more prone to translation errors than coordinates, but Olton found little between-language generalization and no compound-coordinate differences.

The present study examines this question of semantic generalization again. Reconsidering Olton's study, it becomes evident that both compounds and coordinates must develop efficient ways of keeping track of languages in their everyday experiences in bilingual settings. Perhaps, then, Olton found no differences because the task presented may have been oversimplified. For example, in his shock avoidance study only one or two words had to be remembered and it is very likely that the physical rather than the semantic properties of the words were the cues which *S* used. If so, *S*s would not need to consider translation equivalents as possible substitutes for the original list words. To show cross-language semantic generalization, it is necessary to ensure that *S*s operate primarily with the semantic properties of the test words, and to demonstrate clearly that within-language semantic generalization was indeed obtained.

The purpose of the present study is to determine if bilinguals do generalize semantically between their languages when tested with what is believed to be a comprehensive procedure, and to examine compound-coordinate comparisons with regard to language generalizations.

METHOD

Subjects

The *S*s were 20 high school and university undergraduate and graduate students (ages 17–26) who were bilingual in French and English. Some *S*s were known to be balanced bilinguals (equally fluent in English and French) from other studies they had participated in, and the others were rated for balance using the Stroop Color Card test (see Macnamara, 1967, and Preston and Lambert, in press) as one index of balance along with self-rating scales for fluency in speaking, comprehension, reading, and writing skills in both languages. Only balanced bilinguals (according to these indices) were used. Those who were also skilled in languages other than French and English were eliminated from the study.

A profile of each *S*'s language acquisition history was obtained, permitting a classification into subgroups on the basis of the following criteria: compound bilinguals must have learned both languages at the same time and have attained fluency in both by the age of 6; coordinate bilinguals must have started the acquisition of the second language after 6 years of age. Ten balanced compound and ten balanced coordinate bilinguals were selected in this way, for the present study.

Materials

The *S*s were trained to distinguish a special set of ten words which formed a general conceptual category from 30 neutral (or noncategory) words in a 40-item list. For five of the compounds and five of the coordinates, the category words were in French and the neutral words were distributed 10 in French and 20 in English. Thus the complete list of training words was half in French and half in English. The remaining *S*s received their special category items in English with the neutral items split 10 in English and 20 in French. The two training lists are presented in the Appendix. All items were presented in the same order for each *S*. The list was randomized with the restriction that *S* never received more than five neutral words in a row.

For the test phase of the experiment new lists of 50 words were drawn up. Ten of these words were English synonyms of the special category words and ten were French synonyms. In addition, ten new neutral words in English and ten in French were included, along with the ten original special category words from the training list. The test lists for the French-trained and English-trained groups were identical except for the language in which the original special category words were presented. The list was randomized with the restriction that not more than three words from each group of ten described above appeared in sequence. These lists are also presented in the Appendix.

Apparatus

Words were projected on a screen from a Kodak Carousel slide projector. Each word appeared for 0.5 sec every 4 sec during the training procedure and every 3 sec during the testing procedure. Each 4- or 3-sec trial cycle was initiated by *E* by means of a switch. The *E*'s switch also reset and started the electric time clock which measured, in milliseconds, the time lapse between the beginning of the trial and *S*'s pressing the reaction time button. An electric timer automatically stopped the slide projector (and time clock if *S* did not react) after the 4- or 3-sec phase. Reaction latencies were taken from the onset of the trial to the time when *S* pressed the button. Since the stimulus word appeared 0.5 sec after the onset of each trial, actual reaction times can be obtained by subtracting 0.5 sec from each entry score listed in Table 1.

Procedure

The experimental procedure had a training and a test phase. Before the training phase, *S* was told that words would be cast on the screen before him one after another, and shortly after each word (i.e., 3 sec) a plus (+) or a minus (−) would follow. The *S* was told to press the reaction button immediately as soon as he saw a word that he thought was a plus word. Since on the first trial *S*s would not be able to tell which words were plus and which minus, they were told to press for all words. Upon repetitions of the list, *S* was to guess if he was not sure (i.e., to press if he thought the word was plus and withhold his response if he thought the word was minus). Thus, *S* received feedback (i.e., plus or minus sign) after each response, informing him how to respond. The *S* was told to remember his mistakes in order to correct them on subsequent repetitions. It was explained that there were more plus words than minus words, that all the minus words had an element of meaning in common which might be helpful to him in distinguishing minus words from plus words, and that his task was to learn to respond correctly and to remember the minus words so that his memory for them could be tested later in a similar experiment in which there would be no feedback.

The *E* recorded *S*'s responses (press–not press). When he responded correctly (withheld pressing) to eight consecutive minus words and made no errors (i.e., button presses) for all the intervening plus words, the training procedure stopped. The *E* also noted the number of trials (words presented) that *S* required to reach this criterion.

In the test phase, the procedure was similar except that no feedback signals (plus or minus signs) were used and each trial period was reduced from 4 to 3 sec. Before the test phase it was explained that another list of words, all new except for the original minus words, were going to be presented, that he was to press for all words except for those he recognized as the original minus words, and that there would no longer be plus or minus signs to inform him of the correctness of his response. Time was recorded from the onset of the trial (i.e., when the word appeared on the screen) to the moment *S* pressed the button, stopping the clock counter. Thus the longer *S* took to react the greater was his reaction time score for any particular item. If he did not press at all (i.e., treated the item as a minus word), he received a maximum time score of 1.900 sec. Note in this procedure that scores will be greatest (latency longest) for minus words and smallest for words quickly rejected as being not minus. Reaction time, then, was used as a measure of generalization, the greater the latency the more the generalization.

There was a 2- to 3-min interval between the training and test phases during which time *S* completed a check list questionnaire concerning his language acquisition history. The test list of 50 different items was presented twice.

Results

The mean number of trials to criterion was 138.5 ($SD = 20.32$) for compounds, and 92.2 ($SD = 31.13$) for coordinates. The mean number of errors (pressing for minus words, during the test phase) was 2.6 for compounds and 3.5 for coordinates. Neither of these differences was significant.

The mean reaction times for each *S* on each of the four groups of test words (synonymous English and French category words) are shown in Table 1. The data are collapsed over the two training groups (English or French minus words) since no significant difference between these groups was found ($F < 1$). A four-way analysis of variance ($2 \times 2 \times 2 \times 2$) was applied to these data. The levels of variables were: C—classification of bilingual, compound, or coordinate; L—language of category items (minus words) during training, English or French; W—word type, synonym or neutral; T—language of test word, same or other (with respect to L). The four-way analysis CLWT was made for repeated measures across W and T.

There was a significant overall difference in reaction latencies between category-synonym and neutral words (W), with the latencies greater for category words, $F(1, 16) = 96.51$, $p < .001$. There was also a significant overall difference in reaction latencies between words appearing in the same language as the minus words in training and those appearing in the other language (T), with greater latencies for same-language words, $F(1, 16) = 5.07, p < .05$. The interaction of test-language (same-other) and word type (synonym-neutral); i.e., $T \times W$, was significant, $F(1, 16) = 5.57, p < .05$. However, the difference between the mean reaction latencies for same language and other language and other language (1.663 sec as compared to 1.615 sec) was significant for synonyms only, $t(16) = 3.58$, $p < .01$, two-tail test. The interaction of synonym-neutral and compound-coordinate; i.e., $W \times C$, was significant, $F(1, 16) = 9.60$, $p < .01$, with compounds showing less differences in latencies between synonym and neutral words than coordinates. No significant difference in latencies was found between compounds and coordinates for either synonyms or neutral words considered separately.

The second order interaction of training language, synonym-neutral, and compound-coordinate; i.e., $L \times W \times C$, was significant, $F(1, 16) = 5.47$, $p < .05$. Also the interaction of training language, same-other, and synonym-neutral; i.e., $L \times T \times W$, was significant, $F(1, 16) = 13.96$, $p < .01$.

TABLE 1

SUBGROUP MEAN REACTION LATENCIES IN SECONDS FOR EACH OF FOUR TYPES OF TEST WORD

			Test items			
			Category-synonyms		Neutral words	
Type of bilingual	Language of training category	N	Same language as training	Other language	Same language as training	Other language
Compound	English	5	1.615	1.624	1.544	1.506
	French	5	1.683	1.587	1.576	1.630
Coordinate	English	5	1.657	1.658	1.554	1.540
	French	5	1.641	1.593	1.498	1.528

DISCUSSION

The findings will be discussed around the following questions: Do bilinguals show between-language semantic generalization? Do compound and coordinate bilinguals differ in the way they generalize across languages? What can be said about the processes involved in this recognition task?

Cross-Language Generalization

The results show clearly that bilinguals do generalize across languages through meaning. This finding contrasts with that of Olton (1960). As well, our results indicate that bilinguals show more within-language than cross-language generalization (the significant $T \times W$ interaction).

Compounds vs. Coordinates

The significant interaction ($W \times C$) of word-type (synonym-neutral) and subject classification (compound-coordinateness), with compounds showing less difference in latencies than coordinates between synonyms and neutral words, also contrasts with Olton's results. While no significant differences are found between the two types of bilingual when either synonyms or neutral words were considered separately, the strong overall interaction may indicate that coordinate and compound bilinguals use different processes for screening words. For example, the words can be screened according to their semantic properties (i.e., meaning relationship to the general concept), language (English or French), and according to their physical properties (written form, sound when pronounced). Neutral words and synonyms differ most with regard to their relation to the training category (the minus words). If an *S* relies heavily on this relational property for identifying words, those which are both wrong (i.e., not belonging to the training category) and different in meaning from the training category words will be more quickly rejected than wrong words with synonymous meaning. The coordinates appear to stress this mode of processing words.

In comparison, compounds do not reject neutral words and accept synonyms as readily as the coordinates do. This contrast in differentiating synonyms from neutral words indicates that the compounds placed less attention on meaning and more on alternative characteristics when processing words.

Recognition Processes

Perhaps the most interesting outcome is the inferences one can now make as to the process used by bilingual *S*s to screen words. The simple analogue that is suggested is a system of pass-fail filters. Consider the three properties of test words that could be used for processing: semantic relatedness to the core concept, language (same or different than the minus words), and physical features (e.g., letters used, sound, length). It is clear that our *S*s screened words according to the first of these criteria, i.e., neutral words were detected more quickly than synonyms (the main W effect). Furthermore, *S*s generalized more to synonyms in the same language as the minus words than to synonyms in the other language (the significant T × W interaction), although in both cases scores for synonyms were significantly higher than for neutral words. These results suggest that *S*s directed attention to the language of the word under consideration after they had screened it for semantic content. Thus, once a word is admitted because it is a synonym of a special-category concept, it is tested for language appropriateness. If it is in the wrong language it is rejected (i.e., *S* presses the button). If it is in the same language as the training set, it is passed on and tested further against the memory of the actual training items, the most difficult of the three processes because of the information required. Presumably the memory-check procedure would be used only when the two other easier tests fail to reject a given item. Of course, even it may fail at times and a synonym may pass for a special category item, and this can occur for both same- and other-language synonyms.

This outcome is especially interesting because of its similarity to the conclusions drawn from recent research on the ways bilinguals organize mixed-language lists in free recall (Lambert, Ignatow, & Krauthamer, 1968; Speidel, 1967). In these studies, organization along semantic lines also appears to be a more common and more useful procedure than along language lines, even though both modes are used.

Both compound and coordinate bilinguals appear to use the same principles for organizing memory, but the emphasis given to them differs. Compared to the coordinate, the compound does not tend to get his languages more confused; rather, in learning to cope with the potential confusability of his languages he may have developed somewhat different skills. Too much reliance on the semantic similarities of words that belong to a general category should increase the compound's chance of mixing languages. The fact that the compounds in this study give somewhat less, though still primary, consideration to the categorizing principle is consonant with theoretical expectations.

Second-Order Interactions

These call for special comment because they provide further understanding of the semantic generalization process at the same time as they limit the generalizability of the present findings. The two significant interactions in question are $L \times W \times T$ ($p < .01$) and $L \times W \times C$ ($p < .05$). The $L \times W \times T$ (language of training, same-other, and synonym-neutral) interaction indicated that *S* trained in French did not differentiate other-language English category-synonyms from English neutral test words while they did differentiate same-language French synonyms from French neutral words by rejecting neutral items more quickly. The $L \times W \times T$ interaction reveals, however, that this strategy is not used symmetrically. That is, *S*s trained in English differentiated synonyms from neutral test words in French as readily as they did in English. Thus, French words were not so readily set aside as English words were when it was logically evident in both instances that "other" language words could not belong to the special category. At the same time, *S*s trained in either French or English were slower in screening out English neutral words than they were in screening out French neutral words.

These unanticipated but clear and significant findings forced us to reexamine the *S*s' language histories since there appeared to be some form of preference for French involved. Since all *S*s had been tested for equivalent proficiency and fluency in their two languages and their self-reports indicated no language dominance, we collected more details on the order in which the two languages were learned. With this information, it was evident that French Canadians are more likely to become bilingual in English than the converse (the general Canadian pattern of mainly one-way bilingualism); 12 of the 20 *S*s started with French, 4 only with English, and 4 with both simultaneously. The possibility arises then that the first language used by the infant bilingual may develop as the "pivot" language, taking preeminence over the other language learned subsequently, but not necessarily expressing itself in linguistic dominance as measured by tests of comparative proficiency in the two languages. Thus, an interlingual dependency could be established between the secondarily acquired language and the first. Although follow-up studies are required to test the usefulness of this idea (e.g., with balanced bilinguals starting with English as a first language), it does help explain both features of the $L \times W \times T$ interaction. (*a*) The slowness in screening out French synonyms when only English words belong to the category concept may be attributed to a tendency to process English words through French (via translation) even during training when the English category is being developed. When tested later, French synonyms of category words would then be more likely perceived as actual category members. Similarly, French-biased bilinguals would find it relatively easy to set English synonyms aside as nonmembers of a category being developed with French words. (*b*) French-biased bilinguals would also take more time to screen out English neutral words if they found it natural to process the English words through French to analyze their meaning.

Of particular importance, however, is the fact that this French-biased strategy is more characteristic of the compound than the coordinate *S*s, as was indicated by the significant $L \times W \times C$ (language of training, synonym-neutral, and compound-coordinate) interaction, and as is reflected in Table 1. Thus the coordinate *S*s, most of whom also started with French but added English at a post-infancy age, did not emphasize the asymmetrical pattern or the tendency for interlingual dependency as much as the compound

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(Received February 3, 1969)

*S*s did. This contrast adds support to the hypothesis that acquisition histories help determine two distinctive forms of bilingualism.

In conclusion it has been shown that both compound and coordinate bilinguals show semantic generalization to same and different language synonyms. Both groups seem to use, as screening principles for recognition, (*a*) the semantic content of the word, (*b*) the language of the word, and (*c*) the actual memory of the item itself (as distinct from the former two abstracted properties) in decreasing order of importance. While semantic categorizing is an important principle for both groups of bilinguals, it is significantly less important or less effective for compounds who place relatively more emphasis on the language principle, apparently because of interlingual dependencies.

Appendix

Training List Items For English-Trained Ss (Unrandomized)

Special Category Words: chasm, cavity, canyon, crevice, slit, puncture, crater, well, gash, pit. *English Neutral Words*: cover, hope, bird, book, picture, shelter, lamp, flower, glass, castle. *French Neutral Words*: île, argent, gant, voix, marbre, auberge, pomme, magasin, lait, poisson, arbre, tiroir, chaise, édifice, gare, château, endroit, manteau, poupée, goutte.

Test List Items For English-Trained Ss (Unrandomized)

Special Category Words: chasm, cavity, canyon, crevice, slit, puncture, crater, well, gash, pit. *English Synonyms*: crack, hole, opening, break, gutter, ditch, gully, hollow, trench, cut. *French Synonyms*: puits, craque, trouée, cassure, trou, creux, coupure, vallon, cavité, ouverture. *English Neutral Words*: paper, sanity, platter, tassel, theft, mouse, holiday, knight, sidewalk, bathrobe. *French Neutral Words*: fleur, règle, livre, temps, poche, chambre, école, montre, jardin, église.

Training List Items For French-Trained Ss

Special Category Words: brêche, fosse, déchirure, crevasse, tranchée, vallée, fêlure, abîme, crevaison, fente. *French Neutral Words*: île, argent, gant, voix, marbre, auberge, pomme, magasin, lait, poisson. *English Neutral Words*: cover, hope, bird, book, picture, shelter, lamp, flower, glass, castle, chart, snow, card, shoe, tree, top, pencil, sit, month, glove.

Test List Items For French-Trained Ss

Special Category Words: brêche, fosse, déchirure, crevasse, tranchée, vallée, fêlure, crevaison, abîme, fente. *English Synonyms*: crack, hole, opening, break, gutter, ditch, gully, hollow, trench, cut. *French Synonyms*: puits, craque, trouée, cassure, trou, creux, coupure, vallon, cavité, ouverture. *English Neutral Words*: paper, sanity, platter, tassel, theft, mouse, holiday, knight, sidewalk, bathrobe. *French Neutral Words*: fleur, règle, livre, temps, poche, chambre, école, montre, jardin, église.

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