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Semantic context effects in visual word recognition: An analysis of semantic strategies

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Using a procedure that isolates the facilitatory and interfering effects of a semantic context, the present study examines two distinct patterns of context effects. One pattern shows a dominance of facilitation for target words in a related context, and the other pattern shows a dominance of interference for target words in an unrelated context. The controlling factor seems to be the overall characteristics of the stimulus list. For materials that include semantic relationships that are consistent in the strength of the relationships, facilitation dominance obtains. For materials that include a wide range of semantic relationship strengths, interference dominance results. These two patterns of facilitation and interference are attributed to two semantic strategies available to subjects for using context information. The explication of the strategies includes a theoretical treatment of the present data.

Recent studies of semantic context effects in visual word recognition have focused on differentiating the facilitatory effect of an appropriate semantic context from the interfering effects of an inappropriate context (Fischler & Bloom, 1979; Neely, 1976, 1977; Schuberth & Eimas, 1977). Briefly, these studies used a trial consisting of a cue stimulus that the subject is instructed to attend to, followed by a target stimulus about which subjects make a lexical (word vs. nonword) decision. For "word" response trials, three types of cue stimuli are used: a stimulus that provides subjects with appropriate semantic information about the target, a stimulus that provides inappropriate semantic information about the target, and a neutral stimulus that provides no semantic information at all. In this procedure, the neutral cue condition is assumed to provide a baseline estimate of the processing requirements of target stimuli. Using these three cuing conditions (a semantically related cue condition, a semantically unrelated cue condition, and a neutral cue condition), several investigators have found that the effect of a semantic context is both facilitatory and interfering. That is, target words in a related cue condition are responded to both faster and with fewer errors than target words in the neutral cue condition. Targets in an unrelated cue condition are responded to more slowly and with a higher error rate compared with the neutral cue condition.

If, for the moment, we ignore many of the details of these studies of semantic context effects, an interesting finding emerges from comparisons across the experiments. For example, Neely (1976) and Schuberth and Eimas (1977) report sizable facilitation effects of about 50 msec for their related context conditions and only nominal interference effects in the 10- to 20-msec range. On the other hand, Fischler and Bloom (1979) and Neely (1977) report substantial interference effects of at least 50 msec coupled with only a 10- to 40-msec facilitation effect for their related conditions. Thus, there appear to be conditions under which the facilitatory effect of an appropriate semantic context dominates the data and other conditions under which the interfering effect of an inappropriate context dominates.

The possibility of two relatively distinct effects of a semantic context is an intriguing one with perhaps wide-ranging implications. If the facilitation-dominant effect of context and a separate interference-dominant effect of context can be substantiated, the distinction may have implications for how we view semantic operations in general. These implications, though, depend first, on substantiating the effects, second, on identifying the factors that control the context effects, and third, on extending the research to encompass tasks other than the type of word recognition task used in the studies above.

Obviously, there are numerous possibilities for identifying the conditions under which each of the facilitation-interference patterns occurs. Across the

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four studies cited above, there are variations in the types of cue materials, in the values of the timing parameters, in the probabilities of the various cue conditions, and in other factors, as well. Any or all of these factors could contribute to defining the conditions for facilitation dominance and for interference dominance. Fortunately, though, some of these factors can be eliminated. For example, two of the experiments (Neely, 1976, 1977) used single words as cue materials, and two of the studies (Fischler & Bloom, 1979; Schuberth & Eimas, 1977) used incomplete sentences to cue the target words. One of each of these pairs of studies resulted in facilitation dominance, and the other member of the pair produced interference dominance. So, the dimension of word cues vs. incomplete sentence cues does not properly discriminate among the studies. Also, Neely's studies varied the amount of time that subjects had to read the cue, whereas the other two studies held this factor constant within subjects. Again, this factor does not provide a proper classification of the experiments.

The cue condition probability factor is more complex as well as more variable across the experiments. Based on indirect comparisons across experiments, it appears that increasing the probability of the related cue condition while decreasing the probability of the unrelated condition may shift the data from facilitation dominance toward interference dominance (cf. Neely, 1976, 1977). The only direct evidence on the effectiveness of the probability factor comes from a recent study by Stanovich and West (in press). In that study, a comparison is made between one experiment in which the three cue conditions are equiprobable and another experiment using the same materials in which 80% of the trials used a related cue and the remaining 20% were evenly divided between neutral and unrelated cue trials. This probability manipulation had no effect. In both experiments, facilitation is substantial and interference is minimal. Thus, there is some indirect evidence that cue condition probability influences facilitation and interference effects and some direct evidence that probability is an ineffective factor.

Several years ago (Becker, 1976), I suggested a theoretical characterization for interpreting facilitation and interference effects that may prove useful here in identifying other potentially important factors. In developing the verification model, I assumed that a semantic context allows the subject to create an expectancy set. Words contained in such an expectancy set are essentially the subject's predictions about the identity of possible related target words. When a related target word is presented, it can be recognized rapidly using the set of expected targets, thereby producing a facilitation effect. Interference is described as essentially a side effect of using an expectancy set. It was asserted that "if the expectancy set is sufficiently large . . . , the identification of an unexpected input . . . would be delayed relative to a neutral condition . . . " (Becker, 1976, p. 565). Basically, the assertion maintains that the larger the number of possible related targets, the longer it should take to reject them and the longer it should take to begin considering the possible unrelated targets. In the present discussion, this assertion identifies the semantic attributes of the cue materials as an important factor. Specifically, a cue that allows relatively few related target words should produce only a small interference effect. Conversely, a cue that could possibly be related to a large number of target words should yield a large interference effect.

An examination of the semantic characteristics of the related cues used in the semantic context studies suggests that the assertion may be valid. For instance, in Neely's (1976) first experiment, strongly associated word pairs were used in the related cue condition. Here, one might expect that only a limited number of words would be included in an expectancy set. In agreement with this expectation, the experiment resulted in a definite facilitation dominance. In Neely's (1977) second experiment, category names served as the cues and members of the categories served as related target words. The category-member target words varied from those that are quite typical of the category to those that are fairly low on a category typicality dimension. Here, the size of an expectancy set may be rather large in order to accommodate the wide range of possible related targets. In this study, the interference effect was, on average, larger than the facilitation effect.

In the studies using incomplete sentence cues, the support is even more clear-cut. Schuberth and Eimas (1977) used incomplete sentences that were rated as "strongly related" to the word targets.[1] In this study, the facilitation effect was about 50 msec and the interference effect was only about 20 msec. In the other study, the Fischler and Bloom (1979) materials ranged from strongly related cue-target pairings to cue-target pairs that are minimally related. The strength of the relationships was measured using a cloze procedure. For these materials, the interference effect was nearly 100 msec, whereas the facilitation effect was a nominal 10 msec. Thus, the existing studies provide some support for the importance of the size of an expectancy set in determining the amount of interference.

This same set-size factor may also provide a rationale for why the facilitation effect varies inversely with the interference effect. Again, we start by assuming that a context allows the creation of an expectancy set. Then, assuming a strict serial search of such a set, we would expect a related target item to be encountered, on average, halfway through the set. For sets that are relatively small, the average search time should also be small, resulting in fairly fast recognition of a related target. For sets that are relatively large, the average search time should be longer, producing somewhat slower recognition of a related target. Thus, as the size of a context-based expectancy set increases, the average search time to recognize a related word increases and the average observed facilitation effect should decrease.

Although the set-size idea receives some support, a further analysis of the various studies suggests that the basic idea may be sound, but the focus on the characteristics of individual cue items may be incorrect. In the studies reporting facilitation dominance, the related cue-target pairs are fairly uniform in the strength of the relationship. Neely (1976) used only strongly associated word pairs, and Schuberth and Eimas (1977) had materials in which the relationships between cues and targets were rated as relatively strong, with little variance in the ratings. Alternatively, the studies reporting interference dominance explicitly used a range of relationship strengths. Neely (1977) had both high-typicality and low-typicality category members in his target materials. Fischler and Bloom (1979) explicitly included a wide range of relationship strengths based on the results of a cloze task. It may be, then, that the distribution of relationship strengths in a list of stimulus materials determines the facilitation and interference effects and not simply the size of the related set for a particular cue stimulus.

The appropriateness of the list focus for the set-size factor can be supported by further consideration of the semantic attributes of individual words. For example, given a cue word like HOT, there are numerous possibilities for a related target word. The target COLD is related as an antonym, and the targets HEAT and WARM are roughly synonymous. The target TEMPERATURE names a dimension on which the word is a descriptor. Similarly, SPICY names another dimension in which HOT participates. For a gambler, the word STREAK may be a high associate of HOT, and in other contexts, the word SHOT may be quite common. At base, then, the word HOT can be used to cue a fairly large set of related targets. In any given situation, though, the number of related targets can be quite small. For instance, in a stimulus list composed exclusively of antonym relationships, a target word related to the cue HOT is quite likely to be the word COLD, and TEMPERATURE may not even be considered related. Thus, it may be that the restrictiveness of a particular cue can be varied by manipulating the characteristics of the entire stimulus list.

In order to evaluate the effectiveness of the set-size factor, the first two experiments reported here use the lexical decision task and vary the semantic characteristics of the cue materials across experiments. Presumably, this manipulation will influence the way in which subjects develop their expectancy sets. Specifically, Experiment 1 uses only pairs of antonyms as related cue-target materials, and Experiment 2 uses category-name/category-member pairs. Experiment 1 should produce a situation in which subjects can rather explicitly predict what a related target word should be; Experiment 2 should provide for far less explicit predictions. If the analysis based on set size is accurate, Experiment 1 should produce a facilitation-dominant result and Experiment 2 should yield interference dominance. Across the two experiments, the timing and probability factors are held constant, and both experiments use single words as cues.

EXPERIMENT 1

Method

Subjects. Twenty-five University of Minnesota undergraduates were recruited through the introductory psychology course or through advertisements in the university newspaper. Each subject either received course credit or was paid for participating.

Procedure. Subjects were run either individually or in pairs in a darkened, sound-attenuated room. Each subject station consisted of a video monitor placed at one end of a 1.8-m table and a response panel with two microswitches at the opposite end of the table. Subjects were seated a comfortable distance from the response panel. The subject stations were separated by a free-standing divider. A Data General computer controlled the video display, the timing of events, and the recording of data.

The subjects were instructed that they would be shown a number of letter strings and that they would have to decide which of them spelled valid English words and which did not. On each trial, a cue was presented for 750 msec slightly above the center of the display. The display was then blanked for 300 msec before a target letter string was presented slightly below the center of the display. All stimuli were presented in uppercase letters.

Subjects were instructed to press the right-hand button on the response panel if the letter string spelled a word and to press the left-hand button if the string did not spell a word. They were told to read the target stimuli, make their decision, and respond as quickly as possible while keeping errors to a minimum. Reaction time was measured to the nearest millisecond from the onset of the display containing the letter string. The subject's response terminated the display and initiated a 1.5-sec intertrial interval. If the subject pressed the wrong button or failed to respond within 1.5 sec of the onset of the letter string, an error message was displayed for 1 sec, and the intertrial interval was timed from message offset.

In addition to the response requirements of the task, subjects were told about the relationships between the cue and the target. They were told that the cue would be either a word or a string of five Xs. If a word cue was presented, subjects were to read it to themselves and get the meaning of the cue. They were told that if a word target was presented, it was likely to be meaningfully related to the cue. An example, such as cue-POSITIVE/target-NEGATIVE, was given to illustrate the type of relationship used here. If the neutral string of Xs was presented as the cue, subjects were told to get ready to make their decision about the target letter string.

In all, four blocks of 50 trials each were run. The first block served as practice. Between blocks, the subjects rested for a minimum of 15 sec before they initiated the next block. A session lasted approximately 25 min.

Stimulus materials. Thirty pairs of antonyms (e.g., SMART-DUMB, DRY-WET) were selected to be used as the critical items. One word in each pair was designated to be used as a cue, and the other, as the target. The 30 pairs were divided into three sets of 10 word pairs each. For one group of subjects, the first set of 10 pairs was presented as related pairs. The words in the second set were recombined to form unrelated pairs (e.g., SMART-WET, DRY-DUMB), and for the third set, the cue words were replaced by a string of five Xs, the neutral cue. For a second and third group of subjects, the assignment of word sets to the cuing conditions was varied so that across all subjects, each critical target word appeared equally often in each cue condition.

In addition to the critical items, the following filler materials were used. A second related word was generated for each of the 30 critical material cue words. These added words were used as targets and were always preceded by the related cue word. For each subject, then, each of the critical cue words was presented once, followed by a related filler item. As described above, 20 of the 30 cue words were also presented as cues for critical target words. The remaining 10 cue words, those replaced by the neutral cue for the critical target words, were paired with 10 unrelated filler words. Thus, each of the critical cue words was presented twice and followed by a stimulus requiring a word response. In addition to the related and unrelated filler words, 30 words were selected for use as neutral condition filler targets. In all, then, 100 words were used as targets, 40 preceded by related cues, 20 preceded by unrelated cues, and 40 preceded by the neutral cue.

A total of 50 nonwords was added to the 100 word targets. All nonwords were derived from words by changing one or two letters. If possible, the alterations preserved the pronunciation of the word (e.g., DITURMINE). Thirty of the nonwords were paired with the 30 critical cue words. The remaining 20 nonwords were paired with the neutral cue. The stimulus materials and the various conditions are summarized in Table 1. A block of 50 practice trials was developed to match the characteristics of the test materials.

Results

Only correct responses to the critical antonym materials were included in the analysis of the reaction time data. Both reaction times and error rates for the critical materials were analyzed using a min F′ procedure (cf. Clark, 1973), with cue condition (related vs. neutral vs. unrelated) as the only factor. Planned comparisons evaluated the facilitation and interference effects. Trials on which subjects failed to respond within 1.5 sec were excluded from the analyses. These trials accounted for less than .1% of the data. One of the 25 subjects was excluded from the analysis because of an overall error rate greater than 10%.

The reaction time data, plotted in Figure 1, show a significant effect of cue condition [min $F'(2,103) = 7.4899$, $p < .001$]. The facilitation and interference components of the overall context effects were evaluated using a pooled error term based on both subject and item variability. The 52-msec facilitation effect was significant [min $F'(1,103) = 19.457$, $p < .001$]. The 4-msec interference effect was not reliable [min $F'(1,103) < 1$]. Thus, the antonym materials used here produced substantial facilitation and negligible interference.

Table 1
Summary of the Design for Experiments 1 and 2

Cue Condition	Experiment 1 Example	Experiment 2 Example	p
	Word Target Trials		
Related	UP-DOWN	BIRD-CROW	.27
Neutral	XXXXX-DOWN	XXXXX-CROW	.27
Unrelated	HOT-DOWN	CLOTHING-CROW	.13
	Nonword Target Trials		
Word Cue	UP-MITTLE	BIRD-MEDER	.20
Neutral	XXXXX-REVER	XXXXX-STRETE	.13

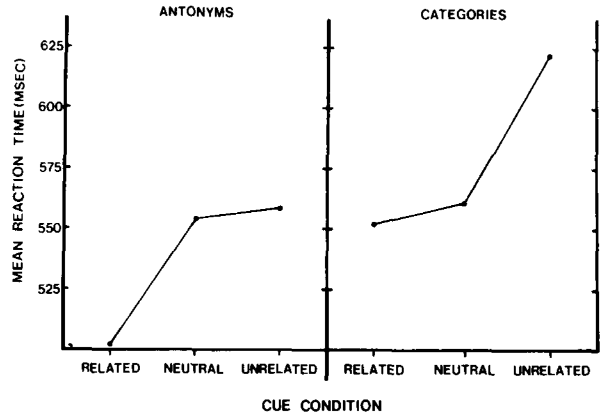


Figure 1. Mean reaction times as a function of cue condition for the antonym materials in Experiment 1 and the category materials in Experiment 2.

The error data did not show a statistically reliable effect of cuing condition [min $F'(2,102) < 1$]. Overall, errors on the critical items were quite rare, and therefore, the paired comparisons were not done. The error rates for the three cue conditions were .0%, 1.2%, and 1.2%, respectively, for the related, neutral, and unrelated conditions.

EXPERIMENT 2

Method

Subjects. Twenty-four additional subjects were sampled from the same population used in Experiment 1.

Procedure. All apparatus, display, and timing characteristics from Experiment 1 were used here, as were the instructions, with the following exceptions. First, the example used to illustrate the cue-target relationship used a category-name/category-member pair (e.g., DOGS-COLLIE). Second, four blocks of 45 trials each were run, with the first block serving as practice. Each session lasted about 25 min.

Stimulus materials. The critical materials used here consisted of 18 category names and 54 category members selected from the Battig and Montague (1969) norms. The 18 category names were those that could be represented by a single word (e.g., FURNITURE, CLOTHING). These were used as cue words. Three members of each category were selected for use as word targets. These three items within a category were used to define a normative category typicality factor. One of the words selected from each category appeared as the first or second category member on the rank list. The second category member was selected from farther down on the list, and the third item from even farther down the list. Across the 18 categories, the mean number of subjects who mentioned the item in response to the category name was 298 for the highly typical category members, 191 for the moderately typical items, and 57 for the low-typicality items. Across the three levels of category typicality, the items were reasonably well controlled for word frequency (the Carroll, Davies, & Richman, 1971, Standard Frequency Index was 51.2, 54.8, and 48.6 for the high, moderate, and low item sets, respectively).

The assignment of stimulus materials to cuing conditions used a scheme similar to that used in Experiment 1. Of the 18 high-typicality category items, 6 were presented following the appropriate category name (e.g., FURNITURE-CHAIR). Six other items were preceded by the neutral cue (e.g., XXXXX-AUNT), and the final six were preceded by the category cues used in the related cue condition (e.g., FURNITURE-SHIRT). For the moderate-typicality category material, six other categories were used in the related cue condition and to provide the cues for the unrelated condition. For the low-typicality materials, the final six categories were used in the related condition and as cues for unrelated trials. Thus, each category cue was presented twice, once followed by a related category member, and once followed by an unrelated word from another category. Across subjects, the category cues used at each level of typicality were varied so that across all subjects, each of the critical target items appeared equally often in each of the cuing conditions.

In addition to these critical materials, the following filler materials were added. First, nine additional category names were selected, along with a high-typicality and a low-typicality member of each category. These items were used as related filler materials. Second, two more members of each of the nine filler categories were selected to be used as neutral filler target words. Finally, 45 nonwords were developed in the same way as in Experiment 1. Twenty-seven of the nonwords were paired with the total of 27 category cues, and the remaining 18 were paired with the neutral cue. The various conditions are summarized in Table 1. A practice set of 45 trials was developed to match the characteristics of the test materials, while using different categories.

Results

The analysis of Experiment 2 was the same as that of Experiment 1, except that category typicality was included as a factor, in addition to the cue condition.

The reaction time data for Experiment 2, plotted in Figure 1, yielded a significant effect of cue condition [min $F'(2,147) = 11.8766$, $p < .001$]. The main effect of category typicality was not reliable [min $F'(2,51) < 1$]. Also, the interaction of cue condition with category typicality was not significant [min $F'(4,177) < 1$].

The error data yielded a significant effect of cue condition [min $F'(2,128) = 4.0393$, $p < .025$] for error rates of 1.6%, 2.0%, and 5.8% for the related, neutral, and unrelated cue conditions, respectively. Neither the main effect of category typicality nor the interaction of category typicality with cue condition was reliable. The category typicality data are presented in Table 2.

Because of the significant effects of cue condition in both the reaction time and the error data, the evaluation of facilitation and interference effects was carried out for both sets of data. In the error data, the .4% difference between the related and the neutral conditions was not reliable [min $F'(1,128) < 1$], but the 3.8% error difference between the neutral and unrelated cue conditions was significant [min $F'(1,128) = 7.442$, $p < .01$]. The reaction time data parallel these findings. The 9-msec facilitation for the related condition over the neutral condition was not significant [min $F'(1,147) < 1$]; however, the 61-msec interference in the unrelated condition was reliable [min $F'(1,147) = 10.883$, $p < .005$]. Thus, for both the reaction time data and the error data, the category-name/category-member materials used here resulted in a small facilitation effect and a substantial interference effect.

Table 2
Category Typicality Data for Experiment 2

	Cue Condition					
	Related		Neutral		Unrelated	
Typicality	RT	% Err	RT	% Err	RT	% Err
High	550	2.0	559	1.3	621	4.3
Moderate	545	.6	556	2.7	643	9.7
Low	559	2.0	569	2.0	611	3.4

Discussion

The results of Experiments 1 and 2 provide rather strong support for a qualitative distinction in the effects of a semantic context. Experiment 1, using only rather specific antonym relationships, produced a substantial facilitation effect with no interference. Experiment 2, using a less predictable category-name/category-member relationship, yielded only nominal facilitation, but substantial interference. With virtually all other facets of the two experiments held constant, we are in a much better position to conclude that there are two patterns of facilitation and interference and that the characteristics of the stimulus materials can determine which of the patterns is obtained.

Given this basic conclusion, we need to consider in detail just which attributes of the stimulus materials are critical. Relying solely on the present experiments, we have several possibilities. The antonym and category materials used here differ in a variety of ways. First, the category materials represent a superordinate-subordinate semantic relationship, whereas the antonym relationship is a more coordinate one. Second, the average predictability of an antonym target word is probably higher than the average predictability of a category-member target word. Third, the predictability of an antonym target is likely more consistent across the pairs sampled than the predictability of a category-member target. Any or all of these differences could contribute to the difference in facilitation-interference patterns.

When the experiments described earlier are considered in this analysis of stimulus materials, the critical attribute of the materials becomes more clear. So far, there are three experiments that show facilitation dominance: Neely's (1976) first experiment, the Schuberth and Eimas (1977) study, and Experiment 1 of the present study. Each of these experiments employed different types of semantic relationships. One used strongly associated pairs of words, another used presumably a variety of relationships embodied in sentences, and the third used antonym word pairs. Thus, it seems unlikely that a facilitation-dominant result is a function of the exact type of semantic relationship used. What these three experiments have in common is that the related cue condition stimuli used in a given experiment are consistently of about the same level of predictability. The absolute level of predictability varies across the experiments, but within an experiment, target predictability appears to be relatively consistent.

Of the three experiments reporting interference dominance (Fischler & Bloom, 1979; Neely, 1977; the present Experiment 2), two use category-name cues and category-member targets, and the third uses a variety of different semantic relationships embedded in sentences. Here, again, the results cannot be attributed to a specific type of relationship. Rather, in contrast to the facilitation-dominant experiments, these studies share the attribute of using a broad range of cue-target predictability levels. On average, the predictability in the interference-dominant studies may not be that different from the average predictability of the facilitation-dominant experiments (cf. Fischler & Bloom, 1979, p. 13), but the two classes of experiments do differ in the distribution of predictability.

In addition to this major outcome, one aspect of the results of Experiment 2 needs to be considered further. The manipulation of category typicality has no effect in this study. For all three levels of typicality, facilitation is about 10 msec and interference is in excess of 50 msec. This is perhaps a counterintuitive result. Even if we can rationalize the large interference effect and explain an average decrease in facilitation, it seems unreasonable that highly typical category members should show no more facilitation than low-typicality category members. To a great extent, the counterintuitive character of this result may stem from the long tradition of "strength gradients" in psychology. Ordinarily, we assume that "the farther away" one stimulus is from another, the less is the effect of the two stimuli on each other. This general assumption has taken many specific forms, and it has recently played a large role in theories of lexical and semantic memory (Collins & Loftus, 1975; Meyer & Schvaneveldt, 1971). Therefore, it seems odd that the present typicality data are inconsistent with expectations based on notions of a strength gradient.

The category typicality result reported here is not an isolated result, however. Each of the other studies reporting an interference-dominant effect of context finds the same equivalence of facilitation effects across a range of context strengths. Neely (1977) used a category manipulation similar to that used here and found the same result for the typicality factor. Fischler and Bloom (1979) selected their materials using a cloze sentence-completion procedure. The related target words used in that study varied from those that were generated by 99% of the subjects to those that were generated by 9% of the subjects. Across a large portion of this range, the data are consistent with the results obtained here. That is, facilitation is rather small and interference is quite large in all cases. Thus, within a set of materials that produce interference dominance, it seems that the predictability of individual target words generally has no effect on a subject's performance.[2]

At this point, we have data that support the distinction between a facilitation-dominant effect and an interference-dominant effect of context. Also, we seem to have some handle on the controlling factor. However, all of the existing data come from comparisons across different experiments and across different groups of subjects. Given the clean results found in Experiments 1 and 2, it seems reasonable to expect that the same subject would produce each of the facilitation-interference patterns under the proper conditions. If the results for individual subjects are consistent with the data from the separate groups, this would provide further evidence for the identifiability of the two patterns of context effects, and it may provide a useful methodology for further work aimed at a more discriminating analysis of the effects.

In an attempt to further isolate the two facilitation-interference patterns, Experiment 3 was designed to employ a stimulus list factor within subjects. For this experiment, the separation between materials lists is maintained, with each subject seeing one list using the antonym materials from Experiment 1 and another list using the category materials from Experiment 2. The order of the antonym and category lists is counterbalanced so that we have the capability to detect any influence that one list might have on the succeeding list.

In this design, we also have the capability to assess what is hopefully an unimportant point. In the data presented in Figure 1, there are two possibilities for exactly what is changing across the two panels. First, as we have assumed here, the data points for the related and unrelated cue conditions may be changing across stimulus lists. Second, it could be that the single data point for the neutral cue condition shifts and thereby changes the measured facilitation and interference effects. How this type of neutral condition shift could occur seems to be a mystery, but if such a shift does occur, it would have a profound effect on any interpretation of these data. To evaluate this hopefully unlikely possibility, the stimulus materials used as neutral condition fillers in the earlier experiments are balanced across the stimulus lists used in Experiment 3. Including this manipulation will allow us to determine the effect of each list type on the neutral cue condition. If these controlled neutral materials differ across the two lists, then we must conclude that the stimulus list factor affects the neutral condition. If performance on the neutral material is equivalent across lists, then we can conclude that the list factor probably influences the related and unrelated cue conditions.

EXPERIMENT 3

Method

Subjects. Twenty-five subjects were recruited from the same population used earlier. None had participated in the previous experiments.

Stimulus materials. The materials from both Experiments 1 and 2 were used here. The only changes were those made on the assignment of neutral filler words to stimulus lists. The 18 neutral filler words from the category list were divided into two sets of 9 words each. One set was used in a category list and the other in an antonym list for half of the subjects. For the other half of the subjects, the assignment of filler sets to list type was reversed. Eighteen of the neutral filler words in the antonym list were similarly handled. The variations in the assignment of critical word materials to cue conditions used earlier were preserved here.

Procedure. The apparatus, stimulus presentation, and timing parameters were the same as in the two prior experiments. Each subject was run on a practice-test-practice-test sequence using the antonym list from Experiment 1, the category list from Experiment 2, and the practice materials from both experiments. Half of the subjects were run under the order category practice/category test/antonym practice/antonym test, and the other half received the reverse order of practice and test lists. Before the first practice set, subjects were told the types of relationships to be used and were given an appropriate example. Before the second practice set, the subjects were informed of the shift in semantic relationship and, again, given an example. The other aspects of the subjects' instructions were the same as those used earlier. Each session lasted about 40 min.

Design. This experiment used two mixed designs, one with semantic relationship, list, and cue condition as within-subjects factors and the order of lists between subjects. The other design, for the neutral filler materials, had list within subjects and order between subjects.

Results

One subject was eliminated from the experiment for exceeding a 10% overall error rate on both test lists. No other subject exceeded the 10% rate on either list.

The data from the neutral filler materials were analyzed using the min F′ procedure. None of the effects was significant (min $F' < 1$ for all terms). The neutral fillers in the antonym list yielded a mean reaction time of 637 msec and an error rate of 6.5%. These same materials in the category list resulted in a mean reaction time of 634 msec, with an error rate of 5.8%. According to these data, then, the neutral cue conditions are indeed equivalent across the two types of semantic relationship lists. Although this is a null result, it still provides a good deal of support for the conclusion. If the difference between the two patterns of facilitation and interference is the result of changes in the neutral condition, the change in mean reaction time should be about 40-50 msec. A difference that large would have been detected here.

With the neutral filler data to comfort us, we now turn to an evaluation of the cue condition factor for the two types of lists. Since our interest in these data focuses on questions about subject consistency, these data were analyzed treating subjects as the only random factor in the design. Given the counterbalancing of target words across subjects, some of the error variance was contributed by differences among stimulus items. Therefore, this analysis generalizes to both subject and item populations, but it is somewhat less conservative.

The reaction time data showed a marginal effect of order, with the second list somewhat faster than the first [$F(1,22) = 2.8496$, $p < .10$]. There were also main effects of list [$F(1,22) = 49.4043$, $p < .001$] and cue condition [$F(2,44 = 31.5769$, $p < .001$]. The antonym list yielded overall faster reaction times than the category list. The related cue condition produced relatively fast reaction times, with the neutral condition somewhat slower and the unrelated cue condition the slowest. In addition to the main effects, two of the interactions reached significance. First, list interacted with cue condition [$F(2,44) = 14.4472$, $p < .001$, MSe = 1,039.68]. As would be expected from the results of Experiments 1 and 2, the antonym list produced large facilitation and no interference, whereas the category list resulted in decreased facilitation and increased interference. The second reliable interaction was that of Order by Cue Condition [$F(2,44) = 3.7521$, $p < .05$, MSe = 1,705.82]. When the antonym list preceded the category list, the facilitation effect was 44 msec and the interference effect was 7 msec, averaged across the two types of lists. For the reverse order, facilitation was 30 msec and interference was 52 msec. This shift in the pattern of facilitation and interference suggests that the subjects' performance was not entirely under the control of the stimulus list factor. The three-way interaction of Order by List by Cue Condition was not reliable [$F(2,44) = 2.0539$, $p > .10$, MSe = 1,039.69].

The reaction time data for the three-way interaction are plotted in Figure 2. For these data, the most obvious effect was the change in the category list data as a function of order. When the category list was a subject's first list, the data closely resembled the results of Experiment 2. However, when the category list followed the antonym list, facilitation was enhanced and interference was substantially reduced. This, combined with the smaller shifts in the antonym data, contributed to the significant Order by Cue Condition interaction.

The analysis of the error data generally supports the reaction time results. First, somewhat fewer errors were made on the second list than on the first list

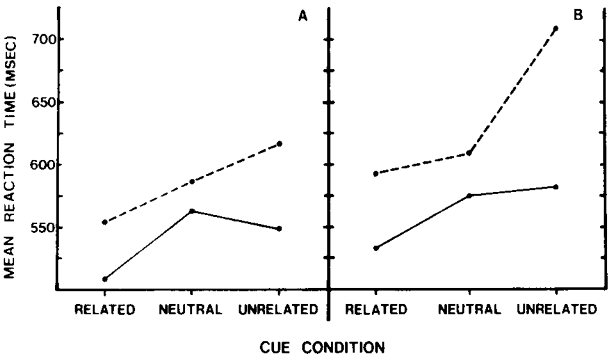


Figure 2. Mean reaction times for the cue conditions as a function of list and order for Experiment 3. Panel A presents the data for the antonym list first/category list second subjects; Panel B presents the data for subjects receiving the category list first. Solid lines are the antonym data, and the dashed lines are the category data.

(1.2% vs. 2.4%). Substantially more errors were committed on the category list than on the antonym list (3.5% vs. .17%) [$F(1,22) = 11.1276$, $p < .005$]. Also, the effect of cue condition was significant [$F(2,44) = 4.7010$, $p < .05$], with the related cue condition producing the fewest errors and the unrelated condition resulting in the highest error rate.

In the error data, only one interaction was significant, the List by Cue Condition interaction [$F(2,44) = 3.4956$, $p < .05$]. For the antonym list, error rates were .0%, .0%, and .4%, respectively, for the related, neutral, and unrelated cue conditions. For the category list, the rates were .9%, 2.0%, and 7.6%, respectively. The Order by Cue Condition interaction was not reliable [$F(2,44) = 2.2619$, $p > .10$, MSe = 3,743.66], but the pattern of errors was consistent with the pattern obtained in the reaction time data. Finally, the error data revealed a marginally significant three-way interaction [$F(2,44) = 3.0501$, $p < .10$, MSe = 3,763.75]. These data are presented in Table 3. The error results for the three-way interaction conform rather well to the results for reaction time. When the category list followed the antonym list, the interference effect in both reaction time and errors was small. When the category list preceded the antonym list, both reaction time and errors showed sizable interference effects.

Table 3
Percent Errors for List, Order, and Cue Conditions for Experiment 3

	Cue Condition		
	Related	Neutral	Unrelated
Antonym First	.0	.0	.8
Category Second	1.8	2.3	3.2
Category First	.0	1.8	12.0
Antonym Second	.0	.0	.0

Discussion

Three of the results of Experiment 3 are of interest. First, there is no difference in the neutral filler condition across the list factor. This outcome eliminates an interpretation of Experiments 1 and 2 that would attribute the difference in facilitation-interference patterns to changes in the neutral condition. Second, the analysis of the antonym and category data suggests that the same subjects can produce both the large facilitation pattern and the large interference pattern. This conclusion, though, must be qualified because of the third outcome of the present experiment. That is, the order in which subjects saw the antonym and category lists had some effect on the results. This effect is most noticeable in the data from the category list when it followed the antonym list. Here, facilitation is somewhat enhanced and interference is reduced, a shift toward the facilitation-dominant pattern obtained for the antonym list. The finding that order affects the facilitation-interference pattern must also qualify the first conclusion. Specifically, since we were unable to obtain pure results for the antonym and category lists, the equivalence of the neutral filler condition across lists may have resulted from an undetected effect of order in those data.

To clarify the results of Experiment 3, the interaction of order with other factors needs to be eliminated. In Experiment 3, the list factor, overall, has a substantial influence on the pattern of facilitation and interference. However, that influence is apparently not strong enough to eliminate the order effects. Working from our original analysis, we might suppose that an increase in the distribution of relationship strengths in the category materials could reduce the interactions with order. This manipulation is aimed at increasing the difference between the antonym and category materials along the assumed critical dimension, thereby making the change from one list to the other more distinct. In Experiment 4, the category list materials are changed to include an even less typical set of category members.

EXPERIMENT 4

Method

Subjects. Twenty-seven subjects were recruited from the same source used in the earlier studies. None had participated earlier.

Procedure. The procedures used here were identical to those used in Experiment 3.

Stimulus materials. The stimuli used in Experiment 3 were used here, with the exception of some of the critical category stimuli. The following changes were made. First, the targets used as low-typicality items were substituted for the moderately typical materials. Second, a new set of low-typicality items was selected. The new items were given by an average of only 19 subjects in the Battig and Montague (1969) norms. These words have a mean overall frequency of occurrence of 47.2 (Standard Frequency Index; Carroll et al., 1971). In this new set of materials, then, the high-typicality materials remain unchanged, the moderately typical materials have an average normative strength of 57, and the low-typicality targets have a strength index of 19. The mean frequency of occurrence for each type of category member is 51.2, 48.6, and 47.2, for the high-, moderate-, and low-typicality levels, respectively. The category practice materials were similarly modified to include even less typical category members.

Design. The design used here was identical to the design used in Experiment 3, including the design for the neutral filler materials.

Results

Three subjects were eliminated from the analysis because they exceeded the 10% error criterion on both lists. The analysis of the remaining 24 subjects' data parallels that of Experiment 3.

For the neutral filler materials, only one significant effect was detected. A subject's second list yielded a reaction time 42 msec faster than that of the first list [min $F'(1,42) = 4.3793$, $p < .05$]. All other effects for both the reaction time and the error data were not reliable (min $F' < 1$ for all terms). Averaged across all subjects, the neutral filler materials in the antonym list resulted in a mean reaction time of 593 msec and an error rate of 8.1%. For the category list, mean reaction time was 603 msec and the error rate was 7.4%. In the reaction time data, a difference of 45 msec across the two lists would have been detected.

The analysis of the critical target data yielded a marginal main effect of order [$F(1,22) = 2.7108$, $p < .10$], with the second list 15 msec faster than the first list. There were also main effects of list and of cue condition [$F(1,22) = 100.9656$, $p < .001$, and $F(2,44) = 24.8576$, $p < .001$, respectively]. On average, the antonym materials were responded to about 75 msec faster than the category materials. As in Experiment 3, the related cue condition produced the fastest reaction time, the neutral condition was intermediate, and the unrelated cue condition yielded the slowest reaction times.

The only interaction to yield significance was the List by Cue Condition interaction [$F(2,44) = 12.6610$, $p < .001$]. The antonym list data showed 59-msec facilitation and 2-msec interference. The category list produced 10-msec facilitation and 57-msec interference. None of the interactions of order with other factors approached significance. The Order by Cue Condition interaction, detected in Experiment 3, was not reliable here [$F(2,44) < 1$, $MSe = 1{,}959.77$]. Also, the three-way interaction of Order by List by Cue Condition was not reliable [$F(2,44) \leqslant 1$, $MSe = 873.70$]. The reaction time data for the three-way interaction are presented in Figure 3. Here, the category list data were similar to the category data from Experiment 2, regardless of order. Also, the antonym list data appeared quite unaffected by order of the lists.

The error data revealed two significant effects. First, fewer errors were made on the antonym list

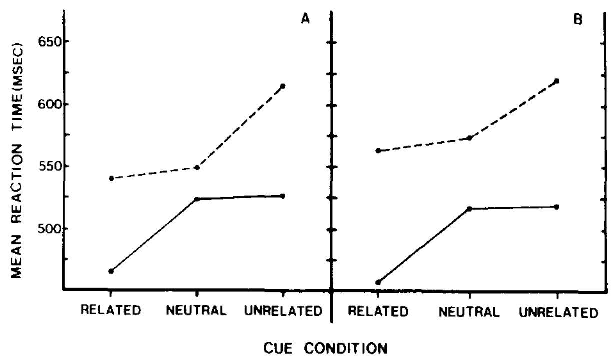


Figure 3. Mean reaction times for the cue conditions as a function of list and order for Experiment 4. Panel A presents the data for the antonym list first/category list second subjects; Panel B presents the data for subjects receiving the category list first. Solid lines are the antonym data, and the dashed lines are the category data.

than on the category list [$F(1,22) = 20.9965$, $p < .001$]. Second, the main effect of cue condition was reliable [$F(2,44) = 6.2411$, $p < .005$]. In line with the reaction time data, the related condition yielded the fewest errors and the unrelated condition produced the most errors. None of the interaction terms approached significance. The pattern of errors, though, generally supported the effects found in the reaction time data. For example, in the antonym list, the error rates were .0%, .4%, and 1.2% for the related, neutral, and unrelated cue conditions. In the category list, the error rates were 2.3%, 2.7%, and 5.5% for the related, neutral, and unrelated conditions. The interactions involving the order factor were quite small. Neither the Order by Cue Condition interaction nor the three-way interaction was significant ($F < 1$ in both cases; $MSe = 1{,}089.45$ and $1{,}046.80$, respectively).

Because of the change in the category materials made for the present experiment, one other facet of the data needs to be considered. Table 4 presents the data from the category list, showing a breakdown for the category typicality factor. A comparison of these data with the data in Table 2 reveals no substantive changes in the results, and a statistical analysis supports this comparison. Regardless of the level of category typicality, the facilitation and interference effects were equivalent.

Table 4
Category Typicality Data for Experiment 4

	Cue Condition					
	Related		Neutral		Unrelated	
Typicality	RT	% Err	RT	% Err	RT	% Err
High	534	.6	546	.6	610	2.0
Moderate	544	2.0	551	2.0	611	4.8
Low	576	4.1	587	5.5	636	9.7

Discussion

The intent of Experiment 4 was to find out whether the two patterns of facilitation and interference could be obtained within subjects and without effects of list order. The results indicate that this was the case. None of the interactions involving the order factor was significant. The data plotted in Figure 3 provide good visual support for the statistical conclusions.

As a result of this finding, we can now examine the neutral filler data with greater confidence. As in Experiment 3, Experiment 4 shows no difference between the neutral materials in the antonym list and the neutral materials in the category list. Therefore, we can only conclude that the two patterns of facilitation and interference result from changes in the related and unrelated conditions.

Overall, the data from Experiments 3 and 4 provide more information than was initially sought. In addition to demonstrating both of the facilitation-interference patterns within a subject, these studies provide added support for the factor identified as controlling the pattern of context effects. In Experiment 3, the order in which the stimulus lists were presented affected the subjects' performance. It was as though the subjects used their first list to establish how they would utilize the semantic context information. To some extent, this established use of context carried over to the second list. In an effort to eliminate this apparent carry-over, the category materials were changed for Experiment 4. The change in the category list was guided by the principle that the distribution of context strengths determines the facilitation-interference pattern. The lack of order effects in Experiment 4 coupled with the clear facilitation-dominant and interference-dominant patterns suggests that this change was effective in restoring full control to the list factor.

The finding of speculative interest here is that subjects can apparently persevere in one use of semantic context information, even though the list by itself seems to require a change in the mode of semantic processing. There are, of course, numerous possible characterizations for this result. It may simply be that the critical difference between the two lists in Experiment 3 was not sufficiently large to induce subjects to change their mode of semantic processing until they had seen, say, half of the list. This characterization is a rather straightforward extension of the arguments made above for the individual lists. In Experiments 1 and 2, subjects saw only one of the two lists and were therefore able to adjust their semantic processing based on just the one list. In Experiment 3, subjects adjusted their processing for their first list and perhaps continued with this mode of processing until well into their second list. The manipulation made in Experiment 4 apparently had an effect strong enough to induce a nearly immediate shift upon beginning a second list.

This interpretation suggests that the list factor may well be a quite powerful factor for determining the characteristics of semantic processing. If this is the case, then we might be able to devise a situation in which the data for a given set of materials shift from one facilitation-interference pattern to the other pattern. In essence, this would be an attempt to push the list factor to the limits of its effectiveness. Experiment 5 examines this possibility, using a mixture of antonym pairs, category-name/category-member pairs, and strong associates. The associates are included here in order to add generality to the findings and in order to eliminate a possible confounding of word types with type of semantic relationship. The antonym pairs consist largely of adjectives, and the category materials are largely nouns. The associated pairs are a mixture of the two word types. The intent here is to specify a set of materials that, overall, should produce a facilitation-dominant result while including a subset of the materials that have yielded interference dominance in earlier studies.

EXPERIMENT 5

Method

Subjects. Twenty-four subjects were recruited from the same population used in the earlier experiments. None had participated in any similar studies.

Procedure. The procedures used here were identical to those used in Experiments 1 and 2. All timing and display parameters and subject instructions were the same as those used earlier. In all, five blocks of 45 trials each were run, with the first block serving as practice.

Stimulus materials. The antonym materials used here consisted of 18 pairs selected from the 30 pairs used in Experiment 1, and the category materials were the 18 high-typicality items and the 18 low-typicality items from Experiment 4. A critical set of 18 common associates (e.g., DOCTOR-NURSE) was selected from various association norms with the restriction that the pairs be as strongly related as possible. Each of the four sets of 18 cue-target pairs (antonyms, high-typicality category, low-typicality category, and associates) was divided into three subsets of 6 pairs each. These subsets were then assigned to cue conditions, as in the earlier experiments. That is, six of the common associates were used in the related cue condition, six in the neutral condition, and six in the unrelated condition. The cue words used for the unrelated condition were the cues from the related condition. Across subjects, the assignment of target words to cue condition was varied so that each word appeared equally often in each condition.

In addition to these critical materials, the following filler material was included. Twelve strongly associated word triples (e.g., TONGUE-MOUTH-TEETH) were selected to be used as related filler materials. One of the words served as a cue and the other two as target words on two different trials. Twenty-four other words were selected for use as neutral filler materials. Each of these words was cued with the string of five Xs. Finally, 60 nonwords were generated, using the constraints specified above. Thirty-six of the nonwords were paired with the 36 word cues (12 related filler cues, 6 associate cues, 6 antonym cues, and 6 high-typicality and 6 low-typicality category cues), and the remaining 24 nonwords were paired with the neutral cue. In addition, a set of 45 practice trials was constructed to match the characteristics of the test materials. No stimuli used in the test set were used for practice.

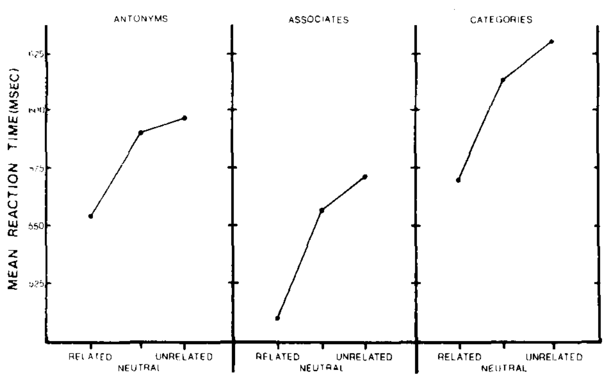
Results

The reaction time and error data were analyzed separately for each type of semantic relationship used here. Since we are interested in generalizing our results to both the subject population and the item population, the min F′ procedures were employed. As in Experiments 1 and 2, planned comparisons were used to test for facilitation and interference effects.

The facilitation-interference patterns for each type of semantic relationship are graphed in Figure 4. The analysis of the reaction time data for the antonym materials showed no reliable effect of cue condition [min F′(2,77) = 1.6841, p > .10]. However, the planned comparisons revealed a marginally significant 35-msec facilitation effect [min F′(1,77) = 3.9516]. The 8-msec interference effect was not significant [min F′(1,77) < 1]. The error data for the antonyms also showed no effect of cue condition [min F′(2,74) < 1] for error rates of .6%, 2.0%, and 2.7% for the related, neutral, and unrelated cue conditions, respectively.

The associative relationship yielded a marginally significant effect of cue condition [min F′(2,60) = 2.8228, p < .10]. The comparisons here revealed a significant 45-msec facilitation effect [min F′(1,60) = 5.5747, p < .025] and a nonsignificant 16-msec interference effect [min F′(1,60) < 1]. The error data showed no significant effect of cue condition [min F′(2,77) < 1] for error rates of 1.3%, 1.3%, and 2.0% for the related, neutral, and unrelated cue conditions, respectively.

For the analysis of the category data, both cue condition and typicality of relationship served as factors in the analyses. These data are presented in Table 5. In the reaction time data, there was no main effect of typicality of relationship [min F′(1,41) = 2.6095, p > .10], but the high-typicality category members were, on average, responded to slightly faster than were the low-typicality materials. In these data, there was a significant main effect of cue condition [min F′(2,113) = 6.6732, p < .005]. The comparisons showed a significant 44-msec facilitation



CUE CONDITION

Figure 4. Mean reaction times as a function of cue condition for each of the semantic relationships used in Experiment 5.

Table 5
Category Typicality Data for Experiment 5

	Cue Condition					
	Related		Neutral		Unrelated	
Typicality	RT	% Err	RT	% Err	RT	% Err
High	534	1.3	605	1.3	620	6.9
Low	606	2.0	623	5.5	630	10.4

effect [min F′(1,113) = 7.8743, p < .01] and a nonsignificant 11-msec interference effect [min F′ (1,113) < 1]. In addition, the interaction of cue condition with typicality of relationship was marginally reliable [min F′(2,113) = 2.4150, p < .10]. Planned comparisons were made to assess the facilitation and interference effects for the high- and low-typicality category materials separately. For the high-typicality category materials, there was a significant 71-msec facilitation effect [min F′(1,111) = 10.9901, p < .005]. For the low-typicality category materials, the 17-msec facilitation effect was not significant [min F′(1,111) < 1]. Neither of the two interference effects approached significance [min F′(1,111) < 1 in both cases]. The error data for the category materials yielded only a main effect of cue condition [min F′(2,110) = 3.7801, p < .05]. The error rates were 1.7% for the related condition, 3.4% for the neutral condition, and 8.6% for the unrelated condition. The pattern of error rates was similar for each level of typicality.

Discussion

The results of Experiment 5 show a substantial facilitation effect for all three types of semantic relationships, and relatively small interference effects. This finding supports the data reported above for the antonym relationship. It also supports the results reported by Neely (1976) for strongly associated word pairs. The facilitation-dominant results for the category materials are essentially the opposite of the interference-dominant results found earlier. This outcome indicates that the list factor is, indeed, powerful enough to affect the facilitation-interference pattern obtained for a given set of materials. In addition to this basic shift in the pattern of facilitation and interference, the analysis of the category typicality factor shows a change. In the earlier experiments, both high- and low-typicality category members yielded only nominal facilitation. In the present experiment in which facilitation dominates, high-typicality category members produce a substantial facilitation effect, but facilitation for the low-typicality items remains small. It seems, then, that in facilitation-dominant situations, the strength of the relationship between a given cue and target does have an effect on the amount of observed facilitation.

There is, however, one inconsistency in the results of Experiment 5. The error data for the category materials still show a sizable interference effect, but the reaction time data show no interference. This pattern of results suggests the possibility of a speed-accuracy tradeoff for the interference effects. Thus, the reaction time estimate of 11-msec interference may be too low.

THEORETICAL CONSIDERATIONS

At this point, there is sufficient reason to believe that the phenomenon identified here is real. The data from Experiments 1 and 2 provide a striking contrast between a facilitation-dominant effect of a semantic context and an interference-dominant effect of context. Experiments 3 and 4 provide additional evidence that demonstrates the difference in patterns within the same subject. Experiment 5 shows that the stimulus list factor identified here is powerful enough to effect a change in the pattern of results for a given set of materials when the overall list is properly structured. These results, combined with data reported by others, provide ample support for the basic facilitation-interference patterns and for the identification of a stimulus list factor as an important determiner of the effect of context.

This distinction between facilitation-dominant and interference-dominant effects of semantic context is a relatively novel one, and, therefore, no existing theory is able to directly accommodate these data. As stated earlier, the verification model (Becker, 1976) has a mechanism available to address the present findings, but the detailed attributes of that mechanism need significant further specification. In addition to the verification model, two other theoretical characterizations may be able to handle the present results. The framework presented by Posner and Snyder (1975) and applied to semantic context effects by Neely (1976, 1977) and by Stanovich and West (1979, in press) may provide a suitable explanatory vehicle. Also, the logogen model presented by Morton (1969) and used by Schuberth and Eimas (1977) to account for their semantic context data may be elucidating. In the remainder of this paper, I shall consider each of these theoretical positions in light of the data reported here.

The first framework to be considered is that originally stated by Posner and Snyder (1975) and elaborated by Neely (1976, 1977) and by Stanovich and West (1979, in press). Here, there are two processes that are relevant. First, it is assumed that the presentation of a cue stimulus initiates an "automatic" spread of activation that primes related stimuli. The process of automatic priming affords the subject some facilitation in the processing of a subsequent related target without any interference in the processing of an unrelated target. For the second process in this framework, it is assumed that, given enough time, a subject's attention can be focused on the cue and on the related items. Attending to these materials increases the total facilitation that subjects enjoy by adding to that derived from automatic priming. It is also through the use of this attentional mechanism that interference results. When a subject's attention is focused on the cue and its related items, the subject must switch that focus in order to respond to an unrelated target. The time to switch attention is assumed to be reflected in interference effects.

In this framework, an interference effect results only from the subject's attending to the cue stimulus. Thus, facilitation without interference provides a measure of the contribution made by the automatic priming mechanism. When interference does occur, the subject is attending to the cue, and the facilitation effect is the sum of the advantages derived from automatic priming and from attending to the cue. In the present study, there are numerous mismatches between this characterization and the data. Here, the largest facilitation effects occur for materials like the antonym list of Experiment 1. According to the present assumptions, then, these antonym-type materials should also produce the largest interference effects; however, this is definitely not the case. For these materials, there is no interference. Taking a slightly different view of the present data, we might expect the antonym-type materials to estimate the facilitation contributed by automatic priming. When there is no interference, only automatic priming can occur, and for the present data, automatic priming appears to reduce reaction time by about 50 msec. If this is the case, then the data from the interference-dominant category materials do not fit within this framework. For these materials, a large interference effect obtains, indicating that subjects are attending to the cue. The present framework suggests that this condition should yield substantial facilitation, but only a rather small facilitation effect is observed. It seems unlikely that this small facilitation effect is the sum of automatic and attentional facilitation, especially when the summed facilitation is substantially smaller than the assumed automatic component measured in an antonym-type list.

The major difficulty that the Posner-Snyder (1975) framework faces seems to be in the assumed direct relationship between facilitation and interference effects. In general, it is assumed that increases in interference are accompanied by increases in facilitation. The present data are inconsistent with this relationship between facilitation and interference. In fact, here the relationship is an inverse one. As interference increases, facilitation decreases.

Proposed elaborations of the Posner-Snyder (1975) viewpoint do not seem to help in addressing the present data. For instance, Stanovich and West (1979, in press) suggest that total processing time determines whether or not interference is observed. They assume that the more time a subject has for processing a cue stimulus, the more likely the subject is to have time to focus attention on the cue. Their view of processing time includes both the interval between cue and target onsets and the amount of time spent in processing the target. However, this processing time assumption does not help to explain the present data. Across the various experiments, the experimenter-controlled timing factors are held constant. In addition, the average reaction times across the different types of stimulus lists are nearly equal. Thus, across all of the experiments, each of the intervals that could vary and could contribute to differential processing times are equivalent. Here, then, there are no time differences that would allow the processing time assumption to be invoked, and yet, there are substantial differences in facilitation and interference effects.

It seems, then, that the framework proposed by Posner and Snyder (1975) and others cannot account for the present data. Neither the basic assumptions of the framework nor the elaborations are appropriate to the type of inverse relationship between facilitation and interference obtained here. Therefore, I will now turn to the other theoretical accounts.

Much of the remainder of this paper describes two models of the word recognition process that have served reasonably well in accounting for other data, and which can come quite close to handling the present results. First, the logogen model (Morton, 1969; Schuberth & Eimas, 1977) will be presented, and then the verification model (Becker, 1976, 1979; Becker & Killion, 1977) will be discussed. Although I have argued elsewhere (Becker, 1979; Becker & Killion, 1977) that the logogen model is inadequate, the focus of those arguments was the mechanism assumed to account for word frequency effects. In any case, a single failure is an insufficient basis for disregarding a theory, especially one that has been used fruitfully elsewhere. However, as we shall see, the logogen model encounters some difficulties when addressed to the present semantic context effects. Both models are described as they have been presented in the literature, and then refinements of the models are made to tailor them to the present data.

The description of the logogen model relies greatly on the characterization given by Schuberth and Eimas (1977). Basically, the logogen model consists of an assumed array of word detectors. Each word detector is a signal detection device that responds to the sensory attributes of the word represented by the detector. Upon presentation of a stimulus word, a feature extraction process begins to identify the sensory attributes of the stimulus and feeds this information to the word detector array. Each detector maintains a count of the sensory features identified in the stimulus that correspond to sensory features of the word represented by the detector. Word recognition in this model occurs when a detector exceeds its criterion count of sensory features.

The effect of semantic context is handled by the logogen model in the following way. Once a word is recognized, it becomes available for further processing. One aspect of this further processing is the identification of the semantic characteristics of the word. These semantic characteristics are used as an input to the word detector array and are handled by it in much the same way as the sensory features. That is, each detector responds to the semantic features as well as to the sensory features of the word it represents. It is assumed that the same counting mechanism keeps track of both types of features. Thus, in the logogen model, a semantic context serves to increment the feature count in detectors for words related to the context. This effectively reduces the number of sensory features needed to exceed criterion in those detectors compared with detectors for words that are unrelated to the context. If a word is related to the context, it would presumably be recognized on the basis of less sensory information than an unrelated word. To translate from this assumed difference in amount of information to a difference in reaction times, we need to assume that the sensory feature extraction process operates in real time. That is, as the time from stimulus onset increases, the number of sensory features identified also increases.

An alternative, but equivalent, characterization of the logogen model has been suggested by Morton (1969) and was used by Schuberth and Eimas (1977). This alternative employs a response-strength analogy instead of a signal detection analogy. In this conceptualization, a word is recognized when the response strength for its detector, compared with the sum of response strength for all detectors, exceeds a critical value. In other words, recognition here is a function of the ratio of the response strength in one detector to the sum of response strengths for all detectors. Changes in response strength for a given detector depend on the availability of appropriate sensory and semantic features.

As Schuberth and Eimas (1977) point out, the response-strength version of the logogen model allows the model to account for general facilitation and interference effects without augmentation or modification. When a semantic context is provided, the response strength for some of the word detectors will increase because of the semantic feature information. This results in an increase in the ratio of response strength for these detectors and produces the facilitation in the processing of words related to the context. For words unrelated to the context, there is no direct effect on their detectors, but, since the response strength for related detectors is increased, the sum of response strengths for all detectors is increased.

This yields a decrease in the ratio of response strengths for unrelated words and results in the interference effects.

This completes the initial description of the logogen model. In its present form, the model can account for the existence of facilitation and interference effects, and therefore, it can begin to address the type of results reported here. At this point, we turn to the explication of the verification model. Later, we will consider how each of the models can be enhanced to accommodate the data reported above.

The verification model (Becker, 1976, 1979; Becker & Killion, 1977) incorporates many of the characteristics of the logogen model, but it attributes a different function to the feature extraction and word detector processes. A representation of the verification model is depicted in Figure 5. As in the logogen model, the presentation of a stimulus and its storage in sensory memory initiates a sensory feature extraction process that feeds information into the array of word detectors. Detectors accumulate sensory information as before, but when a detector exceeds its criterion feature count, the stimulus is not recognized. Rather, the function of the feature extraction process is to limit the number of possibilities for a subsequent analytic search. It is assumed that the feature extraction process can identify only some of the information in the stimulus, the "primitive" components of the stimulus, such as the line segments and arcs that form the letters. Feature extraction processes cannot identify a second type of information, the relations among the primitive features, and this type of information is essential in order to recognize a word. Thus, feature extraction is assumed to be incapable of explicitly identifying a stimulus. The assumed result of the feature extraction process and the operation of the word detectors is the delineation of a set of detectors, each of which is consistent with the primitive feature information in the stimulus.

Once the sensory feature-defined set of words is available, another process, verification, performs a search of that set and explicitly identifies the stimulus. It is during this process that the relations among primitive features become important. Specifically,

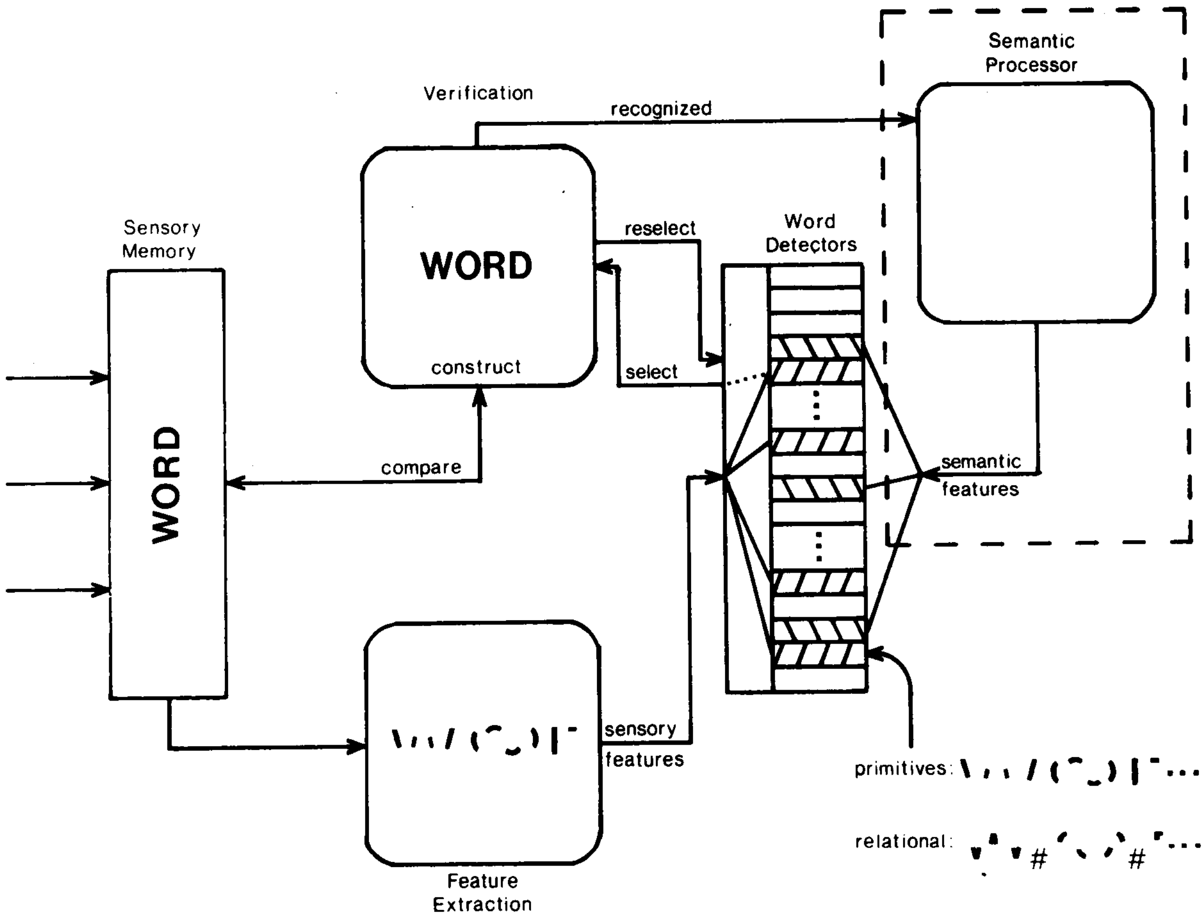


Figure 5. A possible pictorial representation of the verification model. The portion of the figure enclosed in the dashed lines represents the semantic context mechanisms, and the remainder of the figure illustrates the processing required for words presented in isolation. The representation in the lower right-hand corner illustrates the information available in each word detector. In the list of relational features, the # marks letter boundaries.

one word is selected from the sensory feature-defined set, and additional information stored with the word is used to construct a complete sensory representation for the word. The additional information used here is assumed to be the information about relations among primitive features. The construction step of the process combines the primitive and relational information to generate a complete representation for the selected word. The constructed representation is then compared with stimulus information maintained in sensory memory. If the constructed representation successfully "predicts" the relations among the primitive features in sensory memory, the word is recognized. If the predictions fail, another word is selected from the sensory set, constructed, and compared with the sensory memory information. This selection, construction, and comparison cycle continues until a match is found and the stimulus is recognized or until the set of possibilities is exhausted. Essentially, then, the verification process provides a way to identify the relations among primitive features, and it is assumed that this form of stimulus information is crucial to identify a word.

So far, we have described how the model handles the recognition of a word presented in isolation. In the verification model, semantic context effects can be represented by the parts of Figure 5 enclosed in dashed lines. Once a word is recognized, the semantic features of the word can be used to identify a semantically related set of words. As in the logogen model, semantic features are used as an input to the word detector array. In the verification model, though, a detector may exceed its criterion, given just the semantic feature input. Those detectors that do exceed criterion are included as members of a semantic feature-defined set of words. This set of words is used by the verification process in much the same way as the sensory-defined set of words. It is assumed that the members of the semantic set can be evaluated through the verification process as soon as a new stimulus is available in sensory memory, that is, without waiting for the output of the feature extraction process. If a stimulus word is related to the context, it is recognized as the result of a successful verification of a member of the semantic set. The availability of the semantic set prior to stimulus presentation and the early consideration of that set are the mechanisms responsible for the facilitating effects of an appropriate semantic context.

To account for the interference effects of an unrelated context, we can expand on the suggestion made by Becker (1976). When a context is provided, the verification process is assumed to begin processing the semantic context set. For a stimulus that is not related to the context, all members of the semantic set are tested and rejected. At this point, the verification process begins to search the sensory set defined by the features extracted from the stimulus. Presumably, the unrelated word is included here, and it would be recognized when encountered in the search. Thus, the recognition of an unrelated word requires, first, the exhaustive search of the semantic set and, then, a search of the sensory set. With this assumed ordering of the semantic and sensory sets, it becomes clear that interference in the processing of an unrelated word is a function of the size of the semantic set. If the size of the semantic set is relatively small, it could be exhaustively searched during the time required to identify the sensory set. Under these conditions, evaluation of the sensory set could begin as soon as the set becomes available. Alternatively, if the number of words related to a context stimulus is quite large, the search of the semantic set may still be in progress when the sensory set becomes available. In this case, consideration of the sensory set is delayed until the semantic set search is complete, thereby interfering with the recognition of an unrelated word.

We now have each of the models described, with the basic mechanisms to address facilitation and interference effects. What remains is to specify how the models handle the data presented here. Obviously, this requires a detailing of the operations of the semantic components of the models. Fortunately, the two models can accommodate the same set of semantic assumptions; so, the assumptions proposed here are stated once and then integrated into each of the models. The important distinction to be made here is that between situations that allow rather specific predictions of related target words and situations that allow only general expectations to be formed. The basis for this distinction comes largely from the types of materials that produce the two patterns of results. On the one hand, stimulus materials that allow subjects to fairly well predict the related target produce facilitation dominance. On the other hand, materials that preclude prediction but seem to allow a general expectation yield interference dominance. For consistency with the two models under consideration, this distinction is developed in terms of semantic feature processes, although an automatic spreading activation analogy might serve the purpose as well.

In the models, the effect of having recognized a cue stimulus is to initiate a semantic process that characterizes the stimulus in terms of semantic features. These semantic features are then fed into the array of word detectors and serve to "prime" the detectors for words related to the cue. The exact meaning of the term "prime" differs for the two models, but the basic concept is the same. In order to refine this mechanism to address the present data, we need to identify some influence of the type of stimulus list on the process that generates the semantic features. One possibility is that simply the number of semantic features generated for a cue varies across the two types of stimulus lists. We might suppose that larger numbers of features would prime larger numbers of detectors. So, for high-predictability lists, only a few features are generated, whereas for low-predictability lists, many features are generated. This would produce only a small set of possible related targets in a high-predictability list but a large set in a low-predictability list.

If this assumption is integrated into the models, an apparent problem arises. With only a difference in number of features, it is difficult for either model to address the apparently robust effect from Experiments 2 and 4, that category typicality does not influence the amount of observed facilitation. The problem comes in the assumptions that we often make about the distribution of things like semantic features. That is, we assume basically a normal distribution about some "center," in this case, the cue word. In the present framework, this type of distribution implies that large numbers of features are clustered about the center, with relatively few features in the tails of the distribution. This, in turn, suggests that words "closer" to the center should benefit more than words "farther away," and it harks back to notions of "strength gradients." The detailed implications of this view are inconsistent with the data from Experiments 2 and 4. Thus, it seems that other aspects of semantic feature generation need to be considered.

A second possibility is that the effect of list type is at least partly on the quality of the semantic features that are generated. For instance, we might assume that the two types of stimulus lists differ in the distribution of the semantic features generated. For facilitation-dominant materials, the distribution may well be normal, but for interference-dominant materials, the distribution may be much more rectangular. When this type of assumption is combined with the assumption of differing numbers of features, there may be a sufficient theoretical base to address all of the data reported here. To explicate these two assumptions, consider the following characterizations of facilitation-dominant and interference-dominant semantic processing.

For facilitation-dominant processing, specific predictions of related targets can be supported by a process that generates only those few semantic features that are most appropriate to the cue stimulus in its immediate list environment. For example, for the cue FURNITURE, these features might include "something to sit on," "something to put things on," "something to put things in," and "something to lie on." Essentially, these "features" are appropriate to the major subcategories of FURNITURE, like tables, chairs, cabinets, and beds. This set of "features" is to be treated as merely a crude example of the type of features that could be generated here. In addition to being relatively few in number, the exact features included in this type of set could vary across instances of a cue stimulus. Using an earlier example, if the word HOT is encountered as a cue, semantic features appropriate to the TEMPERATURE dimension would likely be generated. However, if a prior cue established a context of MEXICAN FOOD, features appropriate for PEPPERS and other spices, as well as for the now appropriate antonym, BLAND, would be generated. Thus, for facilitation-dominant semantic processing, the set of semantic features generated is assumed to be relatively small and appropriate to only one connotation of the cue stimulus.

Alternatively, for the interference-dominant semantic processing, more general expectancies could be supported by a process that generates features appropriate to all possible connotations of a cue stimulus. Thus, the features for a general expectancy for FURNITURE might also include "padded and upholstered," "seats more than one person," and "can be slept on in emergencies." These additional features are appropriate to the members of the subcategory CHAIRS, like couches, sofas, love seats, and so on, but not to coffee tables, china cabinets, and coat racks. These last items of furniture would presumably have their own set of features. In any case, though, the number of features generated here should be substantially larger than the number generated for a specific prediction, and the semantic attributes included should be more varied, as well.

The distinction being made here, then, is that both the number of semantic features generated and, to some extent, the quality of those features may differ for the two types of stimulus lists. Under facilitation-dominant conditions, it is assumed that only a few semantic features are generated, those appropriate to a single connotation of the cue. Under interference-dominant conditions, the semantic features appropriate to all possible interpretations are generated.

In addition to the arguments above, there is some independent support for the kind of qualitative difference in features assumed here. This support comes from studies using ambiguous words as stimuli. The available evidence indicates that sometimes an ambiguous word is recognized using only one of its possible meanings, whereas at other times, all possible meanings of an ambiguous word are involved. In a study by Swinney and Hakes (1976), a manipulation similar to the list manipulation used here determined whether just one meaning or all meanings were recognized. Thus, the distinction between one vs. all interpretations of a cue stimulus receives at least some independent support, and, in any case, a test of the distinction is suggested later. At this point, though, we turn to the integration of the semantic feature assumptions into the word recognition models.

When these two types of semantic feature sets are used to prime word detectors, there should be two different outcomes. For the small feature set, the number of word detectors that are primed is assumed to be rather small, consisting only of those words that are related to the current interpretation of the cue stimulus. For the larger set of features, the priming effect is assumed to be much more widespread, with words related to all meanings of the cue receiving the benefits of priming.

To clarify this distinction for further reference, below, the facilitation-dominant semantic process is referred to as a specific prediction strategy and the interference-dominant semantic process is referred to as a general expectancy strategy. To some extent, the distinction between prediction and expectancy is similar to that drawn by Allport (1979) in his recent review of the word recognition literature, but the details developed here differ from those stated by Allport. The two types of processing are labeled strategies to highlight the distinction between them. For the present, the two strategies are treated as separate processes that subjects may be able to choose between. Although it may be that the two semantic processes described here are extreme variants of the same underlying process, a clean separation is assumed.

To integrate the semantic strategies into the two models requires an elaboration of the effects of semantic features on word detectors and a characterization of how those effects propagate through the other components of the models. For the logogen model, the general effect of semantic features is to increase the response strength for words related to the cue and to indirectly decrease the response strength for unrelated words. Each of these changes in strength is represented as a ratio of the strength in one detector to the sum of the strengths in all detectors. When the prediction strategy is considered in this framework, relatively few word detectors are expected to show an increase in response strength. Therefore, any effects on total response strengths should be fairly small. The implications of this are that the response-strength ratios for the related words should show a substantial change and the ratios for unrelated words should show little, if any, change. For example, in a set of 1,000 word detectors, each detector might have a response strength value of 5 units, given no cue stimulus. In a neutral state, then, the total response strength is 5,000 units, and each word detector has a response-strength ratio of 5/5,000 (.001). When the prediction strategy is being used, a cue could cause, say, 10 related words to show an increase in response strength of 10 units. This effect of the cue would increase total response strength to 5,100, resulting in a strength ratio for the related words of 15/5,100 (.00294) and a ratio for the unrelated words of 5/5,100 (.00098). Thus, the ratio for the related words nearly triples, whereas the ratio for the unrelated words decreases only minimally. Under these conditions, then, facilitation for the related words should be sizable, but the interference for unrelated words should be quite small.

In contrast to this characterization, the expectancy strategy produces a different effect in the array of word detectors. Here, the semantic features generated under the expectancy strategy are assumed to directly prime a larger number of words. For example, we might assume that priming under this strategy would cause 100 detectors to have their response strengths incremented by 10 units. The total response strength is now 6,000, and the ratio for related target detectors is 15/6,000 (.0025), whereas the ratio for unrelated detectors becomes 5/6,000 (.00083). Thus, the amount of priming has decreased, and the decrement in response strength for unrelated detectors has increased, compared with the values for the prediction strategy. Basically, then, the response-strength version of the logogen model can begin to address the type of effects observed here.

Although the logogen model has the basic capability to handle the present data, a close examination of the example given above indicates a problem. Unfortunately, the changes in value for the strength ratios are rather small in the example. To perhaps obtain a cleaner numerical example, we might assume that the expectancy strategy primes 250 detectors instead of 100. Then, the ratios become 15/7,500 (.002) for related detectors and 5/7,500 (.00067) for unrelated detectors. In this case, the value changes are, perhaps, more reasonable. The priming effect has decreased to about half that found for the prediction strategy, and the ratio for unrelated detectors has decreased substantially. However, the problem seems more significant. In order to make the ratios more reasonable, we must continue to assume even larger effects of semantic priming by increasing the number of detectors directly affected. This soon becomes unrealistic. We have already assumed that 25% of the detectors are affected by priming, and to increase this amount further seems unwarranted. This problem becomes even clearer when a larger array of detectors is considered. Expanding the above example to an array of 50,000 detectors, 10 words primed with a value of 10 units results in a related ratio of .0000599 and an unrelated ratio of .00001999, for an average neutral ratio of .00002. When 100 words are primed, the related ratio becomes .0000597, and the unrelated ratio is .00001992. Given a sizable vocabulary, then, the numerical effects of priming different numbers of word detectors become negligible. Thus, even though the logogen model has the basic capability to address the present data, the details of the proposed response-strength characterization appear untenable.

In contrast to the logogen model, the verification model does not assume the involvement of the entire array of word detectors in producing interference effects. In this model, the effect of semantic feature priming is the identification of a set of words that are related to the prime. For the two strategies, the crucial difference is in the size of the semantic sets. For the prediction strategy, it is assumed that a relatively small semantic set is generated. This semantic set presumably can be tested by the verification process, relatively quickly producing two effects. First, a related target that is included in the semantic set should be encountered and responded to fairly quickly. Second, with not many alternatives to consider, the verification process should quickly exhaust the semantic set when the target is an unrelated word. Thus, there should be little if any delay in the consideration of the set generated using the sensory feature of the stimulus and little if any delay in responding to the unrelated target.

On the other hand, the expectancy strategy is assumed to generate a large semantic set. The size of this set is presumably large enough that it cannot be exhausted prior to the time that the sensory set becomes available. Again, there are two effects of this processing. First, the average time required to search the semantic set for a related target should increase compared with that for the prediction strategy. As the size of the semantic set increases, so should the average search time needed to identify a related target word. Second, when the target is an unrelated word, the thorough search of the large semantic set delays consideration of the members of the sensory set. This, in turn, produces a delay in the response to an unrelated target word. The amount of the delay is a direct function of the size of the semantic set. The larger the semantic set, the longer is the delay.

At present, the verification model can offer an account of the basic findings described here. This account maintains that the inverse relationship between facilitation and interference effects is a function of semantic set size. There remain two details of the present data to be addressed. First, why are there no effects of category typicality under interference-dominant conditions, and second, why do category typicality effects appear under facilitation-dominant conditions? The treatment of both results rests directly on the semantic feature assumptions stated above.

To address the lack of a category typicality effect when interference predominates requires largely a restatement of the semantic feature assumptions. When using the interference-producing expectancy strategy, subjects are assumed to generate a large set of semantic features that includes features appropriate to all connotations of a cue stimulus. With this diversity of semantic attributes, it seems unlikely that any single detector would be primed by all of the features available. In fact, each detector should be primed only by those features appropriate to the related interpretation of the cue stimulus. That is, the detector for TABLE will not benefit from semantic features appropriate to overstuffed couches, and vice versa. It may also be the case that the detector for the generic representation of TABLE does not benefit from the semantic features for specific types of tables. The generic representation may respond more to the functional aspects of tables and less to the descriptive aspects of particular tables. Thus, detectors for high-typicality category members, like TABLE and CHAIR, may not respond to more than a small number of the available semantic features, a number not very different from the number of features responded to by low-typicality category members. From this, it follows that there should be, at best, small differences in priming effects across word detectors. Thus, there is no strength gradient across primed detectors, and therefore, there is nothing on which to base a prediction of an effect of relative strength.

Given the above characterization that results in a prediction of no category typicality effect, it now becomes imperative to determine an explanation for the typicality effect observed under facilitation dominance. The basis for this explanation is the assumed single-connotation priming for the prediction strategy. Under this strategy, only one interpretation of a cue word is assumed to be used to generate semantic features, and thus, only words related to the current interpretation would be primed. For the most part, the connotation selected by a given subject would be the most common interpretation of the cue. Different subjects, of course, may select different interpretations, but it is assumed that the most common interpretation is the most often selected. In essence, this characterization of processing under the prediction strategy maintains that the effect of category typicality is determined by the likelihood that a target word is included in the prediction strategy semantic set. On most trials, words related to the common interpretation are included in the set, whereas words related to less common meanings are not. On some trials, though, the less common interpretation is selected, for whatever reason, and the words related to this meaning are then included in the set. Under these conditions, words related to the common connotation of the cue would presumably be excluded. Across subjects, then, this characterization of semantic processing suggests that target words related to the most common connotation of a cue should be primed on a large number of trials, whereas targets related to less common interpretations should be primed on relatively few trials. The average data should reflect this assumed processing difference by showing relatively large facilitation effects for the more commonly related targets and relatively small facilitation effects for the less commonly related words.

SUMMARY AND EXTENSIONS

The present study has described a distinction between two effects of a semantic context and provided sufficient evidence to support that distinction. Also, at least one theoretical explanation appears able to address the main points of the data presented here. Earlier, I mentioned that support for the distinction between facilitation dominance and interference dominance might have wide-ranging implications for our characterization of semantic processing, in general. The purpose of this section is to briefly describe three possible extensions of the present research to illustrate the ways that the present strategy distinction might be influential.

The most obvious extension of the present research is that suggested earlier during the characterization of the two semantic strategies. Specifically, it may be that ambiguous words are processed differently under the two strategies. The available data on the recognition of ambiguous words indicate that there may be conditions under which an ambiguous word is recognized "selectively" with respect to meaning (Schvaneveldt, Meyer, & Becker, 1976) and other conditions under which recognition is "nonselective" (Conrad, 1974). The work of Swinney and Hakes (1976) suggests that consistently strong contexts result in selectivity of meaning for ambiguous words and weaker, less consistent contexts produce nonselectivity. An obvious test of this extension is to replicate the Swinney and Hakes type of study and include a neutral cuing condition to assess the relative facilitation and interference effects. Under the present view, consistently strong contexts should result in selectivity of meaning and facilitation dominance, whereas the weaker, less consistent contexts should lead to both nonselectivity and interference dominance.

A second extension concerns the applicability of the present notions to the reading process. It is commonly assumed that the processes isolated in word recognition tasks are the same processes involved in fluent reading skills, although some investigators question this assumption (Mitchell & Green, 1978). To determine the generality of the semantic strategies described here, a continuation of the present research program has demonstrated the two facilitation-interference patterns using sentence cue/sentence target materials in a sentence verification task. To provide an assessment of generality to normal reading, the same study identified individual differences in reading skills and demonstrated a strong link between the individual differences and a subject's strategy selection both in a word recognition task and in the sentence task (Eisenberg & Becker, Note 1).

The final extension to be considered here goes beyond the use of language materials in an attempt to isolate the strategies using nonlinguistic materials. If the types of strategies described here are indeed general strategies, then we should detect their operation in tasks involving, say, the perception of pictures. To assess this level of generality, the event-perception paradigm described by Jenkins, Wald, and Pittenger (1978) may prove useful. Here, an "event" is divided into a set of "snapshots" that, in the proper sequence, represent the event. For example, an event might include pictures of a person entering a store, browsing through the magazine rack, purchasing a magazine, and leaving the store. For present purposes, we might take a pair of snapshots and present them as a cue-target pair, with a binary decision required for the second member of the pair. After incorporating a neutral cue condition, we could measure facilitation and interference effects for these nonlinguistic materials. By manipulating a factor like "time between snapshots," we may be able to isolate the facilitation-interference patterns identified in the present study. For instance, the exclusive use of cue-target pairs like "select a magazine/pay for the magazine" may lead to facilitation dominance in the processing of the second snapshot. Alternatively, mixing this type of pair with a pair like "enter the store/pay for a magazine" might yield interference dominance.

In addition to the three extensions considered above, there are numerous other possibilities. Given the apparent consistency of the data in the present paper and the initial tests of generality already conducted, it seems that the distinction between the two effects of a semantic context must be seriously explored. Studies both of the generality of the phenomenon and of the detailed characteristics of the underlying processing are needed.

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NOTES

1. Fischler and Bloom (1979) report an additional analysis of the Schuberth and Eimas stimulus materials that finds an average cloze technique probability of only .12 for the related cue-target materials. While this is a rather low figure, the procedures used by Schuberth and Eimas may well have counteracted the weakness of the relationships. Specifically, subjects in that experiment were run in three sessions, each using the same target stimuli. The three sessions consisted of two neutral cue conditions and one condition that included the related and unrelated cue materials. The order of the sessions was counterbalanced across subjects. Thus, most of the subjects had seen the sample of target words at least once before they saw the related and unrelated cues. This repetition of stimulus materials may have had the effect of strengthening the relationship between the cue sentences and the related targets in the sample of target words.

2. The only exception to this result was obtained by Fischler and Bloom (1979) for their highest rated set of target words. These words were generated by subjects an average of 91.5% of the time in response to the incomplete sentences used as the cues. Thus, these incomplete sentence cues seem quite restricted in the words that could complete the sentence. Following the logic of the expectancy set-size argument, we might expect these materials to produce fairly small expectancy sets regardless of the attributes of the list in which they are embedded. This should lead to large facilitation effects, and indeed, for these materials, facilitation is substantial. Continuing the set-size logic, we should now expect the interference effect for these materials to be rather small, but even for these materials, interference remains large. It may be, then, that in this exceptional case, facilitation effects are determined by the characteristics of the individual cues, whereas the interference effects remain under the control of the overall characteristics of the stimulus list.

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