The Retrieval of Phonetically Similar and Dissimilar Category Members

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Subjects were given a category and a letter (e.g., 'relative-M') and asked to name a member of that category beginning with that letter (e.g., 'mother'). Immediately afterward, they were given the same category and a different letter and asked to name a second member beginning with that different letter, which had been chosen for its likelihood of eliciting a phonetically similar or dissimilar response (e.g., 'brother' or 'cousin'). They responded faster with a second instance of the category than with a first and faster with a phonetically similar second member than a dissimilar one. The results place certain constraints on theories of the nature of storage and retrieval from semantic memory.

Loftus (1973) showed that prior retrieval of one member of a category facilitates the retrieval of another member of that category. The results of Brown and McNeill (1966) and those of Bower and Bolton (1969) suggest that prior retrieval of any word will facilitate the retrieval of another phonetically similar word. It is of interest in sorting out of various models of memory to determine if the two facilitating effects are additive. First, a brief description of these studies.

Brown and McNeill (1966) investigated the 'tip of the tongue' phenomenon. Their subjects were presented the definition of an uncommon English word and asked to supply that word. Those subjects who were seized by the tip-of-the-tongue state often reported that during their search for the target word, words came to mind that resembled the target in sound and syllabic aspects. For example, while searching for the word 'sextant,' many subjects reported such words as 'secant,' 'sextet,' and 'sexton.' That might occur if words phonetically similar to one another are, in some sense, stored near one another in memory and, in some way, stumbled across in the subject's search for one like it.

Bower and Bolton (1969) studied the learning of rhymed paired associates as compared with unrhymed (or dissonant) ones. Their subjects learned the rhymed ones more easily, which suggested to Bower and Bolton that a 'rhyming index' might direct the subject's search to a re-
restricted region of memory or serve to call up a restricted set of possible responses from which he can more easily select the desired response.

Loftus (1973) presented her subjects a category and asked them to name a member of that category. Some time later, in a similar manner, she asked them to name a different member of that category. Response latency for the second instance was shorter than that for the first, but it increased as the number of intervening events increased. The results were taken to support the notion that memory locations (in this case, those locations containing members of a particular category) can become temporarily activated.

Our method in the present study was to use Loftus' (1973) technique to measure the effect of phonetic similarity on the ease and speed with which pairs of words are found in memory. We gave the subjects a category (e.g., relatives) and asked them to name a member of that category beginning with a particular letter (e.g., M). Immediately afterward, they were presented the same category and asked to name another member beginning with a different letter—this different letter (e.g., B or C) chosen, however, for its likelihood of eliciting a phonetically similar or dissimilar member. Thus, the responses to the sequence 'relative-M, relative-B' might be 'mother, brother,' while the responses to 'relative-M, relative-C' might be 'mother, cousin.'

METHOD

Subjects—The subjects were 24 students at the New School for Social Research; they were fulfilling a course requirement. Each subject was tested individually in a small room with the experimenter.

Stimulus materials—Each stimulus was a category name and a letter. Thus, the subject saw, for example, 'relative-M' printed in block letters on a 5-by-8-in. index card.

Most of the stimuli involved a critical category name. The 24 critical categories were selected from the Battig and Montague (1969) and the Shapiro and Palermo (1970) norms, and for each of these categories, three instances were chosen. Two of the instances were phonetically similar to one another (e.g., for the category 'relatives,' the instances 'mother' and 'brother' are phonetically similar). The third instance (e.g., 'cousin') was chosen to satisfy two criteria: that it begin with a letter different from that beginning the first two instances and that it meet certain criteria for dominance. 'Dominance' was defined as the likelihood that a particular response would be given when a subject was asked simply to name words that fit a category. Since we could not precisely match dominance, we chose instances such that half the time the third instance was more, and half the time less, dominant than the less dominant of the phonetically similar instances.

For each critical category, then, the three instances were of three types: type
S₁, the phonetically similar instance with higher dominance; type S₂, the phonetically similar instance with lower dominance; and type D, the dissimilar instance 'matched' in dominance with S₄. For the critical category 'relatives,' for example, the instances were 'mother' (type S₁), 'brother' (type S₂), and 'cousin' (type D).

Each critical category name was paired once with each of the first letters of the three chosen instances, but it was presented only twice to each subject.

In addition to the stimuli involving the 24 critical categories, 20 filler stimuli were used. These also consisted of a category and a letter. Some of the filler categories were used only once; others appeared twice, but with different letters. Thus, each subject saw 68 unique stimuli (24 critical categories, each paired with two letters, and 20 filler stimuli).

Each subject received a different permutation of 68 items, with three restrictions. First, the initial presentation of a critical category was followed immediately by the presentation of the same category paired with a different letter by the following method. We designated as an S₁ stimulus one that required a response of type S₁, as the stimulus 'relative-M' should elicit the phonetically similar instance with higher dominance ('mother'), for example. On half the trials on which a subject saw an S₂ stimulus, then, that stimulus was preceded by an S₁ stimulus; on the remaining trials, it was not. On half of the trials on which a subject saw a D stimulus, that stimulus was preceded by a S₁ stimulus; on the remaining trials, it was not. Thus, for six categories, an S₂ stimulus followed an S₁ stimulus; for six categories it did not. For six categories, a D stimulus followed an S₁ stimulus; for six categories, it did not. The second restriction was that for each critical category, the following sequences of stimuli occurred equally often across subjects: S₁ followed by S₂; S₂ followed by S₁; S₁ followed by D; D followed by S₁.

The third and final restriction was that the 20 filler items were randomly presented, but never so as to fall between pairs of appearances of a critical category. Their purpose was to discourage the subject from always expecting the same category on the next trial.

Procedure — Each subject was told that we were conducting a study on memory, that he would see items consisting of names of categories and single letters, and that he was to respond to each stimulus with a word that fit in the category and began with the given letter. He was given examples and told to respond as quickly as possible without making errors.

On each trial, the subject sat before a screen that had a half-silvered window. The index card with category and letter was placed in a space behind the window. The experimenter said "Ready" and simultaneously switched on a light that permitted the subject to read the category name. After .5 sec, the letter was automatically illuminated and an electric timing clock was started. When the subject responded into the microphone in front of him, a voice key stopped the clock. A warm-up period of 20 trials preceded the experimental trials.

RESULTS

Because the stimuli generally had more than one possible correct response, we did not always elicit the instances we wanted. We were most
successful with the category 'relatives.' For 21 of 24 subjects, we elicited the responses, 'mother,' 'brother,' and 'cousin,' that we had expected to the stimuli 'relative-M,' 'relative-B,' and 'relative-C.' For the category 'animals,' however, we presented 'animal-C,' 'animal-R,' and 'animal-P,' hoping to elicit 'cat,' 'rat,' and 'pig,' respectively, and did so for only 7 of 24 subjects. Since we so rarely elicited the precise instances we wanted, we decided to analyze all actual responses to the critical categories.

We grouped each subject's responses to the critical categories into four classifications: initial responses that preceded phonetically similar responses (class 1); second responses that followed phonetically similar responses (class 2); initial responses that preceded phonetically dissimilar responses (class 3); and second responses that followed phonetically dissimilar responses (class 4). For example, if a subject said 'mother' the first time he was asked to name a relative and 'brother' (or any phonetically similar response) on the next trial, then 'mother' went into class 1 and 'brother' into class 2. If he said 'mother' followed by 'cousin' (or any phonetically dissimilar response), then 'mother' went into class 3 and 'cousin' into class 4.

Median latencies were obtained for each subject's responses in each of the four classifications. For each classification, group mean latencies were obtained by averaging medians for individual subjects; these means are shown in Table 1. An analysis of variance was done on the latency data, using a repeated-measures design with subjects, type of response (phonetically similar or dissimilar), and response order (first versus second) as factors.

There were several important results. First, the subjects produced a second instance of a category faster than they produced an initial instance [1.37 versus 1.71 sec; \( F(1, 23) = 13.51, p < .01 \)]. Second, they produced an initial instance that preceded a similar response in an amount of time not significantly different from the time it took them to produce an initial

<table>
<thead>
<tr>
<th>Type of response</th>
<th>Phonetically similar</th>
<th>Phonetically dissimilar</th>
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<tr>
<td>Initial responses classes 1 and 3</td>
<td>1.73 (.33)</td>
<td>1.68 (.28)</td>
</tr>
<tr>
<td>Second responses classes 2 and 4</td>
<td>1.23 (.25)</td>
<td>1.50 (.27)</td>
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instance that preceded a dissimilar response [1.73 versus 1.68 sec; \( F < 1 \)]. This is as it should be. And third, the interaction between type of response (similar versus dissimilar) and response order (first versus second) was significant, indicating that the reduction in the speed of second responses that were phonetically similar to the initial responses was larger than the reduction for second responses that were dissimilar \([F(1,43) = 4.38, p < .05]\). Since the two types of initial responses were essentially identical, another way of stating this last result is that second responses which were phonetically similar to initial responses were faster than second responses which were phonetically dissimilar.

**DISCUSSION**

That memory locations can become temporarily activated is central to Loftus’ (1973) explanation of why a subject is faster to name a second category member than a first. As to the question of what it is that a stimulus activates, Loftus (1973) proposed two models: the **specific-activation model**, which assumes that the first presentation of a category name activates the memory location representing just the category name, and the **spreading-activation model**, which assumes that the first presentation of a category name activates not only the location representing the category name but also locations nearby the location of the category name. That is to say, the spreading-activation model holds that retrieving information from a particular memory location produces a spread of excitation to other nearby memory locations, facilitating later retrieval from them. Although Loftus’ data (1973) did not provide evidence for differentiating between the two models, the work of other investigators (e.g., Schvaneveldt and Meyer, 1973) provides strong support for the spreading-activation model.

In the present experiment, we found facilitation of the second member of a category when it was elicited immediately after the first member of the same category. This replicates previous findings. However, the additional facilitation of the phonetically similar second member requires some modification of the spreading-activation model — or any other activation model. The memory system that would allow the data we obtained must be able simultaneously to activate two complete sets of memory locations (or presumably, had we so designed the experiment, some very large number of different sets of locations).

Can a spreading-activation model be used to explain the influence of phonetic similarity observed in various experiments? Bower and Bolton’s (1969) data suggest that a change-of-last-phoneme rule facilitates as
much as rhyming does. They interpreted (1969, p. 461) their results to support either (a) a facilitation based on a reduction of the number of response alternatives or (b) an indexing system that “directs the subject’s search to a restricted region of memory or, alternatively, is used like a ‘callnumber’ to retrieve a restricted set of responses from which the list responses can be selected (because it has been recently tagged in the experimental context).” Their results could as easily be interpreted as supporting the spreading-activation model.

However, our subjects were not told that rhyming was important, so the notion of response restriction as proposed by Bower and Bolton cannot be operating. On the contrary, the effect we found comes from long-term memory structure rather than from the use of a stated rule by the subject. Our data suggest that more than one ‘memory location’ can be simultaneously activated. There seems no reason to limit this to two locations. An alternative model might better be a multidimensional one. One is proposed now.

**A multidimensional model of memory**

Suppose that each word is coded in memory as a vector terminus in multidimensional space, whose dimensions are such things as number of syllables, sound of first syllable, sound of last syllable, category number i (where i is a variable which may take some indeterminate number of values), category number j, and so on. Since the number of words is very large, and since the number of dimensions is very large (infinite?), the storage cannot be in terms of locations but must be distributed throughout a very large volume of the central nervous system. All words, then, are stored throughout this volume.

Suppose further that every stimulus activates a very large number of other words in proportion to their projection on the principal dimensions of the stimulus word. For example, the category activates all words that are words about relatives; the instance first given by the subject activates all words that sound like that instance. The second presentation of the category reactivates the various words about relatives (in accord with Loftus, 1973), and the sound-alike words are activated still more strongly than the others, so the response when it occurs from the sound-alike set is more rapidly retrieved.

Such a memory requires a functional rather than a structural organization. Whatever model of memory one espouses, it does not seem likely that the memory for one word can be ‘near,’ in any literal sense, that for another word — or, in all probability, ‘be’ anywhere at all.
Notes

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