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Does synonym priming exist on a word completion task?

Holland, Cynthia Rose, Ph.D.

Case Western Reserve University, 1992
DOES SYNONYM PRIMING EXIST ON A WORD COMPLETION TASK?

by

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Submitted in partial fulfillment of the requirements for the Degree of Doctor of Psychology

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DOES SYNONYM PRIMING EXIST ON A WORD COMPLETION TASK?

Abstract

by

CYNTHIA HOLLAND

Implicit memory tasks demonstrate that one's performance can be primed by past experience without one being consciously aware that the past experience is affecting the present performance. Roediger (1990) suggests that priming in implicit memory tasks occurs because there is a physical match between a studied stimulus and a test response. Roediger's theory implies that priming will not occur if a conceptual match is the only link between words at study and test.

The present experiments tested the notion that priming may occur in an implicit memory task for conceptually related words, specifically for synonyms. In an initial experiment, subjects were merely requested to study a series of words and then to complete word stems. The word stems would be completed with studied words or with synonyms of studied words. In a second experiment, subjects were
requested to think of as many synonyms as possible for presented words. This study manipulation was intended to draw subjects' attention to synonyms of the study words. No priming effect for synonyms was found in Experiment I. A small but significant priming effect for synonyms was found in Experiment II.

Data for the present experiment and other recent studies suggests that implicit memory tasks can be effected by conceptual priming.
Dedication

This dissertation is dedicated to Edith Cowles, whose life helped me to understand the value of family, love, fun and perseverance.
Acknowledgements

I want to express my sincere appreciation and gratitude to Bob Greene whose patience, wisdom and guidance helped me to realize my dream - a completed, approved dissertation. I owe much of my present status as Dr. Mom to you, thanks Bob.

Thank you also to the members of my committee, Doug Detterman, Lee Thompson and Barry Layton whose insights and suggestions added greatly to the contents of this dissertation.

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Many thanks to my parents who have always been my cheerleaders and in so doing provided the encouragement which kept me going and saved me from losing heart during difficult times. In addition to wonderful parents, I am blessed with two brothers (Pat and Tony), a sister (Laura), and four fun children (Jesse, Nick, Chris and Mike) all of whom have played a role in fueling the fires of both inspiration and sanity.

Last, but certainly not least, thank you to my husband, Joseph, who has been in the unenviable position of a man forced to wear many hats. Each hat fit perfectly but I am most grateful for the one which provided and continues to provide me with a best friend.
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CHAPTER 1

Introduction

The purpose of the present study was to determine whether presentation of words on a list will have a priming effect for the words' synonyms on a subsequent word completion task. The word completion task is an implicit memory task. Implicit memory tasks are designed to demonstrate that one's performance is affected by past experience even though there may be no awareness of that experience. In the past, researchers interested in studying the processes of human memory have typically used tasks where subjects are given a list of words to study and then are later asked to recall or recognize which words were from the original list. A recall task requires the subject to report all the words they remember from the study list. A recognition task asks the subject to judge, for each word viewed on a subsequent test list, which ones were presented on the original study list. In both recall and recognition tasks, the subject is asked explicitly to remember past experience; thus the label, explicit memory, describes this type of memory task. Implicit memory tasks, in contrast, demonstrate that performance can be affected by past experience despite there being no conscious
awareness of the past experience. Graf & Schacter (1985) first employed the terms implicit and explicit to distinguish these two classes of memory tasks.

One example of an implicit memory task is the perceptual identification task popularized by Jacoby and Dallas (1981). There are two phases in experiments of this sort. In the first phase, subjects are shown a list of words. In the second phase, subjects are asked to identify briefly-presented words. A word is much more likely to be perceived correctly in the second phase if it had been presented on the list in the first phase.

A second example of an implicit memory task is the homophone spelling task utilized by Jacoby and Witherspoon (1982). Here, subjects listen to a list of word pairs. On at least some of the pairs, the second word is a homophone, and the first word suggests one particular interpretation of the homophone (e.g., IRON-STEEL, WINDOW-PANE). Later, the subjects are given a spelling test where they are asked to spell words read aloud by the experimenter. Included on the spelling test are homophones that had been presented on the earlier list. Subjects will tend to spell these homophones in a way consistent with the way they had been biased earlier.

Word completion is the most commonly used implicit memory task. Subjects view a list of words. Sometime after they view the list of words, they are given a second list of incomplete words (perhaps only
the first three letters are present), and they are asked to complete each incomplete word with the first word they can think of. The typical finding is that subjects are likely to complete word stems with words they viewed at the initial time of list presentation even though the task instructions did not require or suggest a need to remember the words on the initial list. For example, if subjects saw a list of words and one of those words was INSTRUCTOR, they would later be more likely to complete the stem INS with INSTRUCTOR rather than with other possibilities such as INSTITUTION, INSIDE, or INSULATION. Exposure to the word INSTRUCTOR influenced the subjects' subsequent behavior even though the subjects were not directly asked to remember the previously seen list. Word completion is one example of an implicit memory task, and it is the task which was employed in the present study. The word-completion task is the most commonly-used implicit task and has thus been the task on which most theoretical accounts of implicit memory have been based.

Schacter (1987), in his review of implicit memory, gives an eloquent and detailed history of the concept of implicit memory dating back to the time of Descartes. Many philosophers and psychologists have recognized that our behavior may be influenced by events that we are not consciously remembering; Freud is an obvious example. However, the current interest in implicit memory was spurred by research on amnesic patients who exhibit impaired
performance on explicit memory tasks but demonstrate normal
performance on implicit memory tasks (e.g., Graf, Squire & Mandler, 1984; Jacoby & Witherspoon, 1982). One example of normal implicit
memory on the part of amnesics is the word completion task defined
earlier. If amnesics are given a word completion task with explicit
directions, that is, if they are asked to complete the words with
words they had seen on a previously presented list, the amnesics do
significantly worse than the non-amnesic controls. However, when
amnesics are asked to complete the words with the first word that
comes into their mind, they complete the stems using words from the
previously seen list about as often as the non-amnesic control
subjects do (Graf et al., 1984). Word completion tasks are one
example of tasks that amnesics perform normally on when presented
implicitly but show impaired performance on when presented
explicitly. There are also other tasks on which amnesics show this
implicit/explicit performance discrepancy. The implicit/explicit
discrepancy demonstrated in the early amnesia literature has been
replicated again and again (see Shimamura, 1986, for a review).

Other populations also demonstrate this implicit/explicit
performance discrepancy. Data is accumulating which indicates that
implicit/explicit memory differences exist throughout the life span.
Greenbaum and Graf (1989) studied explicit and implicit remembering
in 3-, 4-, and 5-year-olds. They found increases across age groups
in explicit memory performance but not in implicit memory performance. Age had no impact on implicit remembering. Similar results have been found with the elderly. Light & Singh (1987) found age-related differences in implicit and explicit memory such that the elderly demonstrated deficits in explicit memory tasks but not for implicit memory tasks. Although there is not yet enough evidence to be considered conclusive, the data suggests that throughout the lifespan implicit memory ability remains stable while explicit memory performance shows improvement over age in childhood and decrements over age in the elderly.

The findings on amnesic patients and lifespan changes opened the door to a whole new set of memory tasks to be employed with a normal population. If amnesics evidenced different memory abilities on implicit and explicit tasks, perhaps normal populations would evidence similar separate abilities. Implicit tasks were used for normal populations and the results showed that in a non-memory-impaired population performance on a task was influenced by a previous event even when people were not asked to remember the event, indicating support for separate memory abilities in normal populations similar to those initially found in the amnesic population (Schacter, 1987). Also, variables such as level of processing (Graf & Mandler, 1984) or intentionality of learning (Greene, 1986) that have large effects on explicit tasks may show
little or no effect on implicit tasks. These findings suggest that people do not employ exactly the same processes on implicit tasks that they do on explicit tasks.

The explosion of implicit memory research resulting from these findings has provided data that continues to refine our knowledge of the complex area of memory. The question which the present study addresses is an outgrowth of the information gleaned from an implicit task already described, the word completion task. As discussed, previous research on implicit memory has studied how presentation of a stimulus can influence performance on that same stimulus on a later test. The present research asks whether presentation of a stimulus can effect performance on a different, but related, stimulus on a test. Specifically, will having seen one word (e.g. LAWYER) on a list make a person more likely to use a synonym (e.g. ATTORNEY) as a response on a subsequent word completion task in which the stem ATT____appears? The answer to this question will help shed light on the unresolved theoretical debate concerning the distinctions between explicit and implicit memory.

One of the most influential theoretical accounts of the distinction between implicit and explicit memory is Roediger's (1990) conceptually-driven versus data-driven account. (For related theories that would make identical predictions here, see Jacoby, 1983,a, 1983,b, and Tulving and Schacter, 1990). Roediger's theory
suggests that explicit memory tasks rely predominantly upon meaning, or concepts. That is, subjects on explicit tasks are retrieving meaningful events, not simply patterns of physical stimulation. Thus, performance in recall or recognition will largely be determined by the extent to which list items had been processed meaningfully (Craik & Tulving, 1975). Implicit memory tasks, in contrast, rely predominantly upon physical cues, or data, according to Roediger's (1990) theory. Thus, implicit tasks should primarily be influenced by perceptual processing, not conceptual processing. Data supporting the theory is reported in Roediger's review (1990). Roediger's theory is clearly consistent with findings that implicit tasks are uninfluenced by variables such as level of processing or intentionality of learning. Such variables are believed to have their effect by influencing the amount of meaningful processing carried out on items and would thus not be expected to affect tasks that depend purely on perceptual processing. There are also other experiments (Jacoby & Dallas, 1981) in which self-generation of stimuli by subjects resulted in improved explicit task performance but not in improved implicit task performance. In the same set of experiments, the greatest priming effect (i.e. implicit memory) was found for words read out of context, thus emphasizing the perceptual properties of the words. Similar results were found in other experiments, (Madigan, 1983; Smith & Branscombe, 1988) which also
provide support for Roediger's theory suggesting that priming is facilitated by perceptual, data-driven processes.

Roediger's theory, taken in the strictest sense, assumes that priming effects in implicit memory occur because there is a physical match between the words on a study list and the words on a test list. In other words, to address specifically the present study, actually seeing the word LUNATIC on the study list would prime the response LUNATIC at test to the stem LUN because there's an actual physical match, the letters LUN appearing in both places. On the other hand, if there were no direct physical match between words on the study list and words on the test list, priming would not occur. In regard to the above example this would imply that if subjects saw the word LUNATIC at test time, they would not be prone to finish the word stem CRA with the word CRAZY, because no physical match occurred. If it is physical similarity that is necessary to effect priming then one could hypothesize that in the case of words matched on a study list and a test list for similarity in meaning, as in the example of synonym pairs, priming would probably not occur. It is "look-a-like" not "mean-a-like" which should yield a priming effect.

If implicit memory tasks are driven by perceptual processing and "rely heavily on the match between perceptual operations between study and test," (Roediger, 1990 p. 1049) then there should be no priming effect for synonyms. If study and test words are related
conceptually but not physically (for example, if they are synonyms), Roediger's theory suggests that implicit task performance will not be influenced by the study words. Roediger's account sees implicit memory tests as being basically perceptual tasks that are uninfluenced by the meaning of the stimuli. Thus, there is no reason why seeing a word on a list should make a subject more likely to use a synonym as a response on an implicit test. If word completion is truly a perceptual task, having seen LAWYER earlier should not make one more likely to complete ATT with the word ATTORNEY. Therefore, if subjects were shown a list of words and later on were given a word completion task on which they could complete word stems with study-list words, synonyms of study-list words, or entirely neutral words, the results would allow us to compare different priming effects. Priming for a strict perceptual match condition (the repetition condition) would be compared with the conceptually matched condition (the synonym condition) using the neutral condition as a baseline against which priming is measured.

On the basis of many previous experiments, the repetition condition can be expected to exhibit much higher scores than the baseline condition. However, comparisons of the synonym condition with the baseline and repetition conditions will be far more theoretically important. Strong support for Roediger's (1980) theory that implicit memory is data-driven would occur if the repetition
condition proves to be superior to both the baseline and synonym condition and if there is no difference between the synonym and baseline condition. This would support Roediger's classification of the word stem-completion task as a perceptual, data-driven task. Weak support for Roediger's theory would occur if the repetition condition were superior to the synonym and baseline condition but the synonym condition was superior to the baseline condition. This would imply that word completion may be partly perceptual but would challenge Roediger's claims that meaning can play no role at all in this task. No support for Roediger's theory would result from a situation in which both repetition and synonym conditions were superior to the baseline condition but the repetition and synonym condition were not different from each other. Such a finding would suggest that meaning might be largely responsible for priming effects in this task.

In fact, in a chapter discussing priming effects in general, Roediger and Blaxton (1987) refer to an experiment from Roediger's laboratory in which an attempt was made to elicit a priming effect for synonyms. Subjects were presented with words at study time and at test time were given a word fragment completion task. In a word fragment completion task, some letters are given along with blank spaces. The subject's task is to fill in the blanks to make a word e.g. _L_P_A_T for ELEPHANT. Subjects could complete the word
fragments with repeats of study list words, synonyms of study list words or new words (which served as a baseline measure for priming). Although neither the details of the procedure nor specific results were presented, Roediger and Blaxton state that there was no significant effect for priming of synonyms of presented words over the baseline condition.

There are, however, other tasks that seem to meet the definition of implicit memory but that do reveal priming effects for related words. Lexical decision tasks are one example. In a lexical decision task, subjects are required to judge whether or not a string of letters represent an English word. A common application of this task involves the investigation of priming effects. Meyer and Schvaneveldt (1971) found that a set of related words such as BREAD BUTTER are judged to be "words" more quickly than a set of unrelated words such as NURSE BUTTER. If a subject is processing only the physical qualities of a stimulus, the letter string BREAD BUTTER should be no easier to recognize as consisting of legitimate English words than the letter string NURSE BUTTER. However, in these experiments, the related words were presented at the same time, and thus the effect could be a result of perceiving the two related words as one lexical unit. This may not be inconsistent with the claim that the mechanism underlying priming is data driven rather than conceptually driven. There are other types of lexical decision tasks which address this specific question, for example, Marcel (1980,
1983) found priming effects for related words in a lexical decision task even when the two words were not presented simultaneously and the priming stimulus was quickly followed by a masking pattern. For example, the word "child" facilitated lexical decisions about the word "infant", even though, because of the rapid presentation of a backward masking pattern, subjects were not able consciously to identify the word "child". These particular lexical decision task results support the notion of a priming effect for related words. In other words, because the words "CHILD" and "INFANT" were not shown simultaneously, there is the strong suggestion that the priming effect for "INFANT" relied at least in part on conceptual processes. If all types of priming are a result predominantly of data driven processes, one would not expect facilitation in the lexical decision task for the word INFANT due to prior presentation of the word CHILD. These lexical decision task results support the hypothesis that priming effects do exist for related words. Of course, the lexical decision task differs in many ways from the commonly-used implicit tasks, such as word stem completion or word fragment completion. For example, the two related stimulus words appear either simultaneously or consecutively separated by at most a few seconds. Thus, the physical qualities of both words are present at some point unlike the test list in word-completion tasks where only one word is present. Perhaps for this reason, evidence from lexical-
decision tasks is rarely cited in the literature on implicit memory tasks.

There is, however, some evidence for conceptual priming when an implicit memory task other than lexical decision is employed. In a recent study, Weldon (1991) found a greater priming effect on a word fragment completion task for a target word such as BLACK when it had been previously paired during study with a same meaning compound such as BLACKBIRD than when it had been paired with a different meaning compound such as BLACKMAIL. Weldon proposed that the differential priming effect for the two study conditions was due in part to conceptual priming hypothesizing that when the target words were paired with a same meaning compound the individual meaning of the target word was preserved. In other words, BLACKBIRD is indeed BLACK, whereas BLACKMAIL is a metaphor. So what Weldon does in this set of instructions is to draw the subject’s attention to the concrete meaning of the word by calling to the subject’s attention an object exemplifying that meaning (BLACKBIRD for BLACK). In so doing, somewhat more priming is produced than occurs by presenting a compound BLACKMAIL which also contains the target word BLACK but which does not draw attention to blackness, per se. The results, of course, are problematic for Roediger’s theory, because the actual physical presentation of the word BLACK is equal for the two study lists, but priming effects are different. Thus, in Weldon’s
experiment we find that the conceptual processing carried out on a word may have some influence on the amount of priming found on a common implicit memory test.

The present study also examined whether or not priming effects exist for related words. Specifically, an attempt was made to see if priming occurs for synonyms in a word completion task.
CHAPTER 2

Experiment 1

The purpose of an initial experiment was to see if priming for synonyms would occur in a word stem completion task simply following study of a word without any attention drawn to the synonym of the word during study. The experimental plan was that if no synonym priming effect was found in the word stem completion task of Experiment 1, then an attempt would be made in a second experiment to follow Weldon's (1991) lead of manipulating attention during study so as to obtain a synonym priming effect by drawing the subject's attention to synonyms of words during study.

Method

Subjects. Thirty-six students from introductory psychology classes at Case Western Reserve University served as subjects in partial fulfillment of a course requirement; all were native English speakers.
Materials. There were three versions of the study list. Each version consisted of a set of 40 slides with one word printed on each slide. The set of slides consisted of 30 target words and five filler words at both the beginning and end. The filler words were not tested in any way. All were taken from two lists of synonymous noun pairs (Whitten, Souter & Frank, 1979, and Wilding & Mohindra, 1983) where the degree of synonymity for each noun pair was known. Words on the Whitten et al. and the Wilding and Mohindra lists are arranged by synonymy rating. The pair of words with the highest synonymy rating is first on the list, and pairs continue in that order down to the pair of words with the lowest synonymy rating. Words for the present study were chosen from those words on the Whitten et al. and the Wilding and Mohindra lists with the highest synonymy rating, exempting those words with too few letters or words whose first three letters made up a word in themselves. The test list in the present study consisted of 45 word stems. Of these word stems, 15 were the first three letters of words shown on the study list. Fifteen stems were the first three letters of words that were synonyms of words shown on the study list. The remaining 15 stems bore no relationship to any words presented on the study list. Study words were counterbalanced with respect to condition. For example, all subjects might have seen the word stem ANG at test time. One
third of the subjects would have seen ANGER on the study list, the repetition condition. One third of the subjects would have seen RAGE on the study list, the synonym condition, and for one third of the subjects the ANG would be a new word condition since neither ANGER nor RAGE occurred on the study list. A single test list was used for all subjects.

Procedure. Subjects were tested in groups of 2 to 8 people. They were told that they would be viewing slides of words, one word at a time and that they should attend to each one. Subjects then viewed slides of the 40 study words at a 5-s rate. Immediately after seeing the list, subjects were given a piece of paper. Printed on the paper were 45 stems consisting of three letters. Subjects were instructed to complete each of those stems with the first word that popped into mind. They were allowed to work at their own pace.

Results and Discussion.

The purpose of the present study was to discover if priming occurs for synonyms of words. Following study of 40 slides, each student was asked to complete 45 word stems. There were two scoring systems used, strict and loose. For the strict scoring system, answers were scored correct only if there was an exact match between the word completed on the answer sheet and a word presented at study time. For the loose scoring system, answers on the word completion
task were scored correct if there was an exact match between the completed word and a study word, or if a suffix was used in the completed stem word without the meaning of the word being altered. For example, under the loose scoring system, if a subject completed the word stem ANG with ANGRY instead of ANGER, they would be given credit because the meaning of the root word was the same. Alternately, if a subject completed the word stem CUS with the word CUSTOMER rather than the word CUSTOM, credit was not given because the meanings of the two words differ.

Upon analysis, it was discovered that the list of 45 word stems contained one stem that occurred twice, five that could be considered whole words (e.g. TOT, PRO) and one that could have served as a synonym for another word on the list. Nine stems were omitted from the analysis leaving a total of 36 word stems that were available for scoring. Thus, it was possible for each student to complete 12 of the word stems with an exact repetition of a word seen on the study list. It was possible to complete 12 of the word stems with a synonym of words seen on the study list, and it was possible to complete another 12 word stems with words that did not appear on the study list but did appear on the study list for other subjects. Across subjects, the latter condition served as a baseline for priming effects for the repetition and synonym conditions. Thus, each subject had three scores, a repetition priming score, a synonym
priming score and a baseline score. Table I lists the mean number of word stem completions for each of the three conditions for both the loose and strict scoring systems. As one can see from Table I, only the repetition condition appeared to exhibit a priming effect. In fact, the number of correct completions in the synonym condition was slightly lower than in the baseline condition. The three scores for each subject were entered into a one-way analysis of variance with repeated measures across the three conditions. Only the analysis for the loose scoring system is reported below, since the results of the analyses were almost identical across scoring systems. The F test for the main effect due to conditions from the one-way ANOVA was highly significant (F (2, 70) = 16.77, p < .001). To determine the source of the main effect due to conditions, one-tailed t tests for all three possible comparisons of conditions were undertaken, i.e. repetition with synonym condition, repetition with baseline condition, and synonym with baseline condition. Obviously, the crucial planned comparisons involved contrasting the synonym condition with the other two conditions. The comparison of the repetition and neutral conditions replicates many previous experiments. One-tailed tests were considered appropriate since the hypotheses being tested make clear directional predictions. The number of stems correctly completed in the repetition condition proved to be significantly greater then in the baseline condition (t (35) = 5.04, p < .0001).
The number of stems correctly completed in the repetition condition was also superior to the synonym condition ($t(35) = 4.71, p < .0001$). No reliable difference was obtained when the synonym condition was compared to the baseline condition ($t(35) = 0.55$), that is the number of stems correctly completed in the synonym condition did not significantly differ from the number of stems completed in the new word condition. In summary, the results of Experiment 1 provide no evidence for the priming of synonyms when one simply presents a word and then tests with a stem of a synonym of that word.

Each subject was asked if they were aware that word stems could be completed with words they had seen before. All subjects were aware of this. They were also asked if they were aware that word stems would be completed with a synonym of a presented word. Only eleven out of the 36 subjects reported such awareness. The other 25 said they were unaware that word stems could be completed words. The group was divided according to those who reported awareness and those who did not. An analysis of variance based on the loose scoring system was undertaken in which awareness was a factor, study list used for counterbalancing was a factor, and the three conditions of response was a factor. The analysis revealed no reliable effect for awareness and no interaction of awareness with conditions. In other words, being aware that the word stems could be completed with
synonyms did not produce synonym priming. In summary, Experiment I found no priming effect for synonyms when study list words were presented with no specific instructions. Since no synonym priming effect was found in the word stem completion task of Experiment I, Experiment 2 was conducted in an attempt to obtain a synonym priming effect by drawing the subjects' attention to synonyms of words during study. This was done largely to explore the boundary conditions of the null synonym priming effect found in Experiment I. Is it impossible to find synonym priming effects in word completion? To determine this, Experiment 2 was designed to be as favorable as possible to finding such an effect.
TABLE 1

Number of word stems completed with a repetition of a studied word or a synonym of a studied word, compared with the number of word stems completed with the words in a baseline condition for loose and strict scoring conditions

<table>
<thead>
<tr>
<th>Scoring</th>
<th>Repetition</th>
<th>Synonym</th>
<th>Baseline</th>
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<tr>
<td>Loose</td>
<td>Mean 5.78</td>
<td>2.92</td>
<td>3.19</td>
</tr>
<tr>
<td></td>
<td>SD 2.50</td>
<td>2.09</td>
<td>1.79</td>
</tr>
<tr>
<td>Strict</td>
<td>Mean 5.44</td>
<td>2.53</td>
<td>2.81</td>
</tr>
<tr>
<td></td>
<td>SD 2.56</td>
<td>1.96</td>
<td>1.83</td>
</tr>
</tbody>
</table>
Experiment II

Method

Subjects. Sixty-six students from introductory psychology classes at Case Western Reserve University served as subjects in partial fulfillment of a course requirement. All were native English speakers.

Materials. Materials were exactly the same as described for Experiment I.

Procedure. Subjects were tested in groups of 2 to 8 people. They were told they would be viewing slides of words, one word at a time at a 5-s rate. Subjects were instructed to think of as many synonyms, or similar meaning words, as possible, for each word presented. They were also instructed to write down on a sheet of paper the number of synonyms that they thought of for each word. Immediately after the slide presentation of study words, subjects were given a test list, a sheet containing 45 sets of three letters. Each test list consisted of the same 45 word stems. Subjects were asked to complete each stem with the first word that came to mind and were asked to work as quickly as possible.

Results and Discussion.

The purpose of the present study was to discover if priming
occurs for synonyms of words when instructions at study time require subjects to attend to the synonyms of the presented words. As explained in Experiment 1, a corrected scoring system was necessary. As a result, 36 word stems were used in the analysis. There was also a strict and a loose scoring system employed, as explained in Experiment I. It was possible for each student to complete 12 of the word stems with an exact repetition of a word seen on the study list. It was possible to complete 12 of the word stems with a synonym of words seen on the study list and it was possible to complete another 12 word stems with words that did not appear on the study list but did appear on the study list for other subjects. Across subjects, the latter condition served as a baseline for priming effects for the repetition and synonym conditions. Thus, each subject had three scores, a repetition priming score, a synonym priming score and a baseline score.

Table II lists the mean number of word stem completions for each the loose and strict scoring systems for each of the three conditions. As one can see from Table II, it appears that both the Repetition Condition and the Synonym Condition elicited more correct word stem completions than did the Baseline Condition. To confirm these visual impressions, the three scores based on the loose scoring system for each subject were entered into an analysis of variance with repeated measures. The one way ANOVA yielded a highly
significant main effect due to conditions ($F(2, 130) = 30.92, p < .001$). An ANOVA based on the strict scoring system yielded virtually an identical main effect ($F(2, 130) = 33.24, p < .001$). The source of the main effect due to conditions was tested by comparing the three conditions with a series of one-tailed tests for each scoring system. The repetition condition elicited significantly more correct word stem completions than did the baseline condition, ($t(65) = 7.9, p < .001$) and ($t(65) = 8.20, p < .001$) for the loose and strict systems respectively. The repetition condition was also superior to the synonym condition ($t(65) = 5.21, p < .001$) and ($t(65) = 5.85, p < .001$, loose and strict). Of most importance for our present purposes, however, was the fact that the number of word stem completions for the synonym condition was significantly greater than in the baseline condition ($t(65) = 1.95, p < .028$) and $t(65) = 1.43, p < .079$, loose and strict. In other words, the synonym priming effect in Experiment 2 was clearly significant using one scoring method and approached significance for the other scoring system.

Once again the subjects' responses were analyzed in regard to whether they had realized that word stems could be completed with a word they had seen or with a synonym of a word they had seen. As in Experiment I, all subjects reported an awareness that word stems could be completed with a word they had seen. Unlike Experiment I, in which only a few subjects (11 out of 36) reported awareness that
the word stems could be completed with synonyms of words they had seen, in Experiment II, the majority (50 out of 68) reported that they were aware that the word stems could be completed with synonyms of words they had seen. These results indicated that the manipulation of attention to synonyms was effective for the majority of the subjects in Experiment II. Again, awareness as a factor was entered into a 2 (awareness) by 3 (study lists) by 3 (conditions: Repeat, Synonym, New Word) analysis of variance using scores based on the loose scoring system. As was the case in Experiment I, the interaction between awareness and condition was not significant indicating that reported awareness did not augment priming effects. These results support Bowers & Schacter (1980) who also found that awareness of the relationship between study and test has no influence on priming in word completion.
TABLE 2

Number of word stems completed with a repetition of a studied word or a synonym of a studied word compared with the number of word stems completed with test words in a baseline condition for loose and strict scoring systems

<table>
<thead>
<tr>
<th>Scoring</th>
<th>Repetitions</th>
<th>Synonyms</th>
<th>Baseline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Loose</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>5.32</td>
<td>3.35</td>
<td>2.71</td>
</tr>
<tr>
<td>SD</td>
<td>2.32</td>
<td>1.71</td>
<td>1.59</td>
</tr>
<tr>
<td><strong>Strict</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>4.83</td>
<td>2.77</td>
<td>2.30</td>
</tr>
<tr>
<td>SD</td>
<td>2.14</td>
<td>1.73</td>
<td>1.48</td>
</tr>
</tbody>
</table>
GENERAL DISCUSSION

Implicit memory tasks demonstrate that one's performance can be affected by past experience without one being consciously aware that the past experience is affecting the present performance. The specific theory addressed in the present study is Roediger's (1990). Roediger's theory classifies implicit memory as data-driven as opposed to explicit memory which he classifies as conceptually-driven. Roediger suggests that priming in implicit memory tasks occurs as a result of an exact perceptual match between stimulus at study and test. Roediger's theory implies that implicit task performance will not be facilitated by the relatedness of words at study and test.

The present experiments tested the notion that implicit memory tasks are predominantly data-driven. One way to evaluate the theory is to explore the possibility of a priming effect for related words. If a priming effect for related words could be found, it would provide evidence for conceptually-driven processes in implicit memory. The present experiment attempted to find a priming effect for related words, specifically for synonyms. Words were presented in two different ways. In Experiment I, subjects were merely requested to attend to each word. In Experiment II, subjects were requested to think of as many synonyms as possible for the presented
words and to write down the number of synonyms they thought of. This study manipulation was intended to draw subjects' attention to synonyms of the study words. Synonym word pairs, used in these experiments, were chosen based on high synonymy ratings. Thus, it was likely for subjects in Experiment II to generate the exact synonym that the study word was being tested for. The experiments were designed to test for conceptually-driven priming in two ways. The first experiment tested for conceptually-driven priming when only the actual study words were available to the subjects. The second experiment tested for conceptually-driven priming when subjects were required to generate internally synonyms for the study words they had seen. It was likely for subjects to generate synonyms being tested for. Generation is a conceptually-based process because words are not physically present as required for data-driven processes. That is, subjects were not perceiving the synonyms that they were generating; that is why subjects were not required to write any synonyms down. If synonym priming was found in Experiment II, it would suggest some contribution of conceptually-driven priming for an implicit memory task at least under some circumstances.

No priming effect for synonyms was found in Experiment I. A small but significant priming effect for synonyms was found for Experiment II. These results are in line with other results found recently. Smith (1991), suggested that the level of information
recruited at test to perform word-fragment completion depends upon initial study conditions. Smith's study and test conditions were quite different from the conditions in the present study, but results of the present study echo her conclusions. Conceptual priming was found when subjects were required to process words conceptually at study time but conceptual priming was not found when subjects were not required to process words conceptually at study time. This is not a new concept but rather one which reinforces Roediger (1987): "In general, the more similar the processing activities required by the test to the encoding activities, the better will be performance on the test." Roediger also credits others as precursors of this thought, (Kolers, 1979; Kolers, 1975; Kolers & Roediger, 1984; Tulving & Thomson, 1973). In short, results of the present study support findings in the field in general. Conceptual priming was not found unless, as in Experiment II, subjects were required to process words conceptually.

Although conceptual priming was found in Experiment II, the effect was quite small and barely significant. These results are in line with what other researchers have found in regard to conceptual priming for some implicit memory tasks. Weldon (1991) found no effect for encoding context on a perceptual identification test but did find a small effect for encoding context in a word fragment completion test. Weldon found a 4 to 6% increase in priming for same
meaning words over different meaning words. This is similar to the
5% increase over baseline of synonym priming found in Experiment II
in the present study.

In summary, data suggests that certain implicit memory tasks can
be affected by conceptual priming. The size of the effect is small
but significant. What does this converging evidence mean for
theories of implicit memory? One possible reaction to the finding
that word completion may be affected by conceptual processing is to
reject Roediger’s (1980) account completely. There are some
disadvantages to this reaction. One is that this ignores the fact
that Experiment I’s results were entirely in accord with the theory
and that even in Experiment II, which was designed to maximize the
probability of finding an effect of conceptual processing, the effect
was quite small. A complete rejection of this theory would also
leave unexplained the large body of evidence that is consistent with
Roediger’s account. There is a notable lack of satisfactory
alternatives here. Some researchers in the neuroscience tradition
(e.g., Squire, 1987) have suggested that explicit and implicit memory
tasks may be measuring entirely unrelated memory systems. However,
the properties of these separate memory systems are rarely specified
in detail, and thus these proposals offer little guidance for those
trying to explain how these tasks are influenced by different
variables in normally functioning subjects. Moreover, these accounts
are unable to account for the correlations that may be found between implicit and explicit tasks in normal subjects (Perruchet & Baveaux, 1989).

An alternative reaction to the data reported here is to consider modifying the present conceptualization of Roediger’s (1990) theory. An argument has been made likening data-driven vs. conceptually-driven processes to endpoints on a continuum (Roediger & Blaxton, 1987). Recent data, including the present study, supports such a view. Implicit memory tasks are primarily data-driven. Explicit memory tasks are primarily conceptually driven. Within each type of memory task there is variability as to how close to its endpoint the task is situated. Specifically, as stated earlier, perceptual identification, one type of implicit memory task, does not seem to be affected by conceptual encoding manipulations, according to Weldon (1991).

This category of implicit tasks would be placed close to the endpoint labeled data-driven on our imaginary data-driven/conceptually-driven continuum. Word fragment completion tasks, as in Weldon’s (1991) experiment, and word stem completion tasks, as in the present study, are slightly, yet significantly, effected by conceptual encoding manipulations. Conceptual encoding manipulations result in small amounts of conceptual priming for these tasks. Keeping in mind that word fragment completion and word stem
completion are still both much more significantly influenced by data-driven processes, a picture arises in which these two tasks are placed somewhat to the right of perceptual identification tasks but yet still very much in the data-driven half of the data-driven/conceptually-driven continuum. This vision of a continuum, as Roediger suggests, is in keeping with the spirit of Implicit/Explicit Memory Theory. Implicit memory tasks are most influenced by data-driven processes. Explicit memory tasks are most influenced by conceptually-driven processes. Within each paradigm, tasks can be ordered in accordance with the amount of influence which the opposite endpoint of the continuum is able to exert on them, but said task will always be found, at heart, imbedded in its appropriate half of the data-driven/conceptually-driven continuum. Specifically, although some implicit memory tasks can be effected slightly by conceptual processes, they will always be predominantly data-driven.

Many different dichotomies have been proposed in experimental psychology (e.g., serial vs. parallel processing, automatic vs. effortful processes). These dichotomies have rarely endured the test of time and have typically been replaced by continua. This seems to be the case with the distinction between data-driven and conceptually-driven processing as well. This trend has its frustrating aspects. For one, a continuum is often harder to subject to conclusive empirical test than is a dichotomy; however, it seems likely that true dichotomies may be quite rare in cognition.
BIBLIOGRAPHY


