Journal of Experimental Psychology:
Learning, Memory, and Cognition
1985, Vol. 11, No. 4, 732–741

0278-7393/85/$00.75

Semantic Memory and the Generation Effect: Some Tests of the Lexical Activation Hypothesis

John M. Gardiner and James A. Hampton
The City University, London, England

A word from a list is more likely to be recalled if it was self-generated rather than read. This finding—the generation effect—has been attributed to semantic memory and, more particularly, to the enhanced activation of the semantic features comprising a word's representation in the subjective lexicon. Three experiments showed that a similar generation effect occurs for meaningful but not for meaningless letter bigrams (e.g., *E T* vs. *E C*); for unitized but not for nonunitized 2-digit numbers (e.g., *28* vs. *2, 8*); and for familiar but not for unfamiliar noun compounds (e.g., *cheesecake* vs. *cheese ketchup*). These results indicate that semantic memory involvement is critical to the generation effect only in that the item to be recalled must form some integrated functional unit. Representation in the subjective lexicon is neither a necessary nor a sufficient condition for the effect to emerge.

During recent years there has been renewed interest in how a person's memory is influenced by having self-generated the items to be remembered. Much of this interest has stemmed from, and focused on, the finding of superior memory for words presented in a generate as opposed to a read task—the *generation* effect as delineated by Slamecka and Graf (1978; see also Jacoby, 1978). In Slamecka and Graf's generate task, subjects were given a stimulus word, a rule specifying some relation between it and the target response, and the initial letter of the response word. The read task differed only in that the response word was shown in full. Their study showed that a large and similar generation effect occurred with a number of different sorts of rule; that the effect occurred in recognition memory, cued-recall, and free-recall learning; and that the effect did not extend to the stimulus word—it was restricted to memory for the response word.

Subsequent research indicated that the generation effect is sensitive to the lexical status of the item to be remembered, for McElroy and Slamecka (1982) showed that there was no generation effect in memory for pronounceable nonwords generated (or read) with a letter transposition rule. On the strength of this finding they argued against simple arousal or effort interpretations of the generation effect, and instead proposed that semantic memory involvement was a necessary condition for the generation effect to emerge. More particularly, they suggested an interpretation in terms of lexical activation, according to which the generate task leads to an enhanced activation of semantic features, and a consequent increase in the likelihood of gaining access to the trace. We refer to this as the *lexical activation* hypothesis.

Slamecka and Fevreiski (1983) lent a further refinement to this view by showing that a generation effect occurs even when the self-generation attempt fails. Thus, with respect to the distinction between the surface features and the semantic features of the item, self-generation of the surface features is not essential to the effect. Indeed, Jacoby (1983) has shown that in a test of perceptual identification, where surface rather than semantic features are at a premium, self-generation is actually disadvantageous. He found that self-generated words were less likely to be identified than words which had been read.

Slamecka and Fevreiski (1983) provided a useful summary of the implications of the lexical activation hypothesis. They remarked that

The authors contributed equally to the research reported in this article. We are greatly indebted to Frances Guy for experimental assistance.

Requests for reprints should be sent to John M. Gardiner, Psychology Division, Department of Social Science and Humanities, The City University, Northampton Square, London, EC1V 0HB, England. Copies of the experimental materials are also available from the authors on request.

. . . generation will have functional consequences only if the generated unit already has representation in the subjective lexicon. That is, the generational product must be a word in one's vocabulary, and therefore must possess semantic attributes . . . generation must involve access to a lexical entry in order to produce a memory advantage. . . (p. 161)

The purpose of the present article is to provide some tests of this lexical activation hypothesis. The strategy was to explore further the boundary conditions of the effect with respect to the nature of the item to be remembered. We are concerned with the question of whether the to-be-remembered item has to be a proper dictionary word, a lexical entry, and whether it has to possess semantic attributes. It may be that although semantic memory involvement is a necessary condition for the generation effect to emerge, the generated unit functions at a broader conceptual level than that which characterizes representation in the subjective lexicon. Hence it may be that it is some property of a word other than its lexical status that is essential. Accordingly, each of the three following experiments was designed to investigate the generality of the generation effect across different types of to-be-remembered item, drawn from quite different sorts of material.

Experiment 1

The strongest support for the lexical activation hypothesis comes from McElroy and Slamecka's (1982) finding of no effect with nonwords. However, nonwords differ from words in several ways apart from their lexical status, and because McElroy and Slamecka used only nonwords, they did not test for an interaction with a matched set of materials, nor did they provide evidence that a transposition rule gives rise to a generation effect even with words. The aim of Experiment 1 was to use a more homogeneous set of materials, namely letter bigrams, in such a way that by rearrangement of precisely the same letters the bigrams could be rendered either meaningful, in that they formed well-known abbreviations, or meaningless, in that they did not. In addition, following McElroy and Slamecka's procedure, a letter transposition rule was used, and the experiment involved multitrial free-recall learning. Thus the experiment was designed to investigate whether, with a transposition rule, a generation effect might occur for meaningful but not meaningless letter bigrams.

Method

Subjects. The subjects were 40 undergraduate students at The City University, London. They were allocated arbitrarily to one of two groups, they were tested individually, and they were paid for their services.

Design. The design was a 2 × 2 × 3 factorial with Meaningfulness (meaningful vs. meaningless) as a between-subjects factor, and Task (generate vs. read) and Trials (1–3) as within-subjects factors. One group of 20 subjects learned a list of meaningful bigrams, and another group of 20 subjects learned a list of meaningless bigrams. Within each list, half the bigrams were presented in the generate task, and the other half in the read task. Task was blocked within the list. Within each group, generate items for half the subjects were read items for the other half, and vice versa.

Materials and procedure. Two independent judges selected what they deemed to be 20 of the most meaningful letter bigrams from a larger set in which all bigrams were abbreviations, for example, *E T, V C.* In these examples, *E T* of course is the hero of the eponymous movie, and *V C* stands for Victoria Cross, the highest British military award for valor. Other examples of meaningful bigrams which were all well known to British subjects, are *G P* (General Practitioner), *M P* (Member of Parliament), *U S* (United States), and *T B* (Tuberculosis). Meaningless bigrams were constructed by reassigning first and second letters from the list of meaningful bigrams (e.g., *V T, E C*). All the bigrams were reversed and embedded in the second and fourth positions of arbitrarily constructed 5-letter strings (avoiding any meaningful letter sequences), and hence the transposition rule was to take the second and fourth letters from the string and reverse them. In both generate and read tasks, the subject had to call out each letter from the string, then say *equals,* then the letter bigram (e.g., *G T N E I* equals *E T*).

List materials were presented from a deck of cards. Each string of letters was followed by an equals sign and either a question mark or the letter bigram. The first 10 items for each list were presented in either generate or read conditions, but the order of items within each condition was randomized separately for each subject across each of the three trials.

The subjects read instructions explaining what was required of them, and they were told they would be given several study trials, after each of which they were to recall, in any order they wished, the letter bigrams. The items were presented at about a 4-s rate. In order to reduce the level of recency recall, the subjects were also given a 30-s counting task between each study and test trial. The free-recall tests were written and they were self-terminated.

Results and Discussion

The principal results—the probability of recall of letter bigrams in the various experimental conditions—are summarized in Figure 1. The figure shows that, whereas there is no generation effect with the meaningless bigrams,

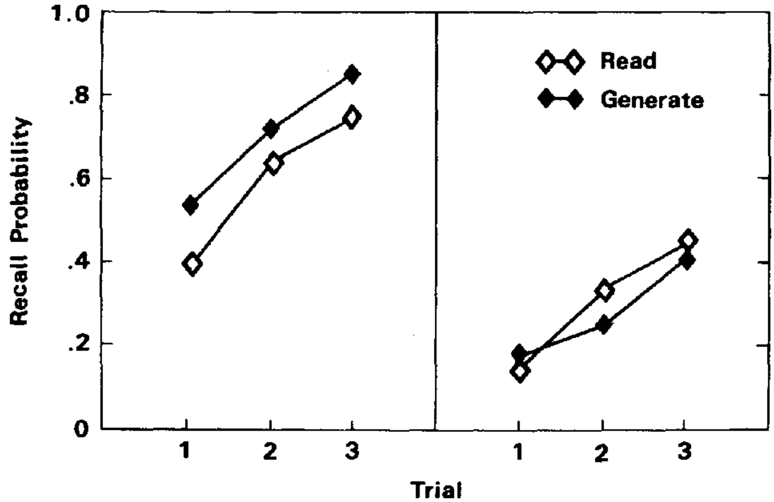

Figure 1. Probability of recall of meaningful (left-hand panel) and meaningless (right-hand panel) letter bigrams as a function of Task and Trials.

there appears to be an effect with the meaningful ones.

An overall analysis of variance (ANOVA) on the complete set of individual subject recall scores was carried out, and then separate ANOVAS were carried out on scores for the meaningful and meaningless letter bigrams. An alpha level of $p < .05$ is used for all tests reported in this article.

The results of the overall ANOVA showed that there was a significant effect of Meaningfulness, $F(1, 38) = 127.20$, $MS_e = 6.00$, and of Trials, $F(2, 76) = 131.50$, $MS_e = 2.43$, but not of Task, $F(1, 38) = 1.94$, $MS_e = 3.79$. However, the Task × Meaningfulness interaction was significant, $F(1, 38) = 6.03$, $MS_e = 3.79$. No other interaction approached significance.

For the meaningful bigrams, the results of the separate ANOVA showed that the effect of Task was significant, $F(1, 19) = 8.24$, $MS_e = 3.4$, as was that of Trials, $F(2, 38) = 97.97$, $MS_e = 1.15$. There was no significant interaction. The comparable ANOVA for the meaningless bigrams showed no significant effect of Task, $F < 1$, only of Trials, $F(2, 38) = 44.47$, $MS_e = 1.58$, and no significant interaction.

Recall performance was considerably poorer in learning the meaningless bigrams, and the difficulty of learning such items was apparent from the intrusion data too. For the meaningless bigrams, the average number of intrusions per subject trial was 3.92, compared with 1.30 for the meaningful bigrams. The absence of a generation effect with meaningless bigrams seems unlikely to be due to the general level of recall, however, for at least two reasons. First, even where performance levels are comparable (i.e., by Trial 3 for the meaningless bigrams), there is no hint of an emergent effect. Second, these bigrams are of course quite similar to the pronounceable nonwords used by McElroy and Slamecka (1982), who consistently failed to find any indication of an effect over a wide range of performance levels.

The finding that the generation effect is not restricted to words in a literal sense but occurs also for letter bigrams, provided the bigrams are meaningful abbreviations of words, lends further support to the conclusion that self-generation of the surface features of a word is not essential to the generation effect (Slamecka & Fevreiski, 1983). It also provides quite good support for the lexical activation hypothesis, for, although it would be possible to argue to the contrary, few theorists, if any, are likely to reject the hypothesis on the grounds that it applies only to words in a purely nominal sense. The experiments we describe subsequently suggest, however, that a rather different interpretation may be more appropriate.

It is of interest also to note that an effect was obtained with the meaningful letter bigrams despite the use of a trivial and meaningless transposition rule in which the letters were simply picked out, in an arbitrary way, from an array.

Experiment 2

Gardiner and Rowley (1984) have recently demonstrated that there is a generation effect in remembering answers to multiplications sums presented in numerical form (e.g., 4 × 7 = ? vs. 4 × 7 = 28). Two-digit numbers such as *28* are presumably largely devoid of semantic features, although in a nominal sense they are also words. Some semantic memory theorists, if not most, regard numbers as being represented in some other system than the subjective lexicon (see, e.g., Kintsch, 1980). On these grounds, Gardiner and Rowley suggested that the lexical activation hypothesis might be rejected solely on the basis of their simple demonstration.

Undoubtedly, however, as Gardiner and Rowley (1984) pointed out, a generation effect in remembering sums would be quite consistent with some weak version of the lexical activation hypothesis, one which in effect maintained that numbers as well as words are represented in the subjective lexicon. Such a view does not seem unreasonable but it raises a difficult theoretical issue, namely, that of specifying in a sufficiently precise way exactly what constitutes an entry in the subjective lexicon. We return to that issue in the general discussion section of this article.

Such a view also raises a more straightforward empirical issue, which is addressed by Experiment 2. This is the question of why 2-digit numbers like *28* seem to be functionally equivalent to the meaningful rather than the meaningless letter bigrams, for in terms of their inherent meaningfulness the constituent numbers *2* and *8* seem very similar to, say, the letters *V* and *T*. One possibility, tested directly in Experiment 2, is that the generational product, the item to be recalled, must form some integrated functional unit. In Experiment 2 subjects had to recall 2-digit numbers which had been self-generated or read either as unitized numbers—in the sense of being formed or converted into a unit—or as nonunitized numbers (e.g., *28* vs. *2, 8*).

Also, Gardiner and Rowley (1984) had used only a multiplication rule, leaving open the question of whether, for numbers at least, the generation effect might depend on the meaningfulness or familiarity of the rule; that is, the numbers might derive their meaning from the multiplication rule context. So, in addition, Experiment 2 tested the replicability of the effect using a similar transposition rule to that used in Experiment 1.

Method

Subjects. The subjects were 48 undergraduate students at The City University, London. They were allocated arbitrarily to one of two groups, they were tested individually, and they were paid for their services.

Design. The design was a 2 × 2 × 3 factorial with Unitization (unitized vs. nonunitized) as a between-subjects factor and Task (generate vs. read) and Trials (1–3) as within-subjects factors. One group of 24 subjects learned a list of unitized 2-digit numbers. Another group of 24 subjects learned the same list but as nonunitized numbers. Except with respect to the use of numerical material, the design of Experiment 2 was similar to that of Experiment 1.

Materials and procedure. The 20 two-digit answers to multiplication sums selected by Gardiner and Rowley (1984) were used as list items, and each pair of digits was assigned arbitrarily and in reverse order, to the second and fourth positions of a different string of five digits, avoiding duplication within any one string. In most other respects, the procedure was similar to that of Experiment 1. In the read task, for instance, the subject saw "5 8 3 2 6 = 2 8" on a card and had to say "five eight three two six equals twenty-eight" in the unitized condition, or in the nonunitized condition, "five eight three two six equals two eight." In the generate task, a question mark replaced the 2-digit responses. The numbers were printed well spaced apart on each card, to discourage any spontaneous unitization in the nonunitized group. Details regarding instructions, presentation rate, recall tests, and so forth, were all similar to those of Experiment 1 except that the distractor task between study and test trials was a word association test.

Results and Discussion

The principal results—the probability of recall of 2-digit numbers in the various experimental conditions—are summarized in Figure 2. The figure shows that there appears to be a generation effect for the unitized but not for the nonunitized numbers.

The recall scores were submitted to similar statistical analyses to those of Experiment 1. The results of an overall ANOVA showed that the effects of Unitization, $F(1, 46) = 15.10$, $MS_e = 11.54$, of Task, $F(1, 46) = 5.66$, $MS_e = 4.97$, and of Trials, $F(2, 92) = 206.06$, $MS_e = 0.97$, were all significant. The Task × Unitization interaction was significant, $F(1, 46) =$

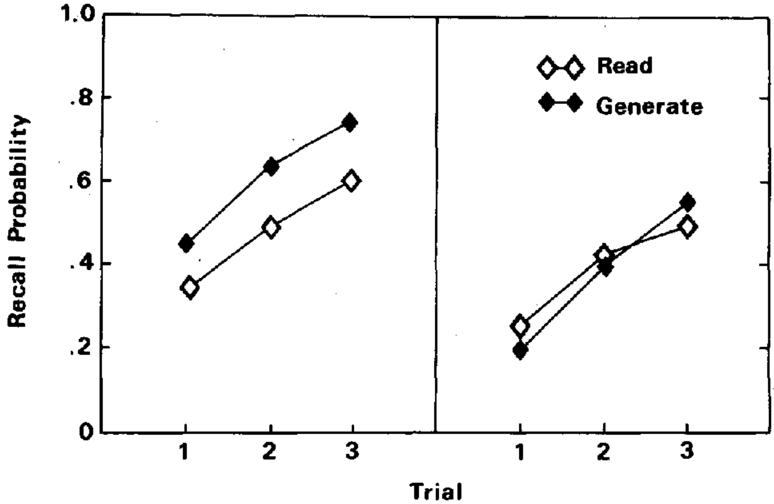

Figure 2. Probability of recall of unitized (left-hand panel) and nonunitized (right-hand panel) 2-digit numbers as a function of Task and Trials.

7.26, $MS_e = 4.97$, but no other interaction approached significance.

The results of a separate ANOVA for the unitized numbers showed a significant effect of Task, $F(1, 23) = 13.50$, $MS_e = 4.74$, as well as of Trials, $F(2, 46) = 130.56$, $MS_e = 0.73$, but no significant interaction. A comparable ANOVA for nonunitized numbers showed no effect of Task, $F < 1$, only of Trials, $F(2, 46) = 86.43$, $MS_e = 1.20$. Also, there was a significant Task $\times$ Trials interaction, $F(2, 46) = 3.22$, $MS_e = 1.74$.

The overall level of recall of nonunitized numbers is somewhat higher than that of the meaningless letter bigrams in Experiment 1. Intrusion rates in Experiment 2 were generally lower and differed in the opposite direction to those of Experiment 1. For nonunitized numbers the average number of intrusions was 2.27 per subject trial, compared with 2.75 for the unitized numbers. It seems unlikely that the absence of a generation effect for nonunitized numbers is attributable to the lower level of recall. Further empirical support for the absence of an effect with nonunitized numbers was thought desirable, however, because of the lack of any corroborative evidence elsewhere. A small, supplementary experiment in which 14 subjects were tested with nonunitized numbers was conducted as part of a laboratory class. In this experiment, the lists were presented at a somewhat slower rate but otherwise the procedure was the same as before. There was no indication of a generation effect: indeed, collapsed over trials, the probability of recall was 0.56 following the read task, and 0.46 following the generate task.

Even a weak version of the lexical activation hypothesis fails to account satisfactorily for the finding of a generation effect with unitized but not nonunitized numbers. This is because it seems incapable of accounting for the critical difference between features it would have to presume are activated by, say, *2 8* perceived as *twenty-eight* but not by *2 8* perceived as *two eight*. The notion that the generational product must form some integrated functional unit does, however, seem to capture this dissociation. Moreover, it also seems to account for the functional equivalence between these numbers and the letter bigrams of Experiment 1.

The replication of a generation effect for numbers with a trivial and meaningless transposition rule parallels the results of Experiment 1 in this respect, and demonstrates that the numbers effect reported by Gardiner and Rowley (1984) did not depend on their use of a multiplication rule.

Experiment 3

Experiment 3 investigated a third type of item, word pairs forming compound nouns.

This type of item can be constructed in such a way that the same words can be paired into either familiar compound nouns or unfamiliar—although still perfectly conceivable and meaningful—ones (e.g., *cheese ketchup, tomato cake*). From the lexical activation hypothesis it may be argued that there should be a generation effect for these compound nouns whether they are familiar or not, for the lexical status of the words themselves does not vary. If it is essential that the item to be remembered form some integrated functional unit, however, a generation effect might be expected only for the familiar noun compounds.

It should be noted that although distinctly odd, there is nothing anomalous about the unfamiliar compounds (cf. Graf, 1980, 1982). The two nouns are linked by a well-formed semantic relation and they are easily understood as a concept. Nevertheless they are not integrated functional units, because they are not familiar concepts in semantic memory.

To retain some comparability with the transposition rules used in Experiments 1 and 2, in Experiment 3 another transposition rule was used, in this case one that yielded a simple definition of the compound noun.

Method

Subjects. The subjects were 40 undergraduate students at The City University, London. They were allocated arbitrarily to one of two groups, they were tested individually, and they were paid for their services.

Design. The design was a 2 × 2 × 3 factorial with Familiarity (familiar vs. unfamiliar) as a between-subjects factor and Task (generate vs. read) and Trials (1–3) as within-subject factors. One group of 20 subjects learned a list of familiar compound nouns. Another group of 20 subjects learned a list of unfamiliar compound nouns. Except with respect to the materials, the design of Experiment 3 was similar to that of Experiments 1 and 2.

Materials and procedure. Two separate 20-item lists were constructed for both the familiar and the unfamiliar noun compounds, together with simple sentences that defined each compound by reversing their constituent nouns. Examples are: *a cake made of cheese; a ketchup made of tomato; a brush for the hair, a cloth for the face.* The corresponding sentences for the unfamiliar noun compounds were: *a cake made of tomato; a ketchup made of cheese; a brush for the face; a cloth for the hair.* The related familiar compounds (e.g., *cheese cake, tomato ketchup*) were assigned to separate lists, as were their unfamiliar equivalents (e.g., *cheese ketchup, tomato cake*), and so no subject learning a list of unfamiliar compounds could rearrange the list items to form familiar compounds.

The experimental procedure was similar to that of Experiments 1 and 2. To standardize the subjects' vocal responses, subjects always said "equals" after reading aloud the sentence and before saying the noun compound (e.g., "A cake made of cheese equals cheesecake"). The distractor task between each study and test trial was the counting task used in Experiment 1.

Results and Discussion

The principal results—the probability of recall of noun compounds in each of the experimental conditions—are summarized in Figure 3. The figure appears to show a generation effect only for the familiar noun compounds.

The results of an overall ANOVA showed that there was a significant effect of Task, $F(1, 38) = 9.28$, $MS_e = 2.94$, as well as of Trials, $F(2, 76) = 328.22$, $MS_e = 1.31$, but that the effect of Familiarity was not significant, $F(1, 38) = 1.72$, $MS_e = 9.61$. The Task × Familiarity interaction was significant, $F(1, 38) = 4.28$, $MS_e = 2.94$, but no other interaction approached significance.

A separate ANOVA for the familiar noun compounds confirmed that the effect of Task was significant, $F(1, 19) = 13.78$, MS_e 2.80, as well as the effect of Trials, $F(2, 38) = 206.86$, $MS_e = 0.95$. The interaction was not significant. The effect of Task was not significant in the comparable ANOVA for the unfamiliar compounds, $F < 1$. The effect of Trials was significant, $F(2, 38) = 140.66$, $MS_e = 1.66$; the interaction was not significant.

There was no overall difference in the level of recall for each type of item in this experiment. Also, intrusion rates were very low and did not differ for familiar and unfamiliar compounds. For both types of compound, the average number of intrusions per subject trial was 0.50.

A generation effect for familiar but not for unfamiliar noun compounds made up of the same actual words indicates that the essence of the generation effect seems to stem not from the lexical status of the words but, more broadly, from their correspondence with some familiar concept in semantic memory. These results, and those of Experiment 2, also imply that it is not a simple matter of the presence or absence of meaning, as had been earlier implied by the results of Experiment 1.

General Discussion

The three experiments we have described in this article show that a generation effect oc-

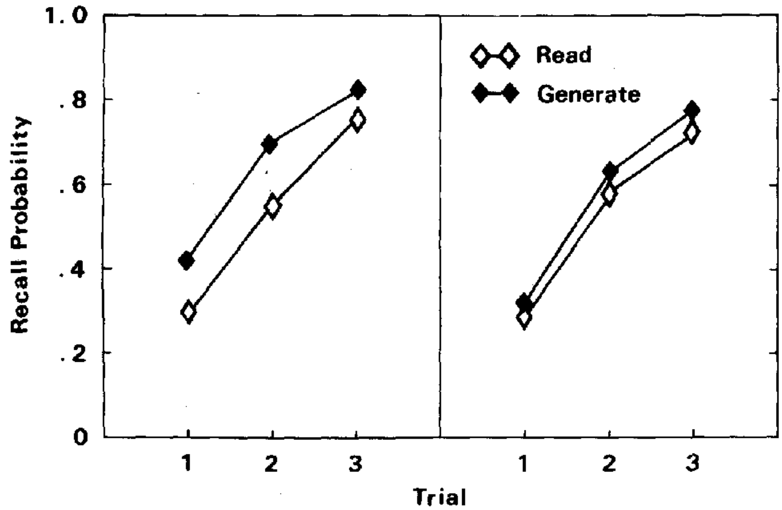

Figure 3. Probability of recall of familiar (left-hand panel) and unfamiliar (right-hand panel) noun compounds as a function of Task and Trials.

curred for meaningful but not meaningless letter bigrams; for unitized but not nonunitized 2-digit numbers; for familiar but not unfamiliar compound nouns. These three experiments therefore show a strongly convergent pattern of results across quite marked differences in the general nature of the material to be learned. This pattern of results demonstrates that the generation effect is remarkably sensitive to the nature of the to-be-remembered item. Apparently, unless the item is represented in semantic memory as an integrated functional unit, and hence perceived and encoded as a familiar concept, no generation effect will occur. Conversely, this pattern of results implies that any item at all that meets these fundamental requirements may give rise to a generation effect.

On this view, the occurrence of a generation effect when the to-be-remembered item is a single word is not attributable to the lexical status of the item, but occurs because a single word is an instance of a much more broadly conceived type of item. A word is a conceptual "chunk," a gestalt, derived from its constituent letters. An abbreviation, a unitized number, and a familiar noun compound, also constitute essentially similar gestalts.

On this view, too, it might be possible to demonstrate a generation effect at the level of an individual letter, or a single number, if the generate task involves the self-generation of the constituent elements from which the item is formed. At another extreme, it should also be possible to demonstrate a generation effect when the to-be-remembered item is a complete sentence. This result has in fact been obtained by Graf (1980, 1982). The results of Experiment 3, in particular, are in good agreement with Graf's major finding of a generation effect with meaningful but not with anomalous sentences (e.g., "The blond girl baked a cake" vs. "The blond leaflet baked the piano").

However, although Graf (1980) found no generation effect for anomalous sentences in cued recall or phrase recognition, he did find an effect in recognition memory for individual words from such sentences (see too, Graf, 1982). The present experiments involved only recall tests. Graf's findings imply that a generation effect for meaningless letter bigrams, nonunitized numbers, and unfamiliar noun compounds, might well occur if recognition memory for single letters, single numbers, and single nouns were to be tested. This possibility would supplement rather than conflict with our conclusions, for such effects can be attributed to the additional processing of the surface features of the item (see e.g., Graf, 1980; see too, Slamecka & Fevreiski, 1983). That is, generate tasks in which the surface features of the item are present may lead to stronger encoding of those features, which benefits recognition memory. Interestingly, this argument suggests that perceptual identification might be facilitated by a generate task in which the surface features of the item are present, the opposite result to that obtained by Jacoby (1983) following a generate task in which the surface features of the item were absent.

Though it has proved to be of heuristic value, the lexical activation hypothesis (McElroy & Slamecka, 1982; Slamecka & Fevreiski, 1983) seems quite unable to capture the subtle dependence of the generation effect on a much more general conceptual property than can be identified with representation in the subjective lexicon. A strong version of the hypothesis may, as we have argued, readily be discounted just on the basis of a generation effect with numbers (Gardiner & Rowley, 1984). A weak version of the hypothesis could now only be sustained by maintaining that not only words, and abbreviations of words, and numbers, but also unitized numbers as opposed to nonunitized numbers, familiar as opposed to unfamiliar noun compounds (and even sentences?) are represented in the subjective lexicon. But herein lies the difficult theoretical issue alluded to earlier in this article. The point at which one concedes that a lexical entry may be something other than a word is the point at which any distinction between lexical and semantic memory becomes blurred; and to the extent that it becomes impossible to draw any sharp distinction between the subjective lexicon and semantic memory as a whole, then it becomes unclear that there is any need to retain the concept of a subjective lexicon at all. One cannot have a subjective lexicon in which almost any kind of item may be represented—provided it gives rise to a generation effect. On these grounds, the available evidence now warrants the firm rejection of even a weak version of the lexical activation hypothesis.

Apart from the lexical activation hypothesis, at least three other hypotheses that have been put forward recently to explain the generation effect seem to face difficulties in accounting for the results described in the present article.

One alternative hypothesis is that the generation effect is due to deeper encoding of the meaningful relation between the stimulus item and the target response, in that having generated the response subjects engage in a check of solutional adequacy (Donaldson & Bass, 1980). McElroy and Slamecka (1982) discuss several problems for this hypothesis, including its failure to account for an effect with an acoustic rather than a semantic rule, but as they point out the hypothesis could readily be extended to include acoustic as well as semantic relations. It is not easy to see, however, how the hypothesis could be extended to include stimulus–response relations that are as trivial and meaningless as those used in Experiments 1 and 2, where the stimulus was a seemingly random string of letters or single digits.

Another hypothesis that has quite recently been put forward subsumes the generation effect under a much larger group of phenomena attributed to greater involvement of the self schema or self system (e.g., Banaji & Greenwald, 1984; Greenwald, 1981). According to Greenwald (1981), for example, the mechanism that produces the generation effect is the self system, and material more actively processed by the subject has a privileged place in retrieval. But why, on this view, should the self system be so extremely selective with respect to the properties of the item to be remembered, as would have to be supposed for this hypothesis to offer a viable account of our findings?

The final hypothesis to be mentioned stems from the procedural view of memory put forward by Kolers and Roediger (1984; see too, Kolers & Smythe, 1984). This view emphasizes the repetition of mental operations and skills, and the extent to which the operations carried out at study and at test are similar, as the critical determinants of memory. Kolers and Roediger claim that this proceduralist view can account for the generation effect. But on this view, too, it is hard to see why subtle characteristics of the item should be such critical determinants of the effect. Our results suggest, rather, that it is the nature of the conceptual processing that is fundamental to the effect, not the mere repetition of mental operations.[1]

---

[1] Since the present article was written, Glisky and Rabinowitz (1985) have shown that the generation effect is enhanced through repetition of similar generation opera-

Finally, it is worth emphasizing that not only is the generation effect highly influenced by item-specific variables, it also seems largely insensitive to relational variables. For example, Slamecka and Graf (1978) found that the effect was uninfluenced by the nature of the rule relating the stimulus–response pair (see too, Gardiner & Arthurs, 1982). This finding is underscored dramatically by the sheer triviality of the rules and stimuli used to obtain the effects in the present study. As the present experiments also testify, the generation effect seems quite unaffected by study trials. And Slamecka and Graf (1978) found also that the effect was restricted entirely to the response word of the stimulus–response pair. What is now known about the generation effect strongly suggests that in essence the effect is due to item-specific rather than relational processing.

Although a number of theorists have found it useful to distinguish between item-specific and relational processing (e.g., Bellezza, Cheeseman, & Reddy, 1977; Humphreys & Bain, 1983; Mandler, 1979), here we have in mind, in particular, the distinction as developed by Hunt and his associates (e.g., Einstein & Hunt, 1980; Hunt & Einstein, 1981; Hunt & Mitchell, 1982; Hunt & Seta, 1984). According to this approach, relational and individual item information correspond respectively with organization and levels of processing as explanatory principles, and item-specific information is assumed important in delineating items in retrieval, that is, in enhancing their distinctiveness. Evidence that orienting tasks that require individual item processing facilitate the recall of a list of strongly related items, but that recall of a list of weakly related items benefits more from tasks that require relational processing (see, e.g., Einstein & Hunt, 1980) seems persuasive evidence in support of the utility of this approach, and Hunt and his associates have successfully applied the distinction to the analysis of a number of different memory phenomena. Speculatively, we suggest that understanding of the generation effect might also increase through application of this distinction, and that the reason self-generation aids recall may just turn out to be that it enhances conceptual distinctiveness in retrieval.

tions in a recognition test. To provide a complete account of the generation effect, they proposed a specific processing component, which involves surface features, and a general encoding factor, which may be semantic, and which makes generated words more accessible. Our findings may be viewed, from the standpoint of their interpretation, as going some way toward specifying the nature of this general encoding factor.

References

Banaji, M. R., & Greenwald, A. G. (1984, May). *Self-generated information aids memory at retrieval.* Paper presented at the meeting of the Midwestern Psychological Association, Chicago.

Bellezza, F. S., Cheeseman, F. L., & Reddy, G. (1977). Organizational and semantic elaboration in free recall. *Journal of Experimental Psychology: Human Learning and Memory, 1,* 539–550.

Donaldson, W., & Bass, M. (1980). Relational information and memory for problem solutions. *Journal of Verbal Learning and Verbal Behavior, 19,* 26–35.

Einstein, G. O., & Hunt, R. R. (1980). Levels of processing and organization: Additive effects of individual-item and relational processing. *Journal of Experimental Psychology: Human Learning and Memory, 6,* 588–598.

Gardiner, J. M., & Arthurs, F. S. (1982). Encoding context and the generation effect in multitrial free-recall learning. *Canadian Journal of Psychology, 36,* 527–531.

Gardiner, J. M., & Rowley, J. M. C. (1984). A generation effect with numbers rather than words. *Memory & Cognition, 12,* 443–445.

Glisky, E. L., & Rabinowitz, J. C. (1985). Enhancing the generation effect through repetition of operations. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 11,* 193–205.

Graf, P. (1980). Two consequences of generating: Increased inter- and intraword organization of sentences. *Journal of Verbal Learning and Verbal Behavior, 19,* 316–327.

Graf, P. (1982). The memorial consequences of generation and transformation. *Journal of Verbal Learning and Verbal Behavior, 21,* 539–548.

Greenwald, A. G. (1981). Self and memory. In G. H. Bower (Ed.), *The psychology of learning and motivation, Vol. 15* (pp. 201–236). New York: Academic Press.

Hunt, R. R., & Einstein, G. O. (1981). Relational and item-specific information in memory. *Journal of Verbal Learning and Verbal Behavior, 20,* 497–514.

Hunt, R. R., & Mitchell, D. B. (1982). Independent effects of semantic and nonsemantic distinctiveness. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 8,* 81–87.

Hunt, R. R., & Seta, C. E. (1984). Category size effects in recall: The roles of relational and individual item information. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 10,* 454–464.

Humphreys, M. S., & Bain, J. D. (1983). Recognition memory: A cue and information analysis. *Memory & Cognition, 11,* 583–600.

Jacoby, L. L. (1978). On interpreting the effects of repetition: Solving a problem versus remembering a solution. *Journal of Verbal Learning and Verbal Behavior, 17,* 649–667.

Jacoby, L. L. (1983). Remembering the data: Analyzing interactive processes in reading. *Journal of Verbal Learning and Verbal Behavior, 22,* 485–508.

Kintsch, W. (1980). Semantic memory: A tutorial. In R. S. Nickerson (Ed.), *Attention and Performance VIII.* Hillsdale NJ: Erlbaum.

Kolers, P. A., & Roediger, H. L. III. (1984). Procedures of mind. *Journal of Verbal Learning and Verbal Behavior, 23,* 425–449.

Kolers, P. A., & Smythe, W. E. (1984). Symbol manipulation: Alternatives to the computational view of mind. *Journal of Verbal Learning and Verbal Behavior, 23,* 289–314.

Mandler, G. (1979). Organization and repetition: Organizational principles with special reference to rote learning. In L.-G. Nilsson (Ed.), *Perspectives on memory research.* Hillsdale, NJ: Erlbaum.

McElroy, L. A., & Slamecka, N. J. (1982). Memorial consequences of generating nonwords: Implications for semantic-memory interpretations of the generation effect. *Journal of Verbal Learning and Verbal Behavior, 21,* 249–259.

Slamecka, N. J., & Fevreiski, J. (1983). The generation effect when generation fails. *Journal of Verbal Learning and Verbal Behavior, 22,* 153–163.

Slamecka, N. J., & Graf, P. (1978). The generation effect: Delineation of a phenomenon. *Journal of Experimental Psychology: Human Learning and Memory, 4,* 492–604.

Received December 28, 1984
Revision received April 3, 1985 ■