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Study-Phase Processing and the Word Frequency Effect in Recognition Memory

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Accuracy on recognition-memory tests has been found to be an inverted U-shaped function of linguistic frequency. The present experiments were designed to provide insight into the basis for this relationship. Experiment 1 demonstrated that the inverted U-shaped function is obtained not only when a semantic orienting task (in this case, a lexical-decision task) is performed during the study phase but also when either a syllable-counting task is performed or nondirected study is allowed. The advantage for low-frequency words relative to high-frequency words was greater with the lexical-decision orienting task than with either of the other orienting tasks. Experiment 2 used self-paced presentation to show that study time is a monotonically decreasing function of linguistic frequency. Thus, recognition for high-frequency words may suffer, in part, from less processing than that performed for low-frequency words. The poor recognition accuracy for very low-frequency words, however, apparently is not due to a deficient amount of processing but rather to limitations in the effectiveness of the processing that is performed.

Studies of recognition memory customarily find that words of low linguistic frequency are recognized more accurately than are words of high linguistic frequency (e.g., Gorman, 1961; Shepard, 1967). Although this word frequency effect has been widely investigated, with many potential explanations proposed (e.g., Gillund & Shiffrin, 1984; Glanzer & Bowles, 1976; McCormack & Swenson, 1972; Underwood & Freund, 1970), the exact nature of its cause has been difficult to determine.

Many of the explanations proposed for the word frequency effect predict that recognition accuracy should vary as a monotonic function of linguistic frequency (e.g., McCormack & Swenson, 1972; Shepard, 1967; see also Murdock, 1974, p. 269). However, several recent studies have found this not to be the case. Rather, these studies have found recognition accuracy to be an inverted U-shaped function of linguistic frequency (Mandler, Goodman, & Wilkes-Gibbs, 1982; Schulman, 1976; Zechmeister, Curt, & Sebastian, 1978). That is, very low-frequency words (words that are equivalent to pronounceable nonwords because subjects are generally unfamiliar with them) were recognized less accurately than were low-frequency words.

One limitation of the previous studies that have obtained nonmonotonic accuracy functions is that subjects performed semantic orienting tasks during the study phase. These tasks involved either lexical decisions (word–nonword judgments; Mandler et al., 1982), judgments of meaningfulness (Zechmeister et al., 1978), judgments of familiarity (Schulman, 1976; Zechmeister et al., 1978), or elaboration of meaning (Mandler et al., 1982). This limitation is particularly critical because the major characteristic of very low-frequency words is that they have relatively little meaning for most people. Thus, because of the emphasis that semantic orienting tasks place on the processing of meaning, such tasks may create or enhance the difference in recognizability between very low-frequency words, which have little meaning, and low-frequency words, which do have meaning (Gillund & Shiffrin, 1984; Rao, 1983).

Evidence suggestive of this possibility was obtained by Rao (1983). He had subjects make situational frequency judgments for words of high, low, and very low linguistic frequencies

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(pronounceable nonwords) that occurred various numbers of times in the study list. Rather than being given an overt orienting task, subjects were instructed simply to study the list for a later memory test, the nature of which was left unspecified. Although the accuracy of the situational frequency judgments was worse for words of high linguistic frequency than for words of low linguistic frequency, no similar difference was found between words of low and very low linguistic frequency. Because Rao's data were comparable in other respects to those commonly obtained for recognition judgments, he suggested that his failure to find a difference between low- and very low-frequency words might lie in his not using a semantic orienting task during the study phase.

Additional evidence suggesting that a semantic orienting task may be necessary to obtain an inverted U-shaped accuracy function is apparent in Mandler et al.'s (1982) study of recognition memory. In one condition of their Experiment 2, subjects performed a surface-level orienting task in which they described the physical characteristics of the words in the target list. Although the hit rate was lower for very low-frequency words than for low-frequency words, a corresponding difference in false-alarm rates suggests that there was little difference in accuracy for the two types of words.

Because of the importance of the inverted U-shaped function in evaluating explanations of the word frequency effect, the present study was designed to determine the pervasiveness of the function and to provide some insight into its basis. In Experiment 1, different groups of subjects made recognition judgments following either a lexical-decision orienting task (for which the inverted U-shaped function previously has been obtained), a nonsemantic orienting task in which subjects counted the number of syllables in each word, or a general memory situation in which they studied the words for a later memory test.

Experiment 1 also evaluated an implication of an account of the word frequency effect proposed by Lockhart, Craik, and Jacoby (1976). According to these authors, because high-frequency words are more easily encoded than low-frequency words, they receive less extensive processing. This relative deficiency in the processing of high-frequency words results in less "rich" episodic traces for these words compared with the traces for low-frequency words, and hence, poorer recognition accuracy.

One implication of Lockhart et al.'s (1976) emphasis on processing differences is that the word frequency effect should vary systematically as a function of the processing required during the study phase of the recognition task. Because the processing of high-frequency words is assumed to be deficient in free-study conditions, orienting tasks that require semantic, elaborative processing of the words should, in most cases, make the processing of high- and low-frequency words more equivalent, and thus, reduce the magnitude of the word frequency effect. Two studies have obtained results consistent with this prediction. Balota and Neely (1980) led subjects to expect either a free-recall test or a recognition test. When subsequently tested for recognition, those subjects who expected recall (and thus, presumably engaged in more elaborate processing) showed a smaller word frequency effect than those expecting recognition, with the reduction attributable primarily to an increase in recognition accuracy for high-frequency words. Eysenck (1979) obtained similar results with a more direct manipulation of orienting tasks. He required subjects to perform phonetic or semantic orienting tasks in which either a typical or an atypical response was required to each word (e.g., a descriptor that typically modified each word vs. an infrequently used descriptor). The orienting tasks that required atypical responses (and thus, more elaborate and distinctive encodings) attenuated the word frequency effect relative to the tasks that required typical responses.

Although the differential processing account of the word frequency effect predicts that the magnitude of the effect should be reduced, in most cases, by orienting tasks that require more extensive semantic processing, it also predicts that this reduction should not occur in all cases. That is, according to the account, the critical factor resulting in the attenuation of the word frequency effect is not the semantic processing, per se, but that the required processing reduces the difference in processing between high- and low-frequency words that is assumed to underlie the effect. Although this is usually the case, a semantic orienting task that induces more extensive processing for low-frequency words relative to high-frequency words should, in fact, have the opposite effect of increasing the magnitude of the word frequency effect.

The lexical-decision task used as the semantic orienting task in the present study is a task in which low-frequency words are processed more extensively than are high-frequency words. Studies consistently find that "word" decisions take longer for low-frequency words than for high-frequency words (Rubenstein, Lewis, & Rubenstein, 1971; Schuberth & Eimas, 1977; Stanners, Jastrzembski, & Westbrook, 1975). Because this processing is primarily of a semantic nature (e.g., Neely, 1977; Schvaneveldt & Meyer, 1973), the differential processing account of the word frequency effect predicts a greater difference in recognition accuracy between low- and high-frequency words than is obtained when either general memory instructions are used or a more surface-level orienting task is used.

Experiment 1

Method

Materials. Eighty words were selected from each of three frequency ranges in the Thorndike and Lorge (1944) linguistic frequency norms. High-frequency words were selected from the 100+ per million category; low-frequency words, from the 1 per million category; and very low-frequency words, from the 1 per 4 million category. In addition, words from the latter category were restricted to ones that the experimenters thought would be unfamiliar to most subjects. The words varied in length from 4 to 8 letters, with identical mean lengths of 6.10 for all three categories.

The target list consisted of 120 words (40 from each frequency category) randomly ordered, plus 5 filler words at the beginning and end. The test list consisted of the 120 target words, plus the remaining 120 words as distractors, randomly intermixed. Four different permutations of the basic target list were constructed by interchanging the targets and distractors and reversing the order of presentation.

Subjects and procedure. A total of 128 subjects, 64 in each of two replications, participated in the experiment. All subjects were students enrolled in undergraduate psychology courses at Auburn University, who received extra credit for their participation. In both replications, half of the subjects received the lexical-decision orienting task, and half did not. The other half of the subjects in the first replication received general memory instructions, whereas the other half in the second replication received a syllable-counting orienting task. All subjects were tested individually.

The target words were printed in uppercase letters on white 10.2 × 15.3-cm index cards. Subjects proceeded through the target list at a rate of 3.5 s per card. A metronome was used to enable subjects to maintain this rate. Those subjects who were given general memory instructions were told to study the list for a later memory test, the nature of which was left unspecified. Subjects who received either of the two orienting tasks were not told of the subsequent memory test and were given instructions regarding the appropriate orienting task. Those who performed the lexical-decision orienting task made word–nonword judgments for each item in the target list. Those who performed the syllable-counting orienting task indicated the number of syllables for each item. Responses on the orienting tasks were made vocally and were recorded on paper by the experimenter.

Upon completion of the target list, subjects were asked to take a yes–no recognition test. They proceeded through a test booklet that contained the 120 targets and the 120 distractors. Responses were marked in the booklet.

Results and Discussion

Orienting-task performance. In the lexical-decision orienting task, 99.6%, 87.6%, and 27.6% of the high-, low-, and very low-frequency words, respectively, were classified as words. Thus, the majority of high- and low-frequency words were identified as such, whereas the majority of very low-frequency words were not.

Performance on the syllable-judgment task was accurate, with the percentage of correct responses being 90.0%, 92.1%, and 84.6%, respectively, for the high-, low-, and very low-frequency words. The slightly lower accuracy for the very low-frequency words is attributable to ambiguities in pronunciation (e.g., "loess") that are not a factor when the word is known (i.e., for high- and low-frequency words).

Recognition-test performance. The proportions of hits and false positives on the recognition test were obtained for each subject as a function of word frequency, and d' measures of sensitivity (Green & Swets, 1966) were computed from these. The mean hit rates, false-positive rates, and d' values are shown in Table 1 for both orienting tasks. Because there was no main effect or interaction with word frequency for the two replications of the lexical-decision condition (Fs < 1.0) the mean values presented for that condition are based on all 64 subjects. Generally the same picture emerges across the hit, false positive, and d' measures, so an analysis of variance (ANOVA) is reported only for the d' measures. In order

Table 1
Number of Hits, False Positives, and the Corresponding d′ *Values as a Function of Orienting Task and Linguistic Frequency*

Measure	Frequency: Very low	Low	High
	Lexical decision		
Hits	26.52	29.84	22.77
False positives	6.68	4.57	7.44
d'	1.59	2.02	1.24
	General memory		
Hits	26.75	28.96	25.50
False positives	8.59	6.41	8.31
d'	1.34	1.71	1.27
	Syllable counting		
Hits	23.41	24.63	21.88
False positives	6.72	3.38	5.84
d'	1.33	1.88	1.39

to have an equal number of subjects in each condition of the analysis, only the first replication of the lexical-decision condition was included. Similar outcomes are obtained when the second replication is used instead.

The analysis indicated no main effect of orienting task ($F < 1.0$). However, both the main effect for word frequency and the Word Frequency × Orienting Task interaction were significant, $F(2, 186) = 55.6$, $p < .001$, and $F(4, 186) = 3.23$, $p < .025$, respectively. Trend analyses performed on the main effect for word frequency indicate that the effect is attributable to the quadratic trend, $F(1, 186) = 109.2$, $p < .001$. Thus, the main effect for word frequency reflects an inverted U-shaped function similar to that reported by Mandler et al. (1982), Schulman (1976), and Zechmeister et al. (1978). Simple effects analyses showed that this general type of function was obtained for all orienting conditions: lexical-decision condition, $F(2, 62) = 28.1$, $p < .001$; general memory condition, $F(2, 62) = 13.0$, $p < .001$; and syllable-counting condition, $F(2, 62) = 20.5$, $p < .001$. That is, in all conditions accuracy was higher for low-frequency words than for either high- or very low-frequency words. Thus, the inverted U-shaped function is a pervasive one that is apparent not only when the lexical-decision task or some other semantic orienting task is used but also when either general memory instructions are used or a nonsemantic syllable-counting task is employed.

Although the functions relating recognition accuracy to word frequency were of a similar inverted U-shaped nature for all orienting conditions, the interaction of word frequency with orienting task indicates that the functions were not identical. A partition of the interaction into two orthogonal components showed that the word frequency effect was reliably greater for the lexical-orienting condition than for the other two conditions, $F(2, 186) = 4.65$, $p < .025$, which did not differ from each other, $F(2, 186) = 1.80$, $p > .05$. As is evident in Table 1, this difference was attributable to low- and very low-frequency words being recognized more accurately following the lexical-decision task than following either the syllable-counting task or the general memory instructions, whereas there was little difference between these tasks in recognition accuracy for high-frequency words. Thus, the results are consistent with the prediction that the word frequency effect should be enhanced when subjects perform the lexical-decision orienting task.

Our initial expectation was that the word frequency effect would be enhanced in the lexical-decision condition primarily by increased accuracy for low-frequency words relative to both very low- and high-frequency words. However, the very low-frequency words showed an increment in recognition accuracy similar to that shown for low-frequency words. That is, when only these two frequency categories were compared, orienting task did not interact with linguistic frequency ($F < 1.0$). This comparison is potentially confounded by the different responses given to very low-frequency words than to low-frequency words (as well as to high-frequency words) in the study phase of the lexical-decision condition (i.e., primarily nonword judgments for the former and word judgments for the latter). The outcome is consistent, though, with the common finding that in lexical-decision tasks, correct nonword judgments generally take longer than do correct word judgments (e.g., Schuberth & Eimas, 1977; Schvaneveldt & Meyer, 1973). Thus, extensive processing is necessary to classify nonword stimuli (in the present study, the very low-frequency words) as such. This processing, which likely consists of a search of possible meanings, may benefit retention in a manner similar to the processing performed for low-frequency words.

The present results show little difference between the syllable-counting condition and the general memory condition in either the overall level of recognition accuracy or in the general pattern. Although these comparisons (particularly that of overall level) must be tempered by the fact that the two different groups of subjects were tested at different times, the similarity in performance between the two conditions is likely reliable. This reliability is supported by the consistency of the lexical-decision condition across the two stages of the experiment, as well as by the agreement of this outcome with other studies that have found relatively little difference in recognition accuracy between general memory and surface-level orienting conditions (e.g., Eagle & Leiter, 1964; Elias & Perfetti, 1973). Thus, subjects apparently do not engage in particularly deep, elaborative encoding when instructed simply to study items for a later test.

To summarize, there were two outcomes of primary importance in Experiment 1. First, poorer recognition accuracy for very low-frequency words than for low-frequency words was equally evident in all orienting conditions, indicating that the downturn in accuracy for words of very low frequency is neither caused nor enhanced by the use of a semantic orienting task. Second, the difference in recognition accuracy between high- and low-frequency words was greater when the orienting task required lexical decisions that when it involved syllable counting or undirected study. This result is consistent with the suggestion of Lockhart et al. (1976) that differences in the extent of processing performed during the study phase contribute, in part, to the word frequency effect.

Experiment 2

Experiment 2 was designed to further investigate the relationship between study-phase processing and the word frequency effect. This was accomplished not by varying the nature of orienting tasks, as in Experiment 1, but by using a self-paced method of presentation that allowed each subject to study each word for as long as he or she desired. The self-paced procedure, which has been used to examine other memory phenomena (e.g., Shaughnessy, Zimmerman, & Underwood, 1972; Zimmerman, 1975), provides a relatively direct method for measuring the amount of time spent studying words of very low, low, and high linguistic frequency.

Lockhart et al. (1976) proposed that, because of their more obvious meanings, the processing of high-frequency words is less extensive than is that of low-frequency words. Thus, according to this account, study time should be less for high-frequency words than for low-frequency words. Similarly, study time for very low-frequency words may be expected to be greater than that for low-frequency words. This outcome would be consistent with Zechmeister et al.'s (1978) suggestion that recognition accuracy is poor for very low-frequency words because of their relative lack of meaning. That is, even though study time for these items might exceed that for low- and high-frequency words, the lack of meaning would limit its effectiveness. Thus, whereas recognition accuracy is an inverted U-shaped function of linguistic frequency, study time should be a monotonically decreasing function of linguistic frequency.

A separate group of subjects was tested in addition to those who received self-paced presentation. This was a yoked control group in which words were presented at a constant rate. Subjects in this group were paired with those in the self-paced group such that the mean exposure duration of the paired subject in the latter condition was used as the constant presentation rate for the subject in the former condition. Assuming that the effective study times for very low-, low-, and high-frequency words should be more similar in the fixed-rate group than in the self-paced group, comparison between groups enables determination of the effectiveness of any differential rehearsal patterns evident for the self-paced group.

Method

Apparatus and stimuli. The specific words used and the particular target and test lists employed were the same as in Experiment 1. The words were presented on the display screen of a Radio Shack TRS-80 Model III microcomputer. Responses were made by pressing the appropriate keys on the computer's keyboard. In the self-paced condition, the study list advanced when the *enter* key was pressed. In both conditions, yes or no responses were made for each item in the test list by pressing the *Z* or the *?* keys, respectively, which were marked with a *Y* and an *N*.

Subjects and procedure. Sixty-four subjects, 32 in the self-paced group and 32 in the fixed-rate group, participated in the experiment. The subjects were from the same pool used in Experiment 1 and had not participated in that experiment. Prior to the experiment, each subject read instructions that were for the appropriate condition. Subjects in the self-paced group were told to study each word for an amount of time that they thought was necessary to remember it, whereas subjects in the fixed-rate group were told to study each word during the time that it was presented. The instructions also explained the nature of the memory test that would follow, indicating that yes–no recognition judgments would be required for individually presented words.

After the subject was seated at the computer, the experimenter initiated presentation of the study list. Words were presented singly, centered on the display screen. For the self-paced group, each word remained in view until the *enter* key was pressed with the right-hand index finger. For the fixed-rate group, the words advanced automatically at a fixed rate that was equal to the mean exposure time for the yoked subject in the self-paced group. For both groups, an interstimulus interval of 500 ms intervened between termination of one word and presentation of the next.

At the end of the study list, the instructions for the memory test were presented again, this time on the test screen. The subject placed his or her left-hand index finger on the yes key and the right-hand finger on the no key. When ready, the subject initiated presentation of the test list by pressing either of these keys. Each word on the test was presented singly and remained in view until a response was made. After a 500-ms interval, the next word was presented.

Results and Discussion

Study time. Mean exposure durations were computed for each subject in the self-paced group, both as a function of word frequency and for all words combined. Across subjects, the mean viewing time for all words was 3.76 s, $SD = 2.21$. Mean exposure durations for the individual subjects ranged from 0.81 s per word to 9.98 s per word. As predicted, viewing time was a monotonically decreasing function of word frequency, $F(2, 62) = 30.1$, $p < .001$, with the mean durations for very low-, low-, and high-frequency words being 4.42 s, 3.57 s, and 3.30 s, respectively. Although the difference in study times between very low- and low-frequency words (0.85 s) was greater than that between low- and high-frequency words (0.27 s), both differences were significant when evaluated alone, $F(1, 31) = 29.8$, $p < .001$, and $F(1, 31) = 6.71$, $p < .025$, respectively. Thus, the results confirm the prediction that viewing time should be an inverse function of word frequency.

Table 2
Number of Hits, False Positives, and the Corresponding d′ *Values as a Function of Study Condition and Linguistic Frequency*

Measure	Frequency: Very low	Low	High
	Self paced		
Hits	30.40	32.60	30.00
False positives	8.88	6.94	10.20
d'	1.64	2.09	1.52
	Fixed rate		
Hits	29.91	31.00	27.84
False positives	8.63	7.63	10.20
d'	1.65	1.88	1.36

Recognition-test performance. Presented in Table 2 are the mean hit rates, false-positive rates, and corresponding d' values for performance on the recognition test. As in Experiment 1, similar patterns were evident for all three measures, so only analyses involving the d' measures are reported.

For both the self-paced and fixed-rate conditions, the overall level of performance on the memory test was positively correlated with mean study time ($r = .39$ and $.42$, respectively, $ps < .05$). This relationship between study time and recognition accuracy held to a similar extent for all linguistic frequency levels, a finding that is consistent with Schulman and Lovelace's (1970) demonstration that the magnitude of the word frequency effect is relatively uninfluenced by rate of presentation.

More importantly, the recognition-test data clearly show the inverted U-shaped function found in previous studies. The main effect of linguistic frequency was significant, $F(2, 62) = 27.9$, $p < .001$, with the primary component being the quadratic trend. Moreover, method of presentation of the study list (self-paced vs. fixed rate) had no main effect ($F < 1.0$) nor did it interact with linguistic frequency, $F(2, 62) = 1.28$, $p > .05$.

Thus, when given control over the exposure time for words, the amount of time that subjects spend examining the words is a monotonically decreasing function of linguistic frequency, with very low-frequency words receiving considerably more study time than either low- or high-frequency words. However, the relatively greater time spent studying very low-frequency words does not result in better performance for them. Rather, recognition accuracy is still an inverted U-shaped function of linguistic frequency. Assuming that the differences in study time obtained with self-paced presentation reflect similar (although probably smaller) differences that occur when presentation rate is constant, the present results suggest that the relatively poor recognition accuracy for high-frequency words is in part due to a deficient amount of processing, whereas the poor accuracy for very low-frequency words lies in the type of processing rather than in the amount.

General Discussion

The present study makes two primary points. First, the inverted U-shaped function relating recognition accuracy to linguistic frequency is ubiquitous. As in previous studies, the function was obtained when subjects performed a lexical-decision task during the study phase. Moreover, the inverted U-shaped function was also evident when subjects performed a syllable-counting task and when no explicit orienting task was performed. In this latter circumstance, the function was obtained regardless of whether presentation of the study list was at a fixed, constant rate or whether it was self-paced and also regardless of whether the instructions explicitly indicated that a recognition test would follow or whether they left the nature of the test unspecified. Contrary to the implication of previous experiments (Mandler et al., 1982; Rao, 1983), the poorer recognition accuracy for very low-frequency words relative to that for low-frequency words is neither created nor enhanced by the use of a semantic orienting task, such as the lexical-decision task. Thus, the study adds to the growing evidence that accounts of the word frequency effect that predict monotonic accuracy functions, such as Shepard's (1967) "strangeness" account, are incomplete and require a second factor to account for the poor retention of very low-frequency words.

Although the function for recognition accuracy is nonmonotonic, the present study shows that when presentation is self-paced, the average amount of time that words are studied is a monotonically decreasing function of linguistic frequency. Therefore, rather than reflecting lesser amounts of processing, the downturn in accuracy for words of very low frequency apparently reflects deficiencies in the nature of the processing that is performed. As Zechmeister et al. (1978) suggested, this deficiency is most likely attributable to the relative lack of meaning for these words. Because of this lack of meaning, subjects probably rely primarily on more superficial structural features of the words. Interestingly, when subjects performed lexical decisions, a task that requires the examination of possible meanings for very low-frequency words, recognition of these words was enhanced. Thus, apparently, semantic processing can benefit the retention of very low-frequency words when it is performed, although subjects do not appear to engage substantially in such processing when it is not required.

The second major point of the study is that the results are generally consistent with the emphasis that Lockhart et al. (1976) placed on deficiencies in the amount of processing as a contributor to the relatively poor retention of high-frequency words. According to Lockhart et al., high-frequency words are not processed as extensively as are low-frequency words, because the meanings of the former words are better known than are those of the latter words. In the present study, subjects who were allowed self-paced presentation of the study list did not study high-frequency words as long, on the average, as they did low-frequency words. This outcome suggests that part of the word frequency effect obtained when presentation rate is fixed is also likely due to less extensive processing of high-frequency words than of low-frequency words. Thus, the basis of the relatively poor recognition accuracy for high-frequency words is apparently different from that of the relatively poor accuracy for very low-frequency words.

Lockhart et al.'s (1976) emphasis on processing differences between high- and low-frequency words suggests that the size of the word frequency effect should vary as a function of the processing required by specific orienting tasks. Previous studies by Balota and Neely (1980) and Eysenck (1979) found that orienting tasks of a semantic, elaborative nature reduced the magnitude of the word frequency effect. An important implication of the processing-differences account is that this reduction should occur only when the orienting task more nearly equalizes the amount of processing performed for words of low and high frequency, as would appear to be the case with the tasks used in the previous studies. In the present study, a task that required semantic processing was found to increase the difference in recognition accuracy between low- and high-frequency words. Because this task requires relatively more extensive processing of low-frequency words than of high-frequency words, the outcome is fully consistent with Lockhart et al.'s emphasis on processing requirements.

Recent accounts of the word frequency effect have focused primarily on the inherent characteristics of words within the respective frequency categories. These accounts have implicated differences in structural characteristics (Landauer & Streeter, 1973), numbers of meanings (Glanzer & Bowles, 1976), probabilities of being generated as implicit associates (Earhard, 1982; Glanzer & Bowles, 1976; Underwood & Freund, 1970), and strengths of connections to other items in memory (Gillund & Shiffrin, 1984). Although intrinsic item characteristics are important factors in the word frequency effect, the relative amount and type of processing that is performed for words of different linguistic frequencies is also of consequence.

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