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ABSTRACT

In an absolute frequency judgment task, 130 sixth graders received either high-frequency (Hi-F), low-frequency, high-meaningfulness (Lo-F/Hi-M), or low-frequency, low-meaningfulness (Lo-F/Lo-M) words selected from the 1944 Thorndike-Lorge list. Subjects were asked to either pronounce the words aloud, listen to the examiner prounounce the written words, or read the words silently. Pronunciation by either the subject or the examiner was found to increase the accuracy of frequency judgment for Lo-F/Hi-M words substantially more than it did for the other groups of words. It is suggested that the pronunciation of the Lo-F/Hi-M words serves to decode the written word into its oral form and increase the likelihood that these potentially meaningful words will elicit meaning responses from subjects during the frequency judgment task. (MKM)

Technical Report No. 344

PRONUNCIATION AND THE FREQUENCY MEANINGFULNESS EFFECT IN CHILDREN'S FREQUENCY DISCRIMINATION

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ABSTRACT

In an absolute frequency judgment task, independent groups of sixth-grade children received either high-frequency (Hi-F), low-frequency, high-meaningfulness (Lo-F/Hi-M), or low-frequency, low-meaningfulness (Lo-F/Lo-M) words under either pronounce or silent conditions. Results indicated that the accuracy of subjects' judgments followed the previously found frequency meaningfulness pattern (Lo-F/Hi-M words were judged more accurately than Hi-F words, whereas Lo-F/Lo-M words were not) only when the words were pronounced. Stated differently, pronunciation was found to increase accuracy for Lo-F/Hi-M words substantially more than it did for the other materials. The effect of pronunciation on the accessibility of word meaning was discussed.

I.

INTRODUCTION

A prediction which can be derived from the frequency theory of discrimination learning (Ekstrand, Wallace, & Underwood, 1966) is that low-frequency words will be learned better than high-frequency words. This prediction is based on the assumption that situational frequency (frequency inputs received in the laboratory) combines with background frequency (frequency inputs received through pre-experimental linguistic encounters) in a manner prescribed by Weber's psychophysical law. However, evidence for this prediction has been equivocal at best, with some experiments finding low-frequency words learned better than high-frequency words in the verbal discrimination paradigm and other studies finding no difference between the two (see Ghatala & Levin, 1974).

Two recent studies have suggested that differences between high- and low-frequency materials (in accord with Weber's law) are found only when the low-frequency words are meaningful to subjects. For example, Ghatala and Levin (1974, Exp. II) found that in an absolute frequency judgment task, low-frequency items which were meaningful (i.e., those for which a majority of sixth-grade pilot subjects could provide a definition response) elicited frequency judgments which tended to be more accurate than judgments elicited by high-frequency words. This result is in accord with Weber's law given the highly plausible assumption that differences in accuracy of frequency judgments reflect underlying differences in discriminability of situational frequency. In contrast, low-frequency words of low meaningfulness were judged no more accurately than high frequency words (in fact, descriptively <u>less</u> accurately), a result not in accord with Weber's law given the same assumption.[1]

In a follow-up study, Ghatala, Levin, and Makoid (1975, Exp. I) contrasted these same materials--high-frequency words (Hi-F), low-frequency/high-meaningfulness words (Lo-F/Hi-M), and low-frequency/low-meaningfulness words (Lo-F/Lo-M) in a verbal discrimination task with sixth-grade children. The results corroborated the earlier interpretation in that only those subjects in the Lo-F/Hi-M condition who could actually give semantic responses to the words (as determined from a subsequent definitions test) performed better on the discrimination task than comparable subjects in the Hi-F condition.

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[1]An example of a low-frequency word which is meaningful to sixth-graders is "hatchet," and of one which is not meaningful to these same subjects is "dory." Whereas the normative (Thorndike-Lorge, 1944) frequencies for these two words are comparably low (8 and 7 occurrences per million respectively), over 80 percent of our subjects could both

While this latter result clearly supported our notion that Weber's law operates only when the low-frequency materials are meaningful, it also indicated that even with low-frequency materials carefully selected (on the basis of pilot testing) to be meaningful, subjects still exhibited considerable variation in their ability to give semantic responses to these items on a definitions test. It was found, however, that having the experimenter pronounce the items reduced variability of subjects' performance on both the definitions test and in verbal discrimination learning of the Lo-F/Hi-M words (Ghatala, Levin, & Makoid, 1975, Exp. I). In this regard, it should be noted that the Ghatala and Levin (1974) frequency judgment data, which led to the predictions for discrimination learning, were obtained under conditions where subjects were explicitly instructed to pronounce the items to themselves.

We infer from these results that pronouncing a Lo-F/Hi-M word both increases the probability that a meaning response will occur for that word and decreases the latency of the meaning response--an important factor for performance on paced tasks. On the other hand, pronouncing the Hi-F words should have little effect because they are so highly meaningful that the meaning response occurs automatically and rapidly. Meaning responses to the Lo-F/Lo-M words are unlikely to be increased with pronunciation, given that they are almost totally unfamiliar to subjects.

The present study was conducted to explore directly the effects of pronunciation on the frequency/meaningfulness relationship. In a frequency judgment task, similar to that used by Ghatala and Levin (1974), subjects were presented with either Hi-F words, Lo-F/Hi-M words, or Lo-F/Lo-M words. For each stimulus type, some subjects were merely instructed to attend to the words, other subjects had the words pronounced for them by the experimenter, and a third group was instructed to pronounce each item aloud as it appeared. If pronunciation makes meaning responses to the Lo-F/Hi-M words more likely, then the frequency/meaningfulness relationship should be more apparent under conditions where items are pronounced (especially when the experimenter pronounces them, thereby guaranteeing that mispronunciations do not occur) than in the silent condition. To say this another way, with pronunciation there should be a greater difference in frequency judgment accuracy favoring the Lo-F/Hi-M over the Hi-F words than with no pronunciation. On the other hand, the difference between Lo-F/Lo-M and Hi-F words is not expected to change with pronunciation for reasons given earlier.

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pronounce and define the former; less than 20 percent of our subjects could define the latter (even though over 80 percent of them could pronounce it).

II

METHOD

SUBJECTS

The subjects were 130 sixth graders from schools around Madison, Wisconsin. Forty children participated in the pilot testing of the materials. The remaining 90 children were assigned by means of a block-randomization procedure to the nine conditions of the experiment.

MATERIALS

The three sets of materials consisted of 24 Hi-F words (Thorndike-Lorge, 1944, values in the AA or A range), and 24 each of Lo-F/Hi-M and Lo-F/Lo-M words. The average Thorndike-Lorge value for the 48 low-frequency words was 6.77 occurrences per million. All of the words were nouns with ratings above six on the concreteness scale of Paivio, Yuille, and Madigan (1968).

The meaningfulness of the low-frequency words was determined from a pilot study in which 20 subjects were presented with the 66 low-frequency words used by Ghatala and Levin (1974) in their pilot study, and another 20 subjects were presented with a new sample of 65 low-frequency words. Each word was presented on a card and the subject was asked to pronounce and then define each word. The 24 Lo-F/Hi-M words were those which at least 80 percent of the subjects could both pronounce and define (any definition was taken to indicate that the word had meaning for the subject). The 24 Lo-F/Lo-M words were those which at least 80 percent of the subjects could pronounce, but no more than 20 percent of the subjects could define in any manner (i.e., subjects said "I don't know" or gave no response when asked to define the word). The average Thorndike-Lorge values were 7.08 occurrences per million for the Lo-F/Hi-M and 6.46 occurrences per million for the Lo-F/Lo-M words.

Of the 24 items of each type selected for use in the frequency judgment task, 20 apiece were randomly distributed among the four presentation frequency categories represented in each of the three study lists. The study list for each of the three sets of words consisted of ten words presented once, five words presented twice, three words presented three times and two words presented four times, making a total of 37 study presentations. The order of items on the study lists was random with the restriction that words of multiple occurrence were distributed equally in each equal-sized section of the list, with the number of sections being determined by the presentation frequency (i.e., a word presented twice occurred once in each half of the list, a word presented three times occurred once in each third, and so on). The sequence of items representing the four presentation frequencies was the same across the three study lists.

The test lists for the three sets of words consisted of the 20 words presented for study plus four words which had not been presented. The order of the words within a test list was random. Items which had occupied the same position across the three study lists were matched on position in the test lists.

PROCEDURE

Each of the three study lists was presented under three conditions: Silent, S-pronounce, and E-pronounce. In the the Silent condition, subjects were instructed to "look at each word carefully." In the S-pronounce condition, subjects were instructed to "look carefully at each word and try to pronounce it." In the E-pronounce condition, the subjects were told to "look carefully at each word while I pronounce it for you."

The words were typed on cards and shown for study at a 4-sec. rate. The subjects were told that some of the words occurred once and some a few times, and that they may or may not know the meanings of all the words. Apart from being told that they would later be asked some questions about the items, subjects were not informed of the precise nature of their task in order to prevent conscious attempts at counting each item. Immediately following the study list, the appropriate test list was given at a 5-sec. rate. No overt pronunciation took place at the time of the test--the subjects were simply asked to state the number of times that each word had occurred in the study list, guessing if uncertain.

III

RESULTS

Each subject's total number of correct frequency judgments (out of 24) comprised the dependent variable in the analysis. Mean accuracy according to experimental conditions is presented in Table 1. Rather than performing an omnibus factorial analysis of variance, more efficient use of the data was achieved by formulating a set of a priori contrasts following the previously stated hypotheses. Contrasts 1 and 2 compared the performance of Lo-F/Hi-M and Hi-F subjects, and of Lo-F/Lo-M and Hi-F subjects, respectively, according to Dunnett's test and $\alpha = .05$. In addition, Contrasts 3 and 4 investigated each of the just mentioned contrasts in interaction with the average of S- and E-pronounce vs Silent (each at $\alpha = .025$); while Contrasts 5 and 6 investigated the same initial contrasts in interaction with S- vs E-pronounce (each at $\alpha = .025$).

According to these procedures it was found that across rehearsal conditions neither Lo-F/Hi-M nor Lo-F/Lo-M subjects performed differently than Hi-F subjects, in that Contrasts 1 and 2 both had associated p values greater than .05. However, as hypothesized, the former difference was found to interact with pronunciation, Contrast 3: $t(81) = 4.69$, $p < .001$. As may be seen in Table 1, the difference between Lo-F/Hi-M and Hi-F materials follows the frequency meaningfulness pattern only when items are pronounced. The nonsignificant difference between S- and E-pronounce vis-à-vis this interaction suggests that it makes little difference who is doing the pronouncing, Contrast 5: $|t|$ (81) < 1. Finally, pronunciation did not have any effect on the Lo-F/Lo-M vs Hi-F difference, either as a result of pronouncing or not, Contrast 4: $|t|$ (81) < 1; or as a function of S- vs E-pronouncing, Contrast 6: $|t|$ (81) < 1. Another way of summarizing these results is to say that only with the Lo-F/Hi-M materials did performance seem to be affected by pronunciation (see Table 1).

TABLE 1

MEAN NUMBER OF CORRECT RESPONSES IN EACH OF THE NINE EXPERIMENTAL CONDITIONS

	Materials		
Rehearsal	Hi-P	Lo-P/Hi-M	Lo-P/Lo-M
[illegible]	14.[illegible]	12.80	12.40
[illegible]	14.50	16.20	13.40
[illegible]	[illegible]	[illegible].40	11.70
Across Rehearsal	14.[illegible]	15.47	12.50

IV

DISCUSSION

Recall that the frequency meaningfulness hypothesis advanced in the introduction states that frequency units accruing to low-frequency items are more stable and hence more accurately discriminated than those accruing to high-frequency words only when the low-frequency words have meaning for subjects. It is now clear that the frequency meaningfulness pattern (at least with the materials used in this and previous experiments) is likely to be found only under conditions where accurate processing of the words is optimized, either by having subjects pronounce them silently (Ghatala & Levin, 1974) or by having the subjects or the experimenter pronounce the words aloud (as found here). As may be seen in Table 1, the pattern was completely absent in the silent condition of this experiment.

As already noted, the effect of pronunciation was localized in the Lo-F/Hi-M materials. This differential effect of pronunciation for materials differing in frequency and meaningfulness can perhaps best be explained in terms of the basic decoding operations involved in attaching meaning to words. Apparently, pronunciation of Lo-F/Hi-M words increases the likelihood that these potentially meaningful words (as determined from a definitions test) will actually elicit meaning responses from subjects in the context of the frequency judgment task. Pronunciation of the Lo-F/Hi-M words serves to decode the written word (which the subject has rarely encountered) into its oral form which can then elicit a recognition (meaning) response if in fact the word is in the oral vocabulary of the subject. From the means for the Lo-F/Hi-M materials across pronunciation conditions (see Table 1), it appears that subjects do not tend to undertake this decoding process when left to their own devices but benefit by being required to do so overtly or by having the experimenter decode the words for them. The slightly higher mean in the E-pronounce than in the S-pronounce condition may be due to more consistent and correct decoding of the words in the former condition. However, this difference is small relative to the difference between the silent condition and either of the pronounce conditions. Moreover, the Ghatala and Levin (1974) study suggests that merely instructing subjects to pronounce Lo-F/Hi-M words to themselves also tends to ensure that decoding of the words occurs.

Pursuing this argument with respect to the other two types of materials provides insight into why pronunciation had little effect with them. In the case of the Hi-F words, which are quite familiar to subjects in written form, requiring subjects to pronounce the words or having the experimenter pronounce them is superfluous in that decoding and recognition responses tend to occur spontaneously to these words in the silent condition. On the other hand, the Lo-F/Lo-M words are unfamiliar to subjects in both written and oral forms. Therefore, even when subjects decode (pronounce) these words or when the experimenter decodes them the likelihood that meaning responses will be elicited by the words is unchanged.

To summarize the argument, because meanings are available, i.e., represented in memory, for the Lo-F/Hi-M words, pronunciation (which ensures decoding) makes these meanings accessible. Pronunciation does not facilitate performance for either Lo-F/Lo-M words or Hi-F words, but for different reasons. For the former, since the words are not a part of the lexical repertoires of the subjects, pronunciation cannot render their meanings accessible. For the latter, since the words are most certainly spontaneously decoded by subjects, pronunciation is redundant. This logic, then, asserts that the frequency and meaningfulness characteristics of words are important factors in determining whether pronunciation has a positive effect upon performance or not. Moreover, from our analysis of the verbal-discrimination literature, it appears that the widely varying magnitude of the effect of pronunciation reported therein (cf., for example, Wilder, 1971, and Wilder & Levin, 1973) may be due, in part, to variations in these stimulus characteristics across experiments.

Finally, the finding that meaningfulness seems to moderate the effect of background frequency in both frequency judgment and verbal-discrimination tasks (Ghatala & Levin, 1974; Ghatala, Levin, & Makoid, 1975) suggests that the stability of situational frequency inputs to an item is positively related to the depth of processing of that item, in the Craik and Lockhart (1972) sense. Moreover, the present finding of an interaction between the frequency/meaningfulness pattern and pronunciation reinforces this view inasmuch as pronunciation may be thought of as inducing a deeper level of processing of Lo-F/Hi-M materials (though not of Lo-F/Lo-M materials) in comparison to when they are not pronounced. Research is currently underway to explore directly and analytically the relationship between depth of processing and frequency discrimination.

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