THE LOWERING OF PERCEPTUAL THRESHOLDS AS A FUNCTION OF AUDITORY LEARNING

by

STUART LEONARD WEISSMAN

B. A., University of Connecticut, 1955

A THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Psychology

KANSAS STATE COLLEGE
OF AGRICULTURE AND APPLIED SCIENCE

1956

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INTRODUCTION

The effect of past experience upon perception has been a subject of great interest to psychologists from all schools of thought. One of the diverse approaches to the problem is evidenced by Braly's (2) experiment in which he demonstrated the effect of past experience upon perception. This experiment was performed in answer to a prior study by Gottschaldt, defending the classical Gestalt viewpoint, which held that experience did not affect what was perceived. Subsequent experiments (10, 13) have demonstrated conclusively that visual experience with an object lowers the threshold of recognition for that object.

This fact has been utilized by authors such as Solomon and Howes (12) to argue against the effects of motivational and personality factors in perception. For example, Postman, et al. (9) administered the Allport-Vernon scale of values to a group of Ss. Their results showed that subjects had a lower recognition threshold for words that related to areas which they valued highly than for words related to areas of lower value for them. This was considered to result from their higher motivation in high-value areas. Solomon and Howes (12) argued that this could be explained in terms of greater frequency of contact with words in high-value areas, rather than motivation. The S's interests, they hold, may cause him to have contact with value-related words more often than is true for the population in general.

Solomon and Postman (13) subsequently demonstrated a high positive correlation between frequency of words used in the English language and recognition threshold. These findings are supported by an experiment by Postman and Conger (10) in which they demonstrated a correlation of -.43 (significant at the .05 level) between frequency of word usage and recognition threshold.

The authors state "If the stimulus is a high-frequency word, a correct response in the presence of incomplete cues is highly probable" (10, p. 672.).

These results have also been used as a basis for rejecting Postman and Bruner's concept of "perceptual defense" (3, p. 90), especially as applied to the results of an experiment by McGinnies (7). McGinnies found that subjects displayed a significantly higher threshold of recognition for "taboo" words such as rape, penis, and bitch, than for words of neutral quality, such as clear, child, and music. McGinnies speculated that this higher threshold resulted from "perceptual defense" by the Ss, i.e., from the tendency for certain words to be perceived at longer thresholds because their connotations are anxiety-producing. McGinnies recognized that his taboo words were infrequently seen on the printed page. However, he stated "...the critical words are quite common in conversational usage despite their infrequent appearance in print" (7, p. 250).

In rebuttal to this notion of "perceptual defense", Howes and Solomon (5) argue that it is inconceivable that McGinnies' taboo words are used with a frequency at all approaching the frequency of the neutral words McGinnies used for controls, and advance the frequency explanation as more parsimonious than the postulation of a mechanism of perceptual defense.

A further theoretical question is raised by Osgood (8), who holds that it should make no difference for visual recognition how frequently the taboo words were used in verbal conversation. Osgood says, "...frequency of conversational usage would not affect recognizability of words as visual stimuli" (8, p. 293). Osgood is thus assuming that auditory experience will not affect visual thresholds. This theoretical assumption is unsubstantiated by empirical data, however. There exists little evidence regarding the degree of

transfer across sensory modalities. It is to this problem that the present study is directed.

In a recent study, Gaydos (4) reported that blindfolded Ss given previous tactual experience with masonite forms showed a significant degree of positive transfer in their ability to recognize these forms visually. And in a still more recent study, Postman and Rosenzweig (11) report that auditory and visual experience can transfer across sense modalities, although the greatest amount of transfer takes place within the same modality.

Such a result was anticipated by McGeoch and Irion (6), who stated:

> One can compare rate of learning under visual stimulation with rate under auditory, but one must remember in interpreting the results that modality of stimulation does not wholly determine the subject's apprehension of the material. He may straightaway translate material presented to one sense organ into terms of other modalities. If unaccustomed to auditory presentation, he may attempt to imagine the material visually or to speak it subvocally or he may make implicit movements of writing or drawing it. The receptor is the starting point of the practiced response, but it is by no means its sole determiner.

The hypothesis of this study, then, was that auditory experience with material would lead to a lower visual recognition threshold for the same material.

METHOD

Materials

The experimental materials were twenty nonsense syllables of five letters each, divided into two groups of ten.

Nonsense syllables rather than meaningful English words were chosen in order to minimize the effects of prior contact with the experimental material. The two lists were constructed in such a way that each nonsense syllable in

one list was balanced by a nonsense syllable in the other list with similar structural properties. Pairs of nonsense syllables were assigned the same meaningful word in the paired associates learning. Thus, half of the Ss was given training with List A, and had List B as a control, while the other half was given training with List B, and used List A as a control list.

All nonsense syllables were pre-tested to determine their comparability regarding speed of learning and recognition thresholds. Thirty general psychology students divided into two groups of fifteen showed no significant differences regarding the mean number of trials required to learn the two lists.

Another group of 15 general psychology students was given a tachistoscopic presentation of all twenty nonsense syllables. Table 1 shows, for each pair of nonsense syllables, the frequency with which each member of the pair was recognized by inexperienced Ss at a lower shutter speed than its structural counterpart. It is evident that the members of some pairs are not equally difficult; however, since each list served as a training list for half the S's and a control list for the other half, this difference in average threshold between matched pairs was not likely to bias the results.

Each nonsense syllable was mounted on a 2" x 1½" slide and flashed on a screen by means of a 16 mm, 220 volt slide projector. The projector was equipped with a tachistoscopic shutter which allowed for the exposure of slides at varying speeds and at a constant brightness. The shutter was set at f14, and the projector hooked to a 110 volt circuit. Brightness at the center of the screen was .10 foot-candles.

Table 1. Frequency with which fifteen subjects were able to recognize each nonsense syllable at a lower threshold than its matched counterpart.

List A	List B	No. times List A Lower	No. times List B Lower	No difference	Total
lavic	trune	3	5	7	15
dipon	bugew	3	4	8	15
jesto	gozie	2	3	10	15
samig	zonep	5	5	5	15
acond	encul	6	7	2	15
wovep*	uerag	12	2	1	15
opant	ugenf	5	4	6	15
harst	kuvel	8	4	3	15
rofan	vetum	4	9	2	15
paldo	guiba	4	10	1	15
TOTAL		52	53	45	150

*difference significant at .05 level of confidence.

Procedure

Thirty college students, 16 males and 14 females, selected from the general psychology course at Kansas State College served as Ss.

The experimental procedure was administered individually. Words on the training list were arranged in random order. In the training trials, the E read the nonsense syllables aloud to the S who was required to respond with its paired associate. The two lists of nonsense syllables and their paired associates are given in Table 2. For each training trial the order of presentation of words was varied. Learning was continued to a criterion of twenty consecutive correct trials. The first 15 Ss (8 men and 7 women) were trained on List A, the second 15 on List B.

The directions for the learning series were as follows:

"I have here a set of 5 letter nonsense syllables. A nonsense syllable is a word which has no meaning. First I shall read through the words and

Table 2. Lists of nonsense syllables and their paired associates.

List A	Meaning	List B
lavic	red	trune
dipon	yellow	bugow
jesto	blue	gozie
semig	orange	zonep
acond	white	encul
wovep	green	uorag
opant	purple	ugenf
harst	pink	kuvel
rofan	brown	vetum
paldo	black	guiba

their meanings, and you are to try to memorize each word and its meaning. After that, I shall call out a word and ask you to repeat its meaning. We will go through the list of words, then have a short rest, then go through the list again. I shall inform you when you are correct, and correct you when wrong.

Do not become discouraged if you do not succeed at first. Early difficulties are usually the rule".

The S was dismissed after achieving the criterion and reported back twenty to twenty-four hours later for tachistoscopic presentations.

For the tachistoscopic presentation, the S was brought into a dimly lit experimental room and seated next to the projector, approximately six feet from the screen. A screen was placed between the S and the projector, preventing him from seeing the E operate the projector.

Before presentation of the slides, the paired associates learning was repeated to a criterion of five consecutive correct trials. When the criterion was met, the S was made comfortable and given the following directions:

"I am going to present to you by means of this exposure device a series of nonsense syllables. Each of the words appearing on the screen has 5 letters and you are to spell them out to me as you see them. Therefore, if the word appears to look like "sigua", say s..i..g..u..a. If you only recognize part of the word, spell out what part you do see. Just to get you acquainted, I shall give you a little practice with a few five letter nonsense words. When practice is over I shall inform you and you are to ready yourself for the regular words. I shall ask you if you are ready before each presentation and if you say "yes", I shall assume that your eyes are fixed on the screen and are ready."

Each S was given practice on three practice slides consisting of five-letter nonsense syllables not used on the training lists at exposure intervals of .01, .02, .04, and .01 seconds, for a total of twelve practice trials. When these were completed, the S was informed that practice was over and he was to do his best on the regular words.

The slides containing both experimental and control words were numbered one through twenty and presented in random order. The same order of presentation was used for each S. The criterion of recognition was two consecutive correct reports. Syllables were presented twice at each shutter speed, beginning with .01 seconds and moving to .02, .04, .10, .20, .50, and 1.00 seconds. The nonsense syllable was eliminated from the series when the criterion of recognition had been met. The shutter speed of the second correct recognition was taken as the recognition threshold.

RESULTS

The results were in general agreement with the hypothesis that percep-

tual thresholds are lowered by previous auditory experience with the material presented.

As was mentioned above, the two lists of nonsense syllables were constructed so that each training syllable was matched by a control syllable which was structurally similar. Therefore, the effect of training was tested by determining the frequency with which a training syllable was recognized at a threshold lower than, equal to, or higher than its structural counterpart. Table 3 shows this comparison for each experimental group and for both groups combined.

Table 3. Frequency of higher or lower visual thresholds for training and control syllables.

Condition	Syllable with lower threshold: Control	No difference	Experimental	Total
Group A	31	39	80	150
Group B	36	54	60	150
TOTAL	67	93	140	300

X^2 Group A = 15.36 $p < .001$
X^2 Group B = 3.84 $p < .05$
X^2 Total = 17.28 $p < .001$

The fact that Group A showed greater training effects than Group B might have resulted from a greater recognizability of syllables in List A compared to those in List B. However, even in Group B, the training syllables were recognized at a significantly lower threshold than the control syllables. Furthermore, let us consider the pair of nonsense syllables "wovep-uorag". Twelve of the 15 Ss for whom recognition thresholds were checked without training recognized "wovep" at a lower threshold than "uorag". This dif-

ference was greater than would be expected by chance ($p < .05$). Nevertheless, 9 Ss in Group B recognized "ucrag" at a lower threshold, 1 recognized both at the same threshold, and only 5 recognized "wovep" at a lower threshold--a reversal of the trend found for Ss without training. A similar reversal occurred for the pair "paldo-guiba" in which the List A word ("guiba") was recognized at a lower threshold by 10 of the 15 control Ss, but the List B word ("paldo") was recognized at a lower threshold by 10 of 15 Ss who received training on List B.

DISCUSSION

One may ask what factors in training operated to produce these results. It is clear that a certain amount of "warm up" is needed before the S settles down, adjusts his line of vision and assumes what might be called an "experimental altitude". This was the reason for including practice syllables. To the extent that this holds true, those words which are presented in the last half of the experiment should be recognized at a lower threshold than those presented in the first half. Furthermore, if in the course of the tachistoscopic presentation the S identifies certain syllables presented visually as identical with those syllables on which previous auditory training had been given, he may develop a "set" toward the recognition of other training syllables.

Since the order in which the nonsense syllables were presented was not counterbalanced so that the effects between difficulty of perception and order could be analyzed separately, it was impossible to determine whether the differences between training and control syllables resulted from experience with words (practice), or "set" to recognize the training word. If

auditory experience with the syllables could account for the differences, than the first three syllables should be recognized at about the same threshold as the last three; if the difference resulted from differential set, the last three syllables should be perceived at a lower threshold. This, however, can only be tested if the order of presentation is counterbalanced.

Judging from their reports, the factor of set was apparently operating for many of the Ss. Each S was asked at the conclusion of the experiment if at any time he had looked for the training syllables. The answer was generally in the affirmative. Ss who did not see the complete syllable on a given trial often reported that they inferred what the rest of the nonsense syllable must have been on the basis of the previous auditory experience.

It might be hypothesized that the auditory training provided as a category of potential auditory stimuli the syllables which the S had heard. Previous verbal experience had made it possible for him to translate these syllables into visual stimuli. Once an actual visual stimulus elicited a response included in the general category, the S's expectancy that other syllables in this category would be presented may have increased. Bitterman and Kniffen (1, p. 250) have made a similar point in their study of the relationship between manifest anxiety and recognition of taboo words. They stated, "...differences in the thresholds of taboo and neutral words may be accounted for in terms of differential readiness to report rather than in terms of perceptual functioning". Although taboo words had a consistently higher threshold than neutral words, the threshold of taboo words farther along in the list was much lower than those early in the list, presumably because the Ss gained insight into the nature of the experiment.

If Ss gained insight into the purpose of the present experiment after a

certain number of presentations had elapsed and readied themselves to perceive the experimental syllables, then it follows that those syllables presented after this insight was gained would have a lower threshold.

Whether the earlier training operated only through providing insight into the nature of the experiment or in some other fashion cannot be answered by this study, but awaits further investigation.

SUMMARY

The investigation was designed to test the hypothesis that previous auditory training with nonsense syllables would lower the perceptual threshold for these syllables.

Thirty students selected from a general psychology class at Kansas State College were taught a list of paired associates to a series of five-letter nonsense syllables read aloud to them by the experimenter.

Two lists of syllables were constructed, composed of pairs of syllables which were structurally similar. The syllables were pre-tested for significant differences regarding ease or difficulty of auditory learning or perceptual recognition. With the exception of one case in the perceptual recognition trials, the difficulty of recognizing or learning associates to the syllables was not greater than would be expected by chance.

The learning task consisted of responding to a nonsense syllable read aloud by the experimenter with a word that had been arbitrarily assigned as an associate. The first 15 Ss learned List A with List B as control. The second 15 Ss learned List B with List A as control. After a 24 hour interval both lists of nonsense syllables were presented in random order at different exposure speeds by means of a tachistoscopic attachment to a slide projector.

Syllables were flashed at successive exposure speeds of 1/100 sec., 1/50 sec., 1/25 sec., 1/10 sec., 1/5 sec., 1/2 sec., and 1 sec. until recognition occurred. The criterion of recognition was two correct responses.

The results supported the hypothesis that perceptual thresholds are lowered by previous auditory experience with the material presented. Ss who received auditory training on List A recognized these words at a lower threshold than words in List B on which no training was received. The differences yielded a chi-square of 15.86 which is much greater than would be expected by chance ($p < .001$). The same was true for Ss trained on List B, although the differences were not as highly significant ($p < .05$).

Those words which were structurally more difficult to recognize than their counterparts in the pre-trial tests showed a reversal of this tendency after auditory training with the counterpart was given.

The extent to which practice functioned to make words presented in the latter part of the experiment easier to recognize could not be stated, since the two lists were not counterbalanced with regard to presentation. It was suggested that this counterbalancing be controlled and its effects tested in subsequent experiments of this nature.

ACKNOWLEDGMENTS

The author wishes to thank gratefully Dr. Walter H. Crockett whose unstinting help and friendly generous counsel made possible the successful completion of this thesis. Many thanks also to Drs. Merrill B. Noble and Donald F. Showalter for their great interest and helpful suggestions.

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