# Noise, negative transfer, and meaningfulness*

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Two studies were conducted to test the hypothesis that the presence of noise, which Ss were instructed to ignore, would facilitate performance on a negative-transfer learning paradigm but not performance on a control learning paradigm. The effect of noise on two levels of item meaningfulness for each paradigm was also studied. In both experiments, negative transfer was successfully generated for low-meaningful items and the predicted interaction between learning paradigms and treatments was obtained. In neither experiment was significant negative transfer generated for high-meaningful items, and the predicted interaction between paradigms and treatments was not obtained.

Houston (Houston & Jones, 1967; Houston, 1969) hypothesizes that inhibiting a response to one source of extraneous stimuli will facilitate inhibiting a response to another source of extraneous stimuli. In other words, an interaction between inhibitory processes is hypothesized to occur when a person attempts to ignore two sources of stimuli irrelevant to task performance. In two experiments to test this hypothesis (Houston & Jones, 1967; Houston, 1969), the presence of continuous variable noise which the S was instructed to ignore facilitated performance on a task which required him to inhibit responses to interfering cues (viz, the Stroop Color-Word Interference Test[1]) but did not do so on a task which did not involve inhibition (viz, a color-naming task[1]).

The generalizability of the inhibition-interaction hypothesis was investigated in this study by assessing the effect of noise on a task involving inhibition other than the Stroop Color-Word Interference Test. Rather than studying another task in which interference is presumed to exist, the intention here was to introduce interference experimentally in the performance of a task. The task investigated was negative transfer in paired-associated (PA) learning. It was hypothesized that noise would facilitate negative transfer (NT) learning but would not facilitate learning which did not involve negative transfer (NNT).

Since NT learning is more difficult than NNT learning, it seemed desirable to include in the design of the study the opportunity to evaluate whether or not noise facilitates learning, which is difficult for a reason other than that it involves NT. To do this, it was planned that two levels of difficulty for NT and NNT learning paradigms would be created, and the interaction of task difficulty with noise would then be evaluated. It was predicted that noise would not interact with the difficulty level of the learning paradigms.

## EXPERIMENT 1

### Method

The design of the experiment required that S first learn high- and low-difficulty A-B pairs in List 1. S then learned two second lists, both of which contained high- and low-difficulty pairs of an A-C NT paradigm and a D-E control paradigm.[2] One of the second lists was learned in quiet (Q) and the other in noise (N). The order in which Q and N were presented, i.e., whether S learned the first of the two second lists in Q or N, was also included in the design. For purposes of statistical analysis, the design was a 2 by 2 by 2 by 2 mixed factorial design with repeated measures on three of the four factors: transfer paradigms (A-C and D-E), difficulty (high-low), and treatments (Q-N); order of treatments (Q first, N second, or N first, Q second) was a between-S factor.

The PA lists consisted of eight consonants as stimulus terms and three-letter words as response terms. The difficulty level of the lists was manipulated by varying the nature of the responses. For low difficulty, the responses were three-letter familiar words taken from the Thorndike-Lorge (1944) list of the 500 most common words. For high difficulty, the responses were three-letter nonsense words taken from Glaze's list (Hilgard, 1951) of 100% association-level nonsense words.

The 32 Ss who participated in the experiment were given 15 acquisition trials on List 1 and 4 acquisition trials each on the second lists. One of the second lists was learned in Q and the other in N. The order in which the second lists were presented and the order in which N and Q were administered were counterbalanced over Ss. In N, a variety of tape-recorded noises (e.g., trains, gibberish, electronic music, etc.) was played to Ss through earphones at an average sound intensity of 78 dB. Ss were instructed to ignore the sounds completely.

All lists were presented on a Lafayette memory drum at a 2:2:2 sec rate, i.e., S saw the stimulus for 2 sec, and 2 more seconds intervened before S saw the S-R pair together for 2 sec. There was a 2-sec intertrial interval.

### Results and Discussion

The mean number of errors (incorrect responses and omissions) made on the four anticipation trials are reported in Table 1. An analysis of variance on the error scores, to which a square-root transformation had been applied, revealed that the attempt to create two levels of difficulty was successful, i.e., the main effect for difficulty was significant, $F(1,30) = 14.57$, $p < .001$. While neither the two-way interaction between treatments and paradigms or treatments and difficulty were significant, the three-way interaction between treatments, paradigms, and difficulty level was significant, $F(1,30) = 8.90$, $p < .01$. Several nonorthogonal comparisons were made to elucidate the meaning of this significant three-way interaction. The experimental manipulation of negative transfer was successful for high-difficulty items but not for the easier items. There was a substantial difference in the mean number of errors between the two learning paradigms in Q for nonsense word items, $F(1,30) = 4.12$, $p = .0515$, but the difference for familiar word items did not approach significance. For nonsense word items, there was a significant interaction between treatments and paradigms consistent with the hypothesis, $F(1,30) = 4.26$, $p < .05$. For the easier items, an interaction between treatments and paradigms opposite to that predicted was observed, which, however, was not significant. In none of the analyses did a main effect of or interaction with order of treatments approach significance.

## EXPERIMENT 2

### Method

A second study was conducted in an attempt to generate significant negative transfer for two levels of difficulty and to assess the effect of noise on the two learning paradigms across the two difficulty levels. A number of modifications in the

**Table 1**
**Mean Number of Errors Made on Four Anticipation Trials for Two Learning Paradigms at Two Difficulty Levels Under Two Treatment Conditions**

| | Low Difficulty | | High Difficulty | |
|---|---|---|---|---|
| | Quiet | Noise | Quiet | Noise |
| A-C | 2.97 | 4.09 | 4.28 | 4.53 |
| D-E | 2.47 | 3.03 | 3.31 | 4.31 |

Table 2
Mean Number of Errors Made on Eight Anticipation Trials for Two Learning Paradigms at Two Difficulty Levels Under Two Treatment Conditions

| | Low Difficulty | | High Difficulty | |
|---|---|---|---|---|
| | Quiet | Noise | Quiet | Noise |
| A-C | 9.71 | 13.92 | 15.58 | 15.25 |
| D-E | 7.88 | 10.08 | 11.88 | 14.67 |

procedure of the first experiment were made in this second experiment. Consonant-vowel-consonant (CVC) trigrams (Archer, 1960) were used as both stimulus and response items. All stimulus CVCs were 99%-100% association-level CVCs. High-difficulty response items were 66%-68% association-level CVCs.

A separate set of first and second lists was created for each of the two levels of response difficulty, and separate groups of Ss learned the two sets of lists. Both sets of lists contained identical stimulus CVCs but differed in the meaningfulness of response CVCs. The two learning paradigms, A-C and D-E, were again contained, i.e., "mixed," in the second lists.

All lists were presented on a Lafayette memory drum at a 2:2 sec rate with a 2-sec intertrial interval. List 1 learning was carried to a criterion of one perfect repetition. All Ss were given eight acquisition trials on each of the second lists. As before, one of the second lists was learned in Q and the other in N, the order of which was counterbalanced across Ss, as was the order in which the two second lists were presented. N was the same as in the previous experiment.

Sixteen males and 32 females participated in the experiment. In order to evaluate possible sex differences, Ss were divided into three groups of 16 Ss apiece, and any main effects for or interactions with this factor were noted. For purposes of statistical analysis, the design was a 3 by 2 by 2 by 2 by 2 mixed factorial design with repeated measures on two of the five factors: transfer paradigms and treatments. Groups of Ss, order of treatments, and difficulty level were between-S factors.

### Results and Discussion

The mean number of errors made on the eight anticipation trials are reported in Table 2. An analysis of variance on the error scores, to which a square-root transformation had been applied, revealed that the main effect for difficulty was significant, $F(1,36) = 11.22$, $p < .005$. While neither the two-way interaction between treatments and paradigms or treatments and difficulty were significant, the three-way interaction between treatments, paradigms, and difficulty was again significant, $F(1,36) = 4.36$, $p < .05$. Several nonorthogonal comparisons were again made to elucidate the meaning of the three-way interaction. Analyses on error scores between paradigms in Q only for the two difficulty levels separately revealed that significant negative transfer had been generated for high-difficulty response items, $F(1,18) = 11.05$, $p < .005$, but negative transfer for low-difficulty items was still not significant. For high-difficulty items, the predicted interaction between paradigms and treatments was obtained, $F(1,18) = 4.06$, $p = .0565$. For low-difficulty items, an interaction between treatments and paradigms opposite to that predicted was observed, but it was not significant.

In none of these analyses did a main effect for or interaction with the groups factor (males and females) even approach significance. We can therefore conclude that no sex differences were operating in this study. It should be noted that a significant Orders by Treatment interaction, $F(1,36) = 5.50$, $p < .05$, was revealed in the overall analysis. An inspection of the data revealed that more errors were made in N and fewer errors were made in Q if N preceded Q than if Q preceded N.

## CONCLUSIONS

In two studies, the predicted interaction between treatments and learning paradigms was obtained for high-difficulty items, and a tendency toward an interaction opposite to that predicted was observed for low-difficulty items. Considering the consistency across the two studies of these interactions which are opposite in nature, the effect of noise on PA learning involving inhibition (viz, negative transfer) appears to depend on the difficulty of the learning task. This is not conclusive, since significant negative transfer was not generated for the easy items in either study. It should be noted that task difficulty was not an important variable for the effect of noise on Stroop performance, whose responses are already learned (Houston, 1969). However, it appears that for a task in which learning is involved and for which the rate of the presentation of the material to be learned is fixed, the difficulty of the material is a qualifying factor. Ss in N may have been more distracted by the noises when presented with the easier material, since Ss could not proceed at their own pace and less concentration was required of the items.

In the two studies reported here, greater negative transfer was obtained with lower than with higher response meaningfulness, although this difference was not significant in either study. This trend is contrary to previous reports (Goulet, 1965; Jung, 1963; and Merikle, 1968). These investigators present evidence that negative transfer for high-meaningfulness stimuli is greater for responses of higher meaningfulness. The results of the two studies presented here suggest that the relationship between negative transfer and response meaningfulness is not as clear or obtainable as the previous studies would lead one to believe.


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NOTES

1. A full description of the two tasks may be found in either of the two previous reports.

2. Conventional notation for paired-associates is employed here. A pair of letters (e.g., A-B) stands for the stimuli (A) and responses (B) in a paired associate list. Two such pairs (e.g., A-B, A-C) identify two lists and the relationships between them. Thus the A-B, A-C paradigm is one in which the S learns in succession two lists in which stimuli are identical (A), but responses differ (B in List 1; C in List 2).