Effects of anxiety and stress on children's paired-associate learning¹

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Abstract

Anxiety or stress was varied in two studies of verbal paired-associate learning, yielding within-Ss comparisons of performance on word pairs of different levels of interpair competition. While neither anxiety nor stress had a reliable effect on low-competition (high association) pairs, learning on high-competition (low initial association and high intrusion) pairs was reliably poorer for high-anxious and for high-stress Ss. The error mechanisms underlying responses to the low-association pairs, however, were different for the anxiety and stress conditions.

Problem

Spence (1956, pp. 221-236) has outlined how the assumption of an interactive relationship between habit strength and drive (D) may be applied to complex learning situations such as paired-associate tasks. Briefly, deductions from this assumption predict that under conditions of high interpair competition (high interpair generalization or high probability of intrusive errors), increased D should impair performance, while under conditions of minimal interpair competition, increases in D should facilitate performance. In its most modest form, this deduction involves a predicted interaction between D-level and amount of interpair competition, with either one or the other, or both, of the above in evidence. Spence reported several studies, using adult Ss, in which this deduction has been substantiated when Manifest Anxiety Scale scores were used in defining D. The present project sought to determine whether these effects are characteristic of children's performance as well, and whether similar results might obtain when some other definition of D is used. Two companion studies, one of which used anxiety-scale scores, the other of which manipulated D through stress-instructions, investigated the predicted interactive relationship.

Subjects

The children were 60 sixth-graders, divided into four groups as indicated below.

Method

All Ss were administered the Children's Manifest Anxiety Scale (Castaneda, McCandless, & Palermo, 1956). On the basis of anxiety scores, two groups were selected for the Anxiety experiment and two for the Stress experiment. Upper- and lower-quartile scorers constituted the High-Anxious and Low-Anxious Ss, respectively. Second- and third-quartile scorers became the Ss for the Stress experiment, and were placed randomly in either the High-Stress or Low-Stress group. All four groups were subsequently treated alike in a paired-associate learning task, with this qualification: High-Stress Ss were given "alerting" instructions before performing in the learning task ("Most children do well in this test. Please don't let me down, for I want you to do just as well as the other children."), while Low-Stress Ss were given "neutral" instructions identical to those given the two anxiety groups ("Most children

find this pretty hard to do. Do the best you can, but don't worry. It doesn't matter when you get some wrong...").

Stimuli were presented on a Hunter Cardmaster, with 5-sec. intertrial and interstimulus intervals, and 5-sec. dual exposure. There were 12 word-pairs to be learned. These were constructed as four triads, each designed to produce one high-association and two low-association pairs. Table 1 shows the 12 word-pairs selected without benefit of association norms. The first pair of each triad provides a stimulus with a highly-associated response-word. The second and third pairs of each triad were constructed by using stimulus words of the same class as the first stimulus, but these were paired with response-words of low-association value. Thus the second and third stimuli should tend to elicit the response-word appropriate for the first pair of a triad. All Ss received 13 complete trials, involving all pairs randomized to prevent serial learning. At the end of learning, all Ss were assured that their performance had been excellent.

TABLE I

The four paired-associate triads used for all Ss

ORANGE	PEEL	MOTHER	HELP
LEMON	STAR	FATHER	RUG
BANANA	TRAIN	TEACHER	SLED
CAT	PET	FORK	EAT
DOG	GLASS	KNIFE	HAT
PONY	STRAW	SPOON	DOOR

Results

Figure 1 plots correct responses over the 12 trials following initial presentation. There it may be seen that the results of the Anxiety and the Stress studies were quite similar, with high anxiety or stress tending to impair performance on the low-association pairs. A separate analysis of variance was run for each study, with Groups (high vs. low anxiety or stress) as a between-Ss variable, and Trials and Association-value (high vs. low) as within-Ss variables. Association and Trials were significant variables in both studies (Association: $F=57.35$; $df=1/28$; $p<.001$ in Anxiety study; and $F=5.71$; $p<.05$ in Stress study. Trials: $F=127.15$; $df=11/308$; $p<.001$ in Anxiety study; and $F=99.03$; $p<.001$ in Stress study). The Trials by Association interaction, indicating a greater climb to asymptote demanded by the low-association pairs, was also common to both studies ($F=8.95$; $df=11/308$; $p<.001$; and $F=2.11$; $p<.05$). Several additional reliable effects were obtained in the Stress study: that of Groups, due to higher overall performance of low-stress Ss ($F=4.78$; $df=1/28$; $p<.05$); the Trials by Groups interaction, due primarily to a slower climb to asymp-

Fig. 1. Mean percentage of correct responses for the Anxiety and Stress replications separately.

tote by high-stress Ss ($F=2.59$; $df=11/308$; $p<.01$); the Association by Groups interaction, produced by a greater disparity between the performance of high and low-stress Ss on the low-association pairs than on the high-association pairs ($F=75.54$; $df=1/28$; $p<.001$); and the triple interaction ($F=12.20$; $df=11/308$; $p<.001$). Thus the primary hypothesis of the study predicting an interaction between Association and Groups, with high-anxious (or high-stress) Ss being relatively more impaired on low-association than on high-association pairs, receives support principally from the Stress study.

Because the results of the Anxiety study seemed to support the hypothesis, and because of the complexity of the interactions obtained in the Stress study, further analyses were conducted within each experiment. Two analyses of variance within each study, one for the high-association pairs and one for the low-association pairs, examined the effects of Anxiety (or Stress) as the between-Ss variable and Trials as the within-Ss variable. Primary interest was in whether the Trials by Anxiety (or Stress) interaction would be reliable for the low-association pairs but not for the high-association pairs. In addition to the Trials effect, which was reliable for all four analyses, the Groups by Trials interaction involving low-association pairs reached the .05 level ($F=1.85$, $df=11/308$) for the Anxiety study, and the .001 level ($F=4.08$, $df=11/308$) for the Stress study. This interaction was not reliable in either comparison involving high-association pairs. These results are taken as definite evidence for the initial interaction hypothesis for the Stress study, and tentative evidence for the Anxiety study.

Recording the errors made to the low-association pairs in the course of learning made comparisons of error-types between the studies possible. The interac-

tion hypothesis assumes that impairment on the low-association pairs will result from the intrusion of dominant-tendency errors (i.e., the use of the response-word appropriate to the high association pairs of each triad). In the Anxiety study, a total of 41 dominant-tendency errors (DTE) were made by the high-anxious Ss, while only 14 DTE were made by the low-anxious Ss ($t=2.14$, $df=28$, $p<.05$). No other error types (other response errors, stimulus errors, extra-list errors, or no-response errors) produced reliable differences between the two Anxiety groups. In the Stress study, on the other hand, total DTE for high- and low-stress Ss were 34 and 26, respectively ($t=.76$, non-significant), and "no-response errors" numbered 434 and 256 respectively ($t=3.72$, $p<.01$). Comparable "no-response" frequencies for the Anxiety study were 306 and 282. Thus it appears that the mechanism presumed to produce the hypothesized interaction effect was present in the Anxiety study, but that some other mechanism (inhibiting responses rather than producing intrusive DTE) was responsible for the effects obtained in the Stress study.

Discussion

Other studies with children (Castaneda & Lipsitt, 1959; Castaneda, 1961; Lipsitt & LoLordo, 1963) have demonstrated that increases in D will tend to enhance performance in dominant-tendency-correct (high-association) learning situations and impair performance in dominant-tendency-incorrect (low association, high generalization) situations. The present study provides some evidence for a similar phenomenon in children's verbal paired-associate learning, in that performance on low-association word pairs was impaired by elevated anxiety or stress. Marshaling against the demonstration of facilitation on dominant-tendency-correct pairs in the present study was the fact that these pairs were already of high-association value and were consequently learned relatively quickly, thus diminishing opportunity for stress or anxiety to further facilitate performance. However, the fact that in both studies low-D Ss tended to do better on these pairs than high-D Ss suggests that this may not be a completely adequate interpretation. Further analyses of errors of all types and for both high- and low-association pairs may provide additional clues as to the mechanisms by which increased D tends to affect high- and low-association pairs differentially.

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Notes

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