may simply reflect differences during acquisition of AC associations. For reasons too complex to present here, covariance adjustment of posttest C responses and agreements did not seem warranted.

Following acquisition of the AC list, C responses to words with high-f and low-f primaries were less frequent than they had been across all 10 or during the last of the acquisition trials. These decrements presumably reflect change in instructions and consequent set, and in context of A words. Nonetheless, C

responses continued to occur: responses acquired in a paragraph or discourse layout transfer to a word-association situation or task.

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Effects of delay of reinforcement and stimulus meaningfulness on the discrimination learning of retardates at two intelligence levels*

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This experiment was designed to study the effects of delay of reinforcement, meaningfulness, and level of retardation (borderline or mild) on performance in a successive discrimination learning task. Ss from both IQ groups were required to learn a left or right motor response to each of six pictures, three meaningful and three nonmeaningful. For a given S, each stimulus from both meaningfulness categories was paired with a different delay interval, 0, 3, or 9 sec. The three main effects proved reliable, but none of the interactions reached significance.

Much of the literature on delay of reinforcement has stressed the importance of the availability of cues for mediating the delay. Studies with animals have shown that delay box cues (Perkins, 1947) and response-produced cues (Grice, 1948) may serve as sources of mediation. When these cues are eliminated, extremely steep delay gradients are obtained. Research with children also provides evidence as to the importance of cues during the delay. Brackbill and her associates have conducted several studies (e.g., Brackbill & Kappy, 1962) which have indicated that delay of reinforcement does not affect rate of discrimination learning in children. In these studies, the stimuli were visible

during the delay, and feedback (reinforcement) indicated the correct response. Thus, S did not have to retain any information through the delay, since all relevant information, stimuli and correct response, were contained in the feedback. Under conditions where S must carry information through the delay in order for learning to occur, delay effects are normally obtained (e.g., Markowitz & Renner, 1966).

Research with retardates has generally been successful in demonstrating detrimental effects due to reinforcement delay (Keeley & Sprague, 1969). However, as yet, there has been little systematic effort directed toward discovery of the crucial variables underlying the delay gradient. Keeley & Sprague (1969) have suggested that the presence of a delay effect may be dependent upon S variables and stimulus complexity. The present study was designed to determine the effect of stimulus

meaningfulness and IQ upon the slope of the delay gradients in a successive discrimination learning task with retardates. It was hypothesized that meaningful materials (pictures of common objects) would provide mediating responses (labeling) more readily than would nonmeaningful stimuli. Similarly, more intelligent Ss should be better able to produce mediating responses and therefore show relatively less decrement with increasing delays than would less intelligent Ss. The latter prediction is also derivable from Ellis's (1963) hypothesis that the rate of decay of a stimulus trace is a function of intelligence.

SUBJECTS

The Ss were 45 mentally retarded females selected from the population of the Partlow State School in Tuscaloosa, Alabama. Of these Ss, 9 were discarded: 3 for failure to follow instructions, 3 for alternation of perseveration, 2 for fixation of the incorrect response (18 consecutive incorrect responses to a given stimulus), and 1 due to an equipment failure. The remaining 36 comprised two intelligence groups: 18 borderline and 18 mildly retarded individuals (classified according to Heber, 1961). The borderline retardation group had a mean IQ of 74.5 (range—70 to 83) and a mean CA of 24 years 5 months (range—13:3 to 40:2). The mildly retarded group had a mean IQ of 61.3 (range—55 to 67) and a mean CA of 28 years 3 months (range—17:8 to 46:1).

APPARATUS

A response console, a Kodak Carousel projector, and programming equipment comprised the apparatus. The response console consisted of a left and right response lever mounted approximately 10 cm apart on a metal casing. It was located on a table in the experimental room. Behind the table and mounted in the wall was a 20-cm-square rear projection screen. The screen was directly in front of S at about eye level when seated. A room adjacent to the experimental room housed the projector and all programming equipment. The programming equipment controlled timing of the intervals, action of the projector, and a feedback to the S. All operations were automatically controlled except that E set manually the delay interval for each trial.

PROCEDURE

Each S performed on a successive discrimination task. He was required to learn a left or right response to each of six stimuli, three meaningful and three nonmeaningful. The meaningful stimuli were pictures of a dog, an Indian, and a group of flowers. The nonmeaningful stimuli were nonsense

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Table 1
Mean Errors (Standard Deviations in Parentheses) in Reaching Criterion
or for the Total of 192 Trials

Meaning- fulness	Degree of Retardation					
	Borderline			Mild		
	Delay			Delay		
	0	3	9	0	3	9
High	3.39 (3.97)	5.33 (5.16)	5.78 (4.79)	4.78 (5.71)	6.94 (4.92)	9.22 (6.48)
Low	6.33 (3.93)	7.83 (5.39)	8.50 (4.99)	9.06 (7.58)	10.17 (5.49)	13.50 (5.74)

figures selected from those used by Ellis & Porter (1966). For a given S, each meaningful stimulus and each nonmeaningful stimulus was assigned a 0-, 3-, or 9-sec delay of feedback. Different Ss received different stimulus-delay combinations and, across Ss, the different combinations were used with equal frequency. A chime was used to indicate correct responses after the appropriate delay interval. Incorrect responses received no feedback. An 11-sec interval separated the response to one item from the presentation of the next stimulus.

At the beginning of a session, S was brought into the experimental room and seated before the screen and response console. He was then read instructions indicating the nature of the task. The stimuli were presented in blocks of 48 trials, consisting of eight groups of the six different stimuli randomized within groups. The only restriction on randomization was that no stimulus follow itself when passing from one random order to the next. No breaks occurred within the blocks of 48 trials, but a 1-min rest was given between each successive block of trials. The Ss were run through four blocks of trials (total of 192) or until they reached a criterion of 18 consecutive correct responses. For each S, the stimuli in each of the four blocks were arranged in the same order, but different Ss received different orders.

RESULTS

The results are summarized in Table 1, which exhibits mean number of errors for each of the 12 experimental conditions. Ss reaching criterion were scored as having made no errors beyond that point. A 2 by 2 by 3 analysis of variance was conducted on the error data for the

effects of intelligence, stimulus meaningfulness, and delay. As expected, all three main effects were significant: intelligence, $F = 4.35$, $p < .05$; meaningfulness, $F = 21.6$, $p < .001$; and delay, $F = 9.7$, $p < .001$. However, none of the interactions reached significance. Analysis of the delay effect by the Newman-Keuls method showed that the 3-sec delay resulted in a significant decrement ($q = 4.39$, $p < .01$) when compared with the 0-sec delay. Similarly, the 9-sec treatment differed significantly ($q = 4.39$, $p < .01$) from that of 3 sec.

DISCUSSION

The present study supports numerous other studies which have found that delay of reinforcement impairs discrimination learning in retardates. It is also in agreement with studies that have found effects due to stimulus meaningfulness and intelligence (e.g., Ellis & Porter, 1966). The design of the present study, while varying delay, holds constant the interval between the Ss' response and the presentation of the next stimulus (intertrial interval). When intertrial interval is constant, the time from feedback to the presentation of the next stimulus (postfeedback interval) covaries with delay of feedback. Thus, in the present study the effects of delay are inseparable from those due to the postfeedback interval. However, Keeley & Sprague (1969) have shown that the postfeedback interval does not influence the discrimination learning of retardates.

Of primary interest are the two-factor interactions of Intelligence by Delay and Stimulus Meaningfulness by Delay. Contrary to prediction, both were found to be nonsignificant. The nonsignificant Intelligence by Delay interaction is in agreement with three

previous studies (Hetherington & Ross, 1967; Hetherington, Ross, & Pick, 1964; Ross, Hetherington, & Wray, 1965). With the exception of one comparison, these studies used only MA-matched intelligence groups. Thus, it appears that at least when Ss are not widely separated in ability, the slope of the delay gradient is independent of IQ. By virtue of the nonsignificant Meaningfulness by Delay interaction, it seems that delay gradient slope is also independent of stimulus meaningfulness. The failure to find the predicted interactions may be explained by recent research (Ellis & Anders, 1968) demonstrating that both stimulus meaningfulness and IQ affect the encoding (learning) of stimulus materials rather than short-term memory.

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