The response to stimulus change as a brightness scaling technique*

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Rats were tested in eight conditions. Trial 1 exposed S, through plastic plates, to the two arms of a T maze, each of a different brightness. Prior to Trial 2, on which choice was permitted, one or both arms were changed in brightness. The magnitudes of the proportions of choice of the changed side were not fully consistent with the size of the brightness changes; hence, a scaling analysis was not justified. One set of Ss was retested after 4 months; the correlation between the conditions on initial test and retest was .90, when entry of an arm with four feet was used as the choice measure.

If a rat is exposed to the two arms of a T-maze while prevented from entering by transparent barriers, it is found that on a subsequent trial, with the barriers removed, the rat will tend to enter whichever arm has had its previous brightness changed (Dember, 1956; Kivy, Earl, & Walker, 1956). Dember & Millbrook (1956) demonstrated that, if both arms are changed in brightness between the exposure and choice trials, the rat will tend to select the arm which has been changed most; they pointed out that this provides a potential brightness scaling technique. The present study was designed to investigate further this potential and determine if choice measures exhibit sufficient reliability to warrant the application of scaling models. Though the T-maze is not the ideal setting in which to assess the rat's visual capabilities, it is the context in which a considerable body of related data on alternation and the response to change has been obtained.

SUBJECTS

The Ss were 96 male Sprague-Dawley albino rats from 90 to 145 days of age on the first experimental day. They were individually housed in cages on either side of the experimental room, with food and water always available. Prior to the first experimental day, each S received 1 week of habituation to the cage in the experimental room, then 5 days of tabletop handling and exploration, and then one trial a day in the maze for 4 successive days, with both arms homogeneously lined with a posterboard of a different brightness on each day. Some Ss had additional prior experience in the open field and in tests of spontaneous alternation; none had previous experience with the response-to-change procedure.

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APPARATUS

The T-maze, which has been described in detail elsewhere (O'Connell, 1964), was designed to eliminate some problems previously encountered with the stimulus-change procedure. With a conventional T, the rat is free to wander in the start stem and vary the duration of his exposure to stimuli at the choice point. This permits variation in exposure to the choice-point stimuli among Ss within the same experiment and among Ss of different studies utilizing various lengths of start stem. The modified T employed here largely solved this problem by moving the entire start stem into the choice area, so that the stimuli of the arms were always visually available during the exposure trial.

A guillotine door was located about midway in each arm, approximately 10 in. from both the choice area and the goalbox. A 4½ x 9-in. startbox, painted flat gray, was separated from the choice area by a guillotine door. Through slots in the roof of the choice area, transparent plastic plates could be inserted so as to create a temporary confinement area, 5-in. wide and extending 1 ft from the glass guillotine door of the startbox to the rear wall of the choice area. The floor and walls of the choice arms and choice area were covered with inserts of poster board. A thin sheet of plastic on the floor permitted easy cleaning. The poster board of the arm walls extended to the startbox and midway across the rear wall of the confinement area. The floor of the confinement area was always of the same midgray. The maze was surrounded with white sheeting and symmetrically located with respect to cages and ceiling lighting.

Maze liners were constructed from four commercial posterboards: black, dark gray, light gray, and white. A Spectra Brightness Spot Meter was used to measure the luminance of the posterboard on the floor of the choice area with the plastic roof raised. The logarithms of the foot-lambert readings were, respectively: .24, .90, 1.51, and 1.67. The posterboard selection enabled the first two of the three log luminance steps to be about equal.

PROCEDURE

The eight experimental conditions are described in Table 1. The first six conditions each presented one of the six changes possible with four stimuli, direction of change not considered. The last two conditions presented changes on both sides. For all conditions, arms were of the same brightness on the choice trial. Each S was tested once under each condition, with one condition administered each day for 8 successive days. A previous study (O'Connell, 1964) indicated that the response to change does not show a between-Ss increase or decrease during an 8-day testing period. Twelve groups of eight Ss each were used. On a given group experimental day, a different condition was administered to each group member. For the odd-numbered groups, conditions were given in forward serial order; order was reversed for the other groups. For half the Ss in each group the side of greatest change occurred in the pattern, rllrlrrl; this pattern was reversed for the other Ss.

On the initial trial each day, S was placed in the startbox, and the guillotine door was raised and then closed behind S as he entered the confinement area between the plastic plates. After 1 min S was removed, placed in his cage for 2 min while plates were removed and liners changed, and then reintroduced into the startbox. After S passed an arm door, it was closed behind him, and he was allowed 1 min more in the goalbox area before being returned to his cage. Between Ss the floor was wiped with tissues wetted with Wizard Evergreen deodorizer.

In order to examine performance with an increased exposure duration and to determine replicability of results with the same Ss, the last four experimental groups were retested after 4 months. During this interval they were frequently tested for spontaneous alternation. The exposure trial was increased to 5 min, and two of the groups had their sequential order of conditions reversed. Again, half the groups were tested with the forward sequential order and half with the reverse order. The two brightnesses used on the exposure trial were so placed, that for half the Ss in each group, the side of greatest change on Trial 2 occurred in the pattern, rrllllrr; the sides were reversed in this pattern for the other Ss.

RESULTS

Three measures were examined: (1) final choice, the side on which S

Table 1
Percentage of Ss Selecting Changed Side

Experimental Conditions				Test 1		Test 2	
No.	Change	Trial 1*	Trial 2	Entry	Choice	Entry	Choice
1	DG → B	B-DG	B-B	45	56	53	56
2	LG → DG	DG-LG	DG-DG	45	44	56	59
3	LG → B	B-LG	B-B	53	60	59	62
4	W → LG	LG-W	LG-LG	45	42	59	66
5	W → DG	DG-W	DG-DG	43	40	59	56
6	W → B	B-W	B-B	73	63	75	69
7	No. 2 vs No. 3	DG-B	LG-LG	55	52	44	44
8	No. 3 vs No. 6	LG-W	B-B	63	52	66	72

Counterbalancing of side on which each brightness is presented is not shown.

first passed a door midway in an arm; (2) entry, the arm first entered with four feet; (3) choice time, the logarithm of the number of seconds elapsed between S's exit from the startbox and his passing an arm door. Prior to analysis, 16 groups of six Ss each were formed, such that Ss in each group received conditions in the same sequence and received the same condition on the same ordinal experimental day. Eight such groups and the 8 experimental days formed the two dimensions of a Latin square of experimental conditions. There were two such squares, one for each sequence of conditions. A choice of the changed side was scored 1, and choice of the unchanged, 0; values were summed for each group to yield a single entry per cell. The assumption of negligible interaction involving the group factor in this repeated-measures design (Winer, 1962, Plan 8A, p. 549) was justified on the grounds that each analysis group within a sequence contained one S from each of the same six experimental groups.

For the final-choice measure, homogeneity of error terms was no problem, but no effects were significant. The Ss which received conditions in reverse sequence displayed more variability among their conditions than did forward-sequence Ss ($F = 4.16$, $df = 7/7$, $p < .01$). Entry, recorded for 10 of the 12 experimental groups, was similarly analyzed. The error term, Day by Condition interaction, was smaller for reverse-sequence Ss ($F = 1.94$, $df = 42/42$, $p < .05$), preventing a meaningful overall ANOVA.

These findings indicated that Ss which had received conditions in different sequences displayed unexpected differences. This was further confirmed by the correlations over the eight conditions of the three dependent variables. For reverse-sequence Ss in the 10 groups for which all these measures were available, final choice and entry correlated .74 ($p < .025$), and these correlated −.55 and −.24, respectively, with latency. For forward-sequence Ss, final choice and entry correlated only .26, and these had correlations of .02 and −.35 with latency. The sequence effect perhaps was due to the fact that on an experimental day a forward-sequence group was usually tested before a reverse-sequence group. Therefore, reverse-sequence Ss could have been more accustomed to activity in the experimental room at the time of testing. The latency differences between the groups support this interpretation: on every ordinal experimental day, reverse-sequence Ss had a shorter latency (Wilcoxon $T = 0$, $p < .05$); forward-sequence Ss showed a rather steady decrease in latency over days until there was little difference by Day 8. The mean latency for all Ss on Day 1, when the maze was maximally unfamiliar, was longer than that of the other days combined ($F = 6.63$, $df = 1/560$, $p < .025$). Thus, all three dependent variables showed sequence effects, with reverse-sequence Ss responding more differentially to the conditions, showing less Day by Condition interaction and less evidence of emotionality. The ordering of proportions of choice of the changed side accorded better with expectation for reverse-sequence Ss. The correlation between the final-choice measures of the two sequence groups was −.14, and between the entry measures it was −.24. The forward-sequence data were therefore set aside.

Results for the reverse-sequence Ss are presented in Table 1. For the final-choice measure no effects were significant. For the entry measure, the condition effect approached significance ($F = 1.87$, $df = 7/42$, $.05 < p < .10$). For latency, the condition effect was significant ($F = 2.98$, $df = 7/280$, $p < .01$); the Newman Keuls test for simple condition effect revealed differences only between Condition 1, with the shortest latency, and Condition 7 [critical value $(7,280)_{.95} = .199$, $p < .05$] and Condition 4 [critical value$(8,280)_{.99} = .234$, $p < .01$] (Winer, 1962, p. 309). The only proportion of choice of the changed side which significantly exceeded the chance level of .50 was that for entry on Condition 6 ($p < .05$). A difference between proportions of .20 was necessary for significance at the .05 level. Condition 6 differed from Conditions 4 and 5 in final choice and from 1 through 5 in entry. Condition 8 differed from 5 in entry. The orderings of the proportions for conditions with a single change were generally consistent for both final choice and entry: Condition 6 was higher than any of the other five, and 3 was greater than 1 or 2. However, 5 was slightly below both 2 and 4. In view of this ordering failure, no attempt was made to scale the six conditions or to predict to 7 and 8.

Data from the retest after 4 months are given in Table 1. A proportion must be at least .67 to differ significantly ($p < .05$) from .50; this occurred for Conditions 6 and 8 only. A difference between proportions of .24 was necessary for significance ($p < .05$); Condition 7 was lower than 6 or 8. Compared with initial final choices for these Ss, all conditions increase on retesting except Condition 7, an unlikely event if increases and decreases were equally likely (binomial $p = .03$). Entry proportions were greater on retesting for all conditions which differed except Condition 7 ($p = .055$). Latencies were shorter for all conditions ($p < .01$). An ANOVA of latency scores yielded no significant effects.

No correlations between the dependent variables at the time of first testing were significant for these Ss, the highest was .50 between final choice and latency. On Test 2 the coefficient for final choice and entry was .88 ($p < .05$); for final choice and latency it was .49; and for entry and latency, .19. Entries which did not continue into a final choice without a return to the choice area were rarer on Test 2, and, of those which did occur, only 8% differed from the final choice, whereas 47% differed at initial testing. The only correlations between the testing periods which were sizable or significant were those involving entry on Test 1. This correlated .75 ($p < .05$) with Test 2 final choice, .90 ($p < .05$) with Test 2 entry, and .39 with latency on Test 2. The entry measure at retest correlated .79 ($p < .05$) with entry for all 96 Ss on initial testing, and .26 with final choice for all on Test 1.

DISCUSSION

The proportions of Ss selecting the changed side were notably low; only Conditions 6 and 8 ever differed from chance. The increased response to change on Test 2 suggests that the relatively short 1-min exposure used

during Test 1 may have been one factor responsible. Though Kivy et al (1956) failed to find significant response to change with 1-min exposure, it has been found with exposures of 2 to 3 min (Dember & Millbrook, 1956; Fowler, 1958) in mazes which permitted S to remove himself from the relevant stimuli at the choice point. The present design did not permit ordinary position or brightness preferences to play a role which could depress response to change below 50%. However, it is possible that the percentages below chance were not merely a result of random processes and that they, and the generally low level of response to change, were due to a systematic and uncontrolled factor. With one exception, the side changed (or changed most) on Trial 2 was the lightest side on Trial 1 for all conditions. If a temporary preference for the darker side developed during Trial 1, and this same side preference continued through Trial 2, when brightness was uniform, a depression of response to change would have resulted.

Though not all reports of previous studies on response to brightness change in T- or Y-mazes are complete in their definitions of the choice criterion, these studies apparently all used the entry measure (Dember, 1965; Dember & Millbrook, 1956; Fowler, 1958; Kivy et al, 1956; Levine, 1958; Levine, Staats, & Frommer, 1958; Woods & Jennings, 1959). In the present study, the entry and final choice measures did not differ significantly on either test; however, the entry measure showed high consistency in tests separated by several months and with different exposure durations. The condition order which displayed this consistency was, from greater to lesser choice of the changed side: Conditions 6, 8, 1 through 5, 7. The absence of consistent or appropriate differences among Conditions 1-5 does not encourage scaling attempts under the conditions used in this study. The latency data did not show sufficient regularity to be interpretable.

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Failure to find polydipsia in isolation-reared monkeys*

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The water consumption of six adult male monkeys, reared in social isolation, was compared with that of five feral-reared controls. Isolate polydipsia, reported elsewhere, was not found in the present study.

Miller et al (1969) reported that three monkeys *(Macaca mulatta)* which had spent their first 12 months of life in total social isolation displayed polydipsia when they were approximately 5 years old. The three isolates they observed, one female and two males, drank "approximately twice as much fluid" as "three feral males of approximately the same size and age [p. 1027]." The polydipsia of their three isolates was marked and fairly uniform.

In a pilot study conducted by one of the present authors, eight four- and five-year-old isolates drank (on the average) nearly twice as much water over a 24-h period as eight mother-peer-raised laboratory controls (see Mirsky, 1968, p. 116). The variability from isolate to isolate was substantial, and there was considerable overlap between the isolate and control groups. Thus, the Miller et al results and our own results were suggestive enough to attempt to replicate with different isolates.

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SUBJECTS

Six wire-cage-reared (socially isolated) adult male rhesus monkeys *(Macaca mulatta)*[1] and five wild-reared adult male rhesus monkeys were used as Ss. One isolate male was 4 years, 8½ months old, while the other five were 12 and 13 years old. The exact ages of the controls are unknown, but their outside age limits are 6 and 10 years of age.

The isolates were born at the University of Wisconsin primate laboratories and were separated from their mothers within 24 h of birth. Though they were not raised in enclosed cages (total isolation), none was permitted other than visual and aural contact with another monkey

ERRATUM

LEVINSON, HOTTMAN AND SHERIDAN Assessment of the generality of enhanced learning following unilateral lesions of posterior neocortex in rats Psychonomic Science, 1971, Vol. 22 (1) 1-3. "Because of the difficulty in determining the extent of brain lesions from the photographs presented in the article, the authors have made additional copies of the originial photographs and will distribute them upon request."