The effect of amount of acquisition training and variability of irrelevant transfer cues on an extradimensional shift

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Rats ($N = 48$) were trained to criterion or given overtraining on a simultaneous visual discrimination (left vs. right oblique stripes) in which position of S+ (right or left) was the only variable irrelevant cue. Then all rats were trained on an extradimensional (ED) shift on which width of stripes (wide vs. narrow) was either constant, variable-between, or variable-within irrelevant. Overtraining facilitated performance on the ED shift regardless of the irrelevant-cue condition during the transfer problem.

Two-process theories of discrimination learning (e.g., Sutherland & Mackintosh, 1971) suggest that to solve a discrimination problem an organism must first learn to attend to relevant cues and then learn an appropriate response. Presumably overtraining, as compared to criterion training, increases the strength of attention to relevant cues and decreases attention to irrelevant cues. Thus, overtraining should facilitate subsequent performance on an intradimensional (ID) shift but should hinder performance on an extradimensional (ED) shift. However, Sutherland and Andelman (1969) and Waller (1970b, 1971) found that overtraining on one visual discrimination *facilitated* performance on an ED shift to another visual discrimination.

One possible explanation of the facilitation concerns the irrelevant visual cues during the acquisition transfer problems. Shepp and Turrisi (1966) described the following three procedures for making a stimulus dimension irrelevant: (a) constant irrelevant (CI), in which case only one value of the irrelevant dimension appears during training, and on all training trials that one value is paired with both rewarded (S+) and nonrewarded (S-) stimuli on the relevant dimension; (b) variable-between irrelevant (VBI), in which two values of the irrelevant dimension appear during training, but only one value appears on any single training trial, that one value being paired both with S+ and with S- on each single trial; or (c) variable-within irrelevant (VWI), in which case two values of the irrelevant dimension appear on each training trial, one value paired with S+ and one value paired with S-, but, over trials, each value appearing equally often with S+ and with S-.

From two-process theories overtraining should hinder an ED shift because attention to the relevant acquisition cues should be strengthened and attention to the irrelevant acquisition cues weakened, and the

overtrained organism should continue to attend to the previously relevant dimension as it is made irrelevant during the ED shift but should not attend to the previously irrelevant dimension as it is made relevant. However, it does not seem unreasonable to assume that an organism is more likely to attend to irrelevant cues if the cues vary, particularly if they vary within a trial as opposed to between trials. In fact, there is considerable evidence suggesting that animals are more susceptible to the influence of variable irrelevant cues than of constant irrelevant cues during acquisition (Turrisi, Shepp & Eimans, 1969; Waller, 1970a) and are more influenced by VWI than by VBI cues during ED transfer (Dickerson, 1967; Shepp & Gray, 1971).

Thus, it was hypothesized that, following training either to criterion or to overtraining on a visual discrimination with no irrelevant visual cues, overtrained animals would perform worse on an ED shift if the relevant acquisition cues were variable irrelevant during transfer but not necessarily if they were constant during transfer, and that overtraining would have a larger negative effect if the irrelevant transfer cues were VWI than VBI. To this end rats were trained on a stripe-orientation discrimination with the width of the stripes held constant. During transfer all animals were trained on a width discrimination and new values on the orientation dimension were irrelevant in either a CI, VBI, or VWI manner.

METHOD

Subjects

The subjects were 48 experimentally naive male albino rats supplied by The Holtzman Company and, on arrival at the laboratory, were reported to be 100 days old.

Apparatus

The apparatus (cf., Waller, 1970b) was a gray Plexiglas-covered discrimination box with start, choice, and goal areas separated by horizontally sliding doors. In the rear wall of each goalbox was a round hole; food pellets were placed in cups located behind vertically swinging doors which covered the

This research was supported by Grant AO-326 from the National Research Council of Canada. Requests for reprints should be sent to T. Gary Waller, Department of Psychology, University of Waterloo, Waterloo, Ontario, Canada, N2L 3G1.

Table 1
Experimental Design and Mean Errors in Transfer

Experimental Group	Discrimination Problem		Mean Errors in Transfer	
	Acquisition	Transfer	Criterion	Over-trained
Constant Irrelevant	LI-RI	WV-NV	31.00	13.50
Variable Between Irrelevant	LI-RI	WV-NV WH-NH	34.37	17.50
Variable Within Irrelevant	LI-RI	WV-NH WH-NV	36.25	7.75

Note—L = left, R = right, H = horizontal, V = vertical, I = intermediate, W = wide, N = narrow.

holes. The doors could be locked from the outside. Stimulus inserts covered the rear wall of each goal box and were covered with alternating black and white stripes in one of four orientations; vertical (V), 45 deg to the left of vertical (L), 45 deg to the right of vertical (R), or horizontal (H); in combination with one of three widths (1.91, 3.18, or 5.08 cm) designated narrow (N), intermediate (I) or wide (W).

Procedure

On arrival subjects were housed individually, given ad-lib food and water for 3 days, and then placed on a once-daily ration of laboratory cubes to maintain a constant 85% (± 10 gm) of terminal ad-lib body weight for the remainder of the experiment. Following the ad-lib period, each subject was handled 4 times daily for 5 days (cf., Waller, 1971). Following prehandling, each subject received acquisition training on a simultaneous discrimination with orientation of stripes (L or R) as the relevant cue. For half the subjects L was positive (S+); for the other half R was S+. Both stimuli were the intermediate width (I) on every trial. Training was with a rerun noncorrection procedure (cf., Sutherland & Mackintosh, 1971, p. 26; Warren & McGonigle, 1969) such that if the subject made an error, the location of S+ was not changed for the next trial. If the subject made a correct response, the probability was .5 that S+ would be moved according to randomly selected Gellerman series (Hilgard, 1951). Subjects were run each day until they made a total of 15 correct responses except on Days 1-5 when they were run to 2, 3, 5, 10, 10 correct responses, respectively. Acquisition training continued for each subject until he made 15 correct responses in any 16 consecutive trials. Reward for a correct response was five pellets; subjects were confined in the goalbox for 5 sec; the within-day intertrial interval was approximately 10 sec; the order of running the rats was reversed each day. On the day following acquisition criterion half the subjects were transferred to a width discrimination; the other half received an additional 150 trials (15 per day) on the orientation discrimination. Overtraining procedures were the same as in acquisition. On the transfer discrimination all rats were trained on an EDS discrimination with width (W-N—relevant and with orientation cues (H-V) either CI, VBI, or VWI. A representative sample of each condition is shown in Table 1. All other training procedures (reward magnitude, intertrial interval, etc.) were the same as in acquisition.

RESULTS AND DISCUSSION

Mean errors to acquisition criterion was 63.81. Mean errors during overtraining was 21.63. In neither case

were there differences among the treatment groups (all $p > .10$). Mean errors to criterion during the transfer discrimination are shown in Table 1. By analysis of variance overtrained animals made fewer errors ($F = 30.13$, $df = 1/42$, $p < .001$) on the transfer discrimination than did those trained only to criterion (12.91 and 33.87 errors, respectively). Neither the effect of irrelevant cue condition nor the interaction with amount of training was significant (both F 's < 1.0). Although the interaction was not significant the effect of amount of training was examined for each irrelevant cue condition and, for each condition, overtrained animals performed better (F 's = 7.02, 6.52 and 18.56; $df = 1/42$; all $p < .05$).

These results are consistent with considerable previous research (Sutherland & Andelman, 1969; Waller, 1970b, 1971) in demonstrating better performance on ED shifts following overtraining as compared to criterion training. The earlier results are extended in that the superiority is shown for VBI and VWI transfer cues. These results are not in accord with at least one previous report (Shepp & Turrissi, 1969) that performance on ED shifts gets progressively worse as acquisition training is increased. The major methodological difference is that in the Shepp and Turrissi study the acquisition problem contained a VWI dimension which became the relevant dimension (with new stimulus values) on the ED problem, while in the research by Sutherland and Andelman and by Waller the only variable irrelevant cues during acquisition were position (right or left) of S+.

That these results collectively suggest is that overtraining interferes with performance on ED shifts if (a) there are irrelevant acquisition cues which are variable, (b) overtraining decreases attention to these cues, and (c) the irrelevant cues are made relevant during transfer. They also suggest that strengthening of attention to specific relevant cues by overtraining during acquisition, which should interfere with ED performance when those cues are made irrelevant, actually has little to do with performance on ED shifts. Rather, the facilitation of performance on ED shifts by overtraining is probably due to reduction of position preferences (Waller, 1973), to strengthening of a learning set (Harlow, 1959), or to increased general attentiveness to discriminative cues (Thomas, et al., 1970).

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(Received for publication November 8, 1974.)

Bulletin of the Psychonomic Society
1975, Vol. 5 (3), 243-245

Masking effectiveness of disks varying in duration and in number of internal segments

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When used as target stimuli, disks become both less detectable and less susceptible to backward masking with an increase in the number of black and white pie-shaped segments of which they are composed. The present study investigated the effectiveness of such stimuli in masking letter targets. Four values of number of mask segments (4, 8, 12, 16) and four mask durations (5, 10, 15, 20 msec) were employed in a backward masking paradigm. The data (in the form of percent correct letter identification) revealed significant effects of both variables and no interaction between them. Masking effectiveness increased both with increasing duration and increasing number of mask segments. The results refute an hypothesis based on the characterization of short-duration, multisegmented disks as "weak figures" and support either of two alternate hypotheses, one that refers to "self-generated inhibition" and the other to "contour confusion."

Research for this paper was supported by Grant GB 33621 from the National Science Foundation. Reprints should be requested from William N. Dember, Department of Psychology, University of Cincinnati, Cincinnati, Ohio 45221.

Visual backward masking involves the effect, usually inhibitory, of one visual stimulus (the mask) on the perception of an immediately preceding visual stimulus