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Intrastimulus conflict in differential classical eyelid conditioning

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The differential classical eyelid conditioning paradigm was used to investigate intrastimulus conflict effects. Intrastimulus conflict was manipulated within subjects by presenting the words "red" and "green" in both their respective colors and their complementary colors. Reinforcement for one group of subjects was signaled by the word itself; for the other group of subjects, it was signaled by the color of the stimulus. Contrary to the findings of an earlier study in which intrastimulus conflict was manipulated between subjects, no conflict effects were observed in the present experiment.

The application of classical conditioning procedures to the investigation of verbal behavior was suggested to experimenters by Pavlov's delineation of the first and second signaling systems of the human cerebral cortex. Pavlov (1955, p. 482) understood the second signaling system to be a characteristic feature of *Homo sapiens*, and consequently it might be said that the line dividing these two systems is no more clearly defined than the line that attempts to discriminate between man and beast on the basis of qualitative cognitive differences. Generally speaking, however, concrete stimuli constitute the "first signals of reality," whereas speech (the "signals of signals") is the domain of the second signaling system (Pavlov, 1938, pp. 615-616).

While it appears to be impossible to design a conditioning experiment in which normal adult subjects will employ only one of the two signaling systems, a number of experiments have investigated the interaction between the two signaling systems (e.g., Levy, 1966; Seredina, 1960). The Levy study, which prompted the work to be described here, is unlike most of the other experiments of this class in that conflict between the two systems was manipulated. Adopting the differential classical eyelid conditioning paradigm, Levy found that discrimination was impaired if the discriminandum, the words "pink" and "blue," were printed in the inappropriate color (blue and pink, respectively), relative to the performance of control groups in which the stimuli were printed in white or in the appropriate colors.

The present study extends Levy's (1966) investigation to the case in which conflict between color and word is varied as a within-subjects factor. Of particular interest are the differential effects that manipulations might have on two classes of subjects: V-form responders (Vs) and C-form responders (Cs). Subjects are classified as Vs and Cs on the basis of an objective response derivative criterion (Hartman & Ross, 1961). Briefly, Vs tend to give conditioned eyelid responses that are more abrupt and complete than the responses given by Cs. Levy unfortunately obtained only 5% Cs and was therefore unable to perform a meaningful V-C analysis on his data.

Whether Levy's (1966) unusually large proportion of Vs was a spurious event or was a consequence of the experimental design remains as much of a question as does the psychological or physiological underpinnings of the V-C dichotomy. Spence and Taylor (1951) originally identified this dimension of response topography in order to discard subjects whom they considered to be responding voluntarily—Vs. Grant (1968, 1972), however, has examined experimental findings that underscore the value of performing a V-C analysis on eyelid conditioning data, findings that would be difficult to explain on the assumption that Vs are not "truly" conditioned but rather are self-instructed responders. Studies conducted with verbal stimuli have suggested the generalization that Vs process verbal stimulus information more at a semantic level, whereas the processing given by Cs is not as "deep" (in the sense outlined by Craik & Lockhart, 1972). It has also been found that Vs tend to reach terminal discrimination by inhibiting responses to the unreinforced conditioned stimuli (CS−), whereas for Cs discrimination is obtained primarily by increasing the frequency of responding to the reinforced conditioned stimuli (CS+). Since Levy's conflict condition yielded a relative increase in the frequency of responding to CS−, it might therefore be the case that his findings were largely a consequence of having obtained so many Vs. For Cs, on the other hand, one might expect the conflict condition to result in the generalization of inhibition rather than of excitation.

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Furthermore, given that Vs engage in more semantic processing than do Cs, it follows that Vs should be more susceptible than Cs to interference from the verbal component of the CSs.

Although the experiment reported here can be partitioned into two essentially unrelated stages of differential conditioning trials (Stages 1 and 2), transfer of conditioned discrimination was not of interest. During Stage 1 the reinforcement contingencies were identical for the two treatment conditions. This made it possible to classify each subject as a V or a C on the basis of Stage 1 performance and to treat this division as a blocking variable in the analysis of Stage 2 results. The intrastimulus conflict manipulation was not introduced until the second stage.

Two additional aspects of the data were examined and are presented elsewhere (Benish & Grant, 1980a, 1980b).

METHOD

Apparatus

Each subject was seated in a sound-attenuating chamber approximately 140 cm in front of a 31 x 45 cm ground glass screen. CSs were projected onto the screen from outside the chamber by a Kodak Ektagraphic slide projector with an attached Gerbrands shutter. A speaker, used to present a 500-msec warning tone (500 Hz, 68 dB), and an intercom were located within the chamber.

Eyelid movements were recorded by means of a 5-cm length of piano wire that was taped to the subject's right eyelid and then inserted into a hypodermic tube attached to the shaft of a microtorque potentiometer. The signal from the potentiometer (x) and its first derivative (dx/dt) were recorded by a Texas Instruments oscilloriter. Both the potentiometer and a plastic nozzle (3-mm inner diameter) were secured to a padded headset worn by the subject. The nozzle delivered the unconditioned stimulus (UCS), a 200-msec, 14,000-N/m^2 (2.0-psi) puff of nitrogen, to the subject's right cornea.

Stimuli and Design

The experiment consisted of 144 differential conditioning trials, which can be partitioned into Stage 1 (Trials 1-64) and Stage 2 (Trials 65-144). Every subject was presented the same order of CSs during both stages; between-groups manipulations were accomplished solely by reinforcing different subsets of the CS set.

On a given Stage 1 trial, the subject saw either XXXX or OOOO flashed in black on the white screen to either the right or the left of a fixation dot centered on the screen (visual field of CS presentation effects were examined and are reported in Benish & Grant, 1980a). Each of these four stimuli appeared twice in successive randomized eight-trial blocks. For half of the subject, CS+ and CS– were, respectively, XXXX and OOOO; these contingencies were reversed for the other half of the subjects.

The CSs presented in Stage 2 varied along three dimensions. On a given trial, a subject saw RED or GREEN displayed in either red or green letters. As in Stage 1, each stimulus appeared to the right or to the left of the fixation point, and this dimension was not relevant in signaling reinforcement. These eight stimuli also were presented in randomized blocks of eight trials. The Stage 2 reinforcement contingency groups contained equal numbers of subjects assigned to the Stage 1 treatments.

Two experimental groups were employed. The reinforcement contingencies for these groups during Stage 2 were as follows. (1) Color group: Reinforcement was signaled by the color of the CS. Half of the subjects in this group received an air puff whenever they saw RED or GREEN displayed in red. Reinforcement for the other half of these subjects was signaled by green stimuli. (2) Word group: Reinforcement was signaled by the verbal component of the CS. Half of the subjects in this group received an air puff whenever they saw RED displayed in either color. Reinforcement for the other half of these subjects was signaled by GREEN.

The CSs presented during both stages spanned 1.0 deg vertically and fell within a range of 2.5-6.5 deg visual angle, as determined by the position of the subject and the fixation point.

Procedure

Upon entering the experimental room, the subject was asked whether he was right- or left-handed and then was administered the A-O Pseudoisochromatic Test for color blindness. Unless the subject was found to be left-handed or color deficient, the measurement apparatus was attached, and recorded instructions were played across the intercom. Instructions asked the subject to neither aid nor inhibit his natural eyelid responses and, after hearing the warning signal, to fixate on the dot until the onset of the visual stimulus. These instructions were repeated after Trials 20, 60, and 90.

On each trial, a 500-msec warning signal preceded the CS by 1.5, 2.0, or 2.5 sec, selected randomly. The CS was displayed for 200 msec, and on reinforced trials, its onset was followed 1,000 msec later by the 200-msec air puff. Intertrial intervals varied randomly from 15 to 35 sec.

Subjects

The data from 40 right-handed female and 24 right-handed male students enrolled in introductory psychology courses at the University of Wisconsin were analyzed. A random assignment of subjects to the experimental treatments was constrained by the necessity of balancing for sex.

RESULTS

A conditioned response (CR) was defined to be an eyelid closure, occurring between 200 and 1,020 msec after the onset of the CS, that produced an oscilloriter pen deflection of at least 1 mm. The Hartman and Ross (1961) criterion was used to classify CRs as V- or C-form. If the CR derivative was greater than .35 of the mean derivative of the first five unconditioned responses (UCRs), it was classified as V-form; otherwise, the CR was classified as C-form. Subjects for whom at least 50% of their Stage 1 CRs were V-form were designated Vs; all other subjects were designated Cs.

Figure 1 presents data from both stages of the experiment for the color condition (upper panel) and the word condition (lower panel). Percent responding to CS+ and CS– is plotted separately for Vs and Cs as a function of trial blocks. As would be expected, no significant Stage 1 treatment group effects were uncovered by an unweighted-means analysis of variance; the pertinent F values all were less than 1.

Separate analyses were performed on the Stage 2 data for each treatment group to investigate possible stimulus conflict effects. Recall that the question of interest is whether or not subjects tended to respond inappropriately (i.e., to decrease their frequency of responding to CS+ and increase their frequency of responding to CS–) when the formal and semantic aspects of the CSs were in conflict (i.e., when RED

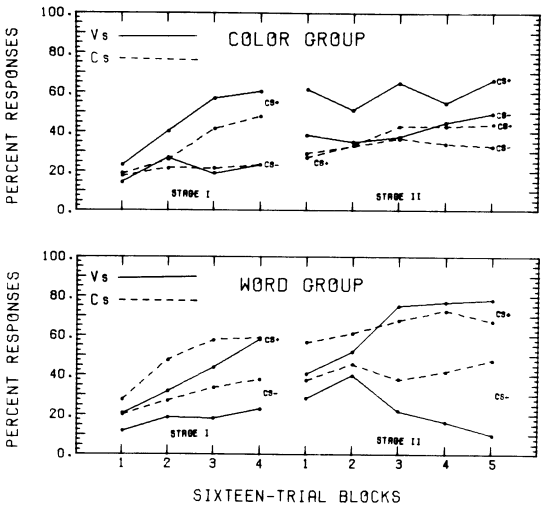

Figure 1. Mean percent CRs as a function of trial block, plotted separately to CS+ and CS– for Vs and Cs in the color group (upper panel) and the word group (lower panel).

was printed in green or vice versa). The critical intrastimulus Conflict by Reinforcement interaction did not approach significance in either treatment group; in both cases the F values were less than 1. Furthermore, F values less than 1 were obtained for the three-way interaction between these two variables and the V-C factor. It is also of interest that no significant conflict effects were obtained when analyses were restricted to subjects classified as good discriminators (see Zajano & Grant, 1974).

It is clear from an inspection of the graphs in Figure 1 that subjects discriminated much better when the verbal dimension of the CS, as opposed to the color dimension, signaled reinforcement. This observation was substantiated statistically by a significant Treatment by Reinforcement interaction [$F(1,57) = 10.6$, $p < .01$]. Although no significant V-C differences were found in the Stage 1 analysis, it is apparent from the graphs that Vs were better discriminators than Cs during Stage 2 [$F(1,57) = 6.5$, $p < .05$]. The superior discrimination performance of Vs relative to Cs is a common finding (cf. Grant, 1972).

DISCUSSION

The verbal component of the CS provided a much more effective discrimination cue than did the color of the CS. This difference in discrimination performance between the two treatment groups is striking visually, but it is not surprising; in man, the second signaling system has not only been elaborated but has come to dominate the first signaling system.

Of more interest than this treatment group difference is the fact that, whereas Levy (1966) obtained a highly significant intrastimulus conflict effect, this variable accounted for a negligible amount of variance in the present experiment. Even though there exist a number of differences between the designs of the two experiments that might be invoked post hoc to explain this disparity, the consequence of Levy's conflict manipulation was of such a magnitude that it is surprising that the effect was not robust enough to appear under the present set of conditions. Conflict was a within-subjects variable in the present experiment; therefore, all other things being equal, the present design should have been the more sensitive of the two, since a smaller error variance can be expected within subjects than among subjects. It should be noted, however, that design differences of this type need not affect only statistical power but also have been shown capable of substantively influencing eyelid conditioning performance (Grice & Hunter, 1964).

Another potentially critical difference might be thought to lie in the fact that Levy's (1966) CSs were larger and, hence, contained more color. This distinction makes the absence of a conflict effect in the color group even more difficult to understand. The possibility of this effect's having been present but obscured in the color condition, as a consequence of the overall poor level of discrimination, is unlikely, since conflict effects also were absent in the analyses restricted to good discriminators.

One reasonable explanation for the different findings of the two experiments follows from the recognition that in Levy's (1966) conflict condition (in which the CS set was PINK printed in blue and BLUE printed in pink), either the color or the verbal component of the CS could have been used to predict the occurrence of the UCS, whereas in the present study only one component was informative. Levy's subjects, quite simply, may have been less likely than the present subjects to adopt a strategy of attending to only one dimension of the CS because of the high information content associated with both components. Consequently, they may have been more vulnerable to the effects of intrastimulus conflict.

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