Some determinants of performance in a commercially available one-way avoidance chamber*

DAVID L. MORSE
HARRIET FEINMAN
and

GERARD A. DIZINNO
State University College
New Paltz, New York 12561

A one-way avoidance chamber using the jump-out procedure has recently been made commercially available by the Lafayette Instrument Co. (Lafayette, Indiana). The purpose of this study was to investigate some potential determinants of one-way avoidance behavior using the apparatus.

Experiment 1: One-way avoidance learning as a function of sex, age, platform delay, and the nature of the CS.

METHOD

Subjects

The Ss were 64 male and 64 female rats of the Wistar strain. All animals were housed in individual cages with food and water available ad lib.

Apparatus

The Ss were tested in a Lafayette Instrument Co. Model 85200 one-way avoidance chamber measuring 9 x 8 x 8 1/4 in. The chamber has clear Plexiglas top and sides, a grid floor with 15 shock bars, and a stainless steel back. The front is stainless steel also and has a door 3 1/2 in. above the grid floor. When a motor is activated, the door retracts and exposes a stainless steel platform, onto which the S can jump to either avoid or escape footshock. The floor of this "safe compartment" is mounted on a microswitch, which terminates the trial when activated. An Eico Model 378 oscillator provides a 1-kHz tone to a 4-in. speaker placed next to one of the side panels of the chamber. A Grason-Stadler Model 901 B white noise generator delivers masking noise to another speaker underneath the test table. The 1-mA footshock was delivered by a Grason-Stadler Model 700 shock generator.

Procedure

The 128 animals were assigned randomly to one of 32 unique treatment combinations with 4 Ss per

group. The four variables were (1) sex, (2) age (Ss were either 63-69 days of age or 157-165 days of age at the time of testing), (3) platform delay (Ss remained on the platform either 2 or 6 sec following an escape or avoidance response before being pushed back into the test chamber), and (4) the nature of the conditioned stimulus. For one-half of the Ss, a 1-kHz tone with an intensity of 83 dB sound pressure level (SPL) was turned on 10 sec before onset of avoidable shock. The other Ss received no tone prior to the onset of shock. Each of the two groups was subdivided so that one-half of the Ss were tested in the presence of a continuous masking noise of 75 dB SPL, and the others were tested in the absence of this masking noise. Ambient background noise for the latter group was 55 dB SPL. All animals were tested in a room with a moderate amount of background illumination provided by fluorescent ceiling fixtures.

Avoidance training was started as soon as the S was placed in the test chamber. Each trial was initiated by the motor retracting the top portion of the front wall, exposing the safe platform. Ten seconds after the start of the trial, a 1-mA footshock was delivered through the floor grid and remained on until the animal escaped to the platform. The response of jumping out of the chamber onto the platform terminated the trial and was scored an avoidance or an escape response, depending on whether the response occurred before or after shock onset. Depending on treatment assignments, the Ss were allowed to remain on the platform for either 2 or 6 sec before being pushed back into the chamber by returning the wall to its original position. Movement of the wall in either direction took approximately 2.5 sec for completion. The intertrial interval (ITI) ranged between 15 and 45 sec, with an average ITI of 30 sec. All Ss were given 30 acquisition trials; the number of avoidance responses in these 30 trials served as the dependent variable.

RESULTS AND DISCUSSION

Statistical analysis of the acquisition data indicated that the amount of time allowed on the platform after the jump-out response had a significant effect on the number of avoidance responses ($t = 5.3$, $df = 126$, $p < .01$). The mean number of avoidance responses for the 2-sec platform delay group was 16.66 (± 4.93); the 6-sec group emitted 20.77 (± 3.74) avoidance responses. This finding confirms the results of Potts & McKown (1969) and Tenen (1966). No other effects were statistically significant.

The mean number of avoidance responses in 30 acquisition trials for all 128 Ss was 18.72, supporting the findings of previous research (Tenen, 1966; Baum, 1965) that the one-way avoidance paradigm gives rapid acquisition. The fact that the group receiving a 10-sec warning tone prior to shock onset did not emit significantly more avoidance responses than the no-tone group suggests that cues other than the tone were used to anticipate the shock, e.g., the sight of the top half of the front wall being retracted at the start of each trial, the sound of the motor that retracted the wall, and the tactual cues from the chamber vibration during motor activation. Two additional experiments were designed to delineate the relative contribution of these various cues to the acquisition of the one-way avoidance response.

Experiment 2: One-way avoidance learning in the absence of visual cues.

METHOD

Subjects and Procedure

In this experiment, 12 male and 12 female rats of the Wistar strain were assigned randomly to one of two groups, with the restriction that an equal number of males and females appear in each group. Group I Ss were given 30 acquisition trials in which a 1-kHz tone of 83 dB intensity preceded a 1-mA footshock onset by 10 sec. Ss in Group II did not have a tone cue. All were tested with a 75-dB SPL white noise background. Age at testing was approximately 100 days. The apparatus and procedure were the same as in Experiment 1 with the exception that the animals were run in total darkness. This eliminated the possibility of the Ss' seeing half of the front wall retracting at the start of each trial.

RESULTS AND DISCUSSION

Over the 30 acquisition trials, Ss who received a tone 10 sec prior to shock onset emitted an average of 13.58 (± 5.79) avoidance responses; the no-tone group averaged 9.75 (± 4.62) responses. Although the difference between means was not statistically significant, the fact that the no-tone group avoided the shock in approximately 30% of the trials suggests that cues were being utilized to warn the S of shock onset. In the third experiment, the sound associated with the motor retracting the front wall was examined as a potential cue.

Experiment 3: One-way avoidance learning in the absence of visual and auditory cues.

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METHOD

Subjects and Procedure

In this study, 24 male albino rats of the Wistar strain were divided randomly into two groups. Group I received a 1-kHz tone 10 sec prior to shock onset, while Group II received no tone. Procedurally, this study and Experiment 2 were identical with one exception: the front wall was retracted and returned by hand, which greatly reduced the auditory and tactual cues.

RESULTS AND DISCUSSION

The mean number of avoidance responses emitted by the tone group was 13.25 (± 5.96), while the no-tone group emitted on the average only 4.50 (± 3.68) avoidance responses. The difference between the means was statistically significant ($t = 3.11$, $df = 22$, $p < .01$). In comparing the results of Experiments 2 and 3, it appears that cues provided by the motor retracting the wall masks any enhancement effects provided by a tone CS. This confounding could obscure the effects of certain independent variables on one-way avoidance acquisition. Ackil and Mellgren (1968), for example, report that rats given tone exposure do not do as well as control animals on subsequent shuttlebox avoidance acquisition. This effect would not have appeared if the Lafayette Instrument Co. one-way avoidance chamber had been used. The cue provided by the motor retracting the door would make the tone CS superfluous in the acquisition of the avoidance response.

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Clarity of Haidinger's brushes as a function of luminance*

STANLEY COREN

and

CLARE P. KAPLAN

Graduate Faculty

The New School for Social Research
New York, New York 10011

In a recent article, Coren (1971)

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Fig. 1. The estimated clarity of the Haidinger brush target plotted against luminance of the field.

suggested a simple and inexpensive method to produce the entopic phenomenon of Haidinger's brushes for use as a stabilized retinal image target. Essentially, this technique involves viewing a bright surface through a blue filter and a rotating Polaroid sheet. The Haidinger's brushes appear as a rotating black propeller on a blue field when created in this fashion. Coren (1971) has shown that the data produced with the Haidinger brush target is comparable to that of stabilized images produced by other methods. A major factor influencing the visibility of the brush pattern is the speed of rotation of the plane of polarization of the light. A speed of around 360 deg/sec yields images of optimal clarity. Recently, we have observed that the clarity of the image also depends upon the luminance of the field. Very bright or very dim fields yield somewhat degraded images. In order to facilitate the use of Haidinger's brushes as a stabilized image by other workers, it seemed advisable to systematically explore the relationship between target clarity and field illumination.

The target used in this experiment was produced in the same manner as that described in Coren (1971). Ss viewed a variable brightness field through a Wratten No. 47 (blue) filter and a rotating sheet of Polaroid (No. 328) that was driven by a motor rotating it at a constant speed of 360 deg/sec. Six luminance levels, 0.08, 1.18, 1.47, 1.85, 2.04, and 2.30 log fL, were rear projected upon a sheet of flashed opal glass by means of a slide projector. This procedure

provided a uniform circular field of view, 25 deg in diam. Ten Ss viewed the Haidinger's brushes twice under each light level, presented in random order. Estimates of the clarity of the target were taken by means of a magnitude estimation task where each S was required to assign a number proportional to the clarity of the target (Stevens, 1956).

The data are shown in Fig. 1. It is clear from this figure that the brush pattern is best seen in the intermediate luminance range. The clarity of the target rises to peak around 1.5 log fL and gradually trails off for higher luminances. The obtained quadratic trend is significant with $F = 17.45$, $df = 1/45$, $p < .01$.

These data provide a basis for choosing a luminance level to provide a Haidinger's brush target of any specified clarity for use as a stabilized retinal image target. The optimal luminance level for maximum visibility seems to be in the intermediate range of luminance, peaking around 1.5 log fL. Raising or lowering the luminance of the field results in a decrease in the clarity of the entopic image.

The reasons for the quadratic variation of the clarity of the target are not fully known. It seems likely, however, that the initial increase in visibility reflects the increase of visual acuity frequently observed with increasing luminance (Pirenne & Marriott, 1962). The decrease in clarity is more difficult to deal with. It may reflect some sort of masking of the brush pattern by the increased quantity of nonpolarized light which