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Operational duplication without behavioral replication of changeover for signaled inescapable shock

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All operations, including nature of chamber and type of shock source, of the Badia and Culbertson (1972) inescapable-shock changeover design were replicated with 16 rat subjects. Despite extensive operational replication precautions, only 1 of the 16 subjects showed behavior resembling the changeover behavior of the inescapable-shock subjects reported by Badia and Culbertson (1972). Aside from methodological problems with this type of asymmetrical changeover design which have been raised elsewhere, the present failure in replication appears by itself to suggest that this form of changeover paradigm does not exert sufficient behavioral control to serve as an adequate measure of the preference for signaled or unsignaled shock.

A recent series of papers have had profound effects on the scientific status of rat preference for signaled shock, demonstrating apparently excellent control of behavior in which responding maintains a signaled inescapable shock condition and nonresponding maintains unsignaled shock. The signal is a 5-sec tone which precedes shock onset. Papers by Badia and Culbertson (1972); Badia, Culbertson, and Harsh (1973); and Badia, Coker, and Harsh (1973) have all reported changeover (CO) evidence of a clear preference for signaled inescapable unavoidable shock. In this arrangement a barpress changes a normally unsignaled shock condition to signaled shock for a 3-min period following each response. In the past, such evidence relating to preference for signaled shock has been obtained from the shuttlebox paradigm (Lockard, 1963; Levis & Seymann, 1963; Perkins, Seymann, Levis & Spencer, 1966). However, the reported CO evidence is the clearest and most impressive individual-subject demonstration of behavior control in the signaled-preference literature.

We (Biederman & Furedy, 1973; Furedy & Biederman, Note 1) have elsewhere raised methodological concerns related to the form of CO used in Badia and Culbertson (1972); Badia, Culbertson and Harsh (1973); and Badia, Coker and Harsh (1973), but our purpose here is to report the results of our first step in experimentally analyzing this CO procedure: a replication of the operations of the Badia and Culbertson (1972) evidence, where the physical parameters of signaled and unsignaled shocks were equal. This is the natural starting place for such a replication inasmuch as the later studies have pitted *signaled* more severe parameters of shock state against *unsignaled* less severe shock parameter state, and yet report strong CO for *signaled* states.

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EXPERIMENT I

Method

Subjects. Twelve experimentally naive female Wistar albino rats, 90 to 120 days old at the start of the experiment served.

Apparatus. Subjects were tested in a modified Foringer operant conditioning chamber supplied by P. Badia.[1] The chamber, enclosed in a Grason-Stadler acoustical chamber, was modified so that the grid bars were perpendicular to the levers and each measured 24 cm long, 25 cm wide, and 13 cm high. The levers required about 20 g to depress and were situated 5 cm from the side along the 25-cm wall, 7.6 cm above the grid floor; each lever produced the identical stimulus contingency, that is, responding on either lever changed the condition from unsignaled to

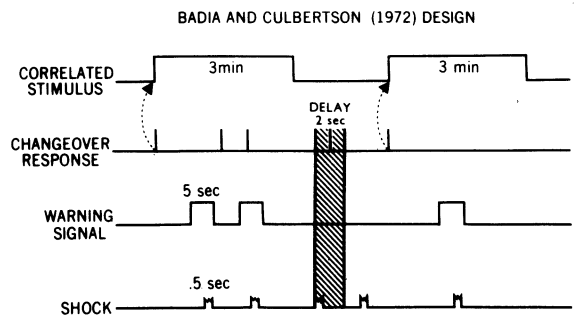

Figure 1. Badia and Culbertson's (1972) experimental design. Response-independent shock appears on the bottom channel. A changeover response (a barpress at either lever) produces the onset of 3 min correlated stimulus and warning signal 5 sec before the occurrence of shock during that 3-min period. For clarity, the 2-sec delay following shock onset is shown by the crosshatching only for Shock 3. A response occurring in this period has no consequences in order to reduce spurious contingencies between shock offset and the changeover response.

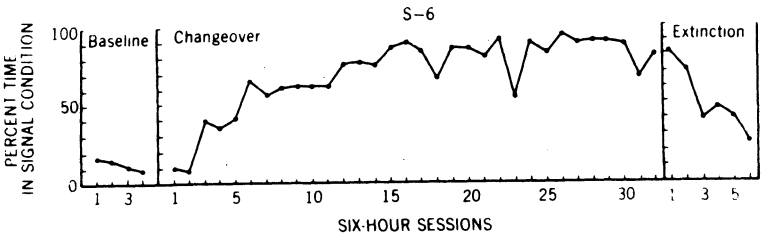

Figure 2. Percent time spent in signaled condition by Subject 6 in all 6-h sessions.

signaled inescapable shock. A 1,400-Hz tone (86 dB) served as the preshock warning signal. Offset of a 1.2-cm white jeweled light (28 V, G-E, 1829) mounted above the left bar identified the beginning of an experimental session. Onset of a 2.5-cm light (120 V, 10 W, G-E, C7) above the right bar served as the stimulus correlated with signaled shock for some subjects and offset of this light served as correlated stimulus for others. Shock was delivered by a constant-wattage shock source (BRS, SGS 001) set at 75 mW. Grid bars were constructed of .64-cm stainless steel, spaced 1.2 cm apart, center to center. The walls and response levers served as one contact in the grid-scrambling circuit. This apparatus follows Badia and Culbertson (1972, p. 463-464), except in the manufacture of the acoustic chamber and in the voltage of indicator lights. However, the versions used in the present arrangement are close functional equivalents as determined during a visit to the Bowling Green laboratory.

Procedure. Following precisely the procedure of Badia and Culbertson (1972, Experiment 2), all subjects were run in 6-h sessions on alternate days. Signaled or unsignaled shock was delivered on a (response-independent) variable tone schedule ranging from 30 to 210 sec in 30-sec blocks. These intervals were measured from shock offset to onset. The mean intershock interval was 120 sec, and subjects received approximately 80 shocks during each session. When in the signaled condition, the tone preceded shock by 5 sec and terminated with shock which was inescapable. Responses on either bar produced changeover for signaled shock as indicated below. To avoid spurious contingencies between the termination of shock and the changeover contingency, a 2-sec delay was scheduled for the changeover lever beginning with shock onset. During the delay, responses did not produce the signaled schedule. The procedure is diagrammed in Figure 1.

Initial training. Subjects received initial training for four sessions with a multiple schedule where signaled shock alternated every hour with unsignaled shock. These subjects were then exposed to the conditions of changeover, extinction, and reacquisition of changeover. During training, for all subjects, responses on the changeover bar and time spent in changeover were recorded, though these responses produced no stimulus change.

Changeover for signaled shock (changeover). Following initial training, subjects began the next session with unsignaled shock. A response on either lever resulted in the immediate onset of the correlated stimulus and initiated the signaled shock schedule. One changeover response produced the correlated stimulus and signaled schedule for a 3-min period. Additional responses within this 3-min period were ineffective. At the end of the 3-min period, the correlated stimulus terminated and subjects could remain in the unsignaled schedule or reinstate the signaled one by making another changeover response. Changeover responding determined only whether a signal would precede shock and did not change the program of shock delivery.

Changeover extinction (EXT 1). One subject was placed in the unsignaled shock condition and neither the correlated stimulus nor the signal was presented following changeover responses. With this procedure, the subject always remained in the unsignaled condition.

Results and Discussion

Badia and Culbertson's (1972) results were replicated in one animal (Figure 2 gives the baseline, CO, and EXT phases) but were not replicated in the remaining 11 rats tested (Figure 3). The development of CO behavior was slow for the single animal showing choice of signaled shock, relative to the early and rapid CO behavior in Badia and Culbertson (1972). In the 11 rats not conditioned, no evidence of choice of signaled state emerged after many 6-h training sessions, except in one animal (Subject 12) who showed some initial choice (over 50% time spent in signaled condition), but this behavior had disappeared by Session 11. If these changeover data were interpreted as providing a valid test of choice of signaled condition, then the performance of Subject 11, Subject 8, Subject 7, and Subject 1 could be used to demonstrate nearly a 100% of time choice of unsignaled state. This illustrates the force of a methodological problem we have raised elsewhere (Furedy & Biederman, Note 1): the behavior which established the signaled state (barpress) is radically different from the behavior which resulted in the unsignaled condition (withholding barpress). The more appropriate interpretation of these data is, of course, that the CO response simply had a low operant rate and that asymmetrical changeover is not a valid measure of choice.

The CO (and EXT 1) behavior of Subject 6, and the performance of Subjects 2, 3, 4, 5, and 12, demonstrate

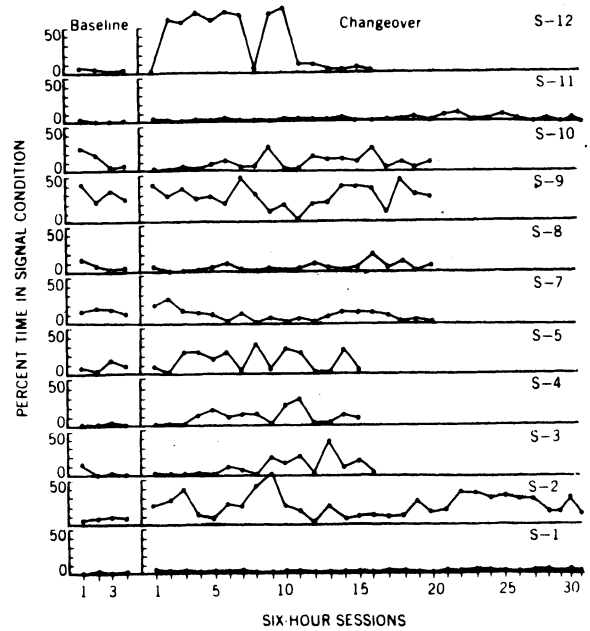

Figure 3. Percent time spent in signaled condition by remaining 11 subjects in all 6-h sessions.

Table 1
Percentage Time Spent in Signaled Condition for All Subjects in All 6-h Sessions

	Baseline				Changeover Sessions														
Subject	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
13	5	5	7	7	4	0	1	3	2	4	2	3	1	1	1	2	1	1	1
14	1	4	1	1	1	3	0	6	4	15	1	0	3	1	2	1	1	0	0
15	15	1	0	0	0	0	0	1	3	8	4	3	19	38	34	41	30	25	24
16	2	0	0	0	2	0	0	0	0	0	0	0	0	0	3	3	0	0	0

that the Badia-Culbertson procedure does have the capacity to modify some behavior in the sense of producing CO responding above operant (baseline) rate. However, the present duplication of operations failed to demonstrate that the sort of control which Badia and Culbertson (1972) view as evidence for the preference for signaled shock (i.e., spending over 50% of time in the signaled condition) is possible with all or even most subjects. The present finding is that while potential behavior control (defined by barpressing above baseline) is logically possible in the Badia-Culbertson arrangement, there is no evidence in the present experiment of a robust and general choice of signaled over unsignaled inescapable shock.

EXPERIMENT II

Method

In Badia and Culbertson (1972), rats of the Sprague-Dawley strain were used; to check on the conceivable circumstance that this phenomenon is strain-specific, we turned to Sprague-Dawley rats, and the results are reported in Experiment II.

Four experimentally naive female albino rats (90 to 120 days old) of the Sprague-Dawley strain served; this experiment was an operational replication of Experiment I, and thus of Badia and Culbertson (1972).

Results and Discussion

The baseline and changeover behavior is given in Table 1. No evidence of CO behavior appeared in three of the subjects; some responding occurred in one subject (Subject 15), but even this animal spent more than 50% of the time in the unsignaled condition. These results, like those of Experiment I, illustrate the inappropriateness of interpreting this asymmetrical CO evidence as a valid index preference for unsignaled shock condition.

GENERAL DISCUSSION

The specificity of our claim in this paper bears emphasis. We have not addressed ourselves to the general question of whether there is a preference for signaling. We have not specified the methodological and technical difficulties inherent in the Bowling Green laboratory, asymmetrical form of the CO design, since these concerns have been expressed more systematically elsewhere (Furedy & Biederman, Note 1). The present paper has been wholly directed towards reporting the results of what has been an operational duplication of the asymmetrical CO paradigm both as detailed in the literature (e.g., Badia & Culbertson, 1972), and as further specified during our communications with the Bowling Green laboratory, as detailed above. The replication we have attempted has not been merely conceptual, but as operationally close as would seem to be practicable. The behavior of the subject producing stable CO did not develop as fast as CO reported by the Bowling Green laboratory for inescapable-shock animals (Badia & Culbertson, 1972, Experiment 2). Moreover, this partial behavioral replication was obtained in only 1 subject of 16 in the present experimental analysis, a finding which is of significance quite independently of any methodological or logical difficulties that may be raised (Furedy & Biederman, Note 1) against this asymmetrical form of CO. Aside from these methodological difficulties, then, the failure of the CO effect to be replicated indicates that this form of changeover paradigm does not exert sufficient behavioral control to serve as an adequate measure of preference for signaled or unsignaled shock.

REFERENCE NOTE

1. Furedy, J. J., & Biederman, G. B. *Methodological problems in evaluating rat preference for signaled or unsignaled shock.* Paper read at Meetings of the Psychonomic Society, Boston, November 1974.

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NOTE

1. We are indebted to Professor P. Badia for his complete cooperation in supplying a modified Forringer chamber and in inviting one of us (GBB) to his laboratory (in an admirable spirit of scientific inquiry) where the "silent parameters" which still play a part in psychological research could best be communicated.

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