

# Preference for signaled over unsignaled shock schedules: A reply to Furedy and Biederman

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A portion of the literature concerning choice between signaled and unsignaled shock is reviewed. Based on this literature, several of the conclusions of Furedy and Biederman are challenged. Contrary to their conclusions, most researchers found a marked preference for the signaled shock condition whether shock was unscrambled, scrambled, or presented through surface electrodes.

Critical comments dealing with empirical and theoretical issues are essential for the development of a scientific discipline. Often these comments may raise questions about the validity of some generalizations and point to existing or emerging theoretical and methodological issues. This is a healthy state of affairs. Dialogue is encouraged by these comments which focus issues and which may lead to their affirmation or refutation. This paper is a response to a series of such comments (Biederman & Furedy, 1973, 1976; Furedy & Biederman, 1976, Note 1). It refutes several of the conclusions presented by Furedy and Biederman regarding the data and methods used in studying choice between signaled and unsignaled shock conditions.

This first part deals with Furedy and Biederman's criticisms of the changeover procedure used by Badia and his colleagues (e.g., Badia, Coker, & Harsh, 1973; Badia & Culbertson, 1972; Harsh & Badia, 1975).

## ISSUES THAT RELATE TO THE CHANGEOVER PROCEDURE

Badia and Culbertson (1972, Experiment 2) describe the initial investigation of choice between signaled and unsignaled unavoidable and inescapable shock conditions using the changeover procedure. In this study, rats were given initial training on either the signaled schedule alone or a multiple schedule comprised of signaled and unsignaled shock components. The stimulus identifying the signaled condition was illumination for some subjects and darkness for others (Badia & Culbertson, 1972, p. 463). Changeover or test conditions followed. During the changeover condition, each session began with the unsignaled schedule. A leverpress produced the stimulus correlated with the signaled schedule for a 3-min period (changeover period), during which all

shocks were preceded by a 5-sec signal. Upon termination of the changeover period, subjects either remained in the unsignaled schedule by withholding responses or reinstated the signaled schedule with further responding. Preference for the signaled schedule in the Badia and Culbertson (1972) study was defined as an increase in the amount of time spent in the changeover condition when the stimuli identifying the signaled schedule were available and a decrease in time in the changeover condition when these stimuli were removed. All subjects preferred the signaled condition. Subsequent studies have identified a number of factors influencing preference in the changeover situation (e.g., Badia, Coker, & Harsh, 1973; Badia, Culbertson, & Harsh, 1973; Badia, Harsh, Coker, & Abbott, 1976; Harsh & Badia, 1974, 1975, 1976). Furedy and Biederman have been critical of both the findings and the method. They argue that photic reinforcement, stimulus change, and unauthorized avoidance responses are plausible alternative explanations for the observed signaled shock preference. They claim that these factors were not properly controlled. In addition, they question whether Badia and Culbertson's (1972, Experiment 2) data are replicable. We will deal with each of these issues in this section.

## Methodological Issues

Furedy and Biederman (Note 1) described what they considered to be three major methodological problems of the changeover procedure. The first they called "choice response asymmetry." According to them, "The choice response which results in the signaled state and the behavior which results in the unsignaled state are radically different." They then assert, without development, that it is "empirically unacceptable to treat a bar press and the withholding of a bar press as equivalent in measuring preference." They called a second problem "asymmetrical effects of the behaviors measuring preference." "The behavior which results in a signal *always* produces an immediate (and contingent) stimulus change—the onset of the correlated stimulus—whereas the behavior resulting in the unsignaled state (that is, withholding the bar press) never leads to im-

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mediately contingent stimulus changes because the return from signaled to unsignaled state is time dependent." The third major problem Furedy and Biederman refer to as "stimulus change confound." They state that, "In the '72 and '73 inescapable shock studies reported by Badia and associates, signaled shock periods have been associated with a 3-minute stimulus whereas the unsignaled state has been associated with no light." Furedy and Biederman conclude that these methodological problems "call this changeover strategy into question as a general tool for assessing preference."

We conclude differently. Furedy and Biederman have not described problems of the changeover procedure; they have simply described (and not accurately) some features of the changeover procedure as used by Badia and Culbertson (1972). It is the case that in *that* study a leverpress resulted in continued exposure to the unsignaled condition, that changeover responses were immediately followed by stimulus changes while withholding the changeover response was not, and, finally, that for some of the subjects a light was correlated with the signaled schedule while the absence of light was correlated with the unsignaled one. These are all features of the changeover procedure in the 1972 study. The extent to which these features create problems in interpreting the data is the issue. We disagree with Furedy and Biederman, and it is unfortunate that they did not review subsequent studies.

A study by Badia, Harsh, and Coker (1975) relates to their comments.<sup>1</sup> In the first experiment of the Badia et al. (1975) study, some subjects were given a choice between a fixed-time (FT) and a variable-time (VT) shock conditions, and they chose the FT condition. This outcome was expected in light of earlier findings with signaled and unsignaled shock conditions. It was assumed that shock and shock-free periods were predictable only with the FT schedule. In the second experiment of the study, subjects chose between an FT and a signaled VT condition. This condition is identical to a signaled vs unsignaled condition except that some predictability is available in the FT condition. Nevertheless, when given this option, subjects preferred the signaled VT condition over the unsignaled FT one. Central to the discussion of the issues is that subjects could make active changeover responses in both directions. That is, subjects were given a chance to change from the signaled condition to the unsignaled one and they were also given the reverse option. All but one subject developed a strong preference for the signaled VT condition. Using an active response for changing both to the signaled condition and to the unsignaled condition renders criticism based upon any asymmetry argument irrelevant. It should be noted that a study by Safarjan and D'Amato (Note 2), using essentially the same changeover procedure of that by Badia and associates, also gave subjects the option of changing in both directions. Their findings were essentially the same as

those of Badia and Culbertson (1972) in that subjects preferred signaled over unsignaled shock. Other related data are described by Badia, Coker, and Harsh (1973). In experiments in which subjects made either an active (Experiment 1) or a passive response (Experiment 2), it was demonstrated that subjects chose signaled shock even when shock density was twice that of unsignaled shock.

Furedy and Biederman have not reported several other relevant studies. The effects of shock intensity on preference for the signaled shock condition were recently studied (Harsh & Badia, 1975). It was found that, at .15 and .30 mA, rats either did not change to the signaled condition or did so with a low frequency. As shock intensity increased, however, changing to the signaled condition also increased, peaking between .6 and 1.0 mA. Active responding, stimulus change, photic stimulation, or shock avoidance did not exert the purported effect, since changing to the signaled condition was not sustained at lower shock intensities. In another study, Harsh and Badia (1976) gave subjects a choice between signaled and unsignaled conditions while varying the average intershock intervals. Choice of the signaled condition was directly related to the average intershock interval. The percent of time in the signaled condition was highest when the average intershock interval was long and lowest when the average interval was short. As with the shock intensity study, it is difficult to understand how the factors described by Furedy and Biederman could give rise to these data.

One other study bearing on the issues of this section will be noted. Badia et al. (1976) varied dependability of the signal predicting safety for some subjects and the dependability of the signal predicting shock for others. The findings were unequivocal. When the dependability of the signal predicting safety decreased, changing to the signaled condition decreased. When the dependability of the signal predicting shock decreased, changing to the signaled condition continued at a high level. None of the factors described by Furedy and Biederman can account for these data.

### Avoidance

Studies involving shock must be carefully conducted and rigorously monitored to insure that the aversive event is fully delivered to the subject. Furedy and Biederman are rightly concerned about this potential problem. However, their criticism of the research by Badia and his colleagues as it relates to unauthorized avoidance is misplaced. They argue that subjects in the Badia et al. studies may have been able to avoid the scrambled shock because of the way the apparatus was constructed. Furedy and Biederman imply that if subjects could avoid shocks, they would prefer the signaled condition. A number of things must be said concerning their comments. Over the last 10 years or so of doing research on choice behavior in animals, we have logged

hundreds of hours of observing our subjects. Several conclusions have emerged from these observations. On occasion, animals do develop unauthorized avoidance responses when shock programmed to be inescapable and unavoidable is used. Invariably, animals that develop an unauthorized avoidance response stop making other responses and remain in whatever condition is programmed. They do not respond on the changeover lever. Obviously, factors other than avoidance are controlling preference. Another observation concerns the performance of the subject in the presence of the signal and in the absence of the signal under the signaled condition. In many ways, the performance is similar to that described by Badia and Culbertson (1970). The subjects tend to explore freely in the absence of the signal but not in its presence. Most relevant, however, is that no consistent pattern of responding has been observed in the presence of the signal. While exploring ceases when the signal is presented, no consistent postural responses are apparent relative to location in the chamber or to the grid bars grasped. We should also note that avoidance responses were unlikely in other studies using scrambled shock, such as Arabian and Desiderato (1975) Hymowitz (1973), Lewis, Gardner, and Echt (Note 3), and Safarjan and D'Amato (Note 2). Arabian and Desiderato omitted all shocks during the testing phase. Other evidence also argues against modifiability or avoidance of shock as a factor in choice. When taken together these studies constitute a persuasive argument, since each used surface electrodes. Fisher and Badia (1975) used goldfish and electrodes submerged in water and found a preference for the signaled condition. A study by Miller, Daniel, and Berk (1974) demonstrated excellent stimulus control by the signaled condition using tail electrodes and a shuttlebox. While it is true that four animals in the Miller et al. study were eliminated on the first day of training, they were eliminated prior to testing because of biting their tails, where the electrodes were attached. Of the four that were tested, each preferred the signaled condition. Three continued in the study and markedly preferred the signaled condition across repeated reversals. To argue, as Furedy and Biederman have, that the study was flawed by a lack of statistical analysis is inappropriate given current standards emphasizing the importance of stimulus control. Other studies using attached electrodes have also been published. Griffin, Honaker, Jones, and Pynes (1974) used pigeons and electrodes attached to the pubis bone and found a preference for the signaled condition. However, the degree of stimulus control established with an N of two pigeons was not strong. A study by Perkins, Seymann, Levis, and Spencer (1966) is also relevant. They used ear electrodes and found that rats preferred the signaled condition. While attrition was high because of difficulty with the ear clips, the findings were clear relative to the remaining subjects.

Special precautions are always taken to prevent unauthorized avoidance in our laboratory. This includes using scrambled shock, electrifying the metal walls and response level, using a low ceiling to prevent standing, and separating grid bars 6 in. or more when one pole of the shock scrambler is used to electrify two grids. But most important, we observe our subjects.

### REPLICATIONS USING THE CHANGEOVER PROCEDURE

It is important to correct the impression left by Furedy and Biederman (1976, Note 1) and Biederman and Furedy (1973, 1976) that it is difficult to replicate the phenomenon of preference using the changeover procedure. The phenomenon has been replicated many times since Badia and Culbertson (1972) first published their reports (e.g., Badia et al., 1973, 1975, 1976; Badia, Culbertson, & Harsh, 1973; Fisher & Badia, 1975; Harsh & Badia, 1974, 1975, 1976). In addition, Safarjan and D'Amato (Note 2) have obtained similar findings using a changeover procedure. The control subjects in the Safarjan and D'Amato study constituted a replication of the inescapable component of the Badia and Culbertson (1972) study. Their results unequivocally supported the Badia and Culbertson findings. More to the point was the direct replication undertaken by Lewis and Gardner (1977) and Lewis et al. (Note 3) in response to Furedy and Biederman. Lewis et al. conducted a direct replication of all phases of the Badia and Culbertson study, and their results were identical in all aspects to that of Badia and Culbertson. Clearly, the various replications in different laboratories, with different procedures, and with different shock delivery systems suggest that the assertions by Furedy and Biederman concerning replications are wrong.

### REFERENCE NOTES

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## NOTE

1. This study was presented at a conference at the University of Toronto, 1973.

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