THE EFFECTS OF INTERSTIMULUS INTERVAL AND THE PREPARATORY ADAPTIVE RESPONSE ON INTENSITY RATINGS OF SIGNALED AND UNSIGNALED EVENTS

Louise Anne Jarrold

A THESIS

in

The Department

of

Psychology

Presented in Partial Fulfillment of the Requirements
for the Degree of Master of Arts at
Sir George Williams University
Montreal, Canada

September, 1973

ABSTRACT

If correctly timed conditioned anticipatory responses (CRs) can positively modify unconditioned stimuli (UCSs), then shock signaled by a conditioned stimulus should be rated as less unpleasant than the same shock unsignaled. Experiment 1 had subjects press a key when they thought signaled shock would occur to insure that they timed the CS-UCS interval correctly, and then rate the signaled and unsignaled shocks. Experiment 2 timed the interval for the subject to prevent interference from the key-press task affecting the ratings. In both experiments signaled shock was rated significantly lower. Experiment 3 employed a light "UCS" to see if signaled but neutral UCSs would also be rated lower, but the ratings were not significantly different. Experiment 4 examined demand characteristics. The discussion reviewed some theories that might explain these and other results; the cognitive, response-strategy model of Martin and Levey was found to be the most appropriate to date.

ACKNOWLEDGEMENTS

The author wishes to thank Dr. Thomas Gray for the counsel and encouragement given during the preparation of this thesis.

TABLE OF CONTENTS

	Page
INTRODUCTION	1
EXPERIMENT 1	
Method	15
Results	18
Discussion	19
EXPERIMENT 2	
Method	22
Results	25
Discussion	25
EXPERIMENT 3	
Method	27
Results	30
Discussion	31
EXPERIMENT 4	
Method	32
Results	34
Discussion	35
GENERAL DISCUSSION	37
SUMMARY	50
REFERENCES	53
APPENDIX A	59
APPENDIX B	73

LIST OF ILLUSTRATIONS AND TABLES

Page

Figure 1 Mean ratings of signaled and unsignaled shock for the five interstimulus interval groups in Experiment 1 . . . . 18a

Figure 2 Proportion of correct key presses that occurred within 0.4 seconds before the onset of shock 19a

Figure 3 Mean ratings of signaled and unsignaled shock for the five interstimulus interval groups in Experiment 1 and the four interstimulus interval groups in Experiment 2 . . . . 25a

Figure 4 Mean ratings of signaled and unsignaled light for the two interstimulus interval groups in Experiment 3 . . . . 31a

Table 1 Summary of replies to the questionnaire presented after Experiment 3 . . . . 31b

INTRODUCTION

Pavlov (1927) frequently stressed the adaptive function of the conditioned response (CR) for its ability to allow the organism to make more specialized and detailed adjustments to its environment than could be accomplished by the inborn reflexes alone. Uniprocess learning theorists (Perkins, 1968; Prokasy, 1965) re-emphasized the adaptive significance of the CR by suggesting that CRs in classical conditioning can be instrumental in modifying the consequences of the unconditioned stimulus (UCS). If this is in fact correct, then it follows that organisms should prefer a situation in which a CS reliably predicts the occurrence of the UCS for only then can the organism make a CR.

Evidence for an organism's preference for information concerning the occurrence of the UCS is provided by the demonstrated acquisition of "observing responses" (Ro) (Wyckoff, 1952). In the typical Ro paradigm, the subject is confronted with a choice between two conditions in each of which he will receive the same outcome with the same probability. However, in one condition reliable cues signal the outcome, while in the other condition there is no signal. The cues inform the subject what outcome will occur but the subject cannot overtly alter the possibility, immediacy, or magnitude of the outcome. Nevertheless, subjects show a preference for information concerning the inevitable outcome even though that outcome is apparently independent of the subject's behaviour.

Such preferences occur with both positive reinforcement (Bower, McLean and Meacham, 1966; Brown, 1968; Levis and Perkins, 1965; Lutz and Perkins, 1960; Mitchell, Perkins and Perkins, 1965; Prokasy, 1956) and with shock (Badia, McBane, Suter and Lewis, 1966; Badia, Suter and Lewis, 1967; Lockard, 1963; Perkins, Levis and Seymann, 1963; Perkins, Seymann, Levis and Spencer, 1966). One reason suggested for the acquisition of Ro is that the advance information enables the organism to make a preparatory adaptive response (PAR) (Perkins, 1968) which results in an increase in the attractiveness of the positive reinforcement or a decrease in the unpleasantness of the shock.

Perkins uses the acquisition of salivary responses (CRs) in classical conditioning as an example of a PAR. The stimulus situation of food (UCS) with saliva is more reinforcing than the same food without saliva, while the stimulus situation of no food without saliva is more attractive than the same situation with saliva. Thus, the warning signal (CS) may enable the animal to enhance the attractiveness of the subsequent stimulus situation (UCS) by appropriate preparation. Similarly, in an aversive situation such as eye-blink conditioning, the instrumental value of the blink (CR) in modifying the consequences of the air puff (UCS) is obvious.

This preference for information in the Ro paradigm has been extended by Perkins to the general prediction that "living organisms will acquire a preference for a stimulus which could serve as a US for classical conditioning when it is preceded by a signal over this same US not preceded by any such signal" (Perkins, 1968, p. 163). Such a preference for signaled over unsignaled shock has been shown with rats (Knapp, Kause and Perkins, 1959; Lockard, 1963; 1965; Matsuyama, 1958; Perkins, Levis and Seymann, 1963; Perkins, Seymann, Levis and Spencer, 1966). Biederman and Furedy (1970) argue that this preference occurs only when shock is delivered through unscrambled floor grids such that the rat can modify the effective intensity through postural adjustments. However, Perkins et al (1966) found a similar preference when shock was delivered through ear clips. Also, Steiner, Beer and Shaffer (1969) found that the same temporal pattern of electrical brain stimulation that rats had maintained on self-stimulation was aversive when delivered independently of their behaviour, i.e. unsignaled. Both these situations preclude peripheral responses that could modify shock intensity.

It has been shown that human subjects prefer signaled to unsignaled shock (Badia, Suter and Lewis, 1967; Lanzetta and Driscoll, 1966) and also indicate a preference for signaled shock after experiencing both (Badia, Suter and Lewis, 1967; Pervin, 1963). Furedy and Doob (1971a; Experiment 1, 1971b) found a similar but weaker preference.

At this point the obvious question is why a signaled situation should be preferable? As previously stated, uniprocess learning theorists regard this preference as indicating that CRs in classical conditioning have instrumental consequences in modifying the UCS. In other words, "the occurrence of another stimulus before US presentation will ... make it possible for S to make conditioned preparatory responses which increase the attractiveness of the stimulus situation at the time of US presentation" (Perkins, 1968, p. 163). Unfortunately, the evidence for such a process is mixed.

In an experiment by Pervin (1963) subjects rated signaled shock slightly less painful or aversive than unsignaled shock. Lovibond (Experiment 1, 1968) found that regularly occurring shock was rated as significantly less aversive than irregularly occurring shock. In two replications of the Lovibond experiment, Furedy and Chan (1971) also found that regularly occurring shock was rated as less aversive than irregularly occurring shock, but the difference was not significant. However, only their second experiment can be considered a replication of Lovibond's, since the results of their first experiment may have been confounded by the introduction of probe stimuli (escapable finger shocks interspersed irregularly between the noxious, inescapable shock UCSs). Schell and Grings (1971), using the right and left earphone technique, found that a loud noise signaled by a red light CS was matched with a less intense noise than was an unsignaled noise. Some studies (Furedy, 1970; Furedy and Katic, 1971) report no significant difference between signaled and unsignaled shock, while others (Furedy and Doob, Experiment 3, 1971a, 1971b; Kimmel, 1967) have shown unsignaled shock rated as less aversive than signaled shock. In Kimmel's (1967) experiment, the 0.5-second interstimulus interval (ISI) group judged unsignaled shock on test trials as <u>more</u> aversive than the preceding signaled shocks, while the three 5-second ISI groups (1-second and 2-second trace CS and a 5-second delayed CS) rated the unsignaled shock UCSs on test trials as less aversive. For these latter groups, the length of the ISI may have contributed to the reversal of the ratings. This possibility will be discussed in more detail later on.

A further hypothesis of the PAR theory is that "electric shock is assumed to be less aversive when preceded by conditioned responses, such as freezing and changes in skin resistance, than when it is not..." (Perkins, 1968, p. 163) or, to state it differently, there should be "a negative correlation between the magnitude of the CR and the aversiveness of the UCS" (Furedy and Doob, 1971a, p. 258). This regression hypothesis has failed to gain empirical support. For example, humans clearly prefer information in an Ro paradigm (Lanzetta and Driscoll, 1966), but measures of the GSR were not related to the preference in any systematic way. Also, no significant relationship was found between the magnitude of autonomic GSR responses and ratings of shock intensity or aversiveness (Furedy, 1970; Furedy and Doob, 1971a; Furedy and Katic, 1971). In two of these experiments, however, there is no evidence that reliable differential conditioning of the GSR was, in fact, obtained (Furedy and Doob, Experiments 1 and 2, 1971a). This failure to obtain the hypothesized negative relationship between CRs and ratings of intensity may simply reflect the difficulty of measuring PARs directly on a physiological level, since at present the exact nature of the PARs is not known. As Furedy and Doob (1971a) point out, "the aversiveness hypothesis could be true, while the regression hypothesis, as applied to such specified responses as anticipatory changes in skin resistance, could be false" (p. 258).

A final prediction of the PAR theory, and one for which the evidence is again mixed, is that the magnitude of the UCR will be positively correlated with ratings of subjective intensity of the UCS. In other words, the subject's unconditioned response to the shock, and his evaluation or rating of the shock should be similar. Kimmel (1967), Grings (1969) and Schell and Grings (1971) all report a significant positive correlation between intensity ratings and UCR magnitude. On the other hand, Kimmel and Schultz (1964) found a positive correlation both between GSR and the physical intensity of the shock, and between judged intensity and physical intensity, but no correlation between GSR and judged intensity. Badia and Harley (1970) found that while GSR was a direct function of shock intensity, there was no relationship between GSR and judged intensity. These latter experiments may be suffering from the same problem as those which sought a negative correlation between conditioned GSRs and magnitude ratings of the UCS, namely that GSR is not necessarily the appropriate response to be measuring. In fact, the whole notion suggested by Perkins that PARs be equated with "conditioned responses, such as freezing and changes in skin resistance" (Perkins, 1968, p. 163) is altogether too limiting.

The data so far reviewed indicate that while there is some support for the PAR theory, there are also a number of studies which fail to support and even appear to contradict this theory. Since all of these studies used a variety of conditioning parameters, it would seem appropriate to directly investigate certain variables known to affect classical conditioning and see how they fit in with the PAR theory.

One important determinant of the ease with which a CR is established is the interstimulus interval (ISI) (Gormezano, 1966). The ISI should be at least as long as the typical latency of the CR, while the upper limit of the ISI "is defined by the temporal span of the immediate memory store" (Martin and Levey, 1969, p. 127). Kimble and Reynolds (1967) note that the "optimum" ISI for classical defense conditioning is generally under several seconds and possibly as short as 0.25 to 0.5 seconds[1].

Prokasy (1965) thinks that conditioning is more effective with shorter intervals because the subject can more accurately time the ISI and thus maximize the CS-UCR overlap. If this is an important aspect for conditioning, then it follows that the preference for signaled shock should be greater for short intervals that favor classical defense conditioning. It also follows that intensity ratings of the signaled shocks following these short intervals should be lower than ratings after long ISIs.

Evidence indicates that human subjects do, in fact

[1]It should be noted that this discussion of optimum intervals is specific to conditioned responses that need to be precisely timed to influence the UCS. There are other kinds of conditioned responses, like the conditioned emotional response for example, that can be easily achieved with intervals of several minutes (Kamin, 1965; Kamin and Schaub, 1967).

prefer immediate (IMM) to variably delayed shock (VDS) (Badia, McBane, Suter and Lewis, 1966; Cook and Barnes, 1964; D'Amato and Gumenik, 1960; Hare, 1966a, 1966b), and an immediate to variably delayed loud noise (Maltzman and Wolff, 1970). However, the problem with these studies is whether the short interval is preferred because it is short or because it is not irregular, i.e. variable. In at least one study (Lanzetta and Driscoll, 1966) the preference was clearly for the short (5-second) over the delayed (10-second) but not variable interval. Rats also selected an immediate shock to one delayed by 30 seconds (Knapp, Kause and Perkins, 1959). Parenthetically, Cook and Barnes (1964) found that with increases in shock intensity, the preference for the immediate over the delayed condition was enhanced.

More systematic investigations of the ISI effect have yielded less consistent results. Rats failed to display a differential preference in a shuttlebox situation for signaled shock when the ISI was either 0.5 or 5 seconds long (Lockard, 1965). In an experiment with human subjects, Perkins <u>et al</u> (1966) found the most marked preference for signaled shock with an 18-

second signal. On the other hand, Franzini (1970) found that ratings of the aversiveness of the ISI increased linearly over intervals of 5, 10, 30, and 75 seconds; furthermore, long ISIs were rated as far more aversive than short ISIs at high shock levels than at low shock levels. Ratings of shock intensity have also been reported to increase with increases in delay of shock (Hare and Thorvaldson, 1970).

The previously mentioned Kimmel (1967) data are the most illuminating to date regarding the relationship between ISI and shock intensity ratings. These data show that shocks at the 0.5-second ISI were judged as less aversive than were shocks at the 5-second ISI or shocks presented unpaired with the CS. In addition, unsignaled shocks on test trials were rated as significantly less aversive than the preceeding signaled shocks by the 5-second ISI group, while the unsignaled test trials were considered as more aversive by the 0.5-second group. These results clearly suggest that ISI is an important factor in the determination of the ratings of signaled shock.

A direct test of the relationship between ISI and ratings of aversiveness was conducted (Suboski, Brace, Jarrold, Teller, and Dieter, 1972) using 5 ISI conditions (0.25, 0.5, 1.0, 2.0 and 4.0 seconds). It was predicted that the lowest ratings of signaled shock would occur at those intervals most favourable to classical defense conditioning (Kimble, 1961). Subjects received three preparatory shocks at intensities of 0.5, 1.0, and 1.5 mA which they were told represented ratings of 1, 5 and 9 respectively. Shock intensity was then set at 1.0 mA for the remainder of the experiment. Subjects then received 8 blocks of trials, with each block comprised of 5 signaled and one unsignaled shock randomly assigned to one of trials 4, 5 or 6. Results of this experiment indicate that ratings of signaled shock were a U-shaped function of ISI, but the lowest ratings occurred at the 1.0-second rather than the 0.5-second interval as had been predicted. Furthermore, ratings of signaled shock were consistently <u>higher</u> than ratings of unsignaled shock except at the 0.5-second interval.

While the outcome of Suboski's experiment is similar to Kimmel's (1967) in that both found signaled shock rated less intense at the 0.5-second interval and more intense at the longer ISI (Suboski, 4.0-seconds; Kimmel, 5.0-seconds), neither experiment is particularly favourable to the notion that CRs can modify the consequences of of aversive UCSs. Possibly Kimmel (1967) is correct in suggesting that in the longer interval groups subjects "may have gradually begun to judge a combination of their own CR-produced proprioception...and the shock itself" (p. 540). On the other hand, it is equally likely that anticipatory responses may not have been accurately timed for the long interval groups.

Clearly, the evidence thus far is inconsistent and most of the inconsistency derives from the fact that no study has been done which includes a measure of anticipatory responding along with a comparison of ratings of the signaled and unsignaled events. To remedy this situation, it was decided to perform an experiment which would measure anticipatory responding as well as compare the ratings of signaled and unsignaled shock.

This experiment exployed the same ISI groups as in the Suboski et al experiment; however, many procedural changes were made. In the first place, an equal number of signaled and unsignaled trials were given to prevent the possibility that unsignaled shock is rated as less aversive than signaled shock simply because it occurs less often. Secondly, in order to measure anticipatory responding, subjects had to press a key as close as possible to the time when they thought the shock would occur. The reasoning here is that if the subject can show instrumentally that he can time the interval then presumably, his conditioned preparatory response which we cannot measure will also be accurately timed. Teller, Dieter and Suboski (1972) had subjects estimate the length of the ISI by pressing a key when they thought the second of the two light CSs would come on. They found that the accuracy of time estimation was best at 0.4 seconds (Experiment 1) and 0.6 seconds (Experiment 2) and poorest at the 2.5-second intervals. On the basis of these results it was predicted that the accuracy of time estimation would be best at 0.5 seconds and poorest at 4.0 seconds. It was further predicted that ratings of signaled shock would be lower than ratings of unsignaled shock for all ISI groups, due to the timing of anticipatory responses, and in particular that ratings for the 0.5-second ISI would be the lowest as this interval is supposed to be the easiest to time.

EXPERIMENT 1

Method

Subjects

The subjects were 25 male and 25 female introductory psychology students from Queen's University (Ontario) participating in the experiment as part of their course requirements.

Apparatus

Two rooms connected by an intercom were used. The subject sat at a table facing a flat white panel at a distance of approximately .5M. The top of a General Electric Neon bulb was exposed through a hole in the center of the panel at about eye level to the subject. A concentric disc electrode (Tursky, Watson and O'Connell, 1965) was mounted on the dorsal surface of the subject's left arm, just proximal to the radial tuberosity. A telegraph key was on the table in a position convenient to the subject's right arm. The intercom was also placed on the table.

Two Hunter Klock timers, one Hunter Klockcounter and a constant current shock source were located in an adjacent room.

Procedure

Five male and five female subjects were randomly assigned to each of the five interstimulus interval groups (ISIs). The five ISIs were 0.25, 0.5, 1.0, 2.0 and 4.0 seconds, which was the time elapsed between the onset of the light and the onset of the shock on signaled trials. Shock duration was 100 msec. and the offset of the neon bulb was coincident with the offset of shock.

Before the subject arrived the ISI was adjusted using the Hunter Klockcounter. The subject was then admitted to the experimental room, the concentric disc electrode was attached, and the instructions were given to the subject to read. These instructions told the subject to watch the light and then to press the key as close as possible to the time when the shock would come on. A correct response was described as one that immediately preceded the shock; an incorrect response was one that followed the shock. Also, the subject was instructed to rate all shocks according to a seven-point scale, with "seven" representing the highest intensity, "four" representing a medium intensity and "one" representing the lowest intensity. The subject was told that each of these intensities would be introduced twice and then he/she would get nine practice trials to gain some experience at rating the shocks. Finally, the instructions stressed the independence of the key press task from the shock itself (see Appendix A for the complete instructions).

If the subject had no questions, the experimenter returned to the control room and introduced the three levels of shock. (See Appendix A for the exact text read by the experimenter). Nine practice trials were given in the order 7, 1, 4, 1, 4, 7, 1, 7, and 4 and the subject was given immediate feedback as to the correct response. The shock levels used for these practice trials were 0.7, 1.5, and 2.5 mA[2]. The final instructions read to the subject were:

> Now we are ready to begin the experiment. Remember, the light will come on and you are to press the key as close as possible to the time when the shock comes on and then you are to rate the unpleasantness of the shock. Do you have any questions? O.K. then we will begin.

---

[2]These shock levels differed from those employed by Suboski et al (1972) because a different shock generator was used which could not be calibrated as theirs had been.

The experimenter then adjusted the shock level to 1.5 mA for the remainder of the experiment. The following 25 signaled and 25 unsignaled trials were ordered according to a Gellerman series and the intertrial intervals were selected at random from 10, 15 and 20 seconds. (A sample data sheet is included in Appendix B). All trials were initiated manually. The experimenter also recorded the subject's ratings of the shock and the latency of the key press on signaled trials.

Results

Figure 1 shows the mean ratings for the 25 signaled and 25 unsignaled shocks for each of the five interstimulus interval groups. Examination of Figure 1 reveals that signaled shock was rated consistently lower than unsignaled shock. A Wilcoxon matched-pairs-signed-ranks test on the ratings of signaled and unsignaled shock also showed that signaled shock was rated as significantly less aversive than unsignaled shock ($p < .0003$).

A Kruskal-Wallis one-way analysis of variance indicated that there was a significant difference between ISI groups for the signaled shock condition ($p < .05$). On the other hand, in the unsignaled shock condition where there

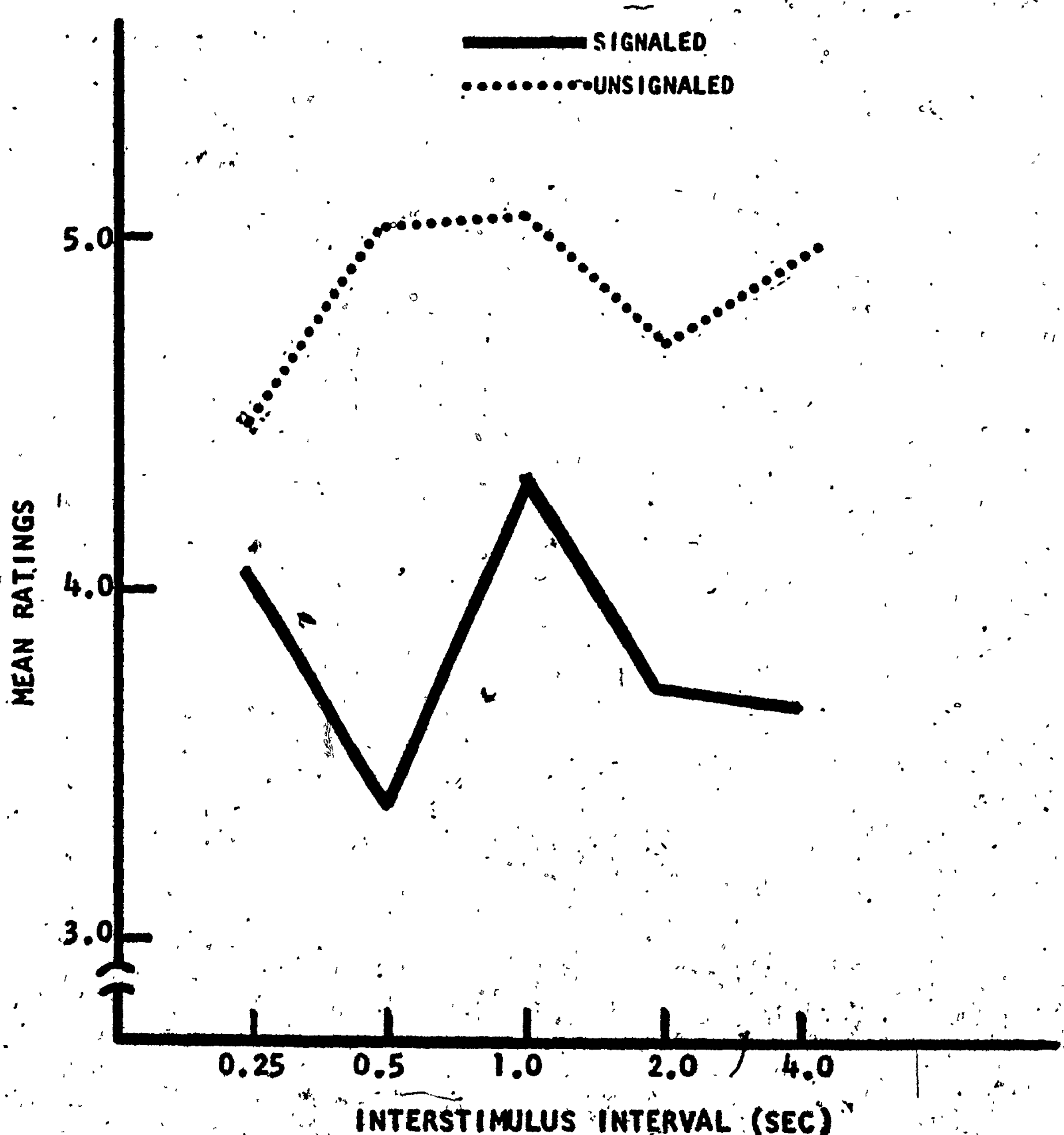

Figure 1. Mean ratings of signaled and unsignaled shock for the five interstimulus interval groups in Experiment 1.

was no ISI, there was also no significant ISI effect.

Figure 2 shows the proportion of key presses that occurred within 0.4 seconds before the onset of shock on signaled trials (this was the criterion employed by Teller et al, 1972). The accuracy of time estimation was an inverted U-shaped function of ISI with time estimation best at 0.5 seconds as had been predicted. Thus, the effects of ISI on time estimation in the present experiment are comparable to the results of Teller et al, (1972).

Discussion

The results of this experiment are completely opposite to those of Suboski et al (Experiment 1, 1972). In their experiment, signaled shock was rated as more aversive than unsignaled shock by all but the 0.5-second group. In the present experiment, all groups rated signaled shock as less aversive than unsignaled shock, particularly the 0.5-second group, but the ratings of signaled shock were not a U-shaped function of ISI as in their experiment.

Because of the many procedural differences between this experiment and Suboski et al's, it is impossible to

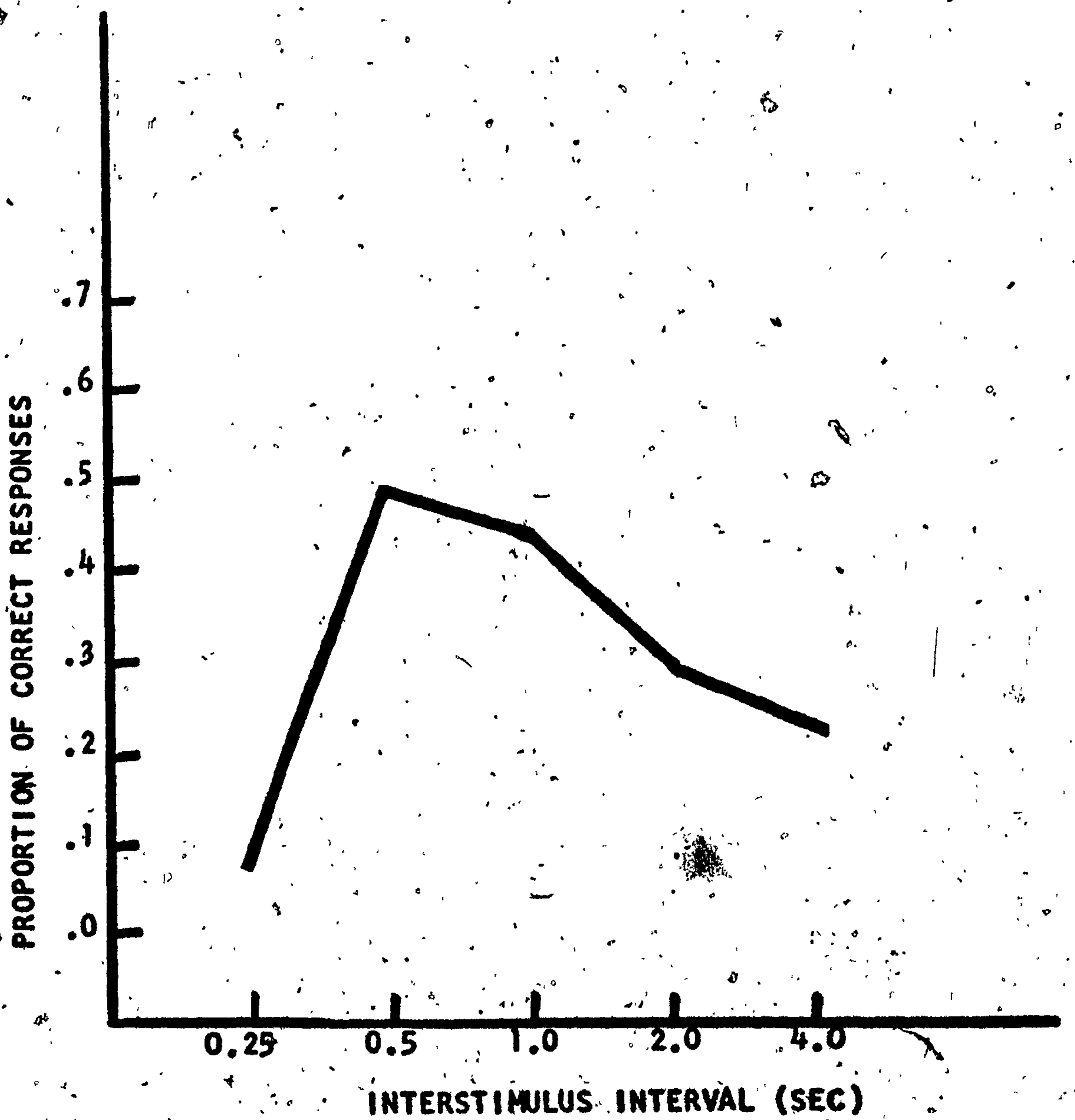

Figure 2. Proportion of correct key presses that occurred within 0.4 seconds before the onset of shock.

say which variable or variables produced the different results. However, it is reasonable to suppose that asking subjects to estimate the length of the ISI forced them to place preparatory responses more accurately. Unfortunately, it is equally likely that the time estimation task simply diverted the subject's attention away from the shock on signaled trials, thereby producing the lower ratings. In order to determine if the time estimation task was responsible for the different results, Suboski et al (Experiment 3, 1972) conducted another experiment in which two ISI groups, 0.5 seconds and 4.0 seconds, were run as outlined above, while two other groups (also 0.5 and 4.0 seconds) were run with no instructions concerning time estimation. The results of this experiment confirm the speculation that the time estimation task was the effective variable producing the different results between the experiment described above and the first Suboski et al experiment. Results of this experiment (i.e. Experiment 3) show that the group performing the time estimation task rated signaled shock as less aversive than unsignaled shock at both the 0.5-second and the 4.0-second intervals which supports the results described above. On the other hand, the results from the groups not performing the time estimation task are the same as in Suboski et al's first experiment, i.e. at 0.5

seconds signaled shock was rated as less aversive but at 4.0 seconds, it was rated as more aversive. Therefore, it would appear that the differences between Suboski et al's first experiment and the experiment described above are primarily due to the time estimation task. However, it remains to be answered whether it was simply the physical and cognitive requirements of the task which interfered with the subject's perception of the shock or whether it was, in fact, the more accurate placement of conditioned anticipatory responses that attenuated the aversiveness of the signaled shocks. In order to investigate this question, the design of the first experiment was replicated but instead of having subjects estimate the length of the ISI, they were provided with a timer which they simply had to watch. If it was the accurate placement of anticipatory responses, and not simply interference from the interval estimation task, that had caused signaled shocks to be rated as less aversive, then signaled shock in this experiment should also be rated as significantly less aversive than unsignaled shock for all ISI groups. Also, no systematic ISI effect is expected since all groups will have the interval timed for them.

EXPERIMENT 2

Method

The design of this experiment was almost identical to the one described above except for the following changes.

Subjects

The subjects were 20 male and 20 female unpaid volunteers from Sir George Williams University and Dawson College in Montreal.

Apparatus

In this experiment only one room was used. The subject sat at a table facing a flat brown cardboard panel at a distance of approximately .5 M. An E4430 timer (Industrial Timer Corp.) was exposed through a 4" by 4" square hole cut in the cardboard at about eye level to the subject. The timer and the wiring were mounted on a Grason Stadler rack behind the cardboard and only the face of the timer was visible to the subject.

The experimenter sat at the opposite end of the table, shielded from the subject by the cardboard panel.

Procedure

Five male and five female subjects were randomly assigned to each of the four ISI groups. The 0.25-second group from the first experiment was omitted as it was considered too close to reaction time to allow a CR to develop.

Before the subject arrived the ISI was adjusted by the experimenter by setting the red arrow on the timer to the appropriate number of seconds for the ISI. On signaled trials this red arrow ran down to zero which coincided with the onset of shock. The experimenter then released the button which had initiated the trial and the arrow returned to the preset number of seconds.

After the subject was admitted to the experimental room, the concentric disc electrode was attached and the instruction sheet was handed to the subject to read. These instructions told the subject to watch the timer and explained that when the red arrow reached the zero point, the subject would receive a shock.

They also informed the subject that shocks would sometimes occur without the timer counting down to zero.

and the subject was instructed to rate all the shocks according to the seven-point scale in the same way as had been done in Experiment 1 (see Appendix A for the complete instructions).

After answering any questions that the subject might have, the experimenter proceeded to read the same instructions as were used in Experiment 1 to introduce the three levels of shock. During the practice trials the criterion for a correct response was extended however, so that all digits from 1 to 7 could be reinforced. Thus, if the subject said 6 and the level delivered had been 7, he was told that this was correct. This change was effected because it was noted in Experiment 1 that after the feedback from the practice trials many subjects tended to restrict their estimates exclusively to ratings of 1, 4, and 7.

The final instructions the experiment read to the subject were:

> Now we are ready to begin the experiment. Remember, the timer will count down to zero and be followed by the shock. Sometimes the shock will also occur without the timer. After

each shock you should give me your ratings of its unpleasantness. Do you have any questions? O.K. then we will begin.

Results

Figure 3 presents the mean ratings of signaled and unsignaled shock plotted for each ISI group in both Experiment 1 and 2. As is apparent there was a greater difference between ratings in Experiment 1 than in Experiment 2, but the difference remained in the predicted direction even without interference from the interval estimation task. Furthermore, the Wilcoxon test again showed that signaled shock was rated significantly lower than unsignaled shock ($p < .0013$). On the other hand, neither ISI effect was significant according to the Kruskal-Wallis analyses of variance.

Discussion

Presumably, in Experiment 1 signaled shock was rated much lower due to the combined effects of preparatory responses plus interference from the manual task while presumably, in Experiment 2 the preparatory responses alone account for the difference in the ratings. It is unlikely

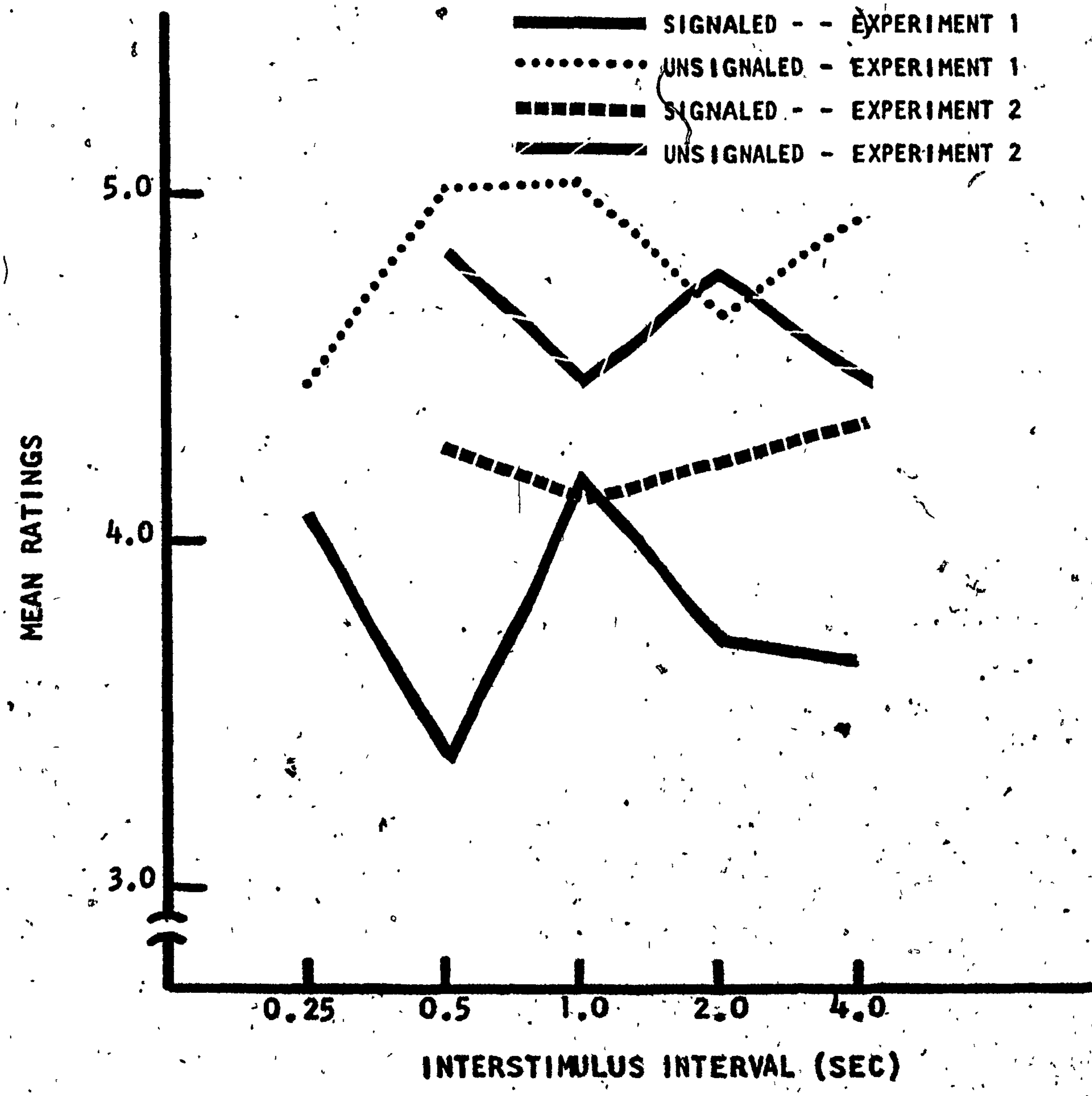

Figure 3. Mean ratings of signaled and unsignaled shock for the five interstimulus interval groups in Experiment 1 and the four interstimulus interval groups in Experiment 2.

that conditioned inhibition of the UCR by the CS (Kimble and Ost, 1961; Kimmel, 1966) is responsible for the lower ratings of signaled shock. If this were the determining factor, then ratings for signaled shock in the first Suboski et al experiment should have been lower than for unsignaled shock. Rather, the results of Experiments 1 and 2 combined with Suboski et al's Experiment 3 support a PAR interpretation but do not preclude an interpretation based on interference alone. Since no measure of conditioning was obtained in any of these studies, it is impossible to say that conditioned preparatory responses were responsible for the lower ratings. When two stimuli are presented in close temporal sequence, attention given to the first may divert attention to the second and thus result in lower ratings for signaled shock. In fact, the 4.0-second ISI group in Experiment 2 rated signaled shock only slightly lower than unsignaled shock, giving grounds for suspecting that the CS may simply have diverted the subject's attention in the shorter interval groups. To investigate this possibility, one would have to show that any stimulus presented after a CS is rated as less intense than the same stimulus presented alone. Thus, Experiment 3 was performed to see if a signaled light "UCS" would be rated significantly lower than unsignaled light. If the CS diverts the subject's attention from the UCS, then signaled light should be rated as significantly lower than unsignaled light. On the other hand, since a light UCS is probably fairly neutral in terms of aversiveness or attractiveness, there is no reason to expect signaled light to be rated any differently from unsignaled light.

EXPERIMENT 3

Method

The design of this experiment was as similar to Experiment 2 as possible, considering the change in UCS.

Subjects

The subjects were 10 male and 10 female unpaid volunteers from Dawson College in Montreal.

Apparatus

The same apparatus was used as in Experiment 2, but instead of the concentric disc electrode being attached to the subject, a 28 volt Dialco lamp was affixed about one inch above the hole through which the timer could be seen. The range of light intensities that were used during the introductory and practice trials was adjusted so that low, medium and high intensities were just slightly different. Interestingly, while many subjects were highly accurate in guessing the intensities during the practice trials, no subject realized that only one intensity was being used during the experiment proper. A student lamp with a shaded 60 watt bulb provided illumination from behind the subject.

Procedure

Five male and five female subjects were randomly assigned to either the 0.5 or the 4.0-second ISI group. It had been previously decided to include the 1.0 and 2.0 second ISI group only if the results without them were not clearcut.

Upon arrival the subject was given instructions to read which said to watch the timer and when the red arrow passed the zero point, to rate the intensity of the light. The instructions also informed the subject that the light would come on without the timer and these lights had to be rated too. The seven-point scale was described, this time in reference to light intensity rather than shock unpleasantness as in the previous two experiments. Finally, the subject was instructed that there would be two series of introductory lights and then nine practice trials before the actual experiment began (see Appendix A for the complete instructions).

The experimenter then proceded to introduce the three levels of light intensity to the subject (see Appendix A for the exact text read by the experimenter). Nine practice trials were then given and feedback was handled as in Experiment 2.

Finally, the experimenter read the following: Now we are ready to begin the experiment. Remember, the timer will count down to zero and be followed by the light. Sometimes the light will also come on without the timer so please don't be looking around or you might miss it. After each light please give me your ratings of its intensity. Do you have any questions? O.K. then we will begin.

Post Experimental Interview

After the experiment was over, the experimenter asked each subject the following questions:

1. Did you feel there was any pattern to your estimates? If the subject answered in the affirmative, the experimenter then asked him/her to explain. If the subject answered "no", then the experimenter asked:
2. Did the light seem any different when the timer was on as opposed to when the timer was absent? Again, after a "yes" answer the subject was asked to elaborate. Finally, the experimenter asked:
3. Did the timer in any way affect your estimates of the light's intensity? If the subject answered "yes", he/she was asked to explain.

Results:

The Wilcoxon matched-pairs signed-ranks test on the difference between the ratings of signaled and unsignaled light was not significant ($p > .05$). On the other hand, the Mann-Whitney U-tests comparing ISI groups were significant for both the signaled and the unsignaled light conditions ($p < .008$ for both tests) but this result simply reflects the lower overall ratings of the light made by the 0.5-second group and the higher overall ratings made by the 4.0-second group.

Table 1 presents the results from the post-experimental inquiry. In summary, though all the subjects said there was no pattern to their estimates of the light's intensity, four subjects thought that the light seemed different on signaled trials (two thought it was brighter while two thought it was probably dimmer). Three subjects said that the timer affected their estimates of the light's intensity, one by distraction and two by concentrating their attention on the light. For all of these cases where the subjects thought that they had altered their estimates because of the timer, the raw data was examined but no pattern was evident in their ratings.

Discussion

The difference between signaled and unsignaled light was not significant even though it was in the same direction as in the two previous experiments. The questionnaire results also indicated that there was no pattern to the subjects' ratings; however, the possibility remains that the subjects were not aware of their response biases.

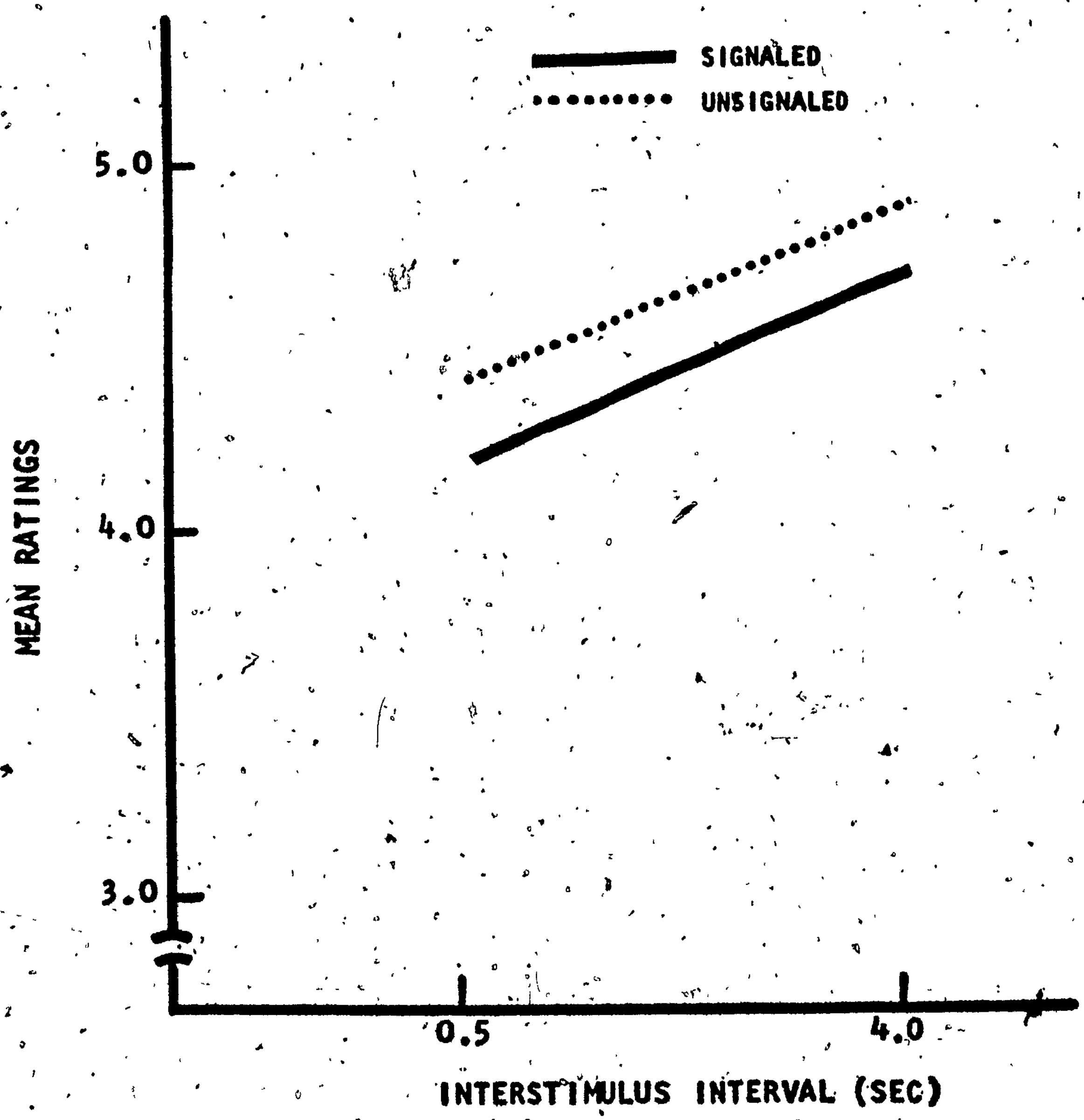

Figure 4: Mean ratings of signaled and unsignaled light for the two interstimulus interval groups in Experiment 3.

TABLE 1

Summary of replies to questions posed after Experiment 3.

Question	Yes (N)	No (N)
1. Did you feel there was any pattern to your estimates.	0	20
2. Did the light seem any different when the timer was on as opposed to when the timer was absent.	4*	16
3. Did the timer in any way affect your estimates of the light's intensity.	3**	17

*Two subjects (one from each group) said the light seemed brighter when the timer counted down since the timer was below the light and consequently in a darker surrounding than the light, hence greater contrast.

Two other subjects (both from the 4.0-second group) said it seemed to be more or less the same, but probably slightly dimmer - neither could explain why they thought this.

**One subject (0.5-second group) said the timer distracted her from looking at the light and speculated that she had rated timer signaled lights much lower (but she had not). Two other subjects (one from each group) thought that on timer-signaled trials they concentrated their attention on the light and as a result had given higher ratings to the signaled lights (again the results do not support their speculations).

Orne (1962) has emphasized that subjects have a stake in experiments, for to appear other than naive would tend to invalidate their performance. Consequently, he advises that the experimental manipulations should be independently investigated to insure that demand characteristics, i.e., anything which conveys the experimental hypothesis to the subject, are not responsible for the results. To do this one should expose a naive subject to the apparatus and procedures of the experiment without actually giving any trials. Then the subject should be interviewed to determine what he thinks would have occurred. This method is called the pre-experimental inquiry (Riecken, 1958; Orne, 1959). To test for demand characteristics in this experiment, the design for Experiment 2 was employed.

EXPERIMENT 4

Method

Subjects:

The subjects were 20 unpaid volunteers from Dawson College in Montreal.

Apparatus:

The same apparatus was used as in Experiment 2 namely, the timer and the concentric disc electrode.

Procedure:

The subjects were treated identically to those in Experiment 2 until the point where the subject had finished reading the instructions. Then instead of introducing the practice trials the experimenter posed the following questions:

1. "What do you think this experiment is trying to prove?" If he said he did not know, he/she was asked to guess.
2. "How do you think you would have rated the shock when the timer preceded it as opposed to the same shock arriving unannounced?"
3. "Do you think it would have made any difference to your ratings of the shock if the timer was set at 1/2 a second as opposed to 4 seconds?"

Each answer was recorded by the experimenter who was sitting behind the cardboard panel.

Results:

When asked the first question "What do you think this experiment is trying to prove?" two subjects insisted they didn't know even when prodded, but eighteen were able to formulate some sort of hypothesis that the experiment was testing the difference between signaled and unsignaled shock. In answer to question two, "How do you think you would have rated the shock when the timer preceded it as opposed to the same shock arriving unannounced?", seven subjects said they would have rated the shocks equally, nine subjects said they would have rated signaled shock lower, and four said they would have rated unsignaled shock lower. Reasons given for these answers were all idiosyncratic ranging from experiences with electric fences used for cattle (one girl said it hurt less if she touched it without knowing it was on) to toasters popping up (another girl described her old toaster as popping unannounced and being very "shocking" while the new one pops up louder but goes click a second or so before and this does not bother her at all). Finally, in reply to question three, "Do you think it would have made any difference to your ratings of the shock if the timer was set at 1/2 second as opposed to 4 seconds?", four subjects said they didn't think it would have made any difference.

Ten other subjects favoured the long interval, all in effect saying it would give them time to prepare while the other six thought they would prefer the short interval giving reasons like "getting it over quickly", "not having a chance to get nervous about it", etc. Those ten who had mentioned preparing for the shock were asked to explain how they thought they might prepare. One mentioned closing his eyes, another said gritting his teeth, while another said she would try to relax; the other seven did not have any particular technique in mind.

Discussion

Assuming that this sample of subjects was similar to those used in the three previous experiments, there is no reason to believe that demand characteristics alone were responsible for the experimental results. Although the subjects were able to verbalize the aim of the experiment (i.e. to see how signaled shock would be rated in comparison to unsignaled shock), only 45 per cent (9/20) of the subjects said they would have rated signaled shock lower. In contrast, 78 per cent (39/50) of the subjects in Experiment 1 actually rated signaled shock lower, as did 75 per cent (30/40) of the subjects in Experiment 2. From a comparison of these figures it would appear that the significantly lower ratings of signaled shock in Experiments 1 and 2 cannot be fully accounted for by demand characteristics alone.

Half of the subjects thought that the longer interval would be preferable, but reference to Figure 3 shows that in Experiments 1 and 2 the lowest ratings occurred at the 0.5-second interval. Possibly in this experiment many subjects thought they would prefer the longer interval because the modes of preparation for the shock that they had mentioned were all long latency responses.

GENERAL DISCUSSION

Can all these results be explained in a parsimonious fashion using a PAR interpretation? Perhaps, but only if we are willing to step outside the limits of the PAR theory as proposed by Perkins. However, since certain elements of his theory have been supported by these experiments, they will be examined first.

If the significantly lower ratings for signaled shock in Experiments 1 and 2 can be interpreted as indicating a preference for this condition then Perkins' prediction that "living organisms will acquire a preference for a stimulus...preceded by a signal over this same US not preceded by any such signal" (Perkins, 1968, p. 163) has been supported. As previously noted, experiments using an Ro paradigm have also shown that organisms prefer signaled shock (Badia, McBane, Suter and Lewis, 1966; Badia, Suter and Lewis, 1967; Lockard, 1963; Perkins, Levis and Seymann, 1963; Perkins, Seymann, Levis and Spencer, 1966). Experiments employing various designs other than the Ro paradigm have also confirmed this preference for signaled shock (Knapp, Krause and Perkins, 1959; Lanzetta and Driscoll, 1966; Lockard, 1965; Matsuyama, 1958; Steiner, Beer and Shaffer, 1969).

The lower ratings for signaled shock in Experiments 1 and 2 also provide indirect support for Perkins' second prediction that the "occurrence of another stimulus before US presentation will...make it possible for S to make a conditioned preparatory response which increases the attractiveness of the stimulus situation at the time of US presentation" (Perkins, 1968, p. 163). However, it must be stressed that this prediction cannot really be tested until the PAR itself has been identified. As previously noted, the traditional CRs that are measured in conditioning experiments have shown little if any relationship to ratings of shock intensity or UCR magnitude. This is not surprising if one considers that the onset latency of many autonomic responses, e.g. GSR, EEG, etc., is at least two seconds or more (Jones, 1962) which makes these responses unlikely candidates for PARs, especially in short ISI designs. It is these short ISI designs that really make untenable Perkins' third prediction that "electric shock is presumed to be less aversive when preceded by CRs, such as freezing and changes in skin resistance, than when it is not..." (Perkins, 1968, p. 163). Since signaled shock was rated as less aversive in Experiments 1 and 2 which employed short ISIs, then some mechanisms other than the PARs suggested by Perkins must be involved. Let us then examine some alternative approaches that might account for these results.

Seligman (1968) has proposed a safety-signal hypothesis to account for the preference for signaled shock. In his experiments, rats which had been trained to bar press for food were assigned either to a group in which a CS reliably predicted shock (CS+) or to a group where CSs and shocks were randomly interspersed. This latter group stopped bar pressing and developed stomach ulcers while the former group experienced only transitory disruption of bar pressing while the CS was present and did not develop ulcers. In his discussion, Seligman equates these results with those obtained using an Ro paradigm, i.e. that rats prefer signaled shock, but he insists that the preference does <u>not</u> occur because a PAR develops to attenuate the aversiveness of the shock. Instead, he adopts the traditional view that the CS acquires negative characteristics through association with the UCS. In the signaled conditioned, Seligman claims, the CS+ defines those specific periods when fear is appropriate - absence of the CS+ (CS-) indicates safety - while in the unsignaled condition the subject is in constant fear. In other words, signaled shock is preferable not because the shock itself is less aversive but because the overall situation is less aversive. This safety-signal hypothesis can be applied to the experiments employing an Ro paradigm but cannot explain the preference for signaled shock in the present experiments where signaled and unsignaled shocks are intermixed. If the CS does acquire negative attributes when paired with the UCS then signaled shock should have been rated as significantly more aversive than unsignaled shock due to the combined negative aspects of both the CS and the shock. Furthermore, it cannot be argued that subjects were unaware of the CS-UCS relationship since the instructions explicitly told them that the CS would preceed the shock. Finally, no subject in the demand characteristics experiment mentioned a preference for the signaled condition based on this argument.

It is rather surprising that Seligman has advanced the safety-signal hypothesis in the light of his work on learned helplessness. In a series of experiments performed by Seligman and his associates (Overmier and Seligman, 1967; Seligman and Maier, 1967; Seligman, Maier and Geer, 1968), dogs who had experienced escapable shock followed by inescapable shock in a harness subsequently learned to avoid shock in a shuttlebox. However, dogs who had their first experience with inescapable shock learned that they were helpless and when subsequently placed in the shuttlebox did not learn to avoid the shock. Applying this concept of learned helplessness to classical conditioning experiments, it is reasonable to suppose that the signaled condition is preferred because the subject can in some way alter the consequences of the UCS, and not simply because the misery he must passively endure is clearly defined by the CS (safety-signal hypothesis).

Another explanation of why a signaled conditions is preferable has been proposed by Bower, McLean and Meacham (1966) who also reject Perkins' PAR theory. In their experiments, they found that pigeons consistently preferred an informative sequence of stimuli indicating when positive reinforcement would occur although the probability of reinforcement following the noninformative sequence was identical. They have interpreted these results in terms of a utility or secondary reinforcement value associated with the informative CS sequence through its obvious association with the reinforement. This interpretation is not unlike Seligman's in assuming that the CS acquires the characteristics of the UCS to which it is paired. This type of argument is plausible if positive reinforcement is employed - as previously noted, it does not account for the preference for signaled shock.

One aspect of their experiments is very interesting. In order to determine if the preference for the informative sequence would obtain if a universally reliable cue preceeded reinforcement, they projected a white cross for the pigeon to see precisely when reinforcement was due. This did not affect the preference for the informative sequence which is exactly what would have been expected according to the PAR theory since this cue was practically simultaneous with the reinforcement and as such would not permit the formation of adaptive CRs.

Again the question returns to the nature of these mysterious PARs. Perhaps a glance at some work that has been done in the area of perception could be enlightening. When Hubel (1963) did single cell recordings from the cat's visual cortex he found that the traditional dimensions so long presumed to be the "stuff" of perception, i.e. shape, size, etc., were not so important after all. The effective variables, it turned out, were such things as edges, slits, and bars of light. This type of research underscores the incredible complexity of perception and cautions against equating variables we can observe and quantify with those that are actually operative. Yet those who have been trying to prove or disprove the PAR theory persist in equating the preparatory adaptive response with variables like GSR and volume-pulse change (Furedy, 1970; Furedy and Doob, 1971a, 1971b). A better approach is suggested by Martin and Levey (1969).

A brief review of the learning model proposed by Martin and Levey is in order here. In their compelling monograph on "The Genesis of the Classical Conditioned Response", they have examined numerous aspects of conditioned response development, including measures of amplitude, frequency, latency and slope, with continual emphasis on the interrelatedness of these measures. Based on the research performed by themselves and others, they conclude that both SS and SR theories are limited since neither type of theory can adequately account for all the data. The model that they propose suggests that during the early stages of conditioning a neuronal model of the incoming stimuli is developed and this model interacts with the developing model of the conditioned response until an appropriate response strategy is evolved.

More specifically, the process of developing a response strategy goes as follows. The paired stimuli, CS and UCS, along with their temporal relationship to each other, are first perceived by the subject. This phase of "stimulus registration" occurs at two levels, first at the level of the reticular formation and second at higher cognitive levels appropriate to the input. At the higher cognitive levels the subject perceives two stimuli but at the level of the reticular formation the CS and UCS are integrated, since numerous receptors channel into this area and "the degree of overlap of the collateral afferent plexuses is so great that specificity of input cannot be maintained" (Martin and Levey, 1969, p. 126).

Once the subject has experienced the paired CS and UCS, the business of developing a response strategy begins. At first the UCS elicits the unconditioned response but because the CS and UCS were intially associated at the reticular level and later in higher cognitive centers, the CS soon acquires the ability to trigger responses similar to the UCR, i.e. the CR. The development of efficient CRs follows the development of a neuronal model which combines information about the incoming stimuli together with feedback from the UCRs and the early, crude CRs.[3] The end point of this process is to produce a response appropriate to the situation and

---

[3] Suboski et al (Experiment 3, 1972) have shown that the lower ratings of signaled shock develop over trials. This strongly suggests that the ratings are reflecting the parallel development of an appropriate response strategy, i.e. conditioned preparatory responses, by the subject.

therefore depends on the nature of the stimuli employed. For instance, if the UCS is an annoying air puff, avoidance will occur through blink CRs that preceed the UCS; on the other hand, if mild air puffs are used, longer latency CRs that do not result in successful avoidance are more likely. Either way, once CR and UCR have blended it is very difficult to distinguish between them.

A weakness of this response strategy model is that, while it does not limit its notion of CRs to easily observable instrumental and autonomic responses, it does not clearly define the nature of the PAR. Instead, Martin and Levey note that the CR cannot be predicted without knowing both the subject variables and the experimental variables. Even when a particular response can usually be expected on the basis of past experimentation, the specific results of any one experiment depend on the salience of the stimuli to the subject. This problem of salience is not easily resolved. For example, one would suppose that most people would find the level of shock employed in Experiments 1 and 2 to be mildly annoying. In reality, the wide range of ratings given during the practice trials reflected the varying sensitivity of the subjects. Adding to this the comments made by subjects during the two experiments, comments ranging from "I can hardly feel the shock" all the way to "This shock is terrible. Will the experiment end soon", further underlines the necessity of using stimuli that are perceived in about the same way by all subjects. Otherwise, responses that should have occurred may not, and one may end up with insignificant or negative results. It may well be that many of the studies described in the introduction that were so inconsistent with each other were plagued by this problem of salience.

Returning to Perkins' final prediction that the UCR will be positively correlated with ratings of subjective intensity, this notion seems somewhat naive in light of the work reviewed by Martin and Levey. "...findings of decreased latency (Martin and Levey, 1966), decreased slope (Prokasy, 1965), and decreased amplitude (Kimble and Ost, 1961) (of the UCR) during acquisition suggest that the characteristics of the CR and UCR come to modify each other" (Martin and Levey, 1969, p. 132). Considering these changes in the UCR, and the relationship of the UCR to the CR, it is unlikely that some simplistic and static relationship between them, like the one proposed by Perkins, could exist.

In summary, re-examining the results of Experiments 1 and 2 in terms of the response strategy model suggests an explanation for the lower ratings of signaled shock. In the first place, it allows for the development of conditioned preparatory responses, not only at the peripheral level but also at the cortical level, that can be instrumental in modifying the signaled shock and thus result in lower ratings. The model also recognizes that optimal ISIs must be employed if these CRs are to be appropriately timed to influence the UCS. Finally, because the model suggests that the conditioned preparatory responses are likely a complicated mixture of cognitive and motor components, taking measures of various autonomic responses would not have added significantly to the findings of Experiments 1 and 2, since these responses probably reflect little more than general reactivity.

The response strategy model would also have predicted that there would be no significant difference in the ratings of signaled and unsignaled light in Experiment 3. As previously mentioned, the nature of the conditioned response and its timing with respect to the UCS depend on the salience of the stimulus employed and in this experiment the light was a relatively neutral stimulus. As a result, even if a CR did develop, there was no reason for it to preceed the light "UCS". More than likely such a CR would simply blend with the UCR at about the time of UCR occurrence.

Even the results of Experiment 4 are encouraging. This inquiry into demand characteristics indicated that many subjects considered preparing for the shock but their modes of preparation all tended to be rather idiosyncratic and vague. No subject said anything about responding in a way that could be equated with preparatory adaptive responses as proposed by the response strategy model. This is exactly as expected since these types of CRs are not conscious and deliberate.

In conclusion, the strength of the response strategy model lies in the fact that it can account for all the experiments performed to date, including those reported herein. In particular, it allows for a reinterpretation of all those studies mentioned in the introduction that were inconsistent with Perkins' PAR theory since its conceptualization of the conditioned preparatory response is not as restrictive.

The weakness of the response strategy model is that it cannot specify the exact nature of the preparatory adaptive response. Consequently, more research is needed to test this model as directly as possible. Unfortunately, this research may have to await the development of more sophisticated techniques in the area of neurophysiology.

SUMMARY

Since interstimulus interval is known to be an important determinant of conditioning, it was hypothesized that intervals optimal for classical defense conditioning, i.e. about 0.5 seconds, would favour the development of preparatory adaptive responses, presumed to be the intervening variables responsible for modifying the consequences of signaled unconditioned stimuli. To test this notion, subjects were assigned to five ISI groups, 0.25, 0.5, 1.0, 2.0 and 4.0 seconds, and were required to rate an equal number of signaled and unsignaled inescapable shocks of the same intensity and also to press a key before the onset of shock on signaled trials. Results showed that signaled shock was rated significantly lower than unsignaled shock, particularly at the 0.5-second interval as had been predicted.

However, performing the key press task may have interfered with the subject's perception of the shock on signaled trials; therefore, Experiment 2 was designed to duplicate the conditions of Experiment 1 except that now a timer was provided to count down the interval and thus insure that the subject would know where to place his preparatory adaptive response to be most effective. Again,

signaled shock was rated as significantly less aversive than unsignaled shock.

To preclude the possibility that all signaled events are rated lower than their unsignaled counterparts for some reason as yet unconsidered, the design of Experiment 2 was modified so that the "unconditioned stimulus" was now a light and only the 0.5 and 4.0-second groups were included. Signaled light was not rated as significantly lower than unsignaled light.

Finally, Experiment 4 was performed to determine if something in the design of the experiments, i.e. demand characteristics, were producing the results. However, only half the subjects mentioned preparing for the shock; moreover, all the techniques of preparation were idiosyncratic.

The results of these experiments were discussed in terms of Perkins' preparatory adaptive response theory which was shown to be inadequate, as was Seligman's safety-signal hypothesis and the utility theory proposed by Bower, McLean and Meacham. Finally, a cognitive response strategy model proposed by Martin and Levey was reviewed and found capable of explaining all the research done to date, though it still leaves the exact nature of the conditioned preparatory response unspecified.

REFERENCES

Badia, P. and Harley, J.P. Habituation and temporal conditioning as related to shock intensity and its judgment. Journal of Experimental Psychology, 1970, 84, 534-536.

Badia, P., McBane, B., Suter, S. and Lewis, P. Preference behavior in an immediate versus variably delayed shock situation with and without a warning signal. Journal of Experimental Psychology, 1966, 72, 847-852.

Badia, P., Suter, S. and Lewis, P. Preference for warned shock: Information and/or preparation. Psychological Reports, 1967, 20, 271-274.

Biederman, G.B. and Furedy, J.J. The preference-for-signaled-shock phenomenon: Signalling shock is reinforcing only if shock is modifiable. Quarterly Journal of Experimental Psychology, 1970, 22, 681-685.

Bower, G., McLean, J. and Meacham, J. Value of knowing when reinforcement is due. Journal of Comparative and Physiological Psychology, 1966, 62, 184-192.

Brown, P.L. Autoshaping and observing responses (Ro) in the pigeon. Proceedings of the 75th Annual Convention of the American Psychological Association, 1968, 3, 139-140.

Cook, J.O. and Barnes, L.W. Choice of delay of inevitable shock. Journal of Abnormal and Social Psychology, 1964, 68, 669-672.

D'Amato, M.R. and Gumenik, W.E. Some effects of immediate versus randomly delayed shock on an instrumental response and cognitive processes. Journal of Abnormal and Social Psychology, 1960, 60, 64-67.

Franzini, L.R. Magnitude estimations of the averseness of the interval preceding shock. Journal of Experimental Psychology, 1970, 84, 526-528.

Furedy, J.J. Test of the preparatory adaptive response interpretation of aversive classical autonomic conditioning. Journal of Experimental Psychology, 1970, 84, 301-307.

Furedy, J.J. and Chan, R.M. Failure of information to reduce rated aversiveness of unmodifiable shock. Australian Journal of Psychology, 1971, 23, 85-94.

Furedy, J.J. and Doob, A.N. Autonomic responses and verbal reports in further tests of the preparatory-adaptive-response interpretation of reinforcement. Journal of Experimental Psychology, 1971a, 89, 258-264.

Furedy, J.J. and Doob, A.N. Classical aversive conditioning of human digital volume-pulse change and tests of the preparatory-adaptive-response interpretation of reinforcement. Journal of Experimental Psychology, 1971b, 89, 403-407.

Furedy, J.J. and Katic, M.J. Two tests of the preparatory-adaptive-response interpretation of aversive classical conditioning. Psychophysiology, 1971, 8, 277-278. (Abstract).

Gormezano, I. Classical conditioning. In J.B. Sidowski (Ed.) Experimental Methods and Instrumentation in Psychology. New York: McGraw-Hill, 1966.

Grings, W.W. Anticipatory and preparatory electrodermal behavior in paired stimulation situations. Psychophysiology, 1969, 5, 597-611.

Hare, R.D. Preference for delay of shock as a function of its intensity and probability. Psychonomic Science, 1966a, 5, 393-394.

Hare, R.D. Psychopathy and choice of immediate versus delayed punishment. Journal of Abnormal Psychology, 1966b, 71, 25-29.

Hare, R.D. and Thorvaldson, S.A. Psychopathy and response to electrical stimulation. Journal of Abnormal Psychology, 1970, 76, 370-374.

Hubel, D.H. The visual cortex of the brain. Scientific American, November, 1963. In R.G. Atkinson (Ed.) Contempory Psychology. San Francisco: W.H. Freeman and Company, 1971.

Jones, J.E. Contiguity and reinforcement in relation to CS-UCS intervals in classical aversive conditioning. Psychological Review, 1962, 69, 176-185.

Kamin, L.J. Temporal and intensity characteristics of the conditioned stimulus. In W.F. Prokasy (Ed.) Classical Conditioning. New York: Appleton-Century-Crofts, 1965.

Kamin, L.J. and Schaub, R.E. Effects of conditioned stimulus intensity on the conditioned emotional response. In G.A. Kimble (Ed.) Foundations of Conditioning and Learning. New York: Appleton-Century-Crofts, 1967.

Kimble, G.A. and Ost, J.W.P. A conditioned inhibitory process in eyelid conditioning. Journal of Experimental Psychology, 1961, 61, 150-156.

Kimble, G.A. and Reynolds, B. Eyelid conditioning as a function of the interval between conditioned and unconditioned stimuli. In G.A. Kimble (Ed.) Foundations of Conditioning and Learning. New York: Appleton-Century-Crofts, 1967.

Kimmel, E. Judgments of UCS intensity and diminution of the UCR in classical GSR conditioning. Journal of Experimental Psychology, 1967, 73, 532-543.

Kimmel, H.D. Inhibition of the unconditioned response in classical conditioning. Psychological Review, 1966, 73, 232-240.

Kimmel, H.D. and Schultz, C.A. Jr. GSR magnitude and judgments of shock intensity as a function of physical intensity of shock. Psychonomic Science, 1964, 1, 17-18.

Knapp, R.K., Kause, R. and Perkins, C.C. Jr. Immediate versus delayed shock in T-maze performance. Journal of Experimental Psychology, 1959, 58, 357-362.

Lanzetta, J.T. and Driscoll, J.M. Preference for information about an uncertain but unavoidable outcome. Journal of Personality and Social Psychology, 1966, 3, 96-102.

Levis, D.J. and Perkins, C.C. Jr. Acquisition of observing responses (Ro) with water reward. Psychological Reports, 1965, 16, p.114.

Lockard, J.S. Choice of a warning signal or no warning signal in an unavoidable shock situation. Journal of Comparative and Physiological Psychology, 1963, 56, 526-530.

Lockard, J.S. Choice of a warning signal or none in several unavoidable-shock situations. Psychonomic Science, 1965, 3, 5-6.

Lovibond, S.H. The aversiveness of uncertainty: An analysis in terms of activation and information theory. Australian Journal of Psychology, 1968, 2.

Lutz, R. and Perkins, C.C. Jr. A time variable in the acquisition of observing responses. Journal of Comparative and Physiological Psychology, 1960, 53, 180-182.

Maltzman, I. and Wolff, C. Preference for immediate versus delayed noxious stimulation and the concomitant GSR. Journal of Experimental Psychology, 1970, 83, 76-79.

Martin, I. and Levey, A.B. Latency of the eyelid UCR during conditioning. Life Sciences, 1966, 5, 17-26.

Martin, I. and Levey, A.B. The genesis of the classical conditioned response. International Series of Monographs in Experimental Psychology, (Vol.8), London: Pergamon Press, 1969.

Matsuyama, Y. The fear drive and the reversibleness of reinforcing value. Japanese Journal of Psychology, 1958, 29, 41-47.

Mitchell, K., Perkins, N. and Perkins, C.C. Jr. Conditions affecting acquisition of observing responses in the absence of differential reward. Journal of Comparative and Physiological Psychology, 1965, 60, 435-437.

Orne, M.T. On the social psychology of the psychological experiment with particular reference to the demand characteristics and their implications. American Psychologist, 1962, 17, 776-783.

Overmier, J.B., and Seligman, M.E.P. Effects of inescapable shock upon subsequent escape and avoidance responding. Journal of Comparative and Physiological Psychology, 1967, 63, 28-33.

Pavlov, I.P. Conditioned Reflexes. (trans. G.V. Anrep), London: Oxford University Press, 1927.

Perkins, C.C. Jr. An analysis of the concept of reinforcement. Psychological Review, 1968, 75, 155-172.

Perkins, C.C. Jr., Levis, D.J. and Seymann, R.G. Preference for signal-shock over shock-signal. Psychological Reports, 1963, 13, 735-738.

Perkins, C.C. Jr., Seymann, R.G., Levis, D.J. and Spencer, H.R. Jr. Factors affecting preference for signal-shock over shock-signal. Journal of Experimental Psychology, 1966, 72, 190-196.

Pervin, L.A. The need to predict and control under conditions of threat. Journal of Personality, 1963, 31, 570-587.

Prokasy, W.F. Acquisition of observing responses in the absence of differential external reinforcement. Journal of Comparative and Physiological Psychology, 1956, 49, 131-134.

Prokasy, W.F. Classical eyelid conditioning. Experimenter operations, task demands, and response shaping. In: W.F. Prokasy (Ed.) Classical Conditioning. New York: Appleton-Century-Crofts, 1965.

Riecken, H.W. A program for research on experiments in social psychology. Paper read at: Behavioral Sciences Conference, University of New Mexico, 1958.

Schell, A. and Grings, W.W. Judgments of UCS intensity and diminution of the unconditioned GSR. Psychophysiology, 1971, 8, 427-432.

Seligman, M.E.P. Chronic fear produced by unpredictable electric shock. Journal of Comparative and Physiological Psychology, 1968, 66, 402-411.

Seligman, M.E.P. and Maier, S.F. Failure to escape traumatic shock. Journal of Experimental Psychology, 1967, 73, 1-9.

Seligman, M.E.P., Maier, S.F. and Geer, J.H. Alleviation of learned helplessness in the dog. Journal of Abnormal Psychology, 1968, 73, 256-262.

Steiner, S.S., Beer, B. and Shaffer, M.M. Escape from self-produced rates of brain stimulation. Science, 1969, 163, 90-91.

Suboski, M.D., Brace, T.G., Jarrold, L.A., Teller, K.J. and Dieter, R. Interstimulus interval and time estimation in ratings of signaled shock aversiveness. Journal of Experimental Psychology, 1972, 96, 407-415.

Teller, K.J., Dieter, R. and Suboski, M.D. Time estimation and the interstimulus interval function in classical conditioning. Journal of Experimental Psychology, 1972, 95, 445-447.

Tursky, B., Watson, P.D. and O'Connell, D.N. A concentric shock electrode for pain stimulation. Psychophysiology, 1965, 1, 296-298.

Wyckoff, L.B. The role of observing responses in discrimination learning. Part 1. Psychological Review, 1952, 59, 431-442.

APPENDIX A

Instructions for Experiment 1.

Please read the following instructions carefully:

This is an experiment on your ability to estimate time and to judge the unpleasantness of electric shocks. You are to watch the light bulb in front of you. From time to time the light will come on and will be followed by a shock. You will have two tasks. First, you are to press the key on the table just before the shock comes on. When the light comes on, wait and try to press the key just before the shock comes on. You will have made a correct response each time that you have pressed the key as close as possible to the time when the shock comes on. You will have made an incorrect response if the shock comes on before you have pressed the key.

Your second task is to make a careful rating of how unpleasant the shock felt to you. I would like you to rate the shocks according to a seven point scale which I will explain to you. To help you rate the shocks, we will start with three shocks. The first will be at a high intensity and will correspond to "seven" on the scale. The second will be a medium intensity and will correspond to "four", the midpoint of the scale. The third will be at a lower intensity and will correspond to "one" on the scale. We will go through the set of three shocks twice.

After that, you will receive some practice shocks that you are to rate and I will tell you how well you are doing. After each shock, consider how unpleasant it felt in relation to the first shocks and then respond with the number between one and seven that is closest to the unpleasantness of the shock. Remember, you can use any number from one to seven and I will tell you whether you are correct or not.

After you have had some practice in rating the shocks, we will begin the main part of the experiment in which the light will come on and be followed by the shock. Then you are to estimate the time by pressing the key just before the shock comes on and also to rate the unpleasantness of the shock. At other times you will receive the shock without the light. These shocks must also be rated; but, of course, you do not have a key to press.

I will be talking to you again over the intercom and you can talk to me at any time by speaking in a normal voice. Remember, you have two tasks. The first is to press the key just before the shock each time that the light comes on and the second is to tell me the number that best corresponds to the unpleasantness of each shock.

One other thing that you should know is that the key press does not affect the shock. The two do not have anything to do with each other.

If you have any questions about what you will be expected to do, please ask them now.

APPENDIX A - Continued -

Introduction of the three levels of shock read by the experimenter to the subject in Experiment 1 and Experiment 2.

Now you will receive the first of the three shocks. This one will correspond to "seven" on scale.

Next you will receive a shock corresponding to "four" on the scale.

This next shock corresponds to "one" on the scale.

Now we will go through the series again. This one will correspond to "seven" on the scale.

Next you will receive a shock corresponding to "four" on the scale.

This next shock corresponds to "one" on the scale.

Now you will have some practice in rating the shocks. After each shock please give me your estimate of its unpleasantness.

APPENDIX A - Continued -

Instructions for Experiment 2.

Please read the following instructions carefully:

This is an experiment on your ability to judge the unpleasantness of electric shocks. You are to watch the timer in front of you. When the red arrow passes the zero point on the timer you will receive a shock. At other times you will receive a shock without the timer. Your task is to make a careful rating of how unpleasant the shock felt to you. I would like you to rate the shocks according to a seven point scale which I will explain to you. To help you rate the shocks, we will start with three shocks. The first will be at a high intensity and will correspond to "seven" on the scale. The second will be at a medium intensity and will correspond to "four", the midpoint of the scale. The third will be at a lower intensity and will correspond to "one" on the scale. We will go through the set of three shocks twice. After that, you will receive nine practice shocks that you are to rate and I will tell you how well you are doing. After each shock, consider how unpleasant it felt in relation to the first shocks and then respond with the number between one and seven that is closest to the unpleasantness of the shock. Remember, you can use any number from one to seven and I will tell you whether you are correct or not.

After you have had some practice in rating the shocks, we will begin the main part of the experiment in which the red arrow on the timer will count down to zero and be followed by a shock. Then you are to rate the unpleasantness of the shock. At other times you will receive the shock without the timer counting down to zero. These shocks must also be rated. After each shock tell me the number that best corresponds to its unpleasantness.

If you have any questions about what you are expected to do, please ask them now.

APPENDIX A - Continued -

Instructions for Experiment 3.

Please read the following instructions carefully:

This is an experiment on your ability to judge the intensity of the light that will appear on the panel in front of you. You are to watch the timer in front of you. When the red arrow passes the zero point on the timer, the light will come on. At other times the light will come on without the timer. Your task is to make a careful rating of how bright the light appears to you. I would like you to rate the intensity of the light according to a seven point scale which I will explain to you. To help you rate the light, we will start with three lights. The first will be at a high intensity and will correspond to "seven" on the scale. The second will be at a medium intensity and will correspond to "four", the midpoint of the scale. The third will be at a lower intensity and will correspond to "one" on the scale. We will go through the set of three lights twice. After that, there will be nine practice lights that you are to rate and I will tell you how you are doing. After each light, consider how intense it appears in relation to the first lights and then respond with the number between one and seven that is closest to the intensity of the light. Remember, you can use any number from one to seven and I will tell you whether you are correct or not.

After you have had some practice in rating the lights, we will begin the main part of the experiment in which the red arrow on the timer will count down to zero and be followed by a light. Then you are to rate the intensity of the light. At other times the light will appear without the timer counting down to zero. These lights must also be rated. After each light, tell me the number that best corresponds to its intensity.

If you have any questions about what you are expected to do, please ask them now.

APPENDIX A - Continued -

Introduction of the three levels of light read by the experiment to the subject in Experiment 3.

Now you will see the first of the three lights. This one will correspond to "seven" on the scale.

Next you will see a light corresponding to "four" on the scale.

This next light corresponds to "one" on the scale.

Now we will go through the series again:

Now you will see the first of the three lights. This one will correspond to "seven" on the scale.

Next you will see a light corresponding to "four" on the scale. This next light corresponds to "one" on the scale.

Now you will have some practice in rating the lights. After each light please give me your estimate of its intensity.

APPENDIX B

Sample data sheet employed Experiment 2.

Name: ______________ ______________ # ______

Age: ______________ M F

Practice trials: 7 1 4 1 4 7 1 7 4

S	30 U	40S
40U	30S	30S
40S	40S	30U
30U	30U	30S
40U	40U	40S
30U	30S	40U
40S	30U	30S
40 S	40S	40U
40 S	40U	30S
30U	40S	40S
40U	30U	40U
30 S	40U	40S
40 U	40S	
40 U	40 S	
30 S	30U	
40S	40 S	
30U	30U	
40S	30U	
30U	40U	