

Evaluation of informational control and preparatory response factors in classical aversive conditioning

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Subjects performed in a differential eyelid conditioning paradigm with either airpuff or infraorbital shock as the UCS. The trial series included interpolated UCS-alone presentations, and subjects rated UCS aversiveness on all trials. Ratings of the airpuff, but not the shock UCS, were negatively correlated with the magnitude of anticipatory eyelid CRs, as predicted by preparatory response or law-of-effect models of classical conditioning. However, subjects showed no tendency to rate signaled (CS-UCS) trials as less aversive than unsignaled (UCS-alone) trials, and showed no significant preference for the signaled UCS. These results suggest that the operation of informational control and preparatory response factors is more complex than is assumed by available theories. Also, instrumental shaping and preparatory response mechanisms may not be involved in the acquisition of CRs.

Signaling noxious unavoidable events such as electric shocks is generally believed to reduce the noxiousness of those events (e.g., D'Amato, 1974, pp. 93-94). The general notion that the effects of signaling under such conditions are beneficial can be summarized in terms of the concept of "informational control" (Furedy, 1975), provided it is recognized that informational control (IC) is reserved for those situations where no obvious source of external modification (e.g., escape or avoidance) exists for the noxious event in question. The classical aversive conditioning paradigm is assumed to exemplify this type of situation, since the noxious UCS is presented on all trials independently of the subject's behavior. The *mechanism* through which IC might operate has, indeed, been most specifically stated by a theory of reinforcement which attributes instrumental properties to classically conditioned responses (Perkins, 1971). According to Perkins' preparatory adaptive response (PAR) theory of classical aversive conditioning, the IC phenomenon (i.e., the beneficial effect of signaling) results from signal-elicited (CS) conditioned responses (CRs) which are learned because of their effect in reducing perceived UCS aversiveness. For example, an anticipatory eye-blick response in classical eyelid conditioning is assumed to mitigate the felt intensity of a corneal airpuff UCS.

In addition to the PAR mechanism of IC, the other major phenomenon which has been linked to the IC notion is that of "preference for signaling" (PFS). The IC, PAR, and PFS notions, though related, need

to be distinguished (Furedy & Doob, 1971, p. 258). Specifically, and in terms of measurable observations, the IC phenomenon may be defined as occurring when, for example, signaled shocks are rated as less aversive than unsignaled shocks of the same physical characteristics. The PAR mechanism would be said to occur if the magnitude of a specific response (CR) elicited by the CS was found to be negatively correlated with the perceived intensity of the UCS. Finally, the PFS phenomenon would be said to occur if, in a situation which pitted signaled and unsignaled shock against each other in an unconfounded choice arrangement, the signaled shock was significantly preferred.

Most current theoretical positions (e.g., Berlyne, 1960; Lykken, 1962; Perkins, 1971; Seligman, 1968) suggest that, in general, the effects of signaling are beneficial, although not all positions require or predict all of the three phenomena defined above. For example, Berlyne's (1960) information-seeking position predicts the PFS, but does not predict the IC phenomenon or PAR mechanism. Moreover, conclusions opposite to those expected on the basis of IC are deducible from other theories which take the motivating effects of conditioned fear into account (Furedy & Doob, 1971, p. 263). In terms of conditioned fear, signaling would be expected to *increase* rather than decrease the aversive affect of the UCS, and preference would be for *unsignaled* noxious events.

With this in mind, it is not surprising that, despite the general belief in beneficial effects of signaling, the evidence that information actually does reduce

aversive affect is far from clear. A review of evidence on IC in humans from the Toronto laboratory has indicated that the limits on IC are quite severe (Furedy, 1975). In brief summary, there was no evidence in these studies to support the occurrence of a PAR mechanism in such signal-elicited anticipatory responses as the GSR, digital vasomotor response, and cardiac rate (Furedy, 1975, pp. 63-65). Concerning the IC phenomenon itself, not only were there repeated failures to obtain the phenomenon, but also its "opposite" was obtained in two studies, where signaled shocks were rated as slightly but significantly more aversive than unsignaled shocks (Furedy, 1975, pp. 65-69). Moreover, such reversed signaling effects are not confined to the Toronto laboratory, as Bowers (1971) has reported this same effect in a cardiac-conditioning paradigm. Finally, the Toronto studies yielded no general evidence of a PFS phenomenon, but only a rather peculiar (though robust and replicable) PFS which appeared to be based on subjects' (false) beliefs in the benefits of signaling (Furedy, 1975, pp. 69-74). Moreover, it has been suggested (Furedy, 1975, pp. 74-77) that much of the evidence supporting the IC phenomenon can be questioned on various methodological grounds.

On the other hand, Suboski, Brace, Jarrold, Teller, and Dieter (1972) have reported a set of experiments which both confirm IC notions and do not appear to be subject to any clear-cut methodological criticisms. The experiment is most directly related to the IC phenomenon itself, since subjective ratings of signaled and unsignaled shocks were obtained. The basic theoretical approach of these investigators is a law-of-effect PAR interpretation, from which the authors suggest that IC and related phenomena should emerge only under conditions optimal for the classical conditioning of PARs. Specifically, Suboski and his associates concentrate on the interstimulus interval (ISI) function in skeletal (e.g., eyelid) conditioning, where little or no conditioning emerges beyond 2.5 sec and the .5-sec optimum value is well supported by numerous empirical studies. Suboski et al. reported an IC phenomenon under short (optimal) ISI conditions, as well as under conditions which seemed to mimic the short-ISI condition either by having the subjects estimate the time of occurrence of the UCS during a longer ISI (presumably allowing the subjects to "time" their PARs to overlap UCS onset) or by shifting gradually from a short to a longer nonoptimal ISI.

However, Suboski et al. (1972) did not include direct measurement of overt conditioned responses in their experiments, so that the presence of a PAR mechanism could only be indirectly inferred. In addition, Suboski did not assess the PFS phenomenon separately, which, as illustrated in detail elsewhere (Furedy, 1975), can often turn out to be independent of the conceptually related IC phenomenon. Accordingly, the present study examined IC and related PAR and PFS phenomena in

a classical eyelid conditioning situation, wherein the anticipatory eyelid CR was directly observed, both in terms of the commonly used CR frequency measure and in terms of both peak anticipatory CR magnitude and eyelid position at UCS onset. This information, of course, was sought in order to shed light on the presence of an eyelid PAR mechanism of IC. In addition to assessing the presence of the IC phenomenon through continuous rating of both signaled and unsignaled UCSs, the PFS phenomenon was assessed by questionnaire at the end of the experiment. Finally, in view of the importance of potential sources of UCS modification for IC and related notions, the present eyelid conditioning study used not only the traditional air-puff UCS but also infraorbital shock (e.g., Gormezano & Fernald, 1971), which, as a UCS, is less obviously modifiable by the eyelid response. Whereas anticipatory eyelid closure might limit the amount of corneal surface affected by an airpuff UCS, there is no physically obvious peripheral mechanism whereby an eyelid CR can mitigate an electric shock delivered to the subject's cheek.¹ Thus, it was expected that results supporting PAR theory would be more likely in the case of the airpuff UCS.

METHOD

Experimental Design

In general, the design followed an earlier autonomic conditioning experiment directed at testing IC and related notions (Furedy, 1970). Modifications were made to suit the eyelid conditioning context, including a shorter interstimulus interval and a larger number of trials. Otherwise, as in Furedy's (1970) autonomic conditioning study, a differential conditioning paradigm was employed in which subjects received CS+/UCS (signaled), UCS-alone (unsignaled), and CS- trials. The factor of UCS (airpuff or shock) intensity was varied with subjects over five levels (.5-2.5 psi or .4-2.5 mA) in order to check on the sensitivity of the subjects' ratings to physical intensity differences. No attempt was made to cross-modally match individual shock levels with airpuff levels, but the intensity levels employed within each UCS modality were selected to represent nearly the entire range of stimulus values used in previous UCS intensity studies (e.g., Gormezano & Fernald, 1971; Spence & Platt, 1966).

Subjects

The subjects were 48 high school and college students (24 males, 24 females) who were paid \$2 each for participating in the experiment.

Apparatus

Subjects were tested individually in an IAC sound-resistant chamber. Programming and recording equipment was located in an adjoining room, from which the experimenter maintained continuous intercom contact with the subject. The visual CS was an increase in room illumination from 2.0 to 4.5 fL, as measured by a Macbeth illuminometer directed at the wall in front of the subject at eye level. The auditory CS was a 1,000-Hz 75-dB SPL tone, produced by an audio oscillator and electronic switch, and presented through Grason-Stadler TDH39 earphones against a continuous background of white noise. The airpuff UCS was regulated by a Hunter pressure control unit and delivered through rubber tubing to a 1.0-mm

airjet positioned 1.5 cm from the cornea of the subject's right eye. The shock UCS was a monophasic dc pulse, produced by a constant current stimulator and delivered through EEG electrodes located 2 cm below the socket of the subject's right eye (negative electrode) and 2 cm from the outer corner of the same eye (positive electrode). The skin surface at each electrode placement was prepared with rubbing alcohol and Sanborn electrode paste, and electrodes were held in place by surgical tape.

Stimulus durations and interstimulus intervals were controlled by Hunter timers arranged in a recycling series; a Lehigh Valley tape reader was used to program CS and UCS events and to randomize intertrial intervals. Eyelid CRs and UCRs were recorded by a standard procedure involving a plastic eyelid attachment and microtorque potentiometer, mounted on an elastic headband worn by the subject. Voltage changes in the potentiometer were fed into a Hewlett-Packard Model 7702B oscillograph, which was run at a chart speed of 100 mm/sec during CS and UCS presentations. The recording system was calibrated, such that a voluntary (instructed) eye blink produced a 40- to 45-mm deflection of the recording pen. As in Furedy's (1970) study, the rated intensity of each shock or airpuff UCS was registered by a lever rotatable up to 180 deg on a dial labeled "increasing intensity." Degrees of lever rotation were linearly related to readings on a voltmeter located in the experimenter's room.

Procedure

Prior to conditioning trials, the subject was given instructions describing the UCS rating task, plus a preliminary stage consisting of five UCS-alone trials, two visual CS presentations, and two auditory CSs in random order. Subjects were told to rate the subjective intensity of each airpuff or shock by rotating the lever in a clockwise direction, and to wait for the experimenter's signal before returning the lever to its original (zero) position. The intensity of the UCS was increased from .5 to 2.5 psi or mA during the preliminary series, and subjects were told that, since they would be receiving no stronger or weaker stimuli during the subsequent conditioning stage, they should use most of the possible 180 deg of lever rotation in their judgments.

The differential conditioning stage of the experiment consisted of 120 trials, of which 40 were CS+/UCS trials, 40 were CS- trials, and 40 were UCS-alone trials. Trial types were presented in irregular order, with the restriction that each successive block of 15 trials included one signaled (CS+/UCS) and one unsignaled (UCS-alone) trial at each of the five airpuff or shock intensity levels, plus five CS- trials. The duration of both the visual and the auditory CS was 800 msec, whereas the airpuff and shock UCS had durations of 100 and 10 msec, respectively. Half of the subjects in each UCS modality group received the tone as CS+ and the visual stimulus as CS-, and half received the reverse arrangement. The visual or auditory CS terminated at UCS onset on reinforced trials, giving an interstimulus interval (ISI) of 800 msec under all treatment conditions. The intertrial interval (ITI), defined as the time period between successive UCS presentations, was 16, 26, or 36 sec, according to a preprogrammed random schedule.

Following the conditioning stage, subjects were asked to indicate on a printed questionnaire whether they preferred signaled UCS presentations, unsignaled presentations, or had no preference. The questionnaire required a separate response for each of the five shock or airpuff levels presented during conditioning.

RESULTS AND DISCUSSION

Conditioning

For purposes of data analysis, a CR was defined as an eyelid closure of at least 2-mm amplitude, occurring

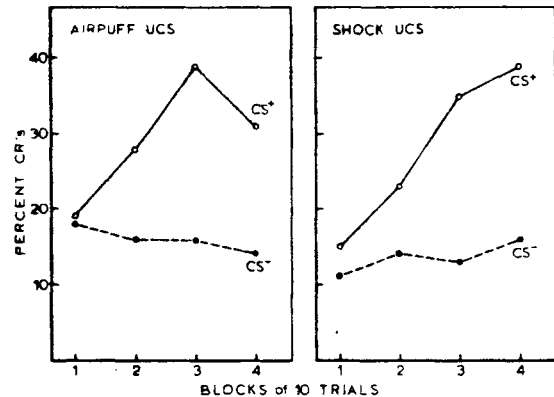


Figure 1. Differential conditioning performance of groups receiving airpuff and shock UCS conditions.

between 150 and 840 msec after CS onset and preceded by a no-response interval of at least 100 msec. Figure 1 shows the percentage of CRs in successive blocks of 10 CS+ and CS- trials for groups receiving airpuff and shock UCSs. It may be noted that clear evidence of differential conditioning was obtained for both UCS types. An analysis of variance indicated that CR frequency was significantly greater to CS+ than to CS-, $F(1,40) = 18.11$, $MS_e = 10.33$, and that differentiation of positive and negative stimuli increased systematically over blocks of trials, $F(3,120) = 9.06$, $MS_e = 2.22$. The main effects of UCS modality (airpuff vs. shock), CS modality (tone vs. light as CS+), and sex of subject were nonsignificant, as was the UCS Modality by CS+ vs. CS- interaction. Separate analyses of the airpuff and shock groups (using MS_e s from the overall analysis) indicated that both the CS+ vs. CS- main effect and the CS+ vs. CS- by Blocks interaction were significant in each case, $F(1,20) = 15.33$ and 19.20 ; $F(3,60) = 7.62$ and 10.11 , respectively.

The development of CS+ vs. CS- differentiation in the anticipatory eyelid CR indicates that responding elicited by CS+ is classifiable as associative conditioning for both airpuff and shock groups (cf. Furedy, 1970). Asymptotic CS+ performance was relatively low considering that an 800-msec ISI is considered to be optimal for differential eyelid conditioning (e.g., Hartman & Grant, 1962). Unusual procedures that may have been responsible for this low asymptotic performance include having subjects rate the UCS on each trial and presenting interpolated (unsignaled) UCS-alone trials. However, the reliability of differential conditioning is sufficient to provide the conditions necessary for testing the operation of a PAR mechanism in the anticipatory eyelid CR elicited by CS+. The UCS modality factor was treated as critical in all such tests because, as noted at the outset, the airpuff UCS is more obviously modifiable than the shock UCS.

Response Topography

One indirect test of PAR theory examined CR latency to see whether, in line with "instrumental shaping" notions (e.g., Prokasy, 1965), CR latency was

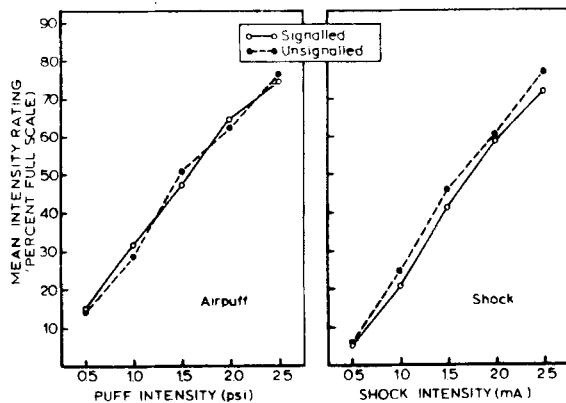


Figure 2. Mean rated intensity of airpuff and shock UCSs as a function of UCS intensity and signaled vs. unsignaled presentation.

closer to the end of the 800-msec ISI in the case of CS+ than in the case of CS-. CR latency was defined as the time, in milliseconds, from CS onset to the first CR of criterion amplitude on a given CS+ or CS- trial. Latency scores were averaged across CR trials for each subject, and the resulting mean scores subjected to a UCS Modality by CS Modality by CS+ vs. CS- analysis of variance. The mean CS+ and CS- values for the airpuff group were 593 and 506 msec, respectively, while the corresponding values for the shock group were 548 and 555 msec. Consistent with these trends, the UCS Modality by Trial Type interaction was significant, $F(1,44) = 6.25$, $MS_e = 8581.70$. The obvious nature of this interaction is that subjects receiving the airpuff UCS showed longer CR latencies to CS+ than to CS-, while subjects receiving the shock UCS did not similarly differentiate between CS+ and CS-. This pattern of results is consistent with a PAR mechanism in the case of the airpuff UCS. In other words, instrumental "shaping" of CR topography occurred through long-latency CRs to CS+ being more effective than short-latency CRs in attenuating airpuff aversiveness. The same CS+ vs. CS- latency difference was presumably irrelevant in the case of the "unmodifiable" shock UCS, and hence did not occur.

A second indirect test examined CR terminal amplitude, or eyelid position, at the end of the ISI (UCS onset for CS+). Specifically, CR terminal amplitude was defined as the amount of pen deflection recorded at a point 20 msec prior to ISI termination (i.e., 780 msec following CS onset); as in the case of the CR latency measure, the critical question was whether this measure differentiated between CS+ and CS-. The same analysis of variance as employed with the latency measure was applied to mean terminal amplitude scores, and the same UCS Modality by Trial Type interaction emerged as significant, $F(1,44) = 4.04$, $MS_e = 46.70$. The nature of this interaction resembled that obtained from the latency analysis, with greater mean terminal amplitude scores on CS+ trials (8.1 mm) than on CS-

trials (3.0 mm) in the airpuff group, but no differentiation between CS+ (6.3 mm) and CS- (6.9 mm) in the shock group. Accordingly, as in the case of CR latency, these results indicate that "shaping" occurred, but only in the case of the airpuff UCS. It bears emphasis, on the other hand, that, as far as level of conditioning is concerned, the airpuff and shock groups did not differ (Figure 1), so that the shaping process apparently present in the former groups is apparently not necessary for the acquisition of the classically conditioned eyelid response.

Regression Test of PAR Mechanism

More direct tests of the PAR mechanism involved the use of trial-to-trial UCS ratings in relationship to characteristics of the potential PAR (the eyelid CR) itself. As in Furedy (1970), the validity of the psychophysical UCS rating measure was first checked by determining whether ratings varied reliably as a function of physical UCS intensity differences. As suggested by Figure 2, and confirmed by statistical analysis, airpuff and shock ratings increased monotonically as a function of UCS intensity, $F(4,176) = 464.09$, $MS_e = 452.69$, a result which supports the sensitivity of the psychophysical ratings. This result, together with the evidence for conditioning of the potential PAR (eyelid CR) indicates that the necessary conditions were met for applying the "regression test" for the presence of PAR mechanisms in this situation. As detailed elsewhere (Furedy, 1970), the regression test involves determining whether the regression of UCS aversiveness ratings on CR amplitude scores is significantly negative. The two CR measures used here were CR peak amplitude, defined as the maximum deflection of the recording pen (from a pre-CS baseline) that occurred during the interval from 150 to 840 msec after CS onset, and CR terminal amplitude, as defined previously.

As in Furedy (1970), each subject's UCS rating scores for the 40 CS+/UCS trials were paired with either CR peak amplitude or CR terminal amplitude scores for the same trials. Amplitude scores of zero were assigned on trials where no CR occurred. The slope of the regression of UCS rating scores on peak or terminal amplitude scores was determined for each subject by applying a covariance analysis that controlled for the effects of both trials and UCS intensity. A series of *t* tests revealed that the predicted negative regression occurred significantly only in the case of CR terminal amplitude for subjects receiving the airpuff UCS, $t(23) = 2.33$. Mean regression coefficients did not deviate significantly from zero for the terminal amplitude/shock, peak amplitude/airpuff, or peak amplitude/shock conditions, $t(23) = -1.39, +1.14, \text{ and } -.89$, respectively.

In summary, the results of both direct and indirect tests for the presence of a PAR mechanism failed to provide general support for this notion, since evidence suggesting the presence of a PAR effect was obtained

only in the case of the more obviously modifiable airpuff UCS, and not with the shock UCS. Yet, the conditions for the adequacy of the tests seemed to be met, since there was evidence both for reliable conditioning and for the sensitivity of the UCS ratings variable used in direct tests of the PAR mechanism. It is also worth noting that, even in cases where the evidence supported the PAR notion (i.e., the airpuff group), there was little to suggest that the classical eyelid conditioning process itself, as most generally measured in terms of CR frequency, is strongly determined by an instrumental PAR component. This conclusion is suggested by the finding that airpuff and shock groups showed equal levels of conditioning (Figure 1), despite the fact that evidence of instrumental shaping and CR-mediated attenuation of the UCS was found for the airpuff group but not for the shock group. The same conclusion is implied by Gormezano and Coleman's (1973) demonstration that classical conditioning of the rabbit's nictitating membrane response is not significantly affected when a decrement in the actual (physical) intensity of the UCS is contingent upon CR occurrence.

The IC Phenomenon

It is important to re-emphasize that the PAR mechanism and the IC phenomenon are separable concepts. For example, although no evidence was found for a PAR mechanism in the case of the shock UCS, it does not follow that no IC phenomenon should emerge, as some other mechanism such as "perception" (Lykken, 1962) could mediate the IC (signaling) effect. Nevertheless, assuming other factors to be equal, it was expected that the IC phenomenon (signaled UCS rated as less intense than unsignaled UCS) would emerge more clearly with the airpuff than with the shock UCS. However, the actual results, as shown in Figure 2, indicate the facts to be more complex than the available theories. Specifically, as comparisons of signaled and unsignaled ratings in Figure 2 indicate, subjects receiving the shock UCS rated signaled presentations as slightly less aversive than unsignaled presentations at all intensity levels, while subjects receiving the airpuff UCS showed no consistent tendency to rate either signaled or unsignaled presentations as more intense. This pattern of results is directly contrary to the expectation that IC-like results would emerge more clearly for the airpuff than the shock UCS group. In statistical terms, there was no evidence of an IC effect for either group, as both the signaled-unsignaled main effect and the Signaling by UCS Modality interaction effect failed to reach statistical significance, $F(1,44) = 3.30$ and 3.31 , respectively, $MS_e = 265.98$.

This pattern of results serves mainly to emphasize the need for logically separate treatment of the PAR mechanism and of the IC phenomenon. Moreover, the fact that, at least in the airpuff UCS group, an independently documented PAR mechanism (reduction of

rated aversiveness by eyelid position at UCS onset on signaled trials) failed to produce an overall IC effect (reduction of UCS aversiveness through signaling) strongly suggests the presence of additional opposing, and "nonbeneficial," factors such as conditioned fear (cf. Furedy & Doob, 1971, p. 263) in the signaling situation.

The PFS Phenomenon

The postexperimental preference questionnaire was completed by 23 and 21 subjects, respectively, in the shock and airpuff groups. With data averaged across all UCS intensity levels, the percentages of subjects preferring signaled UCS, unsignaled UCS, and having no preference were, respectively, 40, 30, and 30 for the shock group and 29, 42, and 29 for the airpuff group. Statistically, these data indicate no evidence for the PFS phenomenon. Moreover, a series of chi-square tests indicated that the proportions of subjects preferring signaled vs. unsignaled UCS presentations did not differ significantly at any of the five intensity levels for either the airpuff or shock UCS. In view of the strength of belief in the PFS phenomenon documented by Furedy (1975), the present results are of interest in providing yet another failure to demonstrate this phenomenon even under conditions where UCS modification is possible (i.e., in the airpuff subjects).

CONCLUSIONS

Especially when attention is restricted to the unmodifiable shock UCS, it is clear that the present results indicate failure of information about time of occurrence (i.e., signaling) to control aversive affect in the differential classical eyelid conditioning paradigm. Moreover, even with the more obviously modifiable airpuff UCS, the instrumental interpretation of eyelid CRs was not clearly supported, since only eyelid position at US onset, and not the CR itself (or CR peak amplitude), seemed to operate in the instrumental, preparatory adaptive response manner. On the other hand, Murray and Carruthers (1974) did obtain evidence supportive of such an instrumental interpretation, although the shorter ISI of .5 sec employed by these investigators made the difference between position-at-UCS-onset and peak-CR-magnitude measures less salient. However, since these investigators did obtain PAR-supportive evidence with a shock UCS, it seems clear that, at least in some forms of eyelid conditioning, a "genuine" (nonperipheral) PAR mechanism occurs.¹ The relevant feature of such conditioning paradigms for the PAR mechanism seems to be strength of conditioning, which was relatively low (although reliable) in the present study, presumably partly because of the differential paradigm employed and the use of interpolated (unsignaled) UCS-alone trials.

To return to the present results, the IC and PFS

phenomena were absent even with the modifiable air-puff UCS. As indicated at the outset, and as detailed elsewhere (Furedy, 1975), there is reason to believe that these findings, though contrary to most current opinion (e.g., D'Amato, 1974), are not inconsistent with recent experimental evidence involving human subjects. The exception to this is the report by Suboski et al. (1972), which indicates a reliable IC phenomena at signal-shock intervals of approximately .5 sec but not at ISIs of 4.0 sec. Failure to find evidence for an IC phenomenon at an ISI of .8 sec would seem to conflict with the findings of Suboski et al. (1972), and there is no obvious way of reconciling this conflict. It should be noted, however, that there have been several studies reported and summarized elsewhere (Furedy, 1975) which employed similarly short ISIs, where the "timing" of PARs would presumably be optimal and where the IC phenomenon failed to emerge. Since both Suboski et al. (1972) and the Toronto laboratory (e.g., Furedy & Doob, 1971) have predicted the emergence of the IC phenomenon with short ISIs, though for different theoretical reasons, it would seem that the data create difficulties for both theoretical positions and indicate the presence of complexities that are hidden from our present theoretical schemas. What is clear is that, while we do not know the conditions under which information controls aversive affect, the assumption that such control is an easily demonstrable phenomenon is unwarranted. The conditions under which such control occurs and does not occur remain a complex problem for investigation.

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NOTE

1. It will be recognized, of course, that a proponent of the PAR theory may wish to argue that, in some way, tensing of the facial muscles may serve to mitigate an electric shock UCS to the cheek. However, it will be noted that this PAR mechanism is both hypothetical and unspecific, rather than being physically obvious, as in the case of the eyelid CR and the airpuff UCS. Nevertheless, as indicated at the end of the present paper in discussing the results of Murray and Carruthers (1974), there is evidence that, in the case of shock UCSs, "genuine" nonperipheral PAR mechanisms do occur, even though their action is, as yet, unspecified.

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