Verbal conditioning and extinction of the GSR index of the orienting reflex

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A two-component theory of classical conditioning of the GSR asserts that one component is mediated by cognitive expectancies whereas an unmediated emotional component is also present when a highly noxious UCS is employed. Evidence for the unmediated emotional component stems from studies reporting considerable resistance to extinction despite prior instructions informing participants that the UCS would no longer occur. Unmediated conditioned emotional responses persist contrary to cognitive expectancies. A forewarned reaction time procedure with an innocuous imperative stimulus was employed to test the two-component theory. Significant differential resistance to extinction was found in groups of instructed students where the conditioned responses were contrary to cognitive expectancies. It was concluded that conditioned responses contrary to cognitive expectancies need not reflect unmediated emotional responses.

Verbal conditioning of the GSR is a well-documented phenomenon (e.g., Cook & Harris, 1937; Dawson & Grings, 1968; Pendery & Maltzman, 1977). It refers to the procedure whereby a participant is verbally informed that a CS will be followed by a UCS. A large GSR-CR is obtained to the CS upon its first presentation, prior to the opportunity for pairing with the UCS. Such conditioning is highly effective, at least as effective as pairings with the UCS. Some form of cognitive interpretation is usually offered for the effect such as the mediation of the GSR by thought-induced anxiety (Bandura, 1969). Verbal conditioning has been taken as one form of evidence to support the notion that much, if not all, human conditioning of the GSR is cognitively mediated (Grings, 1965).

In an analogous manner, participants can be instructed that the UCS will no longer follow the CS. Verbal extinction can also be obtained. However, some investigators claim that they have obtained evidence of unmediated GSR conditioning using a verbal extinction procedure (Bridger & Mandel,

1964, 1965; Mandel & Bridger, 1967, 1973). They hypothesize that the conditioned GSR induced by a highly noxious UCS consists of two components, one dependent upon cognitive expectancies, or mediated, and the other not dependent upon cognitive expectancies or contrary to such expectancies, and therefore unmediated (Mandel & Bridger, 1973). Evidence supporting the two-component hypothesis stems from the observation that instructions informing the participants that shock, the UCS, will no longer be delivered does not result in the immediate and complete elimination of the GSR-CR. Mandel and Bridger (1973) further assert that evidence of an unmediated component in classical conditioning of the GSR can only be obtained when a highly noxious UCS is employed.

The present report addresses itself to the hypothesis that there are two components to the GSR-CR as manifested in an instructed extinction situation and that a highly noxious UCS is a necessary condition for manifestation of an unmediated component. Pendery and Maltzman (1977) have reported a verbal conditioning experiment that differed in certain important respects from previous experiments on the verbal conditioning of the GSR. A forewarned reaction time procedure with an innocuous tone as the imperative stimulus, UCS, was employed rather than the usual noxious UCS. Highly reliable evidence of differential semantic conditioning was obtained to a particular critical word (CW) in students instructed that the CW always preceded the tone to which they were to perform an overt response. Instructed students showed their maximum GSR upon the first presentation of the CW, showed reliable differential conditioning to words, and did so in the absence of

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a noxious UCS. Verbal conditioning occurred because the CW acquired significance as a signal for the task to be performed. As a consequence, the students oriented to that word and manifested a large GSR taken as the CR. It was further hypothesized that conventional conditioning occurs in a similar fashion. Students participating in a classical conditioning experiment usually engage in problem solving activity. If and when they discover the stimulus serving as a signal for the imperative stimulus or the UCS, they orient to that noteworthy cue in the same manner as instructed students (Pendery & Maltzman, 1977). Whether the UCS is a noxious stimulus or an innocuous signal for a task, the preceding CS serves as its signal, hence is a significant stimulus which induces an OR manifested as a GSR-CR.

An interpretation of classical or verbal conditioning of the GSR as a problem solving discovery process (Maltzman, 1977; Pendery & Maltzman, 1977) is not necessarily incompatible with Mandel and Bridger's (1973) two-component theory of conditioning of the GSR. It may be hypothesized that in addition to the voluntary OR which is reflected as a GSR-CR there is a primary emotional response which is unmediated. However, an implication of two-component theory is that a forewarned reaction time situation with an innocuous imperative stimulus should not yield differential resistance to extinction when students are informed that the CS is no longer a signal for the response to the imperative stimulus (Mandel & Bridger, 1973). Rapid and complete extinction should occur because there is no strong emotional component present to maintain the GSR-CR. The present experiment tests this implication of two-component theory by using a forewarned reaction time situation with an innocuous imperative stimulus and instructed extinction. It constitutes the second phase of an experiment on verbal conditioning of the GSR reported elsewhere (Pendery & Maltzman, 1977).

METHOD

Subjects

Initially, 105 University of California, Los Angeles students were recruited for participation in the experiment, which partially fulfilled a course requirement. Since the experiment was concerned with the comparison of the effects of instructions and the conditioning and extinction evident in students who could verbalize the relevant stimulus contingencies, the principal comparisons involved 96 students. There were 24 students in the discovery group and 72 in the total instructed group. Half the participants were male and half were female. Nine additional students who participated in the discovery group but who failed to verbalize the critical contingencies were not included in the analyses of results.

Apparatus and Materials

Stimulus materials, including instructions, words, and tones, were presented to the students through stereophonic earphones from prerecorded magnetic tapes played back using a stereophonic tape recorder and amplifier. Specific instructions as well as the number of tones and their positions with respect to the words

varied for the different groups. Since the word list and interword intervals were identical for all students, one preliminary master tape was prepared containing words spoken in a male voice against low background noise. Appropriate instructions spoken in the same voice and signals set to trigger a voice key that activated .5-sec 1,000-Hz tones from an oscillator and unit power supply were added as the final set of tapes required for the various treatment conditions were recorded from the master tape. Loudness of the voice and tones was calibrated at the earphones for presentation at approximately 70 dB (A).

Palmar GSRs were recorded using two 20-mm circular disk electrodes fitted in 5-mm-deep plastic cups which contained electrode paste made from agar and a 1% zinc sulfate solution. Plastic pressure clips encased in foam rubber held the electrodes in place. Palmar resistance was continuously recorded using a 40- μ A current on one channel of a dual-channel dc Sanborn 320 amplifier-recorder.

Procedure

A habituation session consisting of 20 different neutral words initiated the experiment, followed by Phase I and Phase II of acquisition. Results obtained during habituation and Phase I have been reported elsewhere (Pendery & Maltzman, 1977).

Discovery students (Group D) received the 20 words during habituation, followed by Phase I acquisition, in which only the critical word "plant" was followed in 10 sec by a .5-sec 70-dB (A) 1,000-Hz tone. Prior to habituation, they were instructed to lift their feet from a pedal upon hearing the tone, but they were not informed of the contingency between "plant" and the tone. One group of instructed students (Group I) received the same words and tone pairings as Group D. However, the students in Group I were told that the tone always followed "plant." A third group consisted of instructed students receiving a tone after each word in the experiment (Group I-T). They were instructed prior to habituation to respond to the tone only when it followed "plant." A fourth group consisted of instructed students who were briefly shown the list of words with a tone after each word (Group I-T-S) prior to habituation. They received the same stimulus materials as Group I-T.

In Phase I, the critical word "plant" was presented six times, separated by two to six different filler words. A second set of taped instructions was interpolated between Phase I and Phase II. Three different subgroups were formed within each of the four principal groups, one discovery and three instructed, participating in Phase I (Groups D, I, I-T, and I-T-S). In Phase II, Subgroup 1 (S-1) continued to respond to the tone following "plant," as in Phase I. Subgroup 2 (S-2) was required to shift their responses to a tone following "light" rather than "plant." Subgroup 3 (S-3) was subjected to an extinction procedure where the students no longer performed an overt response to a tone. The three subgroups within the discovery group differed from the subgroups within the instructions groups in terms of their instruction and stimulus contingencies corresponding to the differences between the principal groups in Phase I.

Subgroups within Group D, as in Phase I and as in the usual classical conditioning experiment, were not informed in their instructions of the various contingencies to occur between the critical words (CWs) and tones in their respective stimulus series during Phase II. They were simply told that there would be a short pause while the tape recording was changed, but that their instructions were exactly the same as they had been before. For Subgroup D-1, the continue subgroup, the tone continued to occur after "plant"; for Subgroup D-2, the switch subgroup, the tone occurred after "light" instead of "plant"; the tone was no longer presented to Subgroup D-3, as in the customary extinction procedure.

Subgroups within Group I, that is, I-1, I-2, and I-3, were informed in their instructions of the corresponding CS-tone contingencies during Phase II. Within both Group I-T and Group I-T-S, henceforth treated in an identical manner, the three subgroups were instructed either to continue responding to the tone

after "plant" (I-T-1 and I-T-S-1), to respond to the tone following "light" instead of "plant" (I-T-2 and I-T-S-2), or to stop responding to the tone after "plant" (I-T-3 and I-T-S-3), respectively.

The critical words "plant" and "light" each occurred five times for all participants and were separated by from two to six different filler words. As in Phase I, an interword interval of 20-26 sec occurred between each word. The tone followed the words, where appropriate, by 10 sec. Thus, a 10-sec CS-UCS interval was employed. Assorted high-frequency words (Thorndike & Lorge, 1944) comprised the list of filler words (FWs).

A postexperimental interview and questionnaire were administered to determine the degree of verbal awareness of the stimulus contingencies present in the experiment. Included in the questionnaire was an item designed to determine the credibility of the instructions, the extent to which the participant believed the instructions presented by the experimenter.

RESULTS

The GSR was defined as the largest decrease in palmar resistance, commencing within the interval .5-5 sec after stimulus onset. Responses with latencies greater than 5 sec, so-called second-interval or anticipatory responses, were not scored, since we have found that second-interval responses do not yield additional useful information (Maltzman, Weissbluth, & Wolff, 1978). The GSR was scored for tones following "plant" and "light" and for all critical and filler words. Raw scores were subjected to a log conductance change transformation prior to analyses.

The .05 level of significance for a two-tailed test was adopted in all statistical tests conducted.

Figure 1 presents the results that are most pertinent to the theoretical issue of whether there is an emotional as well as a cognitive component to the GSR-CR. It shows the mean GSR magnitudes induced by the CS "plant" and its preceding, FW₁, and following, FW₂, filler words for the three discovery (V) subgroups and the three instructed subgroups. Discovery (V) students include only those participants who verbalized the conditioning contingency. All instructed groups (I, I-T, I-T-S) are combined in Figure 1, since statistical analyses indicated that they did not differ significantly. It is evident that the instructed students in S-2, switch, and S-3, extinction, continued to show differential responsivity to "plant" despite their instructions not to respond to the tone following "plant." It is noteworthy that students in S-2 who were now responding to the tone following "light" continued to manifest as much or more differential responsivity to "plant" as S-1 students who continued to respond to the tone following "plant." Results from the questionnaire indicated that participants in all subgroups believed their respective instructions.

Results of the statistical analyses generally confirm the impressions given by Figure 1. Analysis of variance of the magnitude of the GSR evoked by "plant" and its immediately preceding and following FWs yielded a significant effect for Words [$F(2,144) =$

Figure 1. Mean magnitude of the GSR to the critical word (CW) "plant" and immediately preceding (FW₁) and following (FW₂) filler words for the three different subgroups in the discovery (V) and the instructed subgroups in Phase II. Subgroup S-1 continued to perform a pedal response to the tone following "plant"; Subgroup S-2 switched their pedal response to the tone following "light"; Subgroup S-3 underwent extinction, did not perform a response to any tone.

93.70, $MS_{W2} = .520$], indicating reliable differential responsivity to the CS. Trials also yielded a significant effect [$F(4,288) = 6.60$, $MS_{W1} = .338$], indicating a reliable overall decrement in response magnitude. Of particular theoretical pertinence, there was a significant Groups by Words interaction [$F(6,144) = 4.17$, $MS_{W2} = .520$]. The latter result supports the impression gained from Figure 1 that instructed students over all subgroups were more differentially responsive to "plant" than their discovery counterparts. A significant Subgroups by Words interaction also occurred [$F(4,144) = 5.38$, $MS_{W2} = .520$], indicating that the three subgroups differed in their differential responsivity to "plant," regardless of their group, discovery or instructed. Specific comparisons of the mean magnitude of the CR indicated that they did not differ significantly. Clearly, instructing students that they need no longer respond to the tone following "plant," that it is no longer a signal, does not abolish the GSR-CR to that stimulus.

Continued differential responsivity to "plant" evidenced by S-2 and S-3 instructed students suggests that differential GSR conditioning, contrary to cognitive expectancies, may occur in the absence of an emotional response induced by a noxious UCS. Such persistence in responding despite instructions to the contrary appears possible without assuming two components to the GSR-CR, one emotional and the other cognitive.

It is important to note that although instructed S-2 and S-3 students compared favorably to the performance of S-1 students in terms of absolute and dif-

Figure 2. Mean magnitude of the GSR to the critical words (CW) "plant" and "light" in Phase II for the three different subgroups in the discovery (V) and instructed groups. Subgroup S-1 continued to perform a pedal response to the tone following "plant"; S-2 switched to performing a pedal response to the tone following "light"; and S-3 underwent extinction, did not perform a pedal response to any tone. Responsivity to "plant" during Phase I is depicted at the top of the left panel.

ferential GSR responsivity to "plant," the latter students continued to perform a pedal response to the tone. The S-1 students manifested significantly larger GSRs to the tone following "plant" than the S-2 and S-3 students no longer performing an instrumental response [$F(2,72) = 96.57$, $MS_B = .953$]. Mean GSRs to the tone or its omission for the three subgroups were 1.53, .23, and .21 for Subgroups S-1, S-2, and S-3, respectively. There was no interaction involving subgroups and groups. Thus, discovery S-3 students who did not receive the tone manifested the same low level of responsivity to omission of the tone as did students in discovery S-2 and instructed S-2 and S-3 subgroups receiving the tone following "plant."

Figure 2 shows the mean GSR magnitudes induced by the CW "plant" and the CW "light" in the left and right panels, respectively. Responses to the FWs are omitted for the sake of simplicity. Responses to "plant" obtained during Phase I are sketched at the top of the left panel for comparison purposes. Figure 2 indicates the relatively high level of GSR responsivity evidenced to "plant" by the S-2 students instructed to respond to the tone following "light." That they also showed a marked increment in responding to "light" is evident in the right panel of Figure 2.

Results of the analysis of variance of the GSR magnitudes evoked by the CW "light" and its immediately preceding and following FWs are as follows. There was a significant effect for subgroups [$F(2,72) = 5.28$, $MS_B = 2.891$]. The right panel of Figure 2 indicates the source of the overall subgroup effect. Students in the S-2, switch, subgroup, both discovery and instructed, showed the largest response to "light." Subgroup S-2 was also primarily responsible for the significant Words effect [$F(2,144) =$

30.72, $MS_{W2} = .491$], producing a larger response by far to "light" than to the filler words. Finally, and most relevant, the greater differential responsivity of the S-2 subgroups was responsible for a significant Subgroups by Words interaction [$F(4,144) = 26.03$, $MS_{W2} = .491$]. Table 1 shows the mean GSR magnitudes to the CWs "light" and "plant" and their FWs for the three subgroups. It is apparent that only Subgroup S-2 shows clearly defined differential responsivity to the new CW, "light."

A number of aspects of the results indicate the important effect of significance imparted to the stimuli by the experimenter's instructions. For example, 16 of the 24 instructed S-2 students gave GSRs larger than 2.0 to the first occurrence of the word "light" for which they had been prepared by instructions as opposed to only 1 of the 48 instructed S-1 and S-3 students. Immediate augmentation of the GSR to "light" in the instructed S-2 students is apparent in the right panel of Figure 2. Despite the continuous course of habituation, the magnitude of the GSR to the first presentation of "light" exceeded the magnitude of the GSR to "plant" evoked in the instructed group during the latter part of Phase I. Markedly

Table 1
Mean GSR Magnitude to the CWs PLANT and LIGHT and Their FWs Obtained by the Three Subgroups

Sub-group	Words					
	FW ₁	Plant	FW ₂	FW ₁	Light	FW ₂
S-1	.34	1.06	.24	.39	.43	.42
S-2	.60	1.11	.54	.47	1.31	.42
S-3	.39	.78	.48	.43	.45	.43

Note—Subgroup S-1 continued to perform an instrumental response to the tone following PLANT; the CW was switched to LIGHT as the signal for the tone in Subgroup S-2; Subgroup S-3 ceased to perform an instrumental response.

enhanced responsivity to the first presentation of "light" on the part of S-2 students as compared to S-1 and S-3 students is also apparent in Figure 2. Although mean GSR magnitude decreased on subsequent "light" trials, it remained enhanced for the S-2 students as compared to the mean GSR magnitude induced by "plant" in S-1 students who continued to respond to the tone following it.

Discovery and instructed S-1 subgroups continued to respond to the tone following "plant," whereas the S-2 subgroups either discovered or were instructed that the tone followed "light." It is clear, however, that the S-2 subgroups were more responsive to their CW, "light," than the S-1 groups were to their CW, "plant." These results suggest that the ORs evoked by certain kinds of stimulus changes may lead to the reintroduction of problem solving activity and heightened GSR-ORs to significant stimuli (Lodwig, 1972; Maltzman, 1977). In this connection, it should be noted that the mean GSR for the discovery S-1 subgroup showed a monotonically decreasing function, even though its reaction times, not shown, were asymptotic.

While the noteworthiness or significance of cues established by the experimenter's instructions is an important determiner of the GSR-OR, significance discovered or produced by the participant is also an important determiner of the GSR-OR. An interpretation of classical conditioning on the part of discovery groups students in Phase 1 has previously been offered (Pendery & Maltzman, 1977). Examination of the right panel of Figure 2 is of interest in this respect. It suggests that discovery S-2 students discovered the "light"-tone contingency in one trial, since their maximum GSR occurred on Trial 2 and its magnitude approximates that of the instructed S-2 students at that point.

Figures 1 and 2 indicate that instructed students showed greater differential responsivity to "plant" than did the discovery students in the corresponding subgroups. Figure 1 indicates that discovery S-2 and S-3 students manifested little if any differential responsivity, a finding that appears somewhat surprising. Absence of differential responsivity in the discovery S-3, extinction, subgroup appears to be the consequence primarily of the relatively large GSRs induced by the FW_2 words. Statistical analyses indicated that mean GSR magnitude induced by CW was significantly greater than the responses induced by FW_1 but not FW_2 . A previous semantic conditioning experiment employing the forewarned reaction time procedure employing a range of different CS-UCS intervals reported reliable differential resistance to extinction (Maltzman, Gould, Barnett, Raskin, & Wolff, 1977). However, the latter study indicated that CS-UCS intervals 10 sec and longer did not provide as effective resistance to extinction as did shorter intervals. Lack of differential resistance to extinction in the longer intervals was a

consequence primarily of the large GSRs to FW_2 . Heightened responsivity to the filler word following the CW is probably due to an OR or disparity response to that filler word because the students, all of whom can verbalize the critical stimulus contingency, have come to anticipate the imperative stimulus, the tone. Instead of the tone, another word occurs in extinction. Heightened responsivity to FW_2 does not occur in short CS-UCS intervals because the students can more readily discriminate the short CS-UCS interval from the long interval between the tone or UCS and the subsequent FW_2 . In any case, the present results indicate that the discovery that the CW is no longer a signal for a response, the usual extinction procedure, results in less differential resistance to extinction than do instructions to that effect.

Not shown in either Figure 1 or Figure 2 is the marked effect on the magnitude of the GSRs to the FWs following the instructions interpolated between Phase 1 and Phase 2. Merely interspersing instructions, regardless of the amount of information contained, was associated with the reinstatement of large GSRs when the first FW was presented. For approximately one-third of the students, these GSRs were even larger than those occurring on the first habituation trial prior to the start of Phase I conditioning. Reliable habituation of the GSRs evoked by the FWs occurred following the instructions prior to Phase II, resulting in the typical decrease in responding to innocuous filler words (Pendery & Maltzman, 1977). A general tendency towards habituation was evident throughout the experiment, as illustrated by the decreased levels of responding shown to "plant" in Phase II as compared to the levels of responding to "plant" during Phase I sketched at the top of the left panel in Figure 2.

DISCUSSION

Two-component theories of conditioning of the GSR assume that one component is mediated by cognitive expectancies whereas the second, emotional, component is unmediated. These different components obey different laws in that the mediated component varies with cognitive expectancies whereas the primary emotional component may be contrary to cognitive expectancies (Mandel & Bridger, 1973).

Results obtained in the present study are contrary to the implications of such theories. Instructed S-2 students, told to switch their instrumental response to the tone following "light" rather than "plant," and the S-3, extinction, subgroup, told to cease responding to the tone, both showed significant differential resistance to extinction. They continued to show significant differential GSRs to the CW "plant." The S-2 subgroup, instructed to respond to the tone following "light" manifested GSRs to "plant" that were as large as or larger than those

displayed by S-1 students who continued to make an overt response to the tone following "plant." Since students in the instructed S-2 and S-3 subgroups followed the instructions and did not respond to the tone following "plant" and in the case of S-2 students responded following "light," the differential responsiveness to "plant" was contrary to their cognitive expectancies. While the instructed S-2 and S-3 students showed reliable differential responding to "plant" over the five extinction trials, the discovery S-2 and S-3 students did not. In this sense, the behavioral laws of the instructed students informed of the nonsignificance of "plant," that it was no longer a signal for a response, differed from the behavioral laws governing the responsiveness of the students who were uninformed.

Mandel and Bridger (1973) offer as evidence for two components to the GSR-CR the finding that there is resistance to extinction contrary to cognitive expectancies and the apparent difference in principles for the two components. But they declare that only a highly noxious UCS will lead to the development of the emotional component of the GSR-CR which functions contrary to cognitive expectancies. On the basis of two-component theory, we may conclude that either our imperative stimulus, the tone, was a highly noxious stimulus contrary to our assumption or two-component theory is incorrect. We believe the latter is the case. No student refused to continue in the present experiment, whereas Mandel and Bridger (1973) report that approximately 10% of their participants refused to continue or complained about the noxious nature of their UCS. Evaluative ratings of the tone in the present experiment were essentially neutral. Other semantic conditioning experiments employing the forewarned reaction time procedure also administered semantic differentials (Maltzman, Gould, Barnett, Raskin, & Wolff, 1977; Maltzman, Gould, Pendery, & Wolff, 1977). The results, unpublished, indicate that the tone is rated as neutral or slightly pleasant. Furthermore, the latter experiments employed control groups that received the tone but were not instructed to make an overt response to its occurrence. These control groups failed to show evidence of differential semantic conditioning, suggesting that the tone was not highly noxious (Maltzman, Gould, Barnett, Raskin, & Wolff, 1977; Maltzman, Gould, Pendery, & Wolff, 1977). There is, therefore, no basis for assuming that the resistance to extinction displayed by the instructed students in the present experiment was the consequence of an emotional component of the GSR-CR conditioned by the noxious quality of the imperative stimulus.

Our interpretation of the resistance to extinction manifested by the instructed students rests upon our theoretical interpretation of conditioning of the GSR. Voluntary ORs may be induced by instructions imparting significance to stimuli and by complex

thought processes. In contrast, involuntary ORs are induced by stimulus change, novelty. We assume also that voluntary and involuntary ORs differ in the roles they play during the course of human classical conditioning (Maltzman, 1977; Pendery & Maltzman, 1977).

Luria (1973) and his associates report a variety of different kinds of evidence indicating that voluntary and involuntary ORs differ in their ontogeny, morphology and physiology. For example, GSR manifestations of the OR to simple tones are disrupted in patients with lesions in the anterior or posterior regions of the cerebral cortex. Providing these stimuli with signal value, making them significant by instructing the patients to perform a response to the stimuli, normalizes indices of the OR in patients with lesions in the posterior regions of the cortex. Patients with lesions in the prefrontal cortex, however, fail to produce normal GSR-ORs to stimuli with signal value. Such lesions interfere with the verbal regulation of goal-directed behavior and voluntary ORs even though speech is intact.

In the classical verbal conditioning situation, students told that a stimulus is a signal for an imperative stimulus or a noxious UCS orient differentially to that stimulus upon its initial appearance and subsequent presentations. As a consequence, they manifest a large GSR on the first conditioning trial which is taken as the CR. Students in a conventional conditioning situation typically engage in problem solving activity. During the course of such activity, they discover the significance of the CS as a signal for the imperative stimulus or UCS and orient differentially to it, producing a large GSR-CR (Pendery & Maltzman, 1977). In the former case, the significance of the signal is imparted by the experimenter's instructions. In the latter, the significance is discovered by the participant. The process is basically the same in both cases. Verbal and conventional classical conditioning with a noxious UCS are not the consequence of thought-mediated anxiety responses, but thought-mediated ORs.

In the present experiment, elicitation of a differential GSR-CR as a consequence of instructions was noted in the performance of instructed S-2 students in response to "light"; its persistence contrary to instructions was noted in the performance of instructed S-2 and S-3 students in response to "plant". Semantic generalization of a differential GSR as a consequence of instructions in the absence of CS-UCS pairings has also been demonstrated in the absence of the threat or experience of noxious stimulation (Maltzman, Langdon, & Feeney, 1970).

Underlying these manifestations of the GSR-OR following instructions imparting significance to stimuli as well as conventional classical conditioning is a process which has not received the attention its importance warrants. We assume that Ukhtomsky's conception of a central dominant focus of excita-

bility (John, 1967; Maltzman, Langdon, & Feeney, 1970; Rusinov, 1973) is established by the instructions and serves as a predeterminer of the occurrence of an OR. The conception of a dominant focus emphasizes that the occurrence of a reflex is a function of the history of the system, the condition of the CNS at the moment as a consequence of the past history of excitations. Without reviewing the experimental evidence in support of the conception of dominant foci (John, 1967; Rusinov, 1973), we will suggest only that it may serve as the cortical substrate of mental sets and therefore plays a vital role in the regulation of the direction of thinking.

Kohlenberg (1970) has demonstrated that instructing students not to pay attention to a particular innocuous tone heightens GSR responsivity to that tone relative to other innocuous tones. Inhibition of an OR or ceasing to pay attention is more difficult to induce by instructions than is the initiation of ORs. Instructing a subject to attend to a stimulus will usually evoke a voluntary OR. But instructing a participant not to attend to a stimulus may also result in the evocation of an OR. A voluntary OR may be induced in the latter circumstance because the instructions referring to the critical stimulus impart it with significance. We believe such was the case in the present experiment as well as in the experiments forming the basis for two-component theory (Bridger & Mandel, 1964, 1965; Mandel & Bridger, 1967). In the absence of detailed information concerning the nature of instructions, other cues present in the experimental situation, and most importantly the problem solving activities these induce in the participants, the present interpretation cannot adequately account for the details of the different results obtained in verbal extinction experiments. Particularly pertinent and in need of further investigation are the conditions responsible for the relatively slow extinction in some cases of informed withdrawal of the UCS and rapid extinction in others (e.g., Grings & Lockhart, 1963; Silverman, 1960; Wickens, Allen, & Hill, 1963; Wilson, 1968).

Finally, we wish to emphasize that the present position does not imply that all conditioning of the GSR is a consequence of a voluntary OR produced in the course of successful problem solving. Classical conditioning may occur in the absence of such complex mediations and the discovery of the significance of a cue signifying what leads to what. We know of at least one laboratory demonstration of conditioning of the GSR that yielded resistance to extinction contrary to cognitive expectancies and where intense emotional activity was present (Campbell, Sanderson, & Laverty, 1964). The horrifying experience induced in the latter experiment by means of apneic paralysis rarely if ever occurs in the usual

laboratory experiment with college students. Most classical conditioning experiments with human participants therefore involve the production of voluntary ORs as a consequence of problem solving.

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