DOCUMENT RESUME

ED 025 335 PS 001 496

By- Eriksen, Charles W.

Subjects' Hypotheses, Experimental Instructions and Autonomic "Conditioning".

Michigan Univ., Ann Arbor. Center for Human Growth and Development.
Spons Agency- National Inst. of Child Health and Human Development, Bethesda, Md.
Report No- UM-CHGD-8
Pub Date 30 Nov 65
Note- 15p.
EDRS Price MF-$0.25 HC-$0.85
Descriptors- *Behavioral Science Research, Behavior Change, Cognitive Processes, Conditioned Response, Discrimination Learning, *Language Role, *Learning Processes, Verbal Learning, *Verbal Operant Conditioning, Verbal Stimuli

Research on learning and conditioning suggests that verbal response modification does not occur in the absence of the subject's ability to define verbally (1) the response-reinforcement relationships and (2) his intention to change his behavior in the direction of reinforcement. This seems to be true for operant conditioning of verbal behavior, operant conditioning of skeletal nonverbal responses, and perceptual learning of correlated cues. Research in the area of conditioning of autonomic responses shows consistently that subjects who are aware of the stimulus-negative reinforcement condition manifest greater autonomic response conditioning than subjects who are not aware of the experimental conditions. (WD)

Subjects' Hypotheses, Experimental Instructions and Autonomic "Conditioning"

Charles W. Eriksen

Learning and/or conditioning in the human adult does not occur to any significant extent in the absence of verbalizable cognitive concomitants. I have reached this conclusion on the basis of not only my own research but in very important measure upon the extensive work of Dulany and Spielberger. They and their associates have intensively and systematically investigated verbal operant conditioning and in my opinion their results demonstrate quite unequivocally that verbal response modification does not occur in the absence of the Ss' ability to define verbally the response-reinforcement relationships, at least at the level of correlated hypotheses. Further, Dulany's work strongly suggests that verbalizable knowledge of response-reinforcement contingencies is, in itself, not sufficient to produce behavior change. The Ss must also verbalize an intention on their part to change their behavior in the direction of reinforcement.

It is true, of course, that the work of these investigators has dealt exclusively with operant conditioning of verbal behavior. And the very fact that the operant response is itself verbal may somehow prevent its blind or automatic shaping by reinforcement without the S being "aware" of the process. However, in my laboratory we've been similarly unsuccessful in producing operant conditioning of skeletal nonverbal responses without the Ss' awareness. Nor have we been successful in getting Ss to learn to use an extraneous but correlated cue on perceptual tasks without their being aware of the nature of the cue.

In one experiment (Paul, Eriksen, and Humphreys, 1963) we attempted operant conditioning of face, hand, or foot movemements through the use of a strong primary reinforcement. The Ss were placed in a heat-humidity chamber and while engaged on an irrelevant task, were reinforced with a 10 sec. draft of cool air to the face and neck upon the occurrence of a preselected movement. While a certain proportion of the Ss showed "operant conditioning" they were without exception those Ss who were able to verbalize the relationship between their behavior and the reinforcement. The remaining Ss did not differ significantly nor

appreciably from a control group who received the same number and distribution of reinforcements but where the reinforcement was not contingent on any specific response.

Following Brunswik's (1943) theorizing on perceptual learning and perceptual constancies, we have attempted to obtain learning of perceptual contingencies in human adults in the absence of their verbal awareness of these relationships (Eriksen and Doroz, 1963). In one experiment Ss were asked to judge which member of a pair of colored lines was longer under the ostensible purpose of studying color illusion on line length. Unknown to the Ss one color when it occurred was invariably associated with the longer line of the pair. Despite a large number of acquisition trials Ss, who at the end of the experiment were unable to verbally state the association of color and line length, showed no use of the color cue in their judgments in the instances where the cue color line was paired with a line of equal length. On the other hand, subjects who could verbalize the contingency showed a significant and appreciable bias in judgments for the line of the contingent color when confronted with pairs of equal lines. Similar results were obtained in a second experiment where a supposedly extraneous but correlated structural cue was associated with affective judgment of stimuli.

While operant conditioning of verbal and nonverbal behavior and even perceptual learning of correlated cues does not seem to occur in the human adult in the absence of some type of cognitive mediation, the area of conditioning, particularly of autonomic responses, would intuitively seem more promising. In fact, experiments by Diven (1937) and Haggard (1943) have been widely interpreted in text books as having demonstrated unconscious conditioning of anxiety.

Lacey and Smith (1954) have pointed out some serious methodological and analytic errors in both the Diven and Haggard studies, deficiencies which render a conclusion of unconscious conditioning extremely equivocal. In an experiment designed to correct the methodological deficiencies, Lacey and Smith administered a chained word association procedure to their Ss in which the stimulus word list contained a number of repetitions of the word 'cow' and the word 'paper'. One group of Ss was always administered an electric shock following chain association to the word cow and the remaining Ss were shocked following their chained

associations to the word paper. Anticipatory changes in the Ss' heart rate that occurred during associations were analyzed for evidence of autonomic conditioning relative to verbal awareness. In their study Ss were classified as unaware if they were unable to verbalize the specific contingency between shock and the word cow (paper). Their questioning of Ss on this point, however, may not have elicited all the information available to the Ss' verbal report. It is quite possible that the Ss if asked, could have given several or more words which they were quite confident were not shocked. It seems reasonable to assume that the Ss' change of heart rate to a stimulus word which he is confident will not be followed by a shock will be less than to words of which he is still unsure (potentially dangerous). It also would seem reasonable to expect the actual shock word in general to be among those that S was uncertain of rather than among the words he was rather confident were not followed by shock, while a semantically dissimilar word would more likely be in the latter category.

The evidence that previous studies have found on conditioned generalization to words in the same semantic classification as the shocked word might actually represent not generalization so much as a beginning on the part of the S to learn to discriminate the general area where shock occurs. Thus Ss in the cow shock group would tend to classify rural words in the uncertain category and nonrural words, including paper, in the confident not-shocked category. The reverse would occur for the paper shock Ss. In view of this possibility it becomes apparent that the control measure used to determine whether conditioning is occurring becomes quite crucial.

In the Lacey and Smith study conditioning was computed by taking each S's heart rate score to cow and subtracting from it his heart rate score to the word paper. It should be readily apparent that this method of computing conditioning is apt to lead to a spurious appearance of precise discrimination by heart rate. To show that conditioning of heart rate is more specific than the stage of the S's verbal awareness, an analysis is required that demonstrates whether on not the S shows greater autonomic conditioning to the actual shock word than he does to the other words to which he verbalizes uncertainty as to whether they were followed by shock.

We repeated the Lacey and Smith experiment in its essential details (Chatterjee and Eriksen, 1960) using the GSR rather than heart rate as the autonomic response and more intensively investigating the Ss' verbalizable hypotheses concerning shock. At the conclusion of the experiment each of the stimulus words was read to S and he was asked to rate how confident he was that he had or had not been shocked to this particular word. When the Lacey and Smith method of classifying awareness was used we were in general successful in verifying their result provided their method of computing conditioning was employed. However, if GSRs to the shocked stimulus word were compared with the Ss' GSRs to other words he thought he had been shocked to or might have been shocked to, there was no evidence of conditioning. The GSR was no greater to the actual shocked word than to other words the S verbalized as being potentially dangerous. In other words, the Ss' GSRs were no more precise in discriminating than were his verbalizable hypotheses. In fact the two showed a high degree of correspondence.

Our conclusions from the above study are in close agreement with those of Branca (1957) who carried out a conditioning and generalization study of the GSR with shock as the UCS. He concluded "expectation of shock as a painful or fearful experience was necessary and sufficient to produce responses to the experimental and generalization stimuli in this experiment and such expectancy was the result of awareness of the existing relationships between the experimental stimuli and experience with the unconditioned stimulus" (p. 549).

In the above experiments the Ss' hypotheses or expectancies were allowed to develop during the experimental procedure. The effect of a S's cognitive expectancies upon autonomic conditioning is even more dramatic when they are experimentally manipulated before the conditioning procedure. In the next experiment (Chatterjee and Eriksen, 1962), Ss were asked to chain associate to a twelve-item word association list. The list was repeated over seven times, for the conditioning trials, each repetition a different random ordering of the words, and three more repetitions of the list were given during extinction. The Ss were assigned to one of three groups. Group I, the informed group, were told prior to conditioning that an electric shock would follow one particular word but that no other words would be followed by shock. They were further told when the extinction trials began

there would be no further shock. Group II, the partially informed Ss, were told that following the presentation of a particular word in the list would always be a shock and that each of the remaining words in the list would be followed by one shock sometime during the trials. They were further told that during the latter part of the experiment all the shocks would cease. Group III, the uninformed Ss, were told that a certain number of shocks would be administered at certain points in time during the experiment but that E could not tell them beforehand when the shocks would come. These different instructions for the three groups were designed to lead to different cognitive expectancies concerning conditioning arrangements. In keeping with these differences in instructions Group I Ss were given only seven shocks while Ss in Groups II and III received 18 (seven to the word boat and one each to the remaining II words presented during the conditioning trials). During conditioning and extinction trials heart rate was continuously monitored with a Grass Model 5-P4 polygraph.

Following the conditioning and extinction trials all Ss in Group I were able to verbalize readily that shock had followed only the critical word boat. The Ss in Group II who had received a total of 18 shocks were also able to readily verbalize that they had discriminated the word boat from the remaining words by the third or fourth presentation of the word boat. On the other hand, none of the Ss in Group III were able to verbalize clearly and unequivocally that shock had followed boat nearly all the time during the conditioning trials and occurred only once to each of the remaining words. However, a post facto attempt was made to subclassify the Group III Ss based upon the frequency of reported shocks to the word boat relative to the other II words in the stimulus list. Group IIIa consisted of those Ss who reported they thought they had received three or more shocks to the word boat and not more than two shocks to any of the remaining words. Group IIIu lacked even this minimal discrimination.

A rigorous test of the precision of conditioning is to plot the percent of Ss in each experimental group who gave the maximum positive cardiac response difference to the word boat in each block of trials. The results of this measure are seen in Fig. 1. It is

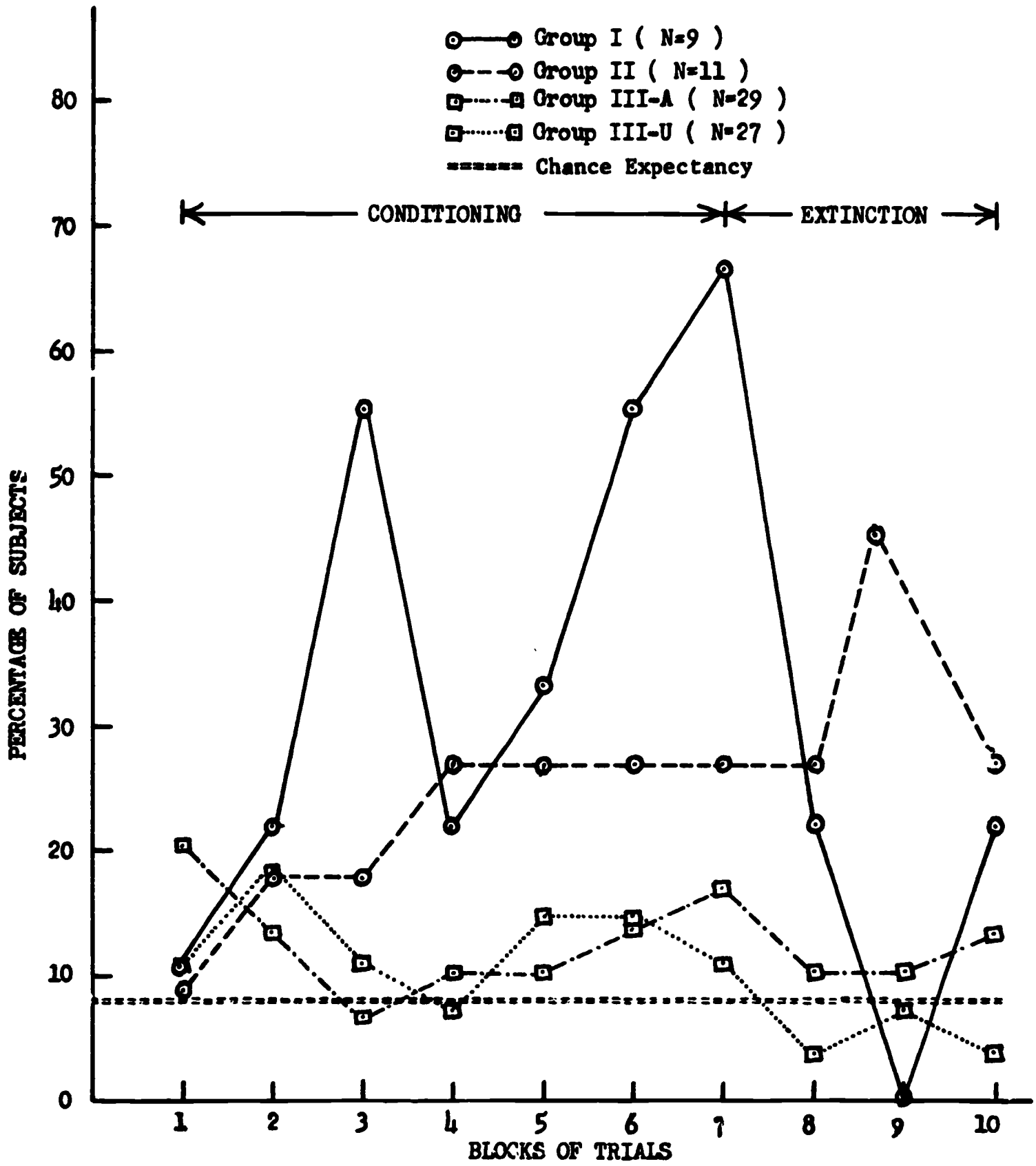

Fig. 1. Percentage of subjects whose "maximum response difference" follows the stimulus boat.

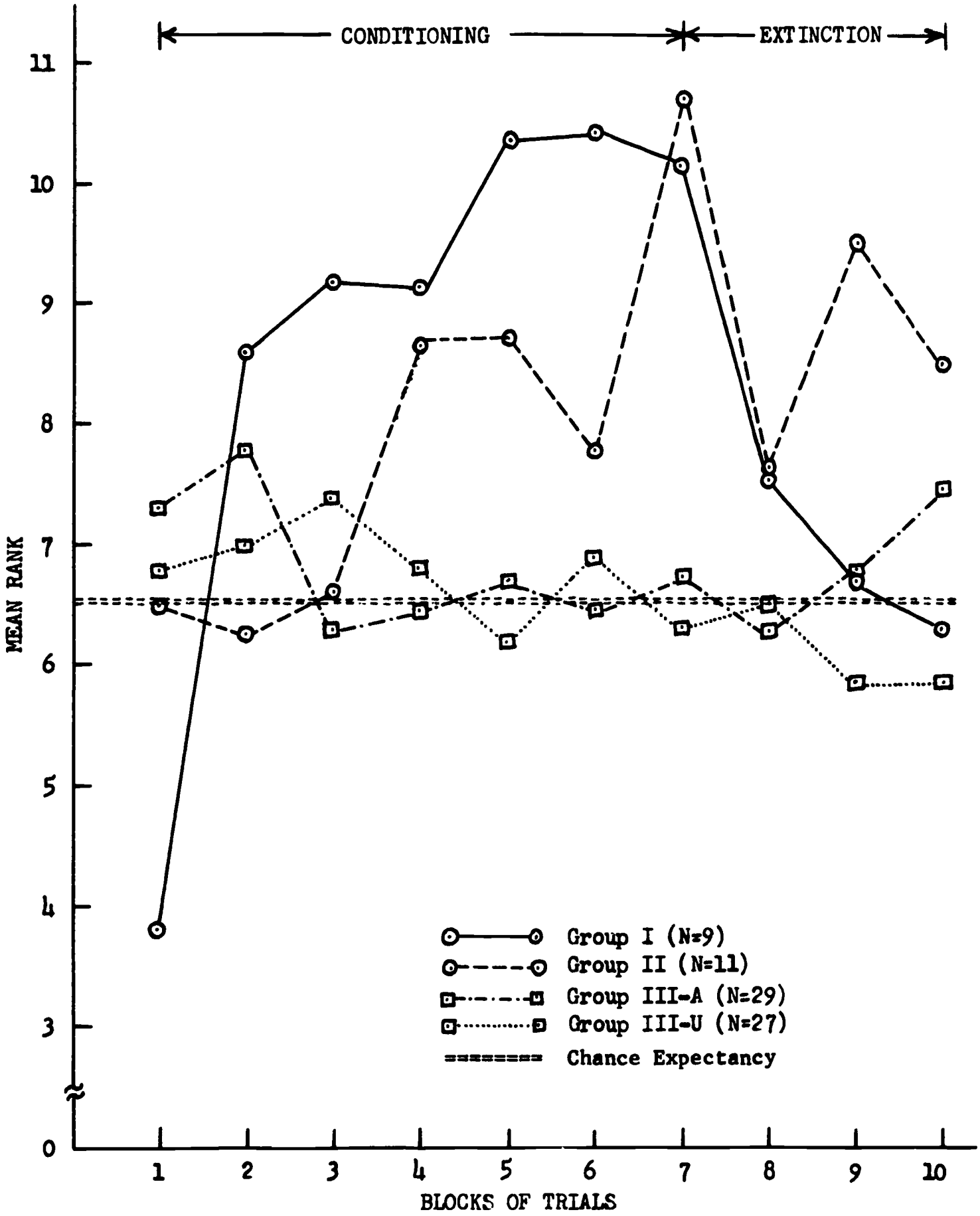

Fig. 2. Mean rank of "cardiac response difference" which follows the stimulus boat.

apparent that the conditioning varies from group to group. It's greatest in Group I, somewhat less so in Group II, and in Groups IIIa and IIIu the curves indicate that no conditioning occurred.

A somewhat less severe criterion of conditioning yields essentially the same results. Here the magnitude of the cardiac response to each word in a trial block was rank-ordered from small to large for each S and then the rank value for boat was averaged through Ss by group and trial block. Curves obtained in this way are shown in Fig. 2. Again Groups I and II show evidence of conditioning whereas Groups IIIa and IIIu do not.

The data in Figs. 1 and 2 are also quite informative concerning cognitive expectancies upon extinction. As will be recalled, the Group I Ss were informed prior to beginning the extinction trials whereas the other two groups were not. As is seen, extinction is present in the Group I Ss on the very first extinction trial as opposed to the noninformed Ss in Group II.

These results show quite clearly the effect of information or instructions given to Ss upon their heart rate responses to the various stimuli. We can ask a reverse question as to whether differences in heart rate behavior will predict Ss' verbalizations. To answer this question the data of the Group III Ss are available. The Ss in this group were asked to report the number of shocks they thought they had received to each of the stimulus words during the experimental trials. Our previous analyses suggest that words having a large cardiac response difference should have a higher number of reported shocks than words with a low cardiac response difference. To test this possibility the word giving the greatest cardiac response difference on the seventh conditioning trial was selected for each S along with the word producing the smallest cardiac response difference. The number of reported shocks to these two words was determined for each S in Group III. The mean number of shocks reported to the word with greatest cardiac response difference was 1.37 as compared with 1.03 for the word with the smallest difference. A t-test for correlat scores gave a value of 1.71, significant at the .05 level for a one-tailed test.

The remaining experiment I have to report is of classical conditioned discrimination using a high and a low frequency tone as the CS and/or neutral stimulus, the GSR as the

conditioned response and electric shock as the UCS. Each S experienced 12 occurrences of the CS and 12 of the neutral stimulus during conditioning in which the CS had a duration of 5 secs. and the UCS was presented .5 secs. after cessation of the CS tone. The Ss were randomly divided into an informed and an uninformed group for the conditioning trials. The informed Ss were told that during the experiment as they sat in the sound-treated room, they would be exposed to two different tones on different occasions. The high (low) tone would always be followed by shock whereas the low (high) tone would never be followed by shock. The uninformed Ss were merely told that they would be shocked during the experiment and their task was to sit as quietly as possible in the experimental apparatus.

In Fig. 3 the GSR response in conductance units is shown to the neutral stimulus and to the conditioned stimulus summed through the 12 conditioning trials by informed and uninformed groups. Both groups show a greater GSR to the CS than to the neutral stimulus but the difference between responsiveness to the neutral and conditioned stimulus is much greater in the informed group. These Ss show less reactivity to the neutral stimulus than do the uninformed Ss and greater reactivity to the CS.

In Fig. 4 GSRs to the CS and neutral stimulus are shown for the informed and uninformed groups as a function of conditioning trials. Both groups show a general adaptation of the GSR as a function of trials but the informed group is the only one that shows a clear difference in responsiveness to the CS and the neutral stimulus. In fact, the largest difference between CS and neutral stimulus response occurs on the very first trial for these Ss. However there is still an appreciable difference in GSR for the Ss in the informed group on the last conditioning trial.

Upon completion of the twelfth conditioning trial, half the Ss in each of the two groups were informed of the reversal between the CS and the neutral stimulus. In other words, the informed Ss were told that from then on the previously neutral stimulus would now be followed by shock whereas the previous CS would no longer be shocked. Figure 5 shows the effects of this reversal of conditioning as a function of whether or not the Ss were informed of the reversal. As is seen, when the results are summed through the 12 reversal conditioning trials the Ss who were informed of the reversal show a clear

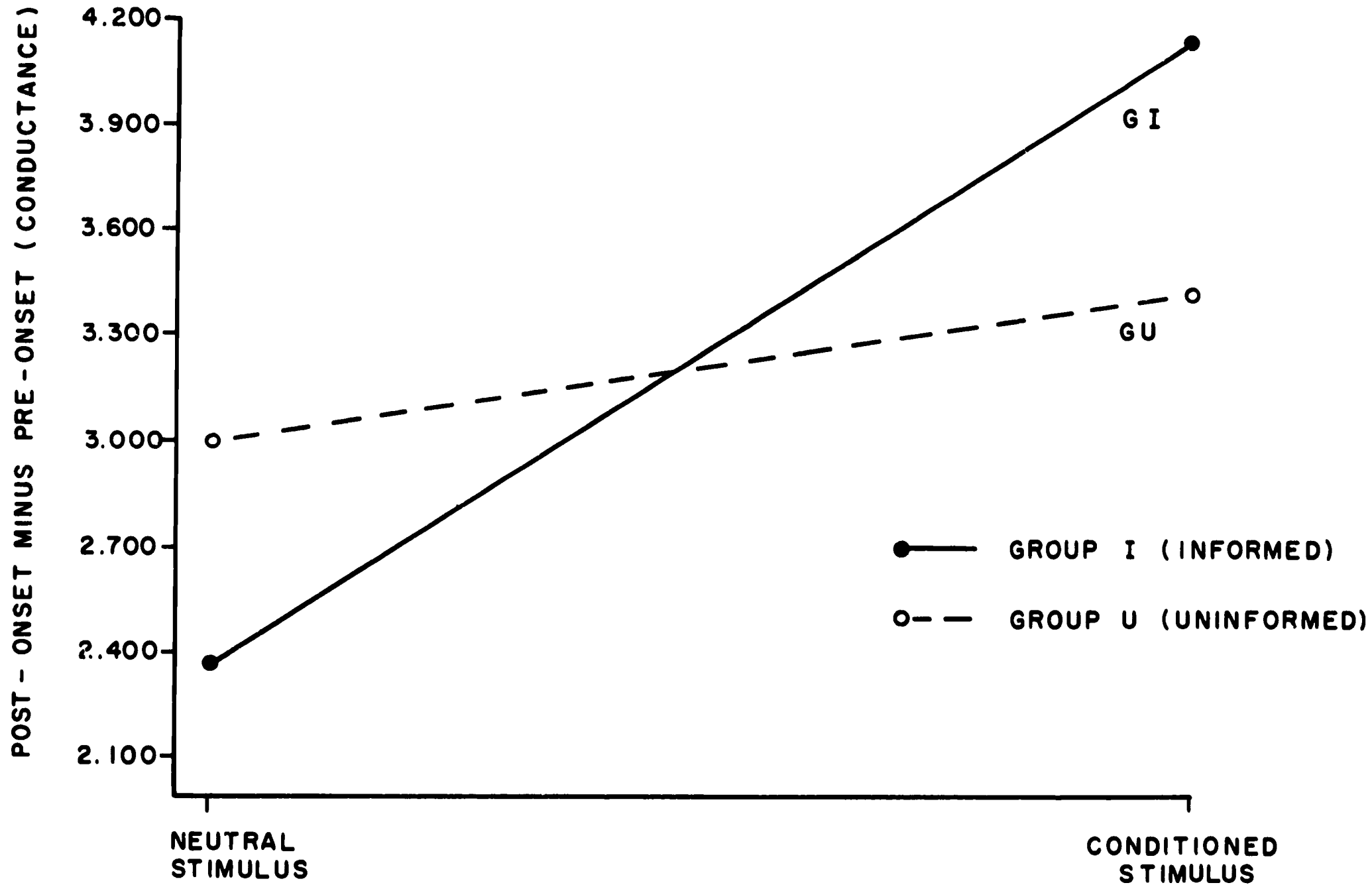

Fig. 3. The GSR to the neutral stimulus and conditioned stimulus summed through the twelve conditioning trials by informed and uninformed groups.

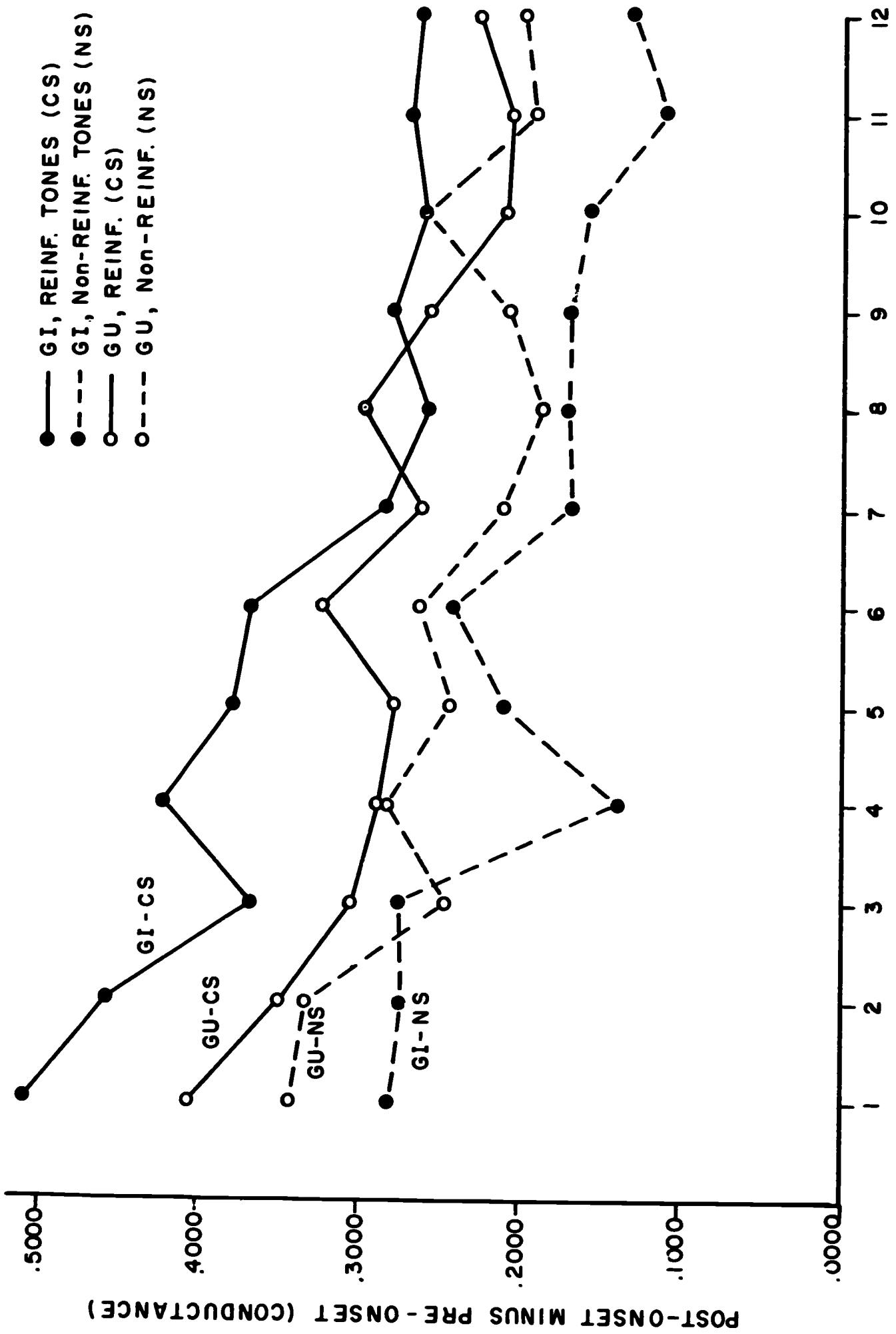

Fig. 4. The GSR to the conditioned and neutral stimulus for the informed and uninformed groups as a function of conditioning trials.

discrimination between the now neutral stimulus and the new CS. The uninformed Ss show no evidence of a discrimination. They also show a much greater reactivity to both stimuli than do the informed Ss.

In Fig. 6 GSRs to the neutral and CS are shown for the informed and uninformed Ss for each of the twelve reversal of conditioning trials. The results are quite similar to those obtained for conditioning. Again, informing the Ss results in a clear discrimination in GSR responses between the CS and neutral stimulus, a difference that is apparent on the first reversal trial and which persists throughout the twelve trials. The uninformed Ss on the other hand show little or no evidence of a discrimination between the two tone signals. They react with appreciably greater GSRs to the neutral stimulus than do the informed Ss which might be anticipated since in keeping with their lack of information, they would tend to perceive this signal as potentially shock-producing.

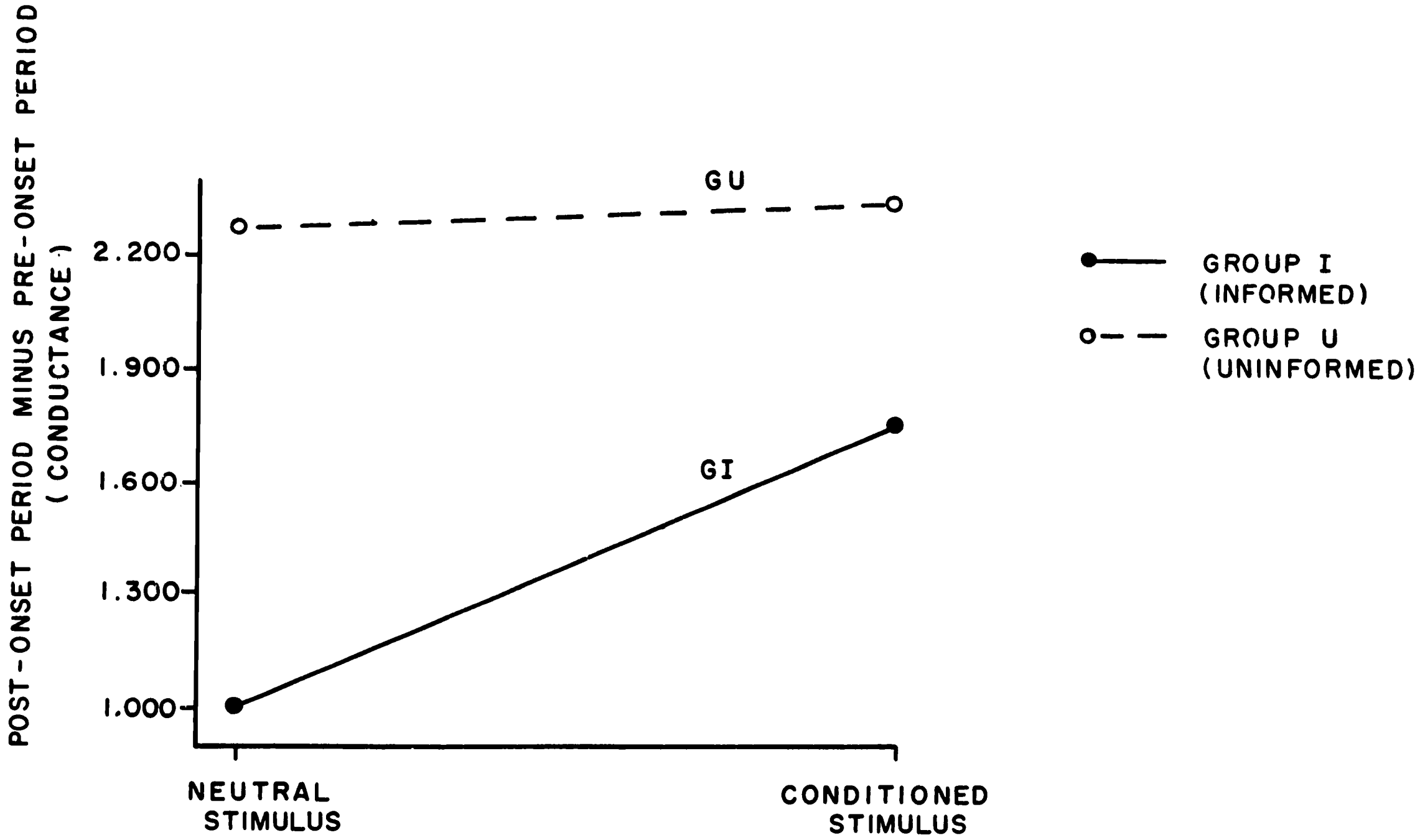

Fig. 5. The effects of reversal of conditioning as a function of whether or not the subjects were informed of the reversal.

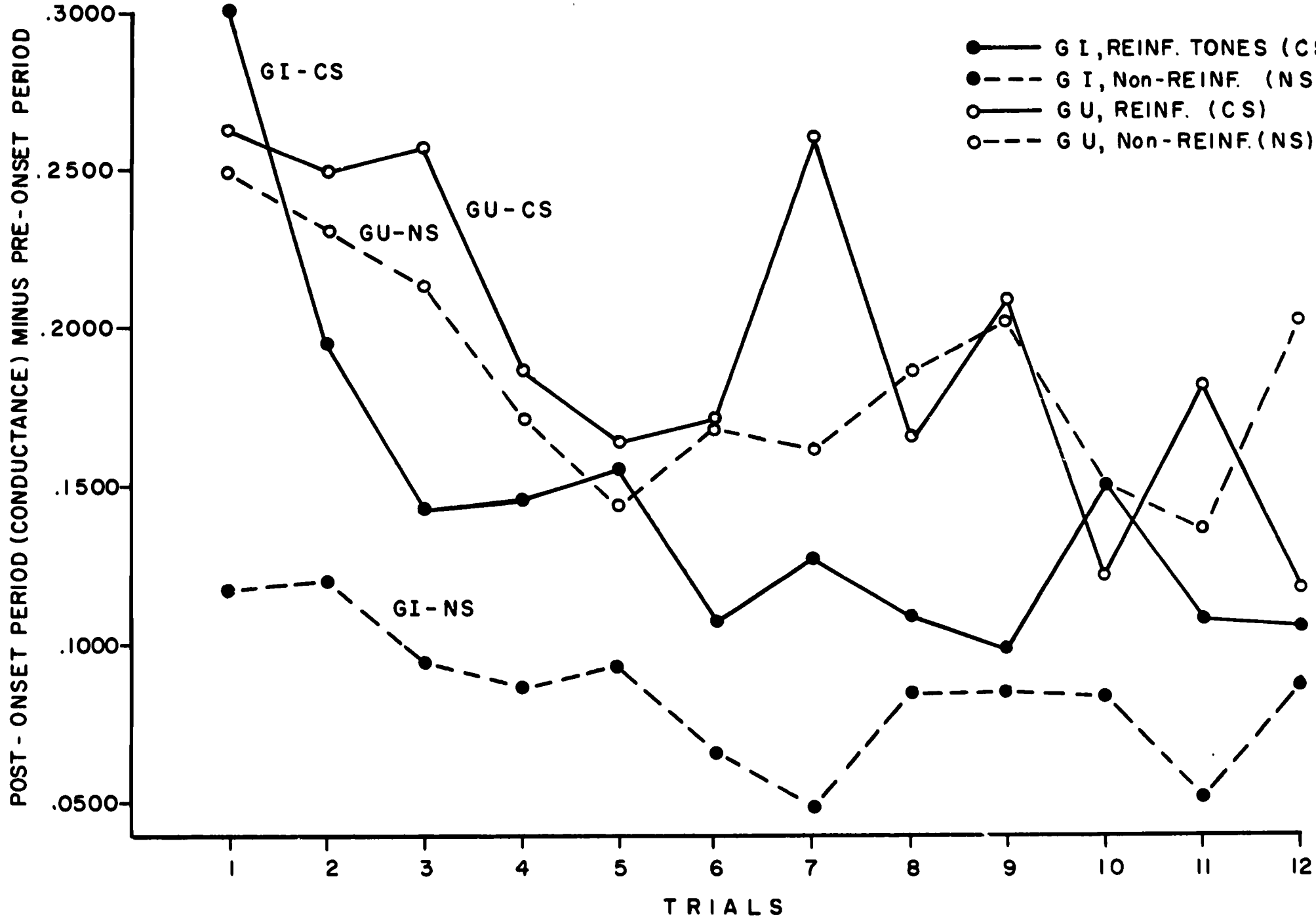

Fig. 6. GSR to the neutral and conditioned stimulus for the informed and uninformed subjects for each of the twelve reversal of conditioning trials.

References

Branca, A. A. Semantic generalization at the level of the conditioning experiment. Amer. J. Psychol., 1957, 70, 549.

Brunswik, E. Organismic achievement and environmental probability. Psychol. Rev., 1943, 50, 255-272.

Chatterjee, B. B. and Eriksen, C. W. Conditioning and generalization of GSR as a function of awareness. J. abnorm. soc. Psychol., 1960, 60, 396-403.

Chatterjee, B. B. and Eriksen, C. W. Cognitive factors in heart rate conditioning. J. exp. Psychol., 1962, 64, 272-279.

Diven, K. Certain determinants in the conditioning of anxiety reactions. J. Psychol., 1937, 3, 291-308.

Eriksen, C. W. and Doroz, L. Role of awareness in learning and use of correlated extraneous cues on perceptual tasks. J. exp. Psychol.,1963, 66, 601-608.

Haggard, E. A. Experimental studies in affective processes: 1. Some effects of cognitive structure and active participation on certain autonomous reactions during and following induced stress. J. exp. Psychol., 1943, 33, 257-284.

Lacey, J. L. and Smith, R. L. Conditioning and generalization of unconscious anxiety. Science, 1954, 120, 1045-1052.

Paul, G. L., Eriksen, C. W., and Humphreys, L. G. Use of temperature stress with cool air reinforcement for human operant conditioning. J. exp. Psychol., 1962, 64, 329-335.

Reference in Dr. Birch's Discussion

Luria, A. R. The genesis of voluntary movements. In N. O'Connor (Ed.), Recent Soviet Psychology. Liverright Pub. Corp., New York, 1961, Pp. 165-185.