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Conditioning without awareness—again

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Discriminative conditioning of the galvanic skin rresponse, achieved under masking conditions, was shown to be a function of interstimulus interval. Tests of awareness, with both recall and recognition measures, indicated that subjects were conditioned in spite of not reporting awareness of the CS-US contingency. A number of problems in regard to the interpretation of the data concerning the relationship of conditioning and interstimulus interval and in regard to the general question of the relationship between conditioning and awareness were discussed.

The purpose of this study was to investigate once again the relationship between conditioning and awareness. Although early experiments reported GSR conditioning without awareness (Chaterjee & Eriksen, 1960; Diven, 1937; Haggard, 1943; Lacey & Smith, 1954), Eriksen (1960) criticized these studies for the manner in which awareness was checked, namely, using open-ended verbal reports rather than deeper probes. He concluded that "learning without awareness in human subjects is not adequately proven [p. 298]."

Later studies (Chaterjee & Eriksen, 1960; Dawson, 1973; Dawson & Bifermo, 1973; Doctor, 1971; Fuhrer & Baer, 1965; Shean, 1969) used a variety of conditions to create different degrees of awareness as well as to test for the presence of awareness and supported the proposition that there is no conditioning without awareness. Dawson (1973) concluded that the discrepancy between those studies that achieved conditioning without awareness and those that failed to achieve conditioning without awareness resulted from the different types of postconditioning questionnaires used to measure awareness. Those studies using recall questionnaire generally report conditioning without awareness, while those studies using recognition questionnaires generally fail to find conditioning without awareness. Dawson and Rearden (unpublished manuscript, Dawson, 1973) report that the recall questionnaires are significantly less valid than the recognition questionnaires. "Considered in its entirety the evidence reviewed . . . fails to prove the existence of human classical conditioning in the absence of contingency learning [Dawson, 1973, p 85]."

The present study, using both types of questionnaires and a masking task, sets out again to determine whether GSR conditioning can be obtained without awareness. It was hoped that awareness could be manipulated by using different interstimulus intervals (ISI) for different groups, and further, that different levels of awareness could be elicited by using a "Guttman type" postconditioning questionnaire. Specifically, the predictions to be tested are: (1) There will be an inverse relationship between conditioning performance and ISI, i.e., longer ISIs will result in poorer conditioning. (2) The above results, if achieved, can be accounted for by finding more unaware subjects in the longer ISI groups than in the shorter ISI groups. (3) Irrespective of the effectiveness of the ISI manipulation on awareness, there will be a positive correlation between degree of awareness and conditioning.

Although a significant correlation cannot be used to infer a causative relationship, the *absence* of such a correlation does weigh heavily *against* such an inference. In other words, a positive correlation is a requirement, although not a proof, of a causal relationship between awareness and conditioning.

METHOD

Subjects

Subjects were 36 volunteer students, 18 males and 18 females,

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from various faculties of Bar-Ilan University. The mean age was 26 years, with a range between 18 and 30.

Apparatus

Stimulus materials consisting of nonsense syllables on 35-mm slides were individually projected onto a 50 x 50 cm screen. The 11 syllables were randomly selected from a list of nonsense syllables of 0% association value (Homzie, Weiner, Schwartz, & Waters, 1969).[1] A 24-W yellow bulb was at the bottom center of the screen and served as a warning signal. The US, a very loud noxious tone of 3800 Hz, was produced by a Heathkit Model IG-72 audiogenerator. The US was delivered to subject through a set of 600-ohm earphones.

GSR was measured with a Stoelting psychogalvanoscope using two Scherring Type 14-R stainless steel electrodes. The electrodes were coated with conductive jelly (Fukuda Electro Corporation) and placed on the underside of the first phalange of the index finger and little finger of the left hand.

Procedure

Subjects were randomly divided into three groups of 12, with an equal number of males and females in each group. The groups differed only in respect to ISI: 8.5, 12.5, and 16.5 sec. ISI was defined as the time between the onset of the CS and the onset of the US.

Each subject was brought into the room and seated in front of the screen. GSR electrodes were attached and the following instructions, designed to mask the CS-US contingencies, were presented: "Sit quietly and look at the screen in front of you. You are going to see words, and you are asked to give a free association or free associations to every word. When the lamp in front of you is lit, it will be a signal for you to stop thinking about an association. Then, wait for the next word."

During the next 5 min subject remained undisturbed in his seat while experimenter nulled the apparatus. At the end of this 5-min period, the first nonsense syllable was presented. Each subject was given 55 trials consisting of five presentations of 11 different syllables. The order of presentation was determined randomly with the restriction that the same syllable not appear on successive trials. Projection time for the syllable was 0.5 sec. All subjects received the same order of stimulus presentation.

Depending on subject's group assignment, at the end of 7.5, 11.5, or 15.5 sec, the yellow light beneath the screen was activated for 5 sec. If the previous syllable was the positive CS, then 1 sec after light onset the US was initiated. The US remained on for 4 sec and terminated with the light. The time between successive presentations of syllables was 40 sec. Programming was accomplished with Massey-Dickenson timing units.

In each group, half of the subjects were conditioned to the syllable DAQ, and their response compared to QOX, which was one of the syllables not followed by the US. For the other half of each group, QOX was followed by the US and compared to DAQ, which was not followed by the US.

GSR was recorded as the maximum deflection of the meter needle on the "reaction unit" scale of the Stoelting instrument during the 7 sec following stimulus projection. Analyses were performed on the differences between the maxima to the CS+ syllable and its immediately preceding CS– control syllable.

At the end of the session, subject was given three questions to answer. The questions were presented separately, from the general (recall) to the specific (recognition): (1) Please write everything you know about the construction of the experiment. (2) Please write down after which word you heard the tone. (3) Look at the words in front of you and mark the word following which you heard the tone.

For the last task, all 11 syllables were presented in a list. The order of the list was random and the same for all subjects.

RESULTS

An examination of the questionnaire indicated that the experimental manipulations for producing different degrees of awareness were not effective. Only five subjects could be labeled as aware. Three subjects, completely aware, mentioned the CS+ syllable as associated with the tone in their first answer and in the two following answers. Two other subjects, labeled as partly aware, correctly answered Questions 2 and 3, but did not mention the CS+ syllable in their first answer. All of the five subjects were in the group conditioned to the QOX syllable, three were in the 12.5-sec ISI group (two completely and one partly aware), and two were in the 16.5-sec ISI group (one completely and one partly aware).

The GSR difference scores were analyzed using a 2 by 3 by 5 analysis of variance, with main factors being CS word (QOX+-DAQ–, DAQ+-QOX–), ISI (8.5, 12.5, and 16.5-sec), and trials. Only unaware subjects were used in the analysis. There were no significant differences between the counterbalanced CS words ($F = 1.71$, $df = 1/25$, $p > .05$).

Trials effect was significant ($F = 53.64$, $df = 4/100$, $p < .001$), with the first trial being significantly lower than the subsequent trials (Scheffes' test, $p < .001$). The main effect of ISI was also significant ($F = 47.61$, $df = 2/25$, $p < .001$), as well as the interaction of ISI by Trials ($F = 2.29$, $df = 8/100$, $p < .05$). All of these effects are clearly illustrated in Figure 1, which shows response to CS+ and CS– separately, collapsed across syllable type.

DISCUSSION

In regard to the first hypothesis, it is quite evident that there was indeed poorer conditioning with longer ISIs. This follows the usual pattern reported in the literature (Kimble, 1961). It should be noted that Figure 1 was drawn excluding the aware subjects. However, inclusion of these subjects has practically no effect on the shapes of the curves nor on the conclusions reached from the statistical analyses.

Concerning the second hypothesis, however, differences in conditionability as a function of ISI cannot be accounted for by differences in awareness. The analyses indicate a significant ISI effect on conditioning even when no aware subjects, as measured by the three questionnaires, are included. On the other hand, the ISI manipulation was singularly ineffective in producing different degrees of awareness. This may simply attest to the overriding effect of the masking task which was employed in this experiment.

The third hypothesis concerning the correlation between the degree of awareness and conditioning could not be reasonably tested because of the few subjects (five) who exhibited any degree of awareness. It should be noted that even these few subjects were distributed contrary to the expected direction, i.e., five aware subjects in the middle– and long–ISI groups and no aware subjects in the short-ISI group.

The fact, then, is that GSR conditioning without awareness was demonstrated even when awareness was measured with a recognition test. This directly contradicts the conclusions of

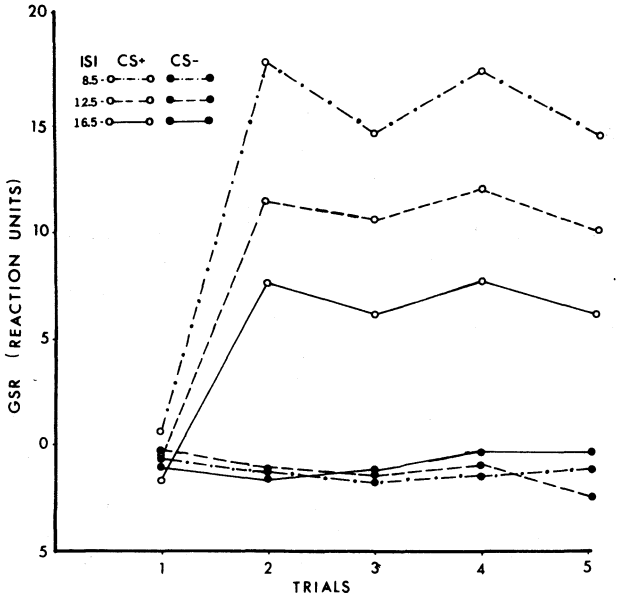

Figure 1. GSR scores to CS+ and CS– over five tirals as a function of interstimulus interval.

Eriksen (1960) and Dawson (1973). The contradiction might be accounted for by interactions with powerful masking conditions. Another possibility is that the questionnaire was not a sensitive instrument for measuring awareness. This is supported by the findings of Chaterjee and Eriksen (1960), who demonstrated that GSR conditioning of "unaware" subjects occurred when awareness was measured by an open ended recall questionnaire but did *not* occur when awareness was measured by a more detailed recognition questionnaire. In the latter case, they presented each CS to the subject and asked him to state "no, yes, uncertain, or whatever you think concerning the probability of the particular word having been followed by shock [p. 397]." The questionnaire employed in the present study would appear to approach the latter condition, but the fact remains that it did not yield differences, while the Chaterjee and Eriksen questionnaire did yield differences.

A second difficulty with the current experiment concerns the measure of GSR conditioning, especially the lack of specificity of the units of measurement. In this regard, it should be noted that there is still not a consensus on the proper units to be employed in GSR work. That the measurements used were reliable is amply illustrated by both the differences in scores between CS+ and CS– and the orderly differences as a function of ISI. In regard to the latter point, however, it is possible that the procedure of measuring the maximum change within 7 sec following the CS onset penalized the long-ISI groups. There may have been a pre-UCS response a few seconds prior to the US (Lockhart, 1966). This pre-UCS response, then, would have been included in the dependent variable measure for the shorter ISI group but not for the longer ISI group.

All of this makes the results in regard to awareness and ISI somewhat ambiguous. What remains, however, is a strong illustration of very effective GSR discrimination learning under trace conditioning procedures and a masking task. As such, the method may well prove a valuable tool in further investigations that use a GSR discrimination paradigm.

In this respect, it should be noted that conditioning was very rapid, reaching asymptote after the first CS-US pairing. It remains an interesting possibility that awareness is necessary for acquisition of the CR but is not a requirement for its maintenance. It would follow from this that, if the conditioning procedure was terminated after the first trial, and the questionnaires administered, subjects would have exhibited a high degree of awareness and a significant positive correlation between conditioning (as measured on the *subsequent* trial), and awareness would have been obtained. Dawson and Bifermo (1972) report this type of finding with a somewhat different procedure.

Perhaps the question of whether classical conditioning can occur without awareness [or their semantic counterparts–contingency learning (Dawson, 1973) and cognitive expectancy (Mandel & Bridger, 1973)] should be rephrased. Instead, efforts should be concentrated on defining the operations which effect classical conditioning, if indeed classical conditioning is the focus of interest, or on the operations that effect awareness, if that happens to be the interest. Conditioning and awareness, as dealt with in this area of research, are organismic states, which no doubt with certain procedures can be shown to be correlated. The preconditions for creating these states, at least for classical conditioning, are well established, but for awareness much less so. It is possible that some of the variables resulting in classical conditioning may also produce awareness (or vice versa), an example of the "third variable" interpretation of correlated data. On the other side, might it not be also possible that conditioning causes awareness?

REFERENCES

Chaterjee, B. B., & Eriksen, C. W. Conditioning and generalization of GSR as a function of awareness. Journal of Abnormal and Social Psychology, 1960, 60, 396-403.

Dawson, M. E. Can classical conditioning occur without contingency learning? A review and evaluation of the evidence. Psychophysiology, 1973, 10, 82-86.

Dawson, M. E., & Bifermo, M. A. Concurrent measurement of awareness and electrodermal classical conditioning. Paper read at 12th Annual Meeting of the Society for Psychophysiological Research, Boston, 1972.

Diven, K. Certain determinants of the conditioning of anxiety reactions. Journal of Psychology, 1937, 3, 291-308.

Doctor, R. M. Bias effects and awareness in studies of verbal conditioning. Journal of Experimental Reserach in Personality, 1971, 5, 243-256.

Eriksen, C. W. Discrimination and learning without awareness: A methodological survey and evaluation. Psychological Review, 1960, 67, 279-300.

Fuhrer, M. J., & Baer, P. E. Differential classical conditioning: Verbalization of stimulus contingencies. Science, 1965, 150, 1479-1481.

Haggard, E. A. Experimental studies in affective processes: I. Some effects of cognitive structure and active participation on certain autonomic reactions during and following experimentally induced stress. Journal of Experimental Psychology, 1943, 33, 257-284.

Homzie, M. J., Weiner, J., Schwartz, J., & Waters, W. Transfer of training as a function of intra-list response similarity and degree of original list learning. Psychonomic Science, 1969, 17, 243-245.

Kimble, G. A. *Hilgard and Marquis' conditioning and learning.* New York: Appleton-Century-Crofts, 1961.

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

Lockhart, R. A. Comments regarding multiple response phenomena in long interstimulus interval conditioning. Psychophysiology, 1966, 3, 108-114.

Mandel, I. J., & Bridger, W. H. Is there classical conditioning without cognitive expectancy. Psychophysiology, 1973, 10, 87-90.

Shean, G. D. Vasomotor conditioning and awareness. Psychophysiology, 1969, 5, 22-30.

NOTE

1. These norms, of course, are only relevant to an English speaking population For the most part our subjects were bilingual, and though the 0% association value would hold for English, it says nothing as to what the association value might be with Hebrew words. The stimulus materials were printed in Latin capital letters.

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