Role of contextual activity in conditioning of voluntary response [1]

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Conditioning of a voluntary response was studied by arranging a tone and a light as CS and UCS respectively with a CS-UCS interval of 200 msec. Ss in Group C were instructed to respond to the light by pressing a key (1250 gm of force, 6250 gm cm of work). Ss in Group E pressed to a prescribed extent to the CS (contextual activity of 500 gm of force or 1000 gm cm of work) and completed the reaction in response to the UCS. It was found that far more CRs and more uniform results were obtained in Group E, suggesting that, with the control of a certain contextual variable, results without exceptions may not be out of our reach.

Experiments on classical and instrumental conditioning procedures are characterized by their primary concern with the elicitation or evocation of a response under investigation. It is well known, however, that many problems have been raised as a result of confoundings by voluntary responses (e.g., Spence & Ross, 1959; Hartman & Ross, 1961) and attitudinal influences (Razran, 1935; Norris & Grant, 1948; Moeller, 1954).

In an effort to control the effects of voluntary responses and attitudinal influences in classical conditioning, the strategy tacitly employed so far has been to attempt to eliminate or neutralize them. The Ss are usually instructed to be relaxed and to respond in a natural way. Many studies (Freeman, 1948) on neuromuscular set, however, suggest the basic impossibility of this strategy. An implication is that all types of CRs may have at least some voluntary involvement. Thus a better way to proceed may be to study the effects of these voluntary processes. The technique for doing this employed in the present experiment is to provide a classical conditioning situation in which the contextual or background activity just preceding the UCR could be specified and measured.

Method

The Ss were 60 high school students. They were asked not to discuss their experience with others after the experiment. The main part of the apparatus, described elsewhere (Liu, 1966), consisted of a response key coupled to a weight of 500 gm and to a spring connected with a polygraph recording pen by means of two strings passing over pulleys. When the response key was pressed downward to a given distance, the weight was lifted and the spring stretched to the same distance. Therefore, the work done by a force applied to the key could be measured in terms of energy. There was a second weight (750 gm) above the first so that when the key was pressed to a distance farther than the height of the second weight, both weights were lifted. The height of the second weight could be manipulated by an E through a lever handle.

The S was seated in a soundproof room. An air-conditioner in the room produced a constant level of noise. Ss were divided into two groups in order of appearance. An S in one group (Group E) was instructed to press as promptly as possible the T-shaped key, upon hearing a tone (65 dB 200 msec.), to a 2-cm. distance. The pressing to this distance could be recognized by S, since the second weight (750 gm) was 2 cm above the first (500 gm) and, in order to press further, more than twice the original force was required. In Group E, S was instructed, further, to press the key all the way down when a light (which consisted of an illumination of a disk of 7.5 cm in diameter for 200-msec. duration at eye level 50 cm away) appeared. Since the key protruded from the surface of a board (on which S rested the heel of his hand) by 7 cm, S's reaction to the light was to press the last 5 cm of the total distance. This required 1250 gm of force. After pressing the key to its full distance, S was instructed to allow the key to return to its initial position.

An S in the other group (Group C) was told that he would hear a tone and see a light at various times during the experiment. When he saw the light, he was to react to it immediately by pressing the key. For this group, the key protruded from the surface of the board by 5 cm, and the force of 1250 gm was necessary to press the key. Therefore, the reaction to the light was exactly the same for this group as for Group E except that no reaction was required to the tone.

For each S in the two groups, the number of paired presentations of the tone and light was randomly selected from 4 to 7, ending with a test trial in which the light was omitted. The number of paired presentations of the stimuli was not fixed, because we were afraid that Ss might inform one another even though they were told not to. The interstimulus interval between the onsets of the tone and light was 200 msec. Every time about 1.5 sec. before the onset of the tone, the polygraph motor started, serving as a ready signal. The average intertrial interval was 10 sec. If S's reaction time to the light exceeded 300 msec. after two trials of training, that S was immediately replaced. For this reason, three Ss in Group C and seven Ss in Group E were discarded.

Results

On the test trials, since the UCS light was omitted, any reaction to the CS tone for Group C was counted

Table 1. Response Latencies (msec.)

Group	Stimulus	F_1*	F_2*	L_1*	L_2*	Test
E	Tone (CS)	367	204	180	178	188
	Light (UCS)	597	262	141	140	146**
C	Light (UCS)	312	162	123	107	72**

*F_1 and F_2 stand for the first two trials; L_1 and L_2, for the last two.

**The latencies were measured from the time of the tone cessation (which corresponded to the UCS onset on training trials). The average was taken on the data from CRs only.

as a CR. In Group E, if the key was pressed farther than 2 cm, it was regarded as a CR. Because of the same position of the key, and the same force required for pressing the key, the CRs for the two groups were comparable.

CRs were obtained in 15 out of 27 Ss in Group C and in 22 out of 23 Ss in Group E. The difference in proportions of Ss giving the CRs in the two groups was highly significant according to the chi-square test ($\chi^2 = 10.48$, df = 1, $p < .005$).

Since pressing the key to a given distance would lift the weight and stretch the coil spring of the recording pen to the same distance, the work done in pressing the key could be calculated. The portion of the work done in stretching the coil spring of the recording pen was comparatively very small and hence omitted. Its possible maximum was less than 1 gm cm. The average magnitudes of the CRs for Groups E and C were, respectively, 5565 and 2194 gm cm. The above difference, using the Mann-Whitney test, was statistically highly significant ($p < .00006$). It is also of interest to note that 46% of the CRs obtained in Group C were smaller in magnitude than the UCR; whereas, only 14% of them were smaller in Group E.

The fact that more CRs were obtained in Group E than in Group C might be attributed to shorter response latencies in Group E. This conjecture is based on the observations from a preliminary experiment in which conditioning could not, in most Ss, be obtained with a CS-UCS interval of more than 300 msec. Therefore, the response latencies of the first two and last two trials together with those of the test trials were obtained from the polygraph recording. From Table 1 it is apparent that the more frequent CRs in Group E were definitely not because of shorter latencies of the CRs.

Discussion

The contextual activities just preceding the UCR for Ss in Group C were practically nil in terms of work. However, before seeing the UCS light, the Ss in this group could apply pressures of less than 1250 gm to the key, because pressures of less than 1250 gm would not equally depress the key at all. In this sense of the contextual set, the amount of force on the key for the Ss in Group C was not controlled. The latter fact may explain the variable results obtained with Group C; about half of the Ss displayed CRs, and about half of the CRs were smaller in magnitude than the UCR. The condition of Group C is exactly that of classical conditioning experiments in which the contextual activity preceding the UCR is not specified or measured in terms of either force or work.

On the other hand, the condition for Group E was such that the contextual activity just preceding the UCR consisted of the work of 1000 gm cm, or in terms of force, of 500 gm of force. This accounts for the rather uniform results obtained with this group. Thus, 96% of Ss in this group showed CRs within from five to eight trials, and 86% of the CRs were equal in magnitude to the UCR. As was studied by various investigators cited in a previous paragraph, this points out the importance of the neuromuscular set or attitudinal factor consisting of the background activity on which a CR appears. Furthermore, it points out that once we can control and manipulate this critical variable, we are more likely to get uniform results without exceptions. The present finding parallels a recent study by Botwinick & Thompson (1966) in which premotor time was found to be closely related to reaction time.

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Note

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