Effect of CS quality on human foot withdrawal conditioning¹

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Conditioned and pseudoconditioned foot withdrawal responses were performed in adult humans using both tactile and buzzer stimuli. Rapid development and extinction of the foot withdrawal response was demonstrated. Conditioning groups performed better than pseudoconditioning groups, and both tactile conditioned and tactile pseudoconditioned groups performed better than their buzzer counterparts. The increment in performance is explained in part on the basis of one or several stimulus properties that are involved in pseudoconditioning per se.

Conditioned responses are known to be affected by intensity, duration, and onset of CS, but little attention has been paid to quality. Meyers (1960) has discussed the problem and given evidence to suggest that the superiority of one CS over another is related to its pseudoconditioning ability. He found that buzzer conditioned Ss performed better than tone conditioned Ss at the same stimulus intensity, and Ss pseudoconditioned with a buzzer performed better than those pseudoconditioned with a tone. The conclusion drawn was that the response of buzzer conditioned Ss is augmented by some effect similar to that operating in the pseudoconditioning group. The precise nature of this effect is, however, as yet undefined.

The present experiment was initially designed to demonstrate rapid foot withdrawal conditioning in the adult human. Previous work with withdrawal conditioning in humans has led most workers to abandon this method of studying the conditioning process because (1) there is great variability in the number of trials to reach a given criteria, (2) the CR is often unstable, and (3) the CR is bound to be affected by the mental attention of the S. However, Lindley & Moyer (1961), Elias (1965), and Fitzwater & Thrush (1956) still use finger withdrawal techniques.

The methods employed in this experiment demonstrate the ease of conditioning and pseudoconditioning of the foot withdrawal response, using either a buzzer or tactile conditioned stimulus. In the results, differences between buzzer and tactile conditioning groups were found which appear to parallel differences between buzzer and tactile pseudoconditioning groups. However, unlike the two auditory stimuli employed by Meyers, the comparison of the intensity of an auditory and tactile stimulus represents a formidable complication to drawing conclusions in that a comparable absolute level of intensity cannot be ascribed to each stimulus. Obviously, a strong tactile stimulus applied near the site of UCS application is more likely to elicit greater conditioning than a weak buzzer. Conversely, a loud buzzer is more likely to elicit greater

conditioning than a weak tactile stimulus applied far from the site of UCS application. Possible methods of generating equivalences or common units could involve psychophysiological studies, or perhaps the comparison of parameters of conditioning of each stimulus applied over a wide range of intensities. However, another method may be to compare the effect of each stimulus on both conditioning and pseudoconditioning procedures. Thus, differences between conditioning groups may at least in part be related to differences between corresponding pseudoconditioning groups.

Method

The Ss were adult male and female patients hospitalized for strictly medical reasons. All Ss were alert, cooperative, and in no distress from their medical ailment. The average age was 60 years for all groups. None of the Ss were on medication for 12 h prior to the experimental sessions. Ss were divided into four groups: (1) conditioning with a tactile CS, consisting of grasping the ankle which is to receive the UCS (Group CT); (2) conditioning with buzzer as CS (Group CB); (3) pseudoconditioning with buzzer as CS (Group PB); and (4) pseudoconditioning with tactile CS (Group PT). There were 15 Ss in each of groups CT and CB, and 10 in each of PT and PB. Classical as opposed to avoidance conditioning was used wherein intertrial interval was 12-18 sec with a mean of 15 sec. CS was 0.5 sec in duration, overlapping the UCS which consisted of three continuous firm strokes by a tongue depressor to the sole of the foot. The foot withdrawal (UCR) was a plantar or withdrawal response, well known to neurologists. It consists of flexion of one or more of the toes and/or the foot. Each S received pretraining habituation trials consisting of CS alone every 12-18 sec until three consecutive trials elicited no response. Immediately following this, 16 reinforcement trials were interspersed with five test trials (CS alone), one every fourth trial. Lastly, extinction trials consisting of CS alone every 12-18 sec were given. Ss underwent the identical session 24 h later. Pseudoconditioning groups received identical pretraining and extinction trials but not reinforcement trials. Rather, CS and UCS were unpaired and randomly distributed over the same length of time as reinforcement trials. Prior to the first session, all Ss were told that they were about to receive a "test of foot reflexes" and that after its completion an explanation as to its purpose would be given which was done.

Results

The learning curves in Fig. 1 present the results obtained in all four groups. For pretraining, test,

Fig. 1. Conditioned and pseudoconditioned foot withdrawal response curves (using both tactile and buzzer CS).

and extinction trials, the percent of Ss showing a foot withdrawal response is plotted. Pseudoconditioning trials are plotted similarly except that the per cent is a running average of three trials. As illustrated, conditioning to either tactile or buzzer CS is rapid (within four trials), but the conditioned response extinguishes just as rapidly. There is significant improvement in pretraining, test, and extinction scores from the first to the second day for Group CT ($p < 0.025$, Wilcoxon matched-pairs signed-ranks). There is significant improvement only in pretraining scores from the first to the second day for Group CB ($p < 0.025$, Wilcoxon). Group CT performed better than CB in test and extinction trials, although only significantly so for the second session ($p < 0.05$, Mann-Whitney U). Both conditioning groups performed better than pseudoconditioning groups on both days. This includes second session pretraining trials ($p < 0.05$, Mann-Whitney U), test trials ($p < 0.01$, Mann-Whitney U), and extinction trials (although not significantly so). Finally, PT test trial scores were superior to those of PB, although only significantly so for the first session ($p < 0.05$, Mann-Whitney U).

Discussion

Unlike some other forms of human withdrawal conditioning (Schlosberg, 1943) the foot withdrawal or plantar response is easily conditioned. Shipley (1932) and Malakhovskaia (1959) confirm this finding. Its chief disadvantage as used in this experiment is that the UCS intensity is determined by the strength of E's manual stroke of the tongue depressor, which may be more variable in its intensity than other stimuli such as electric shock. That CT and CB curves are examples of true conditioning may be questioned if one notes their negatively sloped curves, unlike those

seen in true conditioning. Nevertheless, both CT and CB were far superior to their pseudoconditioning counterparts and showed an improvement from the first to the second session. CT demonstrated a significant improvement in pretraining, test, and extinction trial scores on the second session. CB demonstrated this improvement in pretraining trials only.

Tactile conditioning superiority over buzzer conditioning may or may not be related to tactile pseudoconditioning superiority over buzzer pseudoconditioning. If buzzer and tactile groups are given a score consisting of their conditioning scores minus their corresponding pseudoconditioning scores, they should be equal if pseudoconditioning is the only factor responsible for their differences. Such equality was not the case in this experiment, as plainly seen in Fig. 1. Nevertheless, it would not be unreasonable to assume that the particular quality of tactile stimulation that augments pseudoconditioning also augments true conditioning. Thus, one or more of the mechanisms by which pseudoconditioning occurs might be responsible for the increment in performance of Group CT over CB.

Pseudoconditioning is said to be either (1) a form of sensitization, (2) a generalization from UCS to CS, (3) a phenomenon resulting from increased attitude of expectancy (Harlow & Toltzien, 1940), or (4) a form of true conditioning (Wickens & Wickens, 1942). Increased sensitization is a more likely cause although this is mere speculation. Obviously further studies are necessary.

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Note

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