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HABITUATION OF THE VASOCONSTRICTION RESPONSE AS A FUNCTION OF STIMULUS DURATION AND ANXIETY[1]

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Habituation of the vasoconstriction response to repeated presentation of tones of either 2 or 20 sec. was investigated with 40 college students. The results indicated that speed of habituation did not vary with stimulus duration. Subsequent to habituation stimulus, durations were reversed. Orienting to the reversal in stimulus duration was indicated by an increase in response latency. Both of these results corroborate those reported for the GSR measures recorded simultaneously. Anxiety as measured by the Taylor Anxiety Scale was significantly related to speed of habituation.

The effect of stimulus duration on speed of habituation was investigated using two response measures: vasoconstriction and the GSR. The results with respect to the GSR have been reported along with a discussion of the rationale and design of the experiment (Koepke & Pribram, 1966). In brief, the experiment was designed to investigate the implication of Sokolov's explanation of habituation (Sokolov, 1960) that longer stimulus durations would facilitate the development of conditioned inhibition and thereby accelerate habituation. The results reported for the GSR did not support this hypothesis and indicated that speed of habituation was unrelated to stimulus duration. The experiment further investigated a report by Sokolov (1960) that a change in stimulus duration subsequent to habituation would elicit an orienting reaction. The results for the GSR revealed that some *Ss* did show significant orienting under these conditions.

In addition, the relation between anxiety, as measured by the Taylor Anxiety Scale (TAS) (Taylor, 1953), and speed of habituation was studied. Though anxiety has often been studied with respect to various autonomic measures, there is as yet little evidence pertaining directly to vasoconstriction. With respect to the GSR, speed of habituation was unrelated to TAS scores.

The present findings regarding vasoconstriction provide an indication of the generality of the results reported for the GSR as well as suggesting variables relevant to the habituation of the vasoconstriction response per se.

METHOD

The apparatus and procedure, with the exception of those directly related to the vasoconstriction measure, are more fully described in the report of the GSR results (Koepke & Pribram, 1966).

Apparatus

Variation in vasoconstriction was monitored continuously with a digital plethysmograph. The tip of the index finger was sealed in a small plastic cup approximately 2 × 4 cm., which was connected by a plastic air tube to a Decker Pressure Sensor (No. 306) and a Decker Unit 302. The output of these units was reflected on a Brush recorder, Mark II run at the speed of 1 mm/sec.

The stimulus was a pure tone of 1,000 cps with an intensity of 94-db. SPL. The duration of the tone was either 2 or 20 sec.

Procedure

The *Ss* were seated in a comfortable chair facing a hidden speaker. The finger cup was sealed to the tip of the right finger with a caulking compound (Nu-Calk) and the hand was allowed to rest on the wide arm of the chair. The other recording equipment was attached and *Ss* were left alone in the sound-controlled testing room.

The *Ss* were randomly assigned to short- and long-stimulus groups (20 introductory psychology students in each group). During the habituation sequence the stimulus duration was 2 sec. for the short-stimulus group and 20 sec. for the long-stimulus group. The stimuli were presented repeatedly until *Ss* reached a habituation criterion, defined by the GSR measure as three successive

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trials on which no GSR occurred. At this point the stimulus durations were reversed for half of the *Ss* in each group. The rest of the *Ss* were given 30 additional trials before reversing the stimulus duration. Subsequent to the experiment all *Ss* filled out the TAS (Taylor, 1953).

The intertrial interval was varied at 10–40 sec. for the long-stimulus group. Half of the *Ss* in the short-stimulus group were run with the 10–40-sec. intertrial interval of the long-stimulus group, and the other half with a longer intertrial interval of 30–60 sec. In the latter case the interonset interval for successive stimuli was similar to that of the long-stimulus group.

The response measure obtained for all *Ss* was frequency of response. A response was scored if constriction occurred 2–5.5 sec. after stimulus onset. For those *Ss* who responded when the stimulus duration was reversed, latency of response was scored on the following three responses: (*a*) the initial response in habituation, (*b*) the last response before reversal, and (*c*) the response on the reversal trial. Latency of response was defined as the time elapsing between onset of the stimulus and the midpoint of the last pulse beat before constriction.

The records were scored for frequency of response by one *E*. As an indication of the reliability of scoring, eight records, which were selected randomly with the restriction that there were four from each duration group, were scored by a person who had no knowledge of the purpose of the experiment. Tetrachoric correlation coefficients computed for each of the eight records were .91–1.00. All of the latency measures were scored both by one *E* and an independent person, and any scoring differences were averaged to obtain the final latency measure.

Results

The number of stimulus presentations during which habituation of the vasoconstriction response could be recorded was determined by the speed of habituation of the GSR. Within this time 26 *Ss* reached the habituation criterion of three successive failures to respond with vasoconstriction; 8 *Ss* were in the immediate and 18 in the delayed reversal condition. The larger number in the delayed reversal condition would be expected since the additional 30 trials permitted a greater opportunity for habituation. Four *Ss* who gave no vasoconstriction responses to the first four presentations of the tone were excluded from the analyses of habituation. The median number of trials to criterion for these 26 *Ss* was 13.5, with an average absolute deviation of 7.7.

Stimulus Duration

Speed of habituation did not vary significantly with stimulus duration. Considering those *Ss* who met the habituation criterion, the median number of trials to three successive failures to respond was 11 for the short-stimulus group ($N = 12$) and 14.5 for the long-stimulus group ($N = 14$). A median test of this difference was not significant. The 95% confidence intervals for the medians were 9–32 and 7–24, respectively. There was also no effect of stimulus duration on the number of trials to the first failure to respond. Further, speed of habituation did not vary with the two different intertrial-interval conditions used in running the short duration group.

When the stimulus durations were reversed, 50% (13/26) of the *Ss* who reached the habituation criterion responded; 5 of these were in the immediate and 8 in the delayed reversal condition. Since this difference in frequency was not significant, all 13 *Ss* were considered together in the following analyses.

The reversal in stimulus duration was a short-to-long reversal for 7 *Ss* who responded and long-to-short reversal for the remaining 6 *Ss*. As a means of investigating whether these *Ss* were actually orienting to the reversal in stimulus duration, the latency of the reversal response was compared with that of the initial and last responses in habituation. An analysis of variance of these latencies for the two types of reversal indicated that there was a significant increase in latency over the three responses ($F = 10.20$, $df = 2/22$, $p < .001$) which did not vary with the type of reversal. Thus combining the data for all 13 *Ss*, the mean latencies of the initial, last, and reversal responses were 3.6, 3.7, and 5.6 sec., respectively. During habituation the change in latency from the first to last response was not significant. The increase in latency from the last response to the reversal response, however, was significant ($t = 2.82$, $df = 12$, $p < .02$).

Habituation

To analyze the course of habituation, percentage response measures were computed for the 18 *Ss* in the delayed reversal condition, all of whom had received at least 33 habituation trials. Excluding the first trial on which all *Ss* responded, the mean percentage response in blocks of 4 trials for Blocks 1–8 was: 77.8, 53.7, 46.8, 45.8, 39.3, 48.6, 51.4, and 48.7. These means were obtained by averaging the percentage response values attained by individual *Ss* in each trial block. That habituation was occurring is indicated by a signifi-

cant decrease in percentage response ($F = 3.52$, $df = 7/119$, $p < .005$).

Taylor Anxiety Scale

For those *Ss* who habituated, the TAS scores were significantly correlated with the number of trials to the habituation criterion ($r = .51$, $p < .01$).

Discussion

Stimulus Duration

The results with respect to vasoconstriction suggest that speed of habituation does not vary with stimulus duration and thus fail to support this implication of Sokolov's (1960) explanation of habituation. This corroborates the results obtained with GSR and indicates that the finding is not specific to a single response measure.

When the stimulus durations were reversed, 13 of 26 *Ss* responded. If these *Ss* were responding on the reversal trial as if it were merely another habituation trial, no difference in latency would be expected between the last response in habituation and the reversal response. If, however, these *Ss* were orienting to the change in stimulus duration, an increase in latency would be expected since the change would not be noticeable until 2 sec. after onset. The results indicate a significant increase in latency between the last response and the first reversal response, which strongly suggests that these *Ss* were orienting to the change in duration. This substantiates the results found with the GSR as well as those reported by Sokolov (1960). Taking both measures into consideration, 24 *Ss* oriented to the change in duration, 11 with the GSR alone, 7 with both the GSR and vasoconstriction response, and 6 with vasoconstriction alone.

In general, the results with both measures suggest that the duration of a stimulus is not particularly relevant to the time course of habituation. The fact that some orienting to the change in duration occurred with both measures implies, however, that duration is one of the stimulus characteristics to which habituation occurs.

Taylor Anxiety Scale

The results of this study indicate that anxiety as measured by the TAS is significantly related to speed of habituation, in that the higher the anxiety, the longer it takes for habituation of the vasoconstriction response. These results suggest a relation to anxiety that has not generally been reported for other physiological measures.

As noted earlier, these same *Ss* exhibited no relation between anxiety and speed of habituation of the GSR. This supports a report by Galbrecht, Dykman, Reese, and Suzuki (1965) that TAS scores are unrelated both to intra- and intersession decrements in the GSR to repetitions of a tone. Similar findings have been reported by Dykman, Reese, Galbrecht, and Thomasson (1959). Reports of other measures such as heart rate and respiration rate have also failed to indicate a strong relation to TAS scores (Johnson, 1963; Wilson & Dykman, 1960). Thus, taken together, these results suggest that vasoconstriction may be more directly related to the type of anxiety measured by the TAS than are other physiological indexes.

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