THE EFFECTS OF STIMULUS DURATION ON THE HABITUATION OF A HEAD-SHAKE RESPONSE

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ABSTRACT

THE EFFECTS OF STIMULUS DURATION ON THE HABITUATION OF A HEAD-SHAKE RESPONSE

by Henry R. Askew

The present investigation was concerned with the effects of stimulus duration on the habituation and the retention of habituation of a reflexive head-shake response to a stream of air directed into the ear of a laboratory rat. The nature of this experiment was exploratory since the preparation is a new one for the study of habituation in the rat.

Forty naive rats were divided into 5 groups of 8 animals per group. Each of the groups was run under one of the following conditions: base rate control, 5 sec. fixed stimulus duration, 20 sec. fixed stimulus duration, 5-20 sec. variable stimulus duration, and contingent duration where cessation of the stimulus was contingent on performing the response. All of the animals were tested on two consecutive days. Each session was terminated either when an animal reached a criterion of 10 consecutive trials without a response or when 80 stimulus presentations had been administered.

The only significant result between the groups was that the 5 sec. fixed duration group took fewer trials to

criterion on day 1 than did the 20 sec. fixed duration group. This finding is opposite to the existing literature and a possible explanation for this difference is discussed.

The question of why there were no other significant differences between the groups among the measures on either day was considered. It was concluded that the preparation was less sensitive than anticipated with a relatively large percentage of the animals either not responding or responding at a very low level. As a result, only gross differences could have been detected.

When all of the animals in the experimental groups were taken together, habituation of the head-shake response was conclusively demonstrated. There was no evidence, however, that the habituation in the first session was retained over a 24 hr. rest.

The reliability of the measures was reasonably good with correlations between various measures ranging from .59 to .85. Possible modifications of the preparation to obtain greater sensitivity are discussed.

Date Nov. 21, 1966 Chairman Stanley C. Ratner

THE EFFECTS OF STIMULUS DURATION ON THE HABITUATION OF A HEAD-SHAKE RESPONSE

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INTRODUCTION

Most workers concerned with the topic of habituation subscribe to the definition offered by Harris (1943) as " . . . response decrement as a result of repeated stimulation." Similarly, most workers agree that habituation, at least the relatively enduring variety, is a type of learning, providing one accepts the classical definition of learning as a relatively persistent change in behavior due to experience. Thorpe (1963), Thompson and Spencer (1966), and Ratner and Denny (1964), for example, clearly express this view. Finally, all agree that habituation is the decrement observed in an unconditioned response when an unconditioned stimulus is repeatedly presented. If the response is learned, then the decrement is labeled extinction not habituation.

There is, however, some discrepancy between authors with respect to whether or not an additional requirement should be included in this definition. Thorpe (1963), for example, presents the notion that the decrement must be "relatively permanent" in order to qualify as "true" habituation. More temporary forms of decrement Thorpe refers to as "stimulus satiation". This distinction is attacked by Thompson and Spencer (1966) as being somewhat artificial. They point out that aside from differences in recovery time there seems to be little difference as far as parametric considerations are concerned. For this reason, the authors are of the opinion that it is rather arbitrary to attribute these differences to different processes, as Thorpe's habituation-stimulus satiation distinction appears to do. Thompson and Spencer prefer to label both of these degrees of response decrement as habituation. However, since only for those instances where an observed response decrement is relatively persistent can we say that some sort of learning has taken place, some distinction in terms of recovery time is a necessity. Thompson and Spencer make this distinction simply by indicating whether the habituation is long or short-term. This is the practice which will be followed by the author.

Almost all authors include in their definition two types of response decrement which should not be considered as habituatory. To be excluded are observed response decrement due to receptor adaptation (decrease in receptor activity) and response decrement due to effector fatigue (decrease in effector capacity). Following this practice, any observed response decrement that can be accounted for completely by either of these two processes will not be considered as habituation. This is essentially the position of Harris (1943), Thorpe (1963), and Thompson and Spencer (1966), and is accepted by the author.

This investigation will address itself to the variable of stimulus duration with respect to the following three questions. First, what effect does stimulus duration have on habituation and the retention of habituation? Secondly, is habituation and the retention of habituation different when the stimulus duration is variable rather than fixed? And finally, if the offset of noxious stimulation is made contingent upon performance of the response will this constitute some sort of reinforcement and consequently retard or prevent habituation?

With respect to the first question, there appear to be only three studies in the literature which directly involve the effects of the length of the stimulus duration on habituation. Hinde (1961b) found that the length of the initial presentation of an owl model was inversely related to the intensity of the mobbing response, of the Chaffinch, on the second presentation a day later.

The two other studies dealing with length of duration were done with habituation of a heart rate response to auditory stimulation by Keen, Chase, and Graham (1965), and habituation of the cessation of sucking behavior to auditory stimulation by Keen (1964). These two studies were done with human neonates. In both of these investigations, greater decrement was shown with longer durations. While it appears that longer durations result in greater habituation, the need for other studies with this variable in different situations is obvious.

Nothing can be found in the literature which directly bears on the second question concerning fixed versus variable stimulus duration. However, Fox (1964) in a recent study dealt with the problem of fixed as compared with variable ITI. He reported that habituation readily occurred with fixed ITI but failed to occur when ITI was variable. He hypothesized an expectancy conception to explain his results. While this finding does not directly bear on the variable of stimulus duration, given that some sort of expectancy may be involved in habituation it might be expected to show itself with respect to stimulus duration as well.

Turning to the rationale underlying the third question, it has been noted that some responses which readily habituate in the laboratory could have maladaptive effects if they habituated similarly in nature. Hinde (1954a, 1954b), for example, in his extensive investigations of the mobbing response of the Chaffinch to an owl model found that it habituated quite easily. Furthermore, once this response was habituated it could never be restored to its original magnitude.

Another example is given by Faure (1932), in an investigation of factors which induce the development of the migratory phase of the South African locust. The methodology of the experiment required that the locusts, which are found in nature in constantly moving swarms, be isolated and still be kept at their normal level of activity. Faure found that soon after a locust was isolated it would become quiet. The experimenter tried all kinds of stimulation, including mirrors and a violent jarring apparatus, but to no avail. Nothing could be found that would keep the response from habituating for an extended period of time.

It is readily observed that habituation of the activity level of the locust does not take place when in a swarm in its natural environment. And while there is no direct evidence for the notion that the Chaffinch does not habituate to owls in nature, it seems reasonable to assume tentatively, considering the adjustment to the environment necessary for a species to survive, that in its natural environment this maladaptive habituation does not occur as easily or at all.

As suggested by Harris (1943) and Thorpe (1963), the position taken in this investigation is that it is possible that some sort of reinforcement might occur in nature which would act to support these responses. If Chaffinches mob an owl, for example, it is likely that the owl will fly away. Presumably this successful escape would reinforce the mobbing response. In the locust example it is suggested that obtaining food might tend to keep the activity level of the swarm high.

So, by providing reinforcement, in terms of the cessation of noxious stimulation, can we take a response which normally habituates in the laboratory and prevent it from habituating? There appear to be no studies in the literature that directly bear on this problem.

A secondary purpose in this investigation is the exploration of a new preparation for the study of habituation in the laboratory rat. At the present time good preparations are few and far between.

METHOD

The response investigated can be described as a reflexive head-shake that is elicited by directing a rather intense stream of air into the ear of a laboratory rat. The response has a short duration (1 or 2 tenths of a sec.), and consists of lateral rotation of the head from side to side. Whether there are more subtle components of the response (eye closure and mouth movements, for example), and whether there is some typical number of right-left-right head movements in each response is not known. The film analysis necessary to answer these questions has yet to be done.

The response is very clean in the sense that it either occurs or doesn't occur and can clearly be distinguished by any observer who has seen a few responses. Only very rarely is there a shadow of a doubt as to whether or not the animal responded. Also, the response seems to have a zero base rate. In short, on the basis of pilot work, this behavior seems quite promising for the study of habituation in the rat.

Subjects: The subjects used in this investigation were 40 female albino rats from Michigan State University's colony of mixed stock. They had always been housed in group cages and fed ad lib. The rats were from 90 to 105 days of age at the time of the experiment. Prior to this study they had not participated in any other experiment. Before being used they were tested for inner ear difficulties by lifting them up by the tail.

Apparatus: A diagram of the apparatus is shown in Figure 1. The cages are completely constructed from 1/4 in. wire mesh screen. The diameter of the rubber tube that delivers the air stream is 1/32 in. It is hand held and is moved back and forth across the center of the ear at an approximate rate of 4 right-left-right cycles per sec. Due to the fact that the tube was hand held, and due also to the fact that the animals had some freedom of movement within the cages, the distance of the tube from the ear and the width of the locus of stimulation are given as approximations only. The air source was a Silent Giant aquarium pump. The pressure, as measured at the end of the tube, was enough to push a column of mercury from its 14.8 cm. level on both sides of a manometer, to a height of 28.2 cm., a rise of 13.4 cm. Finally, it should be noted that the sound produced by the pump was carried through the tube, providing a complex air-tone stimulus that started and terminated as the air stream was directed toward the subject's ear.

A diagram of the experimental situation is presented in Figure 2. The room was kept at a temperature of 70-75° F. and was dimly lighted from a desk lamp behind the screen.

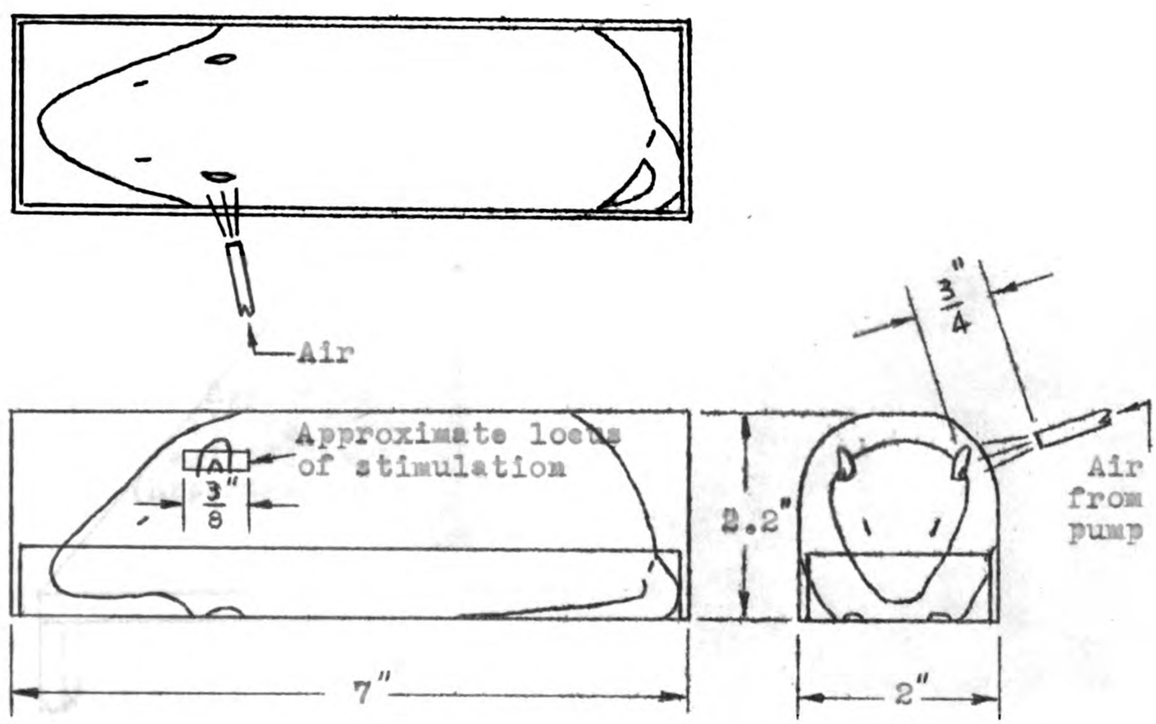


Figure 1: Apparatus

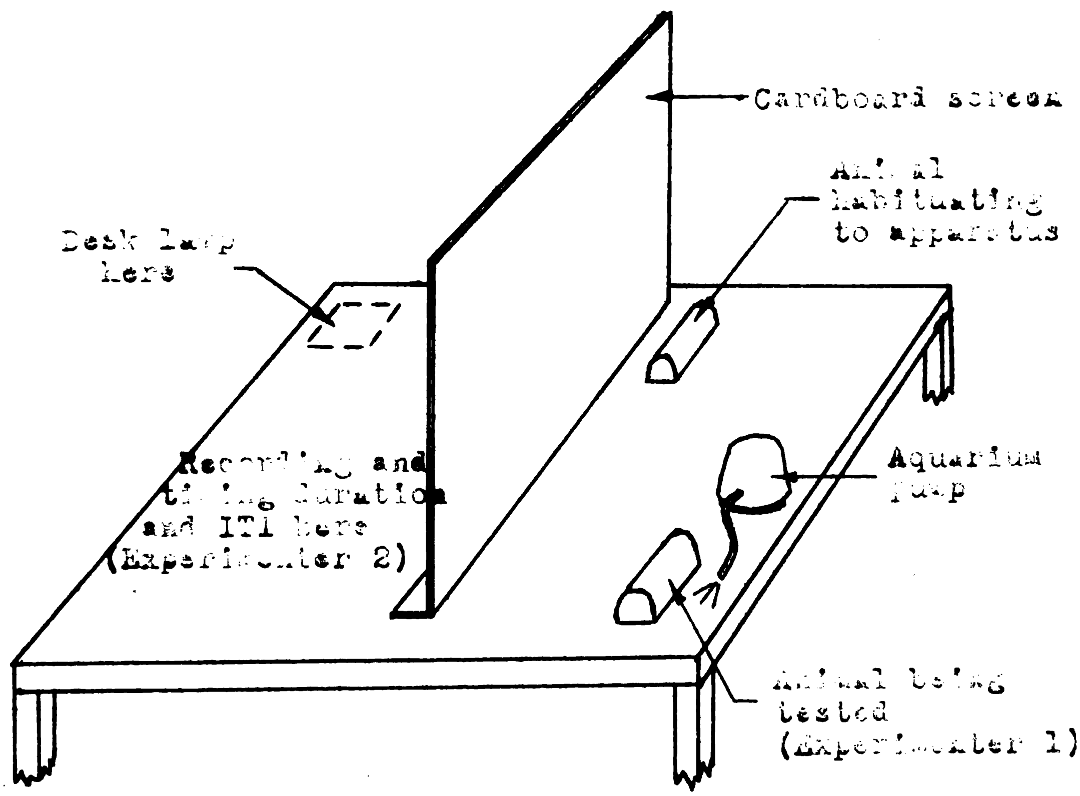


Figure 2: Experimental situation

Procedure: Two response measures were recorded. The first was the number of responses per trial, and the second was the latency of the first response per trial. During the course of pilot work it was noted that responses often occurred within 1 or 2 sec. following the offset of stimulation. It seemed reasonable that these responses were directly attributable to the stimulation even though they occurred after the stimulation had been discontinued. As a result, any response that occurred within 2 sec. of the offset of the stimulation was considered a response on that trial.

Two experimenters were necessary. E-1 delivered the stimulus, counted the number of responses per trial, and measured the latency of the first response on each trial with a hand held stopwatch. E-2 recorded the data, and timed the stimulus duration and ITI. Foot signals were given for the start and end of each stimulus presentation to avoid any regularly occurring auditory stimulation immediately preceding the onset and offset of the stimulus.

Inter-trial intervals of 5, 10, and 15 sec. were used for all animals. These three times were presented in a random order with the restriction that each was given equally often. The randomization was accomplished with the aid of a table of random numbers. This method of random assignment was used throughout this experiment. All animals were run under the same ITI sequence.

The pool of 40 animals was randomly divided into the following groups of 8 animals per group:

Group S (Short duration): This group was given a 5 sec. fixed stimulus duration throughout.

Group L (Long duration): This group was given a 20 sec. fixed stimulus duration throughout.

Group V (Variable duration): For these animals, duration on any given trial was 5, 10, 15, or 20 sec. These durations were presented randomly with the restriction that each appear an equal number of times during the course of each session.

Group C (Contingent duration); For this group, on each trial the stimulus was discontinued as soon as the animal responded. If no response occurred, the stimulation was terminated after a 20 sec. duration.

Group B (Base rate control): These animals experienced all of the conditions that the preceding groups experienced except for the air stimulus itself, which was never administered to them. These animals were observed according to the group S schedule.

All animals were given two sessions 24 hr. apart. Prior to the start of each session, the rats were allowed 30-40 min. to habituate to the individual cages and surrounding environment. At approximately 10 min. before the start of the first session, the animals in the four experimental groups were given a pretest of 20 sec. of stimulation in the right (non-test) ear. Then all of the experimental animals were given successive presentations of the stimulus in the left (test) ear until they reached a criterion of 10 consecutive trials without a response. If criterion had not been reached the session was terminated after 80 trials.

RESULTS

The individual scores of the 32 experimental animals on relevant response measures will be found in Appendix A. These data are summarized for descriptive purposes in Table 1.

Two things should be explained at the outset. First, as can be seen from Appendix A, almost all of the data were skewed toward the "non-responder" end of the distributions. As a consequence, medians rather than means were utilized throughout. Secondly, the number of trials responded, rather than the number of responses, was used due to the fact that for group C, the contingency group, the animals were not likely to make more than one response on any trial. The stimulation was discontinued after they made the first response. On the other hand, animals in the other three experimental groups were allowed to and very frequently did, make more than one response on a given trial. As a result, if the number of responses was used group C would be expected to be lower than the others simply on procedural grounds.

As was previously noted, much of the data were skewed. As a consequence, the assumption of normality, necessary for parametric tests, could not be met. Hence, the non-parametric Kruskal-Wallis "analysis of variance" by ranks and the Mann-Whitney U-test were used for the statistical analysis of most of the data.

Table 1. Medians of the relevant measures.

	Number of responses during pretest	Number of trials responded during the first block of 10 trials		Total number of trials responded		Number of trials to criterion minus 10	
		Day 1	Day 2	Day 1	Day 2	Day 1	Day 2
Group S	0.0	3.0	1.5	3.0	3.0	8.0	11.5
Group L	0.0	3.0	3.5	7.5	8.0	21.0	21.5
Group V	0.0	2.0	0.5	4.5	0.5	21.0	4.0
Group C	0.5	3.0	2.5	12.0	9.5	28.0	26.5
Group B	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Group B, the base rate control group, data will not be presented with the data from the four experimental groups in the following analysis. This is due to the finding that across 160 trials, for each of the 8 animals in this group, only two responses were observed. From this observation it can be concluded that this head-shake response has no appreciable base rate, and consequently, responses elicited from the experimental animals were, in fact, due to the stimulation itself.

Initial level of responding: Kruskal-Wallis ranks tests were carried out to determine if there were any differences between the four experimental groups with respect to the number of responses that occurred during the 20 sec. pretest, and the number of trials responded during the first block of 10 trials. An *H* of 0.80 was obtained for the first test, and an *H* of 0.36 for the second test. An *H* greater than or equal to 7.81 is needed for significance at the .05 level. As can be seen, there were no significant differences between the groups preceding and during the very early stages of the experimental procedure.

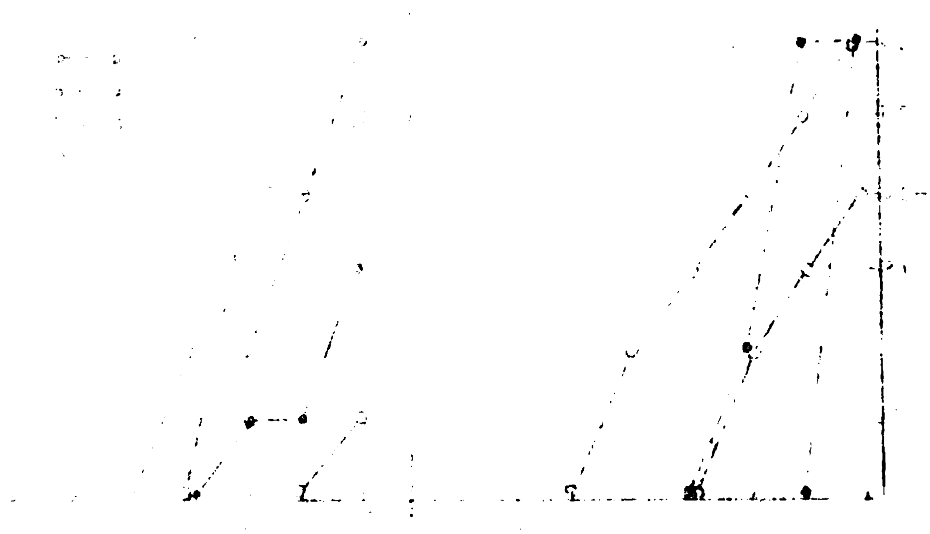
General habituation: Figure 3 gives the habituation curves for the four experimental groups.

As is indicated by these curves, habituation was clearly demonstrated for all four of the experimental groups on both days. All but one of the 26 animals that responded during the first session showed a decrease in the number of trials responded, over their initial level of responding in the first block of 10 trials. Similarly, all of the 24 "responders" on the second day either reached criterion or showed a decrease over their initial level.

Group differences in habituation: (The effects of stimulus duration): Several Kruskal-Wallis tests were carried out here. For all of the following tests an *H* equal to or greater than 7.81 is required for significance at the .05 level.

First, tests were done on the median number of trials responded per blocks of 10 trials on both days. For day 1 an *H* of -5.77 was obtained. For day 2 an *H* of -5.48 resulted. Neither of these results were anywhere near significance.

Figure 3: Median number of trials responded



Next, the number of trials to criterion was tested for both days. An *H* of 2.78 was obtained for the first day, and an *H* of 2.05 resulted on the second day. Again, neither of these results were even close to the required value of 7.81.

Finally, the total number of trials responded on both days was tested. *H*s of 1.52 and 2.31 were obtained for day 1 and day 2 respectively. As before, there were no significant differences.

It is apparent that none of the results even came near to being significant. The appropriate conclusion seems to be that there is no evidence that these different stimulus duration conditions significantly affected the amount or speed of habituation within either session.

Median latency of the first response per trial is presented in Figure 4. The differences in the levels of the four groups seem to represent differences in the average length of the trials, and as such are not particularly relevant. What was of interest to the experimenter was whether there was a consistent increase or decrease in median latency for any of the groups. As can be observed, all of the groups remained at about the same level throughout the experiment.

Two individual comparisons are relevant to two of the original questions posed at the outset of this investigation. These two comparisons involve group S (short duration) vs. group L (long duration), and group V (variable duration)

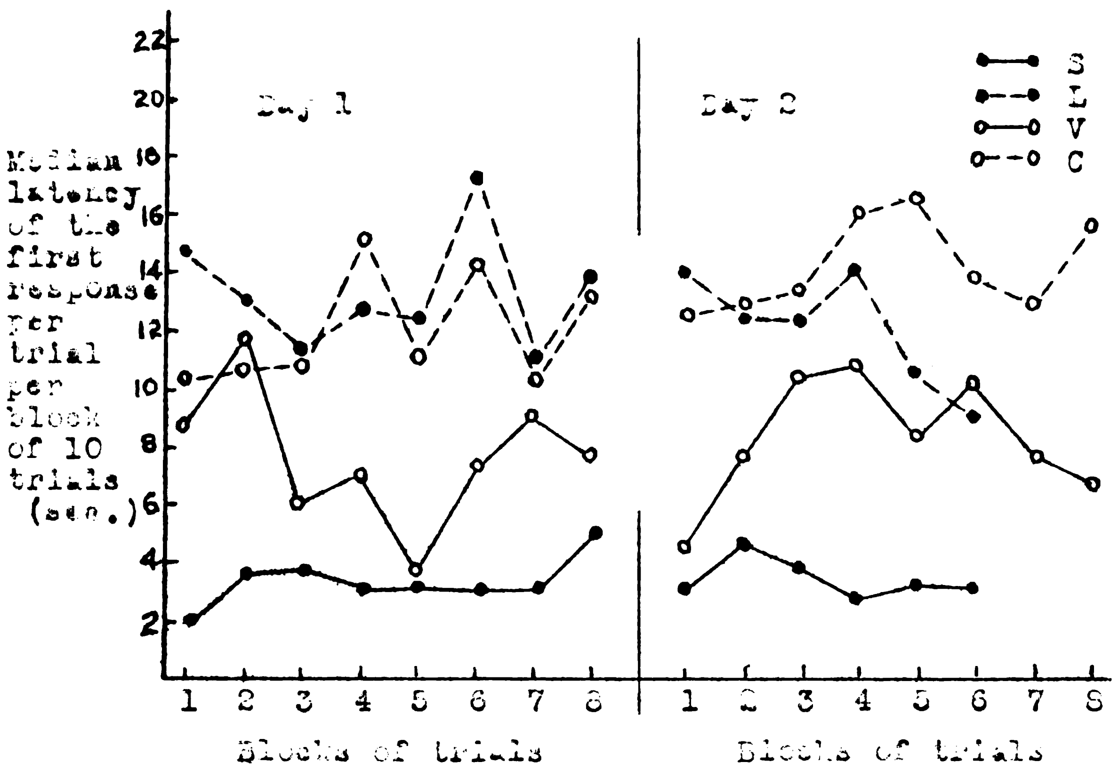


Figure 4: Median latency of the first response per trial

vs. group C (contingent duration). Mann-Whitney *U*-tests were done on the number of trials to criterion on day 1 and day 2. A *U* less than 16 is required for significance at the .05 level for all four of the following tests.

U-tests between group S and group L yielded a *U* of 13.5 on day 1 and a *U* of 23.0 on day 2. The first result was significant beyond the .05 level, with group S requiring fewer trials to criterion than group L. These two groups were not significantly different on the second day, however.

U-tests between group V and group C yielded *U*s of of 32.0 and 22.0 on day 1 and day 2 respectively. Neither of these two findings were even close to significance.

Finally, a Kruskal-Wallis ranks test and some *U*-tests were done eliminating the 6 "non-responders" on the first day. Non-responders were those animals that made no responses during the initial 10 trials of the session (refer to Appendix A). Eliminating these animals did not affect, to any great degree, the results of the statistical tests carried out.

Group differences in the retention of habituation: (The effects of stimulus duration): The difference in the number of trials to criterion from the first to the second day was calculated for each animal. A Kruskal-Wallis test of these differences between the groups yielded an *H* of 3.04. This result was nowhere near the *H* of 7.81 required for significance.

Similarly, the change in the number of trials responded from the last block of 10 trials on the first day to the first block of 10 trials on the second day yielded an *H* of 2.90. Again, the groups did not differ beyond what would be expected on the basis of chance alone.

Finally, to investigate whether these groups differed on their initial level of responding on day 2, as a result of the differential treatments on day 1, another Kruskal-Wallis ranks test was done. An insignificant *H* of 1.48 was obtained.

The appropriate conclusion of the preceding tests seems to be that there is no evidence that these stimulus duration conditions differentially effected the retention of habituation after a 24 hr. rest.

General retention of habituation: If habituation has some permanence here, we would expect that a significant proportion of the animals would start at a lower level on the second day as opposed to the first. An examination of the individual scores showed that 15 of the 32 animals started lower on the second day, 11 started higher, and 6 remained the same. Of the 26 rats that exhibited some change, 58% showed a decrease in the initial level on the second day over the first. A *t*-test of a *p* of .58 yielded a *t* of 0.82. This result was not significantly different than what would have been expected on the basis of chance alone.

A similar procedure was carried out to determine if habituation was more rapid on the second day as opposed to the first. Of the 28 animals who did respond on either the first or the second day, 61% exhibited fewer trials to criterion on the second day, and 39% showed a greater number of trials to criterion on day 2. The *p* of .61 yielded a *t* of 1.19 which was also not significant at the .05 level.

Both of these findings show that there is no evidence that any of the habituatory response decrement observed during the first session is retained after a 24 hr. rest.

Relation among the response measures: Since there was only one significant difference out of the 17 statistical tests that were done, it seems quite justifiable to take all of the animals together and ask about the correlations between the different response measures employed.

The relevant product-moment correlation coefficients are given in Table 2. These correlations were calculated for descriptive purposes only, no significance tests were carried out.

Table 2. Product-moment correlation coefficients between response measures.

	r
Number of trials responded on the first block of trials (day 1) and the number of trials to criterion (day 1)	.75
Number of trials responded on the first block of trials (day 2) and the number of trials to criterion (day 2)	.75
Number of trials responded on the first block of trials (day 1) and the total number of trials responded (day 1)	.84
Number of trials responded on the first block of trials (day 2) and the total number oftrials responded (day 2)	.85
Number of trials to criterion on day 1 and day 2	.59
Total number of trials responded on day 1 and day 2	.77

DISCUSSION

General habituation: Decrement of the head-shake response was clearly demonstrated. All but one of the responders on one of the days showed a decrease in the response level. They either reached the criterion of 10 consecutive trials with no responses, or ended the 80 trial session at a lower level of responding than during the initial 10 trials.

That this decrement was not due to receptor adaptation along was evidenced by various other responses which continued to appear sporadically throughout the session to the stimulus (eye closure and head withdrawal, for example) regardless of whether or not the head-shake response was being elicited. This indicates that the stimulation was being perceived by the rats, and consequently receptor failure cannot entirely explain the observed decrement.

Similarly, a few of the habituated animals were tested immediately following the second session in an attempt to elicit the response. When the tube that delivered the air stream was moved closer to and directed continuously toward the ear, all of these animals responded. Effector fatigue can thus be ruled out by virtue of the preceding demonstration that the observed response decrement did not represent a decrease in the animals capacity to make the head-shake response.

It must be concluded, using the definition and distinctions employed in the introduction, that the observed response decrement was habituatory.

<u>Group differences in habituation</u>: (The effect of stimulus duration): The only significant difference between the groups was between the long duration group (L) and the short duration group (S) on the first day. Here, group S had fewer trials to criterion than did group L.

This result is opposite from what was noted by Keen (1964) and Keen, Chase, and Graham (1965). One possible explanation for this discrepancy is that things work somewhat differently for different response systems. In Keen (1964) and in Keen, Chase, and Graham (1965) the responses habituated could be classified as orientation responses to novel stimulation. They used auditory stimulation and looked at sucking behavior in the first study, and a heart rate response in the second study. In the present investigation, it appears that the stimulation is irritating and the response falls in the care of the body surface class. If this distinction is correct, it is reasonable to expect that the variable of stimulus duration may have a different effect on the two types of response systems. In one case we have orienting responses to novel stimulation and in the other care of the body surface responses to irritating stimulation. If it can then be assumed that longer durations result in a more rapid decrease in the amount of novelty the stimulation offers the subject, then the results of the previously noted studies seem quite reasonable. Similarly, if we can assume that the longer duration in the present investigation had the same effect as making the stimulation more intense, then we would expect that the longer duration would result in slower habituation. This latter statement is based on the well established finding that habituation and stimulus intensity are inversely related.

A more general question now arises. Why were there no other significant differences between the groups with respect to habituation? Two alternative explanations suggest themselves. First, the variable of stimulus duration may, in fact, have no effect on habituation. Considering the studies previously noted which did obtain positive resuls, and considering the significant difference between group S and group L found in this investigation, this explanation seems unlikely.

The second alternative is that in reality stimulus duration does exert an effect on habituation, but the procedure used in this investigation was not sensitive enough to detect it. If in fact this were the case, the problem then becomes one of determining what factors contributed to the lack of sensitivity of the present experimental procedure.

It seems to the author that the major factor responsible for this insensitivity is the prevalence of low and non-responders. On the basis of pilot work this result was unfortunately not anticipated. Of the 32 experimental animals, 6 animals (19%) did not respond on the first day, and 8 animals (25%) did not respond on the second day. As far as the total number of trials responded is concerned, only 12 animals (38%) responded on more than six trials during the first session, and only 15 animals (47%) responded on more than six trials during the second session. In short, using only 8 rats per group with a relatively large percentage of the animals representing "dead weight", it would seem almost impossible to detect anything but very gross differences between the groups.

In any case, it must be concluded that little more is known about the effect of stimulus duration on habituation than was known at the outset of this investigation.

<u>Group differences in the retention of habituation</u>: (The effects of stimulus duration): In the present study there is no evidence that the stimulus duration conditions differentially effected the amount of habituation retained after a 24 hr.rest.

Two of the studies previously cited are relevant here. Hinde (1961b) indicates that there was no appreciable 24 hr. retention of habituation when an owl model was initially presented for only 12 min. However, when the length of the initial presentation was 24 min. or longer, a somewhat smaller response was evidenced on the second presentation 24 hr. later.

Similarly, Keen, Chase, and Graham (1965) demonstrated that there was some 24 hr. retention of decreased acceleration of the heart rate response to auditory stimulation when the initial presentations were 10 sec. long. On the other hand, when the initial presentations were 2 sec. long there was no appreciable retention of habituation after 24 hr.

These two studies indicate that if some habituation is retained, longer durations result in greater retention. The preceding statement was qualified due to the fact that in many studies of habituation there is no appreciable retention of habituation regardless of the conditions. Under such circumstances there would, obviously, be no differences in the amount of retention as a result of different duration conditions. This more basic question of whether or not this procedure resulted in any retention of habituation is dealt with in the following section.

General retention of habituation: As was shown, there was no significant decrease in either the initial level of day 2 as opposed to day 1, or the number of trials to criterion on day 2 as opposed to day 1. While the percentages of animals were in this direction (58% and 61% respectively), they were not significantly greater than what would be expected on the basis of chance alone. We must conclude that the habituation evidenced in this investigation was relatively short-term with no appreciable retention over the 24 hr. rest.

This finding is not uncommon in the literature. Clark (1960), for example, found that in worms habituation to photic and mechanical stimulation was temporary. Its effects persisted for only a relatively short period of time, recovering in a matter of hours.

Another example is given by Nice and Ter Pelkwyk (1941) in a study of habituation of responses made by the Song Sparrow to predator models. The authors found some within session habituation, but there was complete recovery on successive presentations 24 hr. apart.

As is indicated by the preceding discussion, results similar to those obtained in this study are by no means rare. It should be noted, however, that the lack of retention of habituation of the head-shake response was not conclusively demonstrated here. In order to arrive at some certainty, a similar experimental procedure would have to be carried out on a longer term day by day basis.

The preparation: It appears, referring to the correlations presented in Table 2, that there is some reliability in this preparation. While there are some spurious factors involved, such as the initial level being included in and at the same time being correlated with the total number of trials responded, two conclusions can be drawn. First, the number of trials responded on the first block of 10 trials seems to offer a good prediction of both the total number of trials responded and the number of trials to criterion. Secondly, an animal's performance on the first day seems to be a moderately good predictor of how he will respond on the second day.

It seems, however, that the preparation will require some modification to be of use in getting at the process of habituation. This is primarily due to the relatively large percentages of low and non-responders that were observed.

Most of the non-responders were tested following the second session to determine if the response could be elicited by changing some of the characteristics of the stimulation. All of the animals tested responded when the tube that delivered the air was moved closer and was directed continuously toward the ear. Therefore, it appears that the problem is not that some of the animals cannot make the reflexive head-shake response, but that the preparation as it stands does not result in reliable enough elicitation of the response.

There seems to be two possible modifications that could be made to improve the reliability of this preparation. First, physical aspects of the experimental situation could be changed. This modification might take the form of a different kind of a restraining device which would allow the experimenter more precise control over the way in which the stimulation is delivered.

The second alternative involves the use of a pretest for the purpose of selecting and eliminating the non-responders from a somewhat larger pool of animals. In light of the reliability of the measures used, and the relatively great recovery of the habituated response, such a procedure seems quite reasonable. This pretest could reasonably entail 20-30 trials given 2 or 3 days prior to the onset of the experiment. Using such a procedure, a good index of the responsiveness of the animals would be obtained, and as further benefit, groups of animals could be matched accordingly.

SUMMARY

The present study investigated the effects of stimulus duration on the habituation of a reflexive head-shake response to a stream of air directed into the ear of albino rats. Forty naive rats were divided into 5 groups of 8 animals per group. Each of the groups was run under one of the following conditions: base rate control, 5 sec. fixed stimulus duration, 20 sec. fixed stimulus duration, 5-20 sec. variable stimulus duration, and contingent duration where cessation of the stimulus was contingent on performing the response. All of the animals were tested on two consecutive days. Each session was terminated either when an animal reached a criterion of 10 consecutive trials without a response or when 80 stimulus presentations had been administered.

The only significant result was that the 5 sec. fixed duration group took fewer trials to criterion on day 1 than the 20 sec. fixed duration group. This finding is opposite to the existing literature and a possible explanation for this difference is discussed.

More generally, when all of the animals in the 4 experimental groups were taken together, habituation of the head-shake response within each session was conclusively demonstrated. There was no evidence that this habituation was retained after a 24 hr. rest.

The question of why there were no other significant differences between the experimental groups was discussed. It was concluded that due to the large percentage of low and non-responders that resulted, the procedure was quite insensitive with respect to the detection of existing differences. Suggestions were made for possible ways the preparation could be modified to remedy this situation.

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APPENDIX A

Individual scores

	Number of responses during pretest	Number of trials responded during the first block of ten trials		Total number of trials responded		Number of trials to criterion minus ten	
		Day 1	Day 2	Day 1	Day 2	Day 1	Day 2
Group S							
a	1	8	7	38	9	80	21
b	0	5	6	17	21	53	56
c	0	5	2	5	9	10	38
d	0	3	1	3	1	8	2
e	0	3	2	3	5	5	22
f	0	1	0	1	0	8	0
g	0	0	0	0	0	0	0
h	1	0	1	0	1	0	2
Group L							
a	0	9	9	26	23	48	39
b	0	7	3	10	3	20	5
c	2	6	5	29	23	80	59
d	0	3	3	20	12	74	39
e	3	3	5	5	16	21	36
f	0	1	4	4	4	20	7
g	0	1	2	3	2	21	3
h	1	1	0	2	0	14	0
Group V							
a	4	10	10	44	39	80	80
b	0	8	7	40	23	80	57
c	0	4	0	6	0	21	0
d	0	2	6	5	21	27	52
e	0	2	0	4	0	20	0
f	2	1	0	3	0	21	0
g	0	0	0	0	0	0	0
h	0	0	1	0	1	0	8
Group C							
a	1	10	5	51	8	80	26
b	0	6	9	50	56	80	80
c	1	7	10	21	58	42	80
d	2	4	0	25	0	60	0
e	1	2	2	3	4	14	19
f	0	2	1	2	1	7	3
g	0	0	3	0	11	0	27
h	0	0	1	0	11	0	55