The Effects of the Absence of Noise After Repeated Exposure on Performance Time

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Running head: NOISE AND HABITUATION

Abstract

The present study examined how the absence of noise after its repeated exposure affected the time it took subjects to solve multiplication problems. Sessions one (practice), two and six were carried out under the same conditions for all groups. In sessions three, four and five, however, the intensity of noise differed among groups. Within the experimental groups, the noise level was increased in session three and decreased in session six. A statistical analysis revealed that performance times were not affected by either an increase or decrease in the noise level. As well, no significant results were found between groups in any of the five measured sessions.

The Effects of the Absence of Noise After Repeated Exposure on Performance Time

Habituation is defined (Wyers, Peeke and Herz, 1973), as a stimulus specific response decrement resulting from repeated or constant exposure to the response eliciting stimulus. Essentially, it is a decrease in the strength of a response which occurs after a novel stimulus has been presented over a long period of time (either in one prolonged stretch or in repeated short bouts).

The phenomenon of habituation has received much recent attention. Habituation is the simplest form of learning and it appears in even the simplest organisms. This was illustrated by Kandel (1979) who showed that when a sea snail's gill is touched, the gill withdraws reflexively. If the touch is repeated, however, the snail will habituate and stop withdrawing its gill after about the tenth prod. This is habituation in its simplest form. Habituation has been studied in a number of contexts with a wide variety of subjects, including: single-celled protozoans (Applewhite et. al., 1969; Kinastowski, 1963 (a,b); Wood, 1970 (a)), reptilia (Humphrey, 1933; Hayes et. al., 1968), cats (Spencer and Thompson, 1966; Teyler et. al., 1972), and humans.

Habituation has been studied since the beginning of the century, even before the concept of habituation was established and defined. Sherrington (1906) reported a waning of the scratch reflex in the spinalized dog, and Pavlov (1927) first described behavioral habituation in dogs. Harris (1943) stated that representative animals

of all species display response decrement to repetitive stimuli.

Until the 1960s there was little attempt made to describe specific properties associated with behavioral habituation. Thorpe (1963) believed that habituation implies a tendency to drop out responses, not to incorporate new ones or to complicate those already present. He characterized habituation as being the simplest kind of learning and believed that something like it is universal in animals.

Thompson and Spencer (1966) used nine characteristics to define behavioral habituation and various aspects associated with it. These include:

1. Repeated stimulation of the same stimuli results in decreased response.

2. Spontaneous recovery--response recovers over time if stimulus is withheld.

3. With repeated series of habituation training, spontaneous recovery between series, habituation becomes more rapid.

4. The more rapid the rate of stimulation, the more rapid the habituation.

5. Weaker stimulus elicits more rapid habituation.

6. Effects of habituation training may proceed beyond zero or asymptotic level.

7. Habituation of response to one stimulus exhibits generalization to other stimuli.

8. Presentation of another stimulus results in response recovery

(dishabituation).

9. Repeated application of dishabituating stimulus causes less recovery (habituation of dishabituation).

Through their research Thompson and Spencer found that these nine characteristics were all found to be present in both the intact mammal and the spinalized cat (Thompson and Spencer, 1966). Studies on other species, however, such as the intact snail (Humphrey, 1930), the crayfish nerve-muscle (Bruner and Kennedy, 1970), and certain protozoans (Kinastowski, 1963 (a,b); Osborn et. al., 1973) found that some of these characteristics were present, while others were not or it was not yet known.

One area of habituation that has received considerable attention is that of auditory habituation. In the literature reporting investigations of auditory habituation, the term has been used to refer to:

1. The procedure of exposing a subject to a repetitively presented sound; and

2. The progressive decrement of behavioral responses to a sound stimulus as it is repeatedly presented.

One of the most common forms of sound familiar to us all is noise; in fact, noise is defined as unwanted sound. The two words are often used virtually synonymously. So what effects does noise have on people and their performance? Studies examining the effects of noise on task performance have yielded inconsistent results. Results have been found to vary with: the task, the experimental

design, the nature of the noise, the motivation of the subjects, and so forth.

One of the prominent figures in the study of the effects of noise on test performance has been D.E. Broadbent, who conducted a number of experiments in the area. His work has been cited in a number of other studies (Britton and Delay, 1989; Smith, 1983). Broadbent noted that performance decrements on many tasks begin to occur when noise is greater than 80dB. Although the effects of noise onset on performance has been studied in a number of different contexts, one area with relatively little research has been the effects of noise offset after repeated exposure.

One study done in the area was carried out by David Glass and Jerome E. Singer (1972). They showed that subjects working on simple verbal and mathematical problems did equally well under conditions of quiet, predictable noise, or unpredictable noise. Afterward, however, when all subjects worked under quiet conditions, those who had earlier experienced the unpredictable noise made the greatest number of errors on a proofreading task.

In the area of the effects of noise on performance, a study conducted by Gulian and Thomas (1986) examined the effects of noise at two different levels on subjects' performance on an arithmetic task. Results of this study showed that noise significantly impaired subjects' rate of work, but had no detrimental effects on accuracy,

The present study combined various aspects of both these studies, and examined the effects of noise offset after repeated exposure,

with habituation having occurred, on subjects' performance time of multiplication problems. This study involved the use of four groups: a control group and three experimental groups. Subjects in all groups performed multiplication problems in each of six sessions under various noise conditions. Their performance times were individually recorded for each question.

Before conducting this experiment the general belief was that the results could go one of two ways. The decrease in noise level in the last session could either cause subjects' performance times to increase or decrease. There was also the third possibility that the offset of noise would have no significant effect either way. Based on the findings of the two studies previously mentioned (Glass and Singer, 1972; Gulian and Thomas, 1986), the first arguement was chosen as the basis of this study. After being repeatedly presented with noise, either constant or varying, it was believed that the absence of that noise in the last session would cause an increase in subjects' performance time; thus, a decrease in the speed in which they performed multiplication problems.

The hypothesis, therefore, was that repeated exposure to noise, followed by the absence of that noise, once habituation has occurred or has begun to occur, will result in an increase in subjects' performance times. Furthermore, this increase in performance time will be greatest in the experimental group receiving increasing intensities of noise, as opposed to the groups receiving noise at a constant intensity. Essentially, this experiment is based on three

assumptions:

1. Noise will have a negative effect on subjects' performance time of multiplication problems.

2. Subjects will gradually habituate to the presence of noise in all experimental groups.

3. Noise offset in the last session will cause an increase in subjects' performance times, moreso in the experimental group receiving noise at increasing intensities.

Method

Subjects

This experiment was completed by 37 subjects, 5 males and 32 females. All were undergraduate psychology students from Algoma University. These subjects were unpaid, and volunteered their time in return for bonus marks toward their introductory psychology grades. They were randomly assigned by means of sign up sheets, to one of four groups: a control group or one of three experimental groups. The experiment consisted of six sessions, with the first session being a practice session for all groups. The average running time for each group was approximately 35 minutes.

Procedure

Before the experiment began, all subjects were given instructions in which it was explained what was expected of them in the experiment. Subjects were told that they would be performing four by three multiplication problems. As well, they were told that there would be four questions in each of six sessions, and that the first session

would be a practice session. Questions would be timed individually by either myself or a confederate (depending on the number of subjects being run in a particular group). There was a stopwatch for each subject, and subjects were told that their time would begin once I said "GO" and would stop once they placed their pencils down, indicating that they were finished a particular question. Subjects were told that they could write each question down before their time started. Subjects in all groups were given the same questions in the same sequence.

The white noise used in this experiment was produced by a noise generator, which was hooked up to a 50 watt speaker. The generator was turned on before the experiment began. The noise conditions for my four groups were as follows. In the Control or Constant Noise Group, all sessions were carried out with the presence of white noise at an intensity of 60dB. This was the no noise or "quiet" condition with noise at 60dB being used for the purpose of blocking out any extraneous sounds. This was suggested by G.R.J. Hockey (1983).

In Experimental Group A or the Moderate Noise Group, the first two sessions were carried out under the same conditions as in the Constant Noise Group, with white noise at 60dB. The following three sessions, however, were conducted with white noise at 80dB. In the last session, conditions returned to those of the first two sessions. In Experimental Group B or the High Noise Group, conditions were the same as for the previous group except that in sessions three to five, the noise level was increased to 100dB. Finally, in Experimental Group

C or the Varying Noise Group, the sessions between the second and the last were marked by increasing intensities of noise, increasing from 80dB in the third session to 100dB in the fifth session. In the last session, conditions again returned to those of the first two sessions (see Table 1). It is important to note here that in the experimental groups where the noise level increased or decreased in a given session, it was changed before the session began.

Results

In this experiment, the noise level within the experimental groups, was raised at the beginning of the third session, and was decreased at the beginning of the sixth session. A statistical analysis (ANOVA) was carried out within each group to see if there was a significant difference between subjects' performance times from session two to three, as the noise level was increased, and from session five to six, as the noise level was decreased.

Between sessions two and three, results for the Constant Noise Group ($F = 1.29$, $df = 1/14$, $p < .05$), the Moderate Noise Group ($F = 2.09$, $df = 1/18$, $p < .05$), the High Noise Group ($F = 2.50$, $df = 1/20$, $p < .05$) and the Varying Noise Group ($F = 0.42$, $df = 1/14$, $p < .05$) were all found to be non-significant. For sessions five and six, results were similar for the Constant Noise Group ($F = 1.44$, $df = 1/14$, $p < .05$), the Moderate Noise Group ($F = 3.91$, $df = 1/18$, $p < .05$), the High Noise Group ($F = 0.06$, $df = 1/20$, $p < .05$) and the Varying Noise Group ($F = 0.35$, $df = 1/14$, $p < .05$) with results for all groups again being non-significant. Although the average performance

times of subjects increased in the last session in two of the experimental groups, as well as in my control group, this increase was not significant for any of them.

Insert Figure 1 about here

An ANOVA was also used to measure whether there was a significant difference between the four groups in any of the five measured sessions. Results for session two ($F = 0.82$, $df = 3/33$, $p < .05$), session three ($F = 1.49$, $df = 3/33$, $p < .05$), session four ($F = 1.50$, $df = 3/33$, $p < .05$), session five ($F = 2.26$, $df = 3/33$, $p < .05$) and session six ($F = 2.69$, $df = 3/33$, $p < .05$) were all found to be non-significant.

Discussion

This experiment showed no significant effect of noise on the performance time of multiplication problems. Furthermore, results regarding the absence of noise in the last session, did not support the hypothesis that performance times would significantly increase in the last session as the noise level was decreased. Although this experiment was unsuccessful in measuring what it had initially proposed to measure, a couple of factors were noted within the study, which seemed to suggest that the results could be different, given different conditions or circumstances.

First, as noted earlier, in three of the four groups, subjects displayed an increase in performance time in the last session. Two of these groups were experimental groups, and involved a decrease in the noise level in the sixth session. This seems to suggest that

the withdrawal of noise after repeated exposure to it may possibly have an affect on performance time. Although results of this particular study were found not to be significant, they could very well be significant under different conditions.

A second factor comes from comments made by a subject in the Varying Noise Group. She commented that she found she could condition herself to the presence of noise, and increasing the level of noise did not seem to affect her; however, when the noise level was decreased in the last session, she found that it affected her ability to concentrate and to perform adequately. In essence, this was the primary focus of the study; this subject's comments described precisely what this experiment was attempting to discover. From this the conclusion was drawn, that it was not so much the idea of this experiment that was wrong, but more the direction from which it was approached.

This led to an indepth look at the study to try to uncover some of the problems within it, which may have led to the results which were obtained. Noted here are a few of these problems which were discovered. The first of these is that subjects for the most part were run in groups, which caused them to act more as part of their group rather than as an individual. Consequently, much of their performance may have been based on the people around them. This experiment may possibly have been more effective had it been done on an individual basis.

Secondly, where my study was primarily concerned with measuring

the speed of subjects in performing multiplication problems, it may have been more successful in measuring their accuracy in performing a task instead. It has been shown time and again that noise has a negative effect on task performance; in fact, many of the studies researched for this experiment seemed to focus on such effects. This study, however, was approached from a different direction and as seen by the results, subjects' performance time or speed was not significantly affected and in some cases was even enhanced by the presence of noise.

A third problem which was found was that this study focused a great deal on habituation to noise; however, habituation actually played a very small role in respect to subjects' performance times. Subjects seemed to habituate very rapidly to the presence of noise and after the second session subjects in three of the groups followed the same pattern in their performance times. In these groups, subjects' performance times decreased at a continual rate up until the last session, where subjects in all three groups showed a slight increase in performance times. With the Moderate Noise Group, however, subjects' average performance time time increased in the third session and then began to decrease, levelling out in the fifth session and further decreasing in the sixth session. Again it is believed that had this study been examining the effects of noise on accuracy rather than speed, habituation would have been a much larger factor.

In conclusion, this experiment has succeeded in openning the door for future research, and with the proper reconstruction could very well find significant results.

References

Applewhite, P. B. et. al. (1969). Protozoan habituation learning after loss of macro-nuclei and cytoplasm. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 21). New York: Acedemic Press.

Britton, Linda A., & Delay, Eugene R. (1989). Effects of noise on a simple visual attentional task. Perceptual and Motor Skills, 68, 875-878.

Bruner, J. & Kennedy, D. (1970). Habituation: occurrence at a neuromuscular junction. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 4). New York: Acedemic Press.

Gulian, E. & Thomas, J. R. (1986). The effects of noise, cognitive set and gender on mental arithmetic performance. British Journal of Psychology, 77, 503-511.

Harris, J. D. (1943). Habituatory response decrement in the intact organism. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 2). New York: Acedemic Press.

Hayes, W. N. et. al. (1968). Visual alarm reactions in turtles. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation I: behavioral studies (p. 91). New York: Acedemic Press.

Humphrey, G. (1930). Le chatelier's rule and the problem of habituation and dishabituation in Helix alborabris. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 4). New York: Acedemic Press.

Kandel, E. R. (1979). Small systems of neurons. In Richard R. Bootzin, Gordon H. Bower, Robert B. Zajonc, & Elizabeth Hall (eds.). Psychology Today: an introduction, (1986), p. 189. New York: Random House.

Kinastowski, W. (1963b). The influence of mechanical stimuli on the contractility of Spirostomum ambiguum. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 25). New York: Acedemic Press.

Osborn, D. et. al. (1973). The effects of vibratory and electrical stimulation on habituation in the ciliated protozoan. In Harman V. S. Peeke & Michael J. Herz, (1973). Habituation II: physiological substrates (p. 4). New York: Acedemic Press.

Pavlov, I. P. (1927). Conditioned reflexes. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 2). New York: Acedemic Press.

Peeke, Harman V. S. & Herz, Michael J. (1973). Habituation II: physiological substrates. New York: Acedemic Press.

Peeke, Harman V. S. & Herz, Michael J. (1973). Habituation I: behavioral studies. New York: Acedemic Press.

Sherrington, C. S. (1906). The integrative action of the nervous system. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 2). New York: Acedemic Press.

Spencer, W. A., Thompson, R. F., & Nielson, D. R., Jr. (1966a). Response decrement of the flexion reflex in the acute spinal cat and transient respiration by strong stimuli. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 4). New York: Acedemic Press.

Smith, Andrew P., (1983). The effects of noise and time on task on recall of order information. British Journal of Psychology, 74, 83-89.

Smith, Andrew P., (1983). The effects of noise and memory load on a running memory task. British Journal of Psychology, 74, 439-445.

Teyler, T. J. et. al. (1972). An acute atraumatic stereotaxic headholder for cat. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation I: behavioral studies (p. 184). New York: Acedemic Press.

Thompson, R. F. & Spencer, W. A. (1966). Habituation: a model phenomenon for the study of neural substrates of behavior. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 4). New York: Acedemic Press.

(1973). Habituation II: physiological substrates (p. 4). New York: Acedemic Press.

Thorpe, W. H. (1963). Learning and instinct in animals. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 15). New York: Acedemic Press.

Wood, D. C. (1970a). Parametric studies of the response decrement produced by mechanical stimuli in the protozoan. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 4). New York: Acedemic Press.

Singer, J. E. & Glass, D. C. (1972). Urban stress. New York: Acedemic Press.

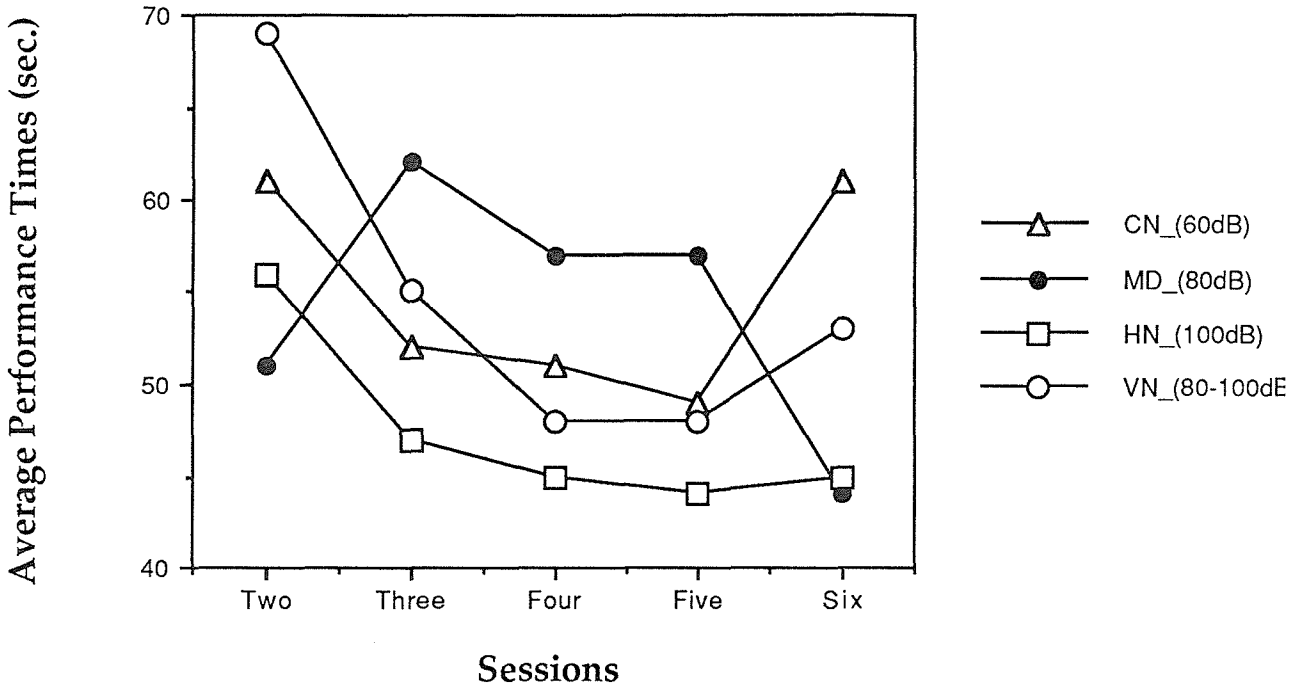
Session	Constant Noise (60 dB)	Moderate Noise (80 dB)	High Noise (100 dB)	Varying Noise (80 -100 dB)
1 (practice)	60 dB	60dB	60 dB	60 dB
2	60 dB	60dB	60 dB	60 dB
3	60 dB	80dB	100 dB	80 dB
4	60 dB	80dB	100 dB	90 dB
5	60 dB	80dB	100 dB	100 dB
6	60 dB	60dB	60 dB	60 dB

Table 1 Control and Experimental Groups

Figure Caption

Figure 1. Subjects average performance times for each of the five measured sessions, measured in seconds.

Results


Average Performance Times (sec.)
70
60
50
40
Two
Three
Four
Five
Six
Sessions
CN_(60dB)
MD_(80dB)
HN_(100dB)
VN_(80-100dE

Literature Review: The Effects of the Absence of Noise After Repeated Exposure on Performance Time

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Running head: LITERATURE REVIEW

Literature Review

Habituation is defined (Wyers, Peeke and Herz, 1973), as a stimulus specific response decrement resulting from repeated or constant exposure to the response eliciting stimulus. Essentially, it is a decrease in the strength of a response which occurs after a stimulus has been presented over a long period of time (either in one prolonged stretch or in repeated short intervals).

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References

Applewhite, P. B. et. al. (1969). Protozoan habituation learning after loss of macro-nuclei and cytoplasm. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 21). New York: Acedemic Press.

Britton, Linda A., & Delay, Eugene R. (1989). Effects of noise on a simple visual attentional task. Perceptual and Motor Skills, 68, 875-878.

Bruner, J. & Kennedy, D. (1970). Habituation: occurrence at a neuromuscular junction. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 4). New York: Acedemic Press.

Gulian, E. & Thomas, J. R. (1986). The effects of noise, cognitive set and gender on mental arithmetic performance. British Journal of Psychology, 77, 503-511.

Harris, J. D. (1943). Habituatory response decrement in the intact organism. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 2). New York: Acedemic Press.

Hayes, W. N. et. al. (1968). Visual alarm reactions in turtles. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation I: behavioral studies (p. 91). New York: Acedemic Press.

Humphrey, G. (1930). Le chatelier's rule and the problem of habituation and dishabituation in Helix alborabris. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 4). New York: Acedemic Press.

Kandel, E. R. (1979). Small systems of neurons. In Richard R. Bootzin, Gordon H. Bower, Robert B. Zajonc, & Elizabeth Hall (eds.). Psychology Today: an introduction, (1986), p. 189. New York: Random House.

Kinastowski, W. (1963b). The influence of mechanical stimuli on the contractility of Spirostomum ambiguum. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 25). New York: Acedemic Press.

Osborn, D. et. al. (1973). The effects of vibratory and electrical stimulation on habituation in the ciliated protozoan. In Harman V. S. Peeke & Michael J. Herz, (1973). Habituation II: physiological substrates (p. 4). New York: Acedemic Press.

Pavlov, I. P. (1927). Conditioned reflexes. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 2). New York: Acedemic Press.

Peeke, Harman V. S. & Herz, Michael J. (1973). Habituation II: physiological substrates. New York: Acedemic Press.

Peeke, Harman V. S. & Herz, Michael J. (1973). Habituation I: behavioral studies. New York: Acedemic Press.

Sherrington, C. S. (1906). The integrative action of the nervous system. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 2). New York: Acedemic Press.

Spencer, W. A., Thompson, R. F., & Nielson, D. R., Jr. (1966a). Response decrement of the flexion reflex in the acute spinal cat and transient respiration by strong stimuli. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 4). New York: Acedemic Press.

Smith, Andrew P., (1983). The effects of noise and time on task on recall of order information. British Journal of Psychology, 74, 83-89.

Smith, Andrew P., (1983). The effects of noise and memory load on a running memory task. British Journal of Psychology, 74, 439-445.

Teyler, T. J. et. al. (1972). An acute atraumatic stereotaxic headholder for cat. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation I: behavioral studies (p. 184). New York: Acedemic Press.

Thompson, R. F. & Spencer, W. A. (1966). Habituation: a model phenomenon for the study of neural substrates of behavior. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 4). New York: Acedemic Press.

(1973). Habituation II: physiological substrates (p. 4). New York: Acedemic Press.

Thorpe, W. H. (1963). Learning and instinct in animals. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 15). New York: Acedemic Press.

Wood, D. C. (1970a). Parametric studies of the response decrement produced by mechanical stimuli in the protozoan. In Harman V. S. Peeke & Michael J. Herz (1973). Habituation II: physiological substrates (p. 4). New York: Acedemic Press.

Singer, J. E. & Glass, D. C. (1972). Urban stress. New York: Acedemic Press.