CHANGES IN IRRELEVANT CUES AND TRANSFER ALONG THE AUDITORY INTENSITY CONTINUUM

Thesis for the Degree of M. A.

MICHIGAN STATE UNIVERSITY

EARL DONALD WALKER

1970

ABSTRACT

CHANGES IN IRRELEVANT CUES AND TRANSFER ALONG THE AUDITORY INTENSITY CONTINUUM

By

Earl Donald Walker

Transfer of training was sought in three groups of rats trained on easy auditory intensity discriminations prior to being shifted to more difficult problems. An easy discrimination between two intensities of a 5000 Hz tone separated by 20 db (60 db = S-, 80 db = S+) was given to two of these groups (20T), while the third group (20N) was trained with 60 db (S-) and 80 db (S+) intensities of white noise. The 20N and one of the 20T groups were then shifted to a very difficult (6T) discrimination between 60 db (S-) and 66 db (S+) intensities of the 5000 Hz tone. The remaining 20T group was shifted to a moderately difficult (9T) discrimination between 60 db (S-) and 69 db (S+) values of that same tone. The performance curves for these three groups were compared to those of two control groups given all of their training on corresponding difficult (6T or 9T) discriminations. There were statistically significant differences between groups prior to shifting but not afterwards, so that transfer of training was not clearly demonstrated.

It was found, however, that the 9T problem was considerably easier than the 6T discrimination, to the point of being close to the minimal difficulty required of a control problem.

The present study also explored a new method for teaching successive-presentation discrimination problems. It was demonstrated that high levels of discrimination accuracy could be achieved in food satiated subjects (working for sucrose reward) with a relatively small number of stimulus presentations.

Approved Robert L. Raisler

Robert L. Raisler
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Date August 12, 1970

CHANGES IN IRRELEVANT CUES AND TRANSFER ALONG THE AUDITORY INTENSITY CONTINUUM

By

Earl Donald Walker

A THESIS

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

MASTER OF ARTS

Department of Psychology

1970

To my parents

ACKNOWLEDGMENTS

I am very grateful for the general support and special attention that has been given to this work by the members of my committee. I thank Dr. John I. Johnson and Dr. Mark E. Rilling for criticisms and suggestions that have caused me to reexamine some old and comfortable ways of thinking. As a result I feel I have gained a broader perspective for evaluating my own work and for making long range research plans.

I am particularly indebted to Dr. Robert L. Raisler, who has served as both my thesis committee chairman and academic advisor. In addition, he has allowed me the use of his laboratory and has devoted an enormous amount of time to listening to my ideas, complaints, and problems. His help has taken the form of a long and close association of which I am very proud. The strengths in this research directly reflect the influence of Dr. Raisler and the other members of my committee, while the weaknesses emphasize that I still have a great deal to gain from their assistance.

This investigation was supported by Biomedical Sciences Support Grants 5S05FR07049-02 and -03 to Robert L. Raisler from the General Research Support Branch, Division of Research Resources, Bureau of Health Professions Education and Manpower Training, N. I. H.

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INTRODUCTION

Performance on a difficult discrimination has been found to be better for animals previously trained on an easier discrimination than for animals given all of their training on that same difficult problem. This effect has been called transfer along a continuum (TAC), and has been observed in dogs (Pavlov, 1927), pigeons (Williams, 1968), octopus (Sutherland, Mackintosh, and Mackintosh, 1963), and rats (Franken, 1967; Lawrence, 1952; Logan, 1966) with respect to stimulus dimensions of visual intensity (Franken, 1967; Lawrence, 1952; Pavlov, 1927), area (Williams, 1968), shape (Sutherland, et al., 1963), and auditory frequency (Logan, 1966).

Two major kinds of explanations have been offered for the TAC effect. One of these, the two-stage model, assumes that in order to make a discrimination it is important for the animal to functionally isolate the relevant stimulus dimension from all other background and irrelevant cues prior to attaching responses to the relevant stimuli. It is then suggested that a dimension becomes more salient

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Two major kinds of explanations have been offered for the TAC effect. One of these, the two-stage model, assumes that in order to make a discrimination it is important for the animal to functionally isolate the relevant stimulus dimension from all other background and irrelevant cues prior to attaching responses to the relevant stimuli. It is then suggested that a dimension becomes more salient and its dominance more readily established when training is given with stimulus values representing points that are widely separated (easy discrimination) as opposed to close together (difficult discrimination) along that dimension (Lawrence, 1952, 1955; Sutherland, 1959).

A modified Hull-Spence (one-stage) model has also been used, explaining the TAC effect in terms of interacting gradients of excitation and inhibition built up around the training stimuli as a direct result of reinforced and unreinforced responses (Logan, 1966). The accuracy of a discrimination between any two values on a continuum is assumed to be reflected as a direct function of the size of the difference between the algebraic sums of excitatory and inhibitory strengths generalized to the stimuli in question from the reinforced and unreinforced training stimuli. With some speculation as to the shape of the gradients of excitation and inhibition produced around the training stimuli, it can be illustrated that the size of this difference between algebraic sums for a given pair of relatively closely spaced stimulus values is greater following training with more widely separated values (which may include one of the original stimuli) than it is following the same amount of training with the original pair itself. This amounts to a prediction of the TAC effect.

Although both models predict transfer of training along the relevant stimulus dimension, they differ in their assessment of the role and importance of irrelevant stimulus dimensions. Spence, whose learning model underlies the generalization gradient explanation of TAC, suggests that changing an irrelevant cue characteristic (e.g., form in a wavelength discrimination) following prolonged, consistently correct (rewarded) discrimination responding may threaten the accuracy of performance.

"In so far as these (irrelevant) characteristics are the same for both stimulus objects, only one member of each dimension is present, and, as they receive both reinforcement and non-reinforcement, their effective excitatory strengths are not greatly increased. If, however, a considerable amount of overtraining is provided, all the stimulus characteristics are increased in excitatory value since all responses are correct and consequently followed by reinforcement. Just what effect such differences in the level of strength of these non-cue characteristics may have, it is not possible to say *a priori*. Possibly they would not affect the differential nature of the response but only the vigor of the reaction. On the other hand it is possible that the amount of difference between excitatory strengths of the cue aspects necessary to produce a differential response is related to the level of strength of the remaining stimulus aspects. This point is of particular importance in connection with the problem of equivalence of stimuli when more than one stimulus aspect is changed." (Spence, 1937).

It seems reasonable to hypothesize from this that changing an appropriate irrelevant cue after training on a relatively easy discrimination problem is likely to disrupt discrimination performance since, by definition, the percentage of correct responses is high in an easy problem and this reduces the opportunity for incorrect responses to equalize excitatory potential build-up to irrelevant cues present in both the rewarded and the unrewarded stimulus manifolds.

The two-stage learning model does not predict this disruption of discrimination performance. Rather, easy discrimination problems tend to channel attention away from irrelevant stimulus dimensions. This is because the isolation of the relevant stimulus dimension from all background and irrelevant cues precedes the attaching of correct responses to the relevant stimuli, and training on an easy discrimination, in which the stimulus values are relatively widely separated along some continuum, facilitates this isolation of the relevant stimulus dimension. Mackintosh (1965) states:

> "the greater the difficulty of the relevant discrimination the more likely subjects are to attend to other, irrelevant features of the stimuli, and therefore the more likely they are to classify the stimuli along other dimensions..."

One would expect then that changing an irrelevant cue following training on an easy problem should produce relatively little performance decrement (MacCaslin, Wodinski, and Bitterman, 1952). This is the opposite of what can be expected according to the Spence model. In general, as discrimination problems become easier, the likelihood that a change in irrelevant cues will produce a decrement in performance increases according to the one-stage model, but decreases according to the two-stage model. In other words, the one-stage model predicts that as problems become easier, this decrement will become larger; the two-stage model predicts that as problems become easier, this decrement will become smaller.

Studies showing the TAC effect have so far dealt only with changes in stimuli on the relevant stimulus dimension. The differential prediction outlined above suggests that the manipulation of irrelevant cues as well may provide an opportunity to further examine the relative effectiveness of the two learning models in esplaining the TAC effect. The amount of transfer of training shown by animals whose discriminanda are changed along both the relevant and an irrelevant stimulus dimension following easy discrimination training, when compared to the amount of transfer shown by animals presented with changes only along the relevant dimension, should give an indication of the magnitude of the disruptive effects of changing irrelevant cues.

Furthermore, this comparison is enhanced if transfer is allowed to occur only along the relevant dimension for the group whose irrelevant cues are changed, but along both the relevant and irrelevant dimensions for the group with changes only in the relevant cues. Maximum transfer along the irrelevant dimension is already provided for in the latter case since the irrelevant stimulus values remain unchanged between the easy and the difficult problems. At the other extreme, minimal transfer with respect to changed irrelevant cues can be obtained (for the other group) if, following easy discrimination training, the irrelevant cue change is between stimuli on two orthogonal stimulus dimensions (e.g., white noise and pure tones), as opposed to between different values on a single dimension.

This kind of situation was created in the present study around the auditory intensity dimension. Easy discrimination training was given to one experimental group using two intensities of white noise. A second group was trained with the same two intensities of a pure tone. Both groups were subsequently shifted to a difficult intensity discrimination between values of that same pure tone. Their performance was compared to a control group given all of its training on the difficult tone intensity problem. Except for the manipulation of irrelevant cues (white noise vs tone), maximal amounts of transfer were encouraged by changing only the intensity of the rewarded stimulus in shifting from the easy discrimination to the difficult one. Logan (1966) found that this shifting procedure, as opposed to changing the non-rewarded stimulus or both stimulus values, produced the greatest amount of TAC.

Another purpose for this study was to further explore a method developed by the present experimenter for teaching successive-presentation (go-no-go) auditory discriminations to rats in a barpress apparatus. This method differs in three notable ways from methods typically used in such problems (e.g., Logan, 1966). First, food satiated animals are used. Correct responses to the reinforced stimulus (S+) are rewarded with sucrose pellets. Also an extinction criterion that may vary in duration from trial to trial is imposed on barpressing during the intertrial interval and following an incorrect response to the unrewarded stimulus (S-). Finally, a trial is never allowed to end with an incorrect response. For example, failure to respond to S+ within five seconds of its onset is scored as an error, but S+ remains on until a response occurs and is rewarded. Likewise, a response that occurs within five seconds of the onset of S- is scored as incorrect, but the S- stimulus condition remains in effect until an extinction criterion is met. Preliminary work suggests that this method may substantially reduce the number of stimulus presentations necessary to teach this type of discrimination problem.

EXPERIMENT 1

Method

Subjects. The subjects (Ss) were 12 experimentally naive male albino rats of the Holzman strain 90-120 days old at the beginning of the experiment. The Ss were housed in individual living cages with food (Wayne Lab Blox) and water available on an ad lib basis throughout the period of experimentation.

Apparatus. The apparatus included an experimental space (inside dimensions: 9" X 12" X 9") painted flat black and equipped at one end with a bar centered three inches above the hardware cloth floor. A depression of the bar (barpress) enabled (at the discression of the experimenter) a single 4 mm X 3.3 mm X 45 mg Noyes "sucrose" pellet (reward) to be automatically delivered to a foodcup located directly below the bar. Sound stimuli were produced by a Hewlett-Packard specification #20-200 CD wide range oscillator and a General Radio Co. type 1382 random-noise generator. These signals were amplified by a McIntosh MA 5100 pre-amplifier and presented through a 4" speaker centered in the ceiling of the experimental space. Signals were presented and data were recorded with the aid of associated electronic programing equipment.

<u>Procedure</u>. The barpress response was conditioned by merely placing the <u>S</u>s in the experimental space for daily 30 min. (maximum) sessions during which all barpresses were rewarded. The first stage of this training ended with the fiftieth barpress to occur in any two consecutive sessions. Subjects failing to meet this criterion in four sessions were replaced. This was the case for three <u>S</u>s (one member of each of the experimental groups formed later). Following this a uniformly high rate of responding was conditioned by continuing the above training until 25 responses occured within a single 20 min. (maximum) session. No sound stimuli were presented during these conditioning periods.

All <u>S</u>s began discrimination training on the day immediately following the completion of original conditioning. A discrimination trial consisted of a silent intertrial interval (ITI) and a period during which a sound stimulus was presented. An ITI did not end until a prescribed period of time had elapsed without a barpress. This period was either 10, 15, 20, 25, or 30 sec. for any given ITI, depending on a prearranged sequence randomizing these values in blocks of five.

Either a rewarded (S+) or an unrewarded (S-) sound stimulus followed each ITI according to a prearranged semi-random sequence that, for blocks of 50 trials, paired each stimulus value with each ITI value an equal number of times. The stimuli were, in addition, randomized in blocks of ten (containing two successive blocks of ITI values), such that each value appeared exactly five times without occuring more than three times in succession.

The first barpress to occur in the presence of S+ simultaneously produced a reward and began an ITI condition. Barpresses made in the presence of S- were not rewarded. The S- was terminated 5 sec. after its onset provided no barpress occured during that time. Otherwise S- remained on until a period of prescribed length had elapsed without a barpress. The length of this period on any given trial was either 10, 15, 20, 25, or 30 sec., as determined by a prearranged sequence randomizing these values in blocks of five. All Ss were given 50 discrimination trials daily. A trial was scored as correct or incorrect on the basis of the animal's performance during the first 5 sec. of stimulus presentation. A barpress occuring during this interval was scored as correct if S+ was present and incorrect if S- was present. Response latencies to S+ that were greater than 5 sec. caused a trial to be scored as incorrect, although the S+ condition remained in effect until a barpress finally occured. Non-occurrence of response during the first 5 sec. of an S-trial was scored as correct and resulted in the termination of S-.

Design. Three matched groups containing four Ss each were formed on the basis of the order in which Ss completed original barpress conditioning (i.e., the first three Ss to meet the conditioning criteria were randomly distributed, one to each group; likewise with the second three Ss etc.). These groups were then randomly assigned to the three conditions of the experiment.

All Ss received a total of 700 discrimination trials. One group (6T) received all 700 trials on a difficult discrimination with S+ and S- being 5000 Hz tones of 66 db (re: .0002 dynes/cm^2) and 60 db intensities, respectively. The Ss in both the remaining groups received their final 300 trials on this same difficult problem. Prior to this they were given 400 trials on a easy discrimination with S+ and S- at 80 db and 60 db, respectively. This easy training was with 5000 Hz tones for one group (20T) and with white noise for the other (20N).

Results

The results are illustrated in Figure 1, which shows the mean percent error per group for each 50-trial session. The 6T (control) group, which was trained on the difficult discrimination problem for the entire 700 trials, showed only a slight overall improvement. At the end of training it averaged approximately 40% errors. Two of the animals in this group were given 500 additional trials (not shown) which reduced average errors to 30%. This suggested that the difficult discrimination could be learned with extended training, although improvement was very gradual.

The 20T and 20N groups both improved rapidly and at about the same rate over the 400 trials of easy discrimination training that they received. They reached what appeared to be near-asymptotic levels of performance with 16-20% errors within 300 to 350 trials. This amounted to at least 100 trials of overtraining past an 80% correct criterion for each of the groups.

For statistical analysis an error score was computed for each S including both errors of omission (not responding to S+ within 5 sec.) and errors of commission (responding to S- within 5 sec.) for each 50-trial session. A two-way analysis of variance of these scores for the first eight sessions yielded differences between groups that were significant beyond the .001 level ($F = 35.92$, $df = 2/9$). The differences within groups were significant over trials ($F = 21.99$, $df = 6/60$, $p < .001$) and for the group-trials interaction ($F = 6.63$, $df = 6/60$, $p < .001$). These results indicate that the differences in group performances

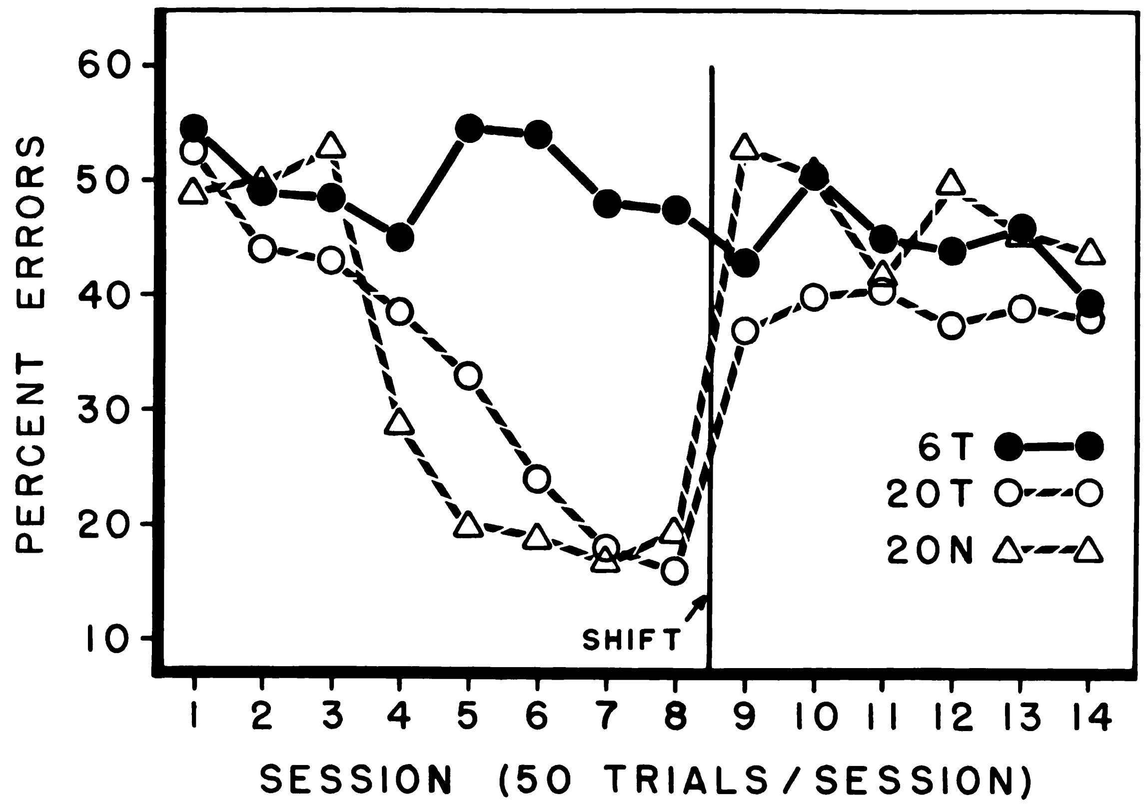

Figure 1. Per cent errors per 50-trial session for three groups of rats in a transfer of training situation. Two experimental groups were given eight sessions of auditory intensity discrimination training with 60 db and 80 db values of either white noise (20N group) or a 5000 Hz tone (20T group). The control group (6T) was trained with 60 db and 66 db intensities of the 5000 Hz tone. Beginning with the ninth session all groups were trained on the 6T problem.

prerequisite for the TAC effect were present by the end of the eighth session.

However, no major differences in performance were observed between any of the groups during the final 300 trials of the experiment after the 20T and 20N groups were shifted to join the 6T group in the difficult discrimination problem. Only one *S*, a member of the 20T group, showed any obvious transfer of training. This animal maintained a relatively high level of performance (18-26% errors) across all 300 trials following the shift. The slight superiority of the 20T group was due largely to the performance of this subject. The analysis of variance for the last six sessions did not show significance either between groups (F = 2.48, df = 2/9, $p < .20$) or within groups (F = 1.60, df = 5/40, $p < .20$ over trials; and F = 1.09, df = 8/40, $p < .5$, for the group-trials interaction).

EXPERIMENT 2

The first experiment failed to show any clear evidence of the TAC effect in either of the transfer groups. This may have been because the 6T discrimination was too difficult, and that possibility was explored using a difficult problem with stimuli separated by 9 db as opposed to the previous 6 db separation. A single transfer group was trained on the 20T problem as before.

Method

The method of training was the same as in Experiment 1 except that eight sessions rather than four were allowed for meeting the criteria of original conditioning. The control (9T) group (n = 4) was trained with 60 db (S-) and 69 db (S+) intensities of the 5000 Hz tone. The transfer (20T) group (n = 2) had 60 db (S-) and 80 db (S+) intensities of that same tone , as in the previous study.

Results

The results are illustrated in figure 2, which shows percent error for each 50-trial session. The 9T group improved steadily, and was performing with approximately 38% errors at the end of 400 trials and with 24% errors by the end of 700 trials. The 20T group improved more rapidly, and was able to maintain a 20-24% error level for 150 trials prior to being shifted to the difficult problem. Although there were only two *S*s in this group, their average performance closely paralleled that of the four *S*s in the 20T group in Experiment 1.

The difference in performance between the two groups over the first eight sessions was statistically significant beyond the .001 level (F = 58.82, df = 1/4) as determined by a two-way analysis of variance of error scores. There was also a significant change in performance over trials (F = 5.67, df = 7/28, $p <$ .001) and a significant interaction of groups and trials (F = 2.81, df = 7/28, $p <$ .05).

These differences once again provided the opportunity for transfer to occur, but, just as in Experiment 1, major differences between groups were no longer observable after the 20T animals were shifted to the difficult problem. A two-way analysis of variance of error scores in sessions 9-14 yielded no significant differences either between groups (F = .01, df = 1/4) or within groups (F = 1.25, df = 5/20, over trials; F = .63, df = 5/20, for the interaction between groups and trials). This occured in spite of the fact that the 9T discrimination was considerably easier than the 6T problem. A two-way analysis of variance comparing the 6T and the 9T groups over sessions 1-14 yielded significant differences both between groups (F = 33.07, df = 1/6, $p <$ .01) and within groups (over trials F = 7.51, df = 12/60, $p <$ .001; and for the group-trials interaction F = 2.29, df = 12/60, $p <$ .025).

The development of differential response tendencies

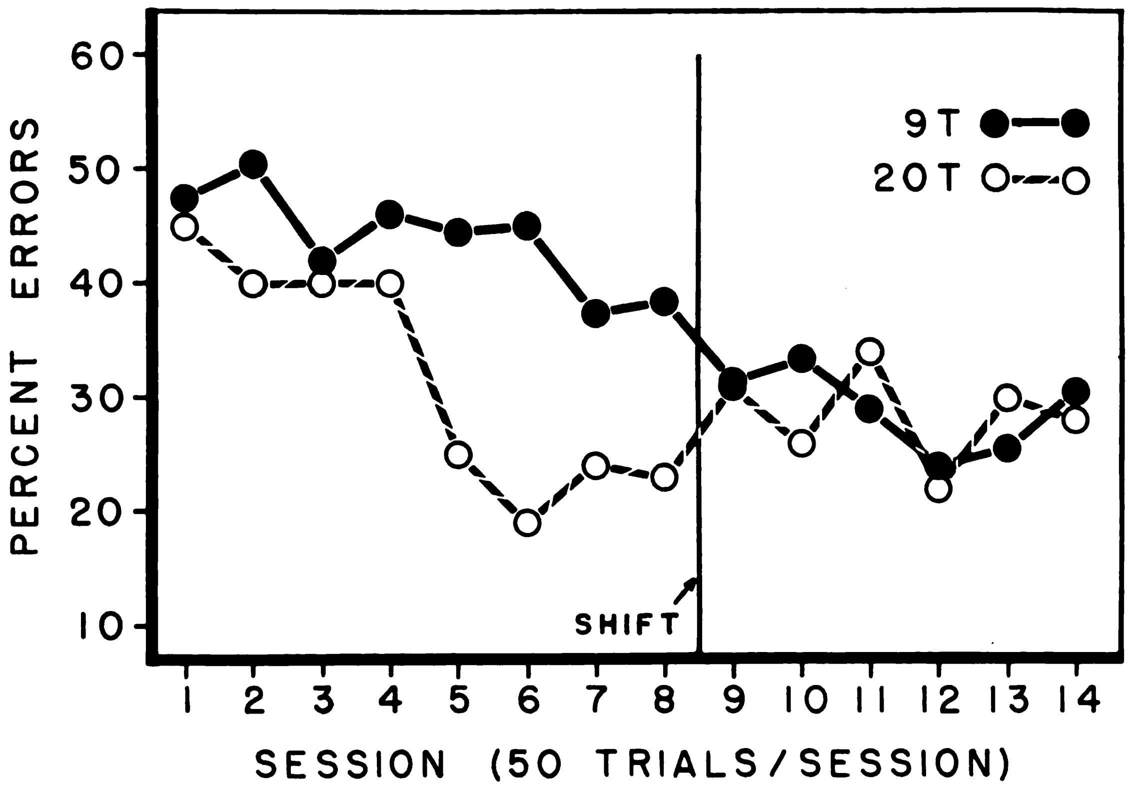

Figure 2. Per cent errors per 50-trial session for two groups of rats in a transfer of training situation. The control (9T) group was given all of its training on an auditory intensity discrimination problem with 60 db (S-) and 69 db (S+) values of a 5000 Hz tone. The experimental (20T) group was given eight sessions of training with 60 db (S-) and 80 db (S+) values of that same tone, then shifted to the 9T problem.

to S+ and S- over trials is shown in Figure 3 for all of the groups (except the 20T group in Experiment 2). The graphs show percent response to S+ and S- within 5 sec. of stimulus onset. This represents correct responding to S+ and incorrect responding to S-. Therefore the degree of response differentiation occuring between these two stimuli is reflected in the amount of separation between the S+ and S- functions. A high degree of differentiation occured after the first 4-5 sessions for the easy discriminations with stimuli separated by 20 db (20T and 20N). Differentiation was more gradual as problem difficulty increased to the level of the 9T discrimination (9 db separation) and was very slow in the case of the 6T problem (6 db separation). In general, except for when training was given on the 6T problem, the S- functions first increased then decreased over the course of training, while the S+ curves were fairly smooth, negatively accelerating, ascending functions that reached near-asymptotic levels (80-90% response) after 250-300 trials.

Shifting to the 6T problem resulted in marked disruption of differential responding in both the 20T and the 20N groups. This appeared to be somewhat less for the 20T group, but the difference was not statistically significant as shown by the two-way analysis of variance performed

Figure 3. Per cent response to the rewarded (S+) and the nonrewarded (S-) stimuli for 50-trial sessions of auditory intensity discrimination training given four groups of rats in a barpress apparatus. Transfer of training was attempted with two groups that were given 60 db (S-) and 80 db (S+) values of either white noise (20N group) or a 5000 Hz tone (20T group) during sessions 1-8 then shifted to a problem given the 6T group over all 14 sessions. The 6T discrimination was between 60 db (S-) and 66 db (S+) intensities of the 5000 Hz tone. The 9T group had all of its training with 60 db (S-) and 69 db (S+) values of that same tone.

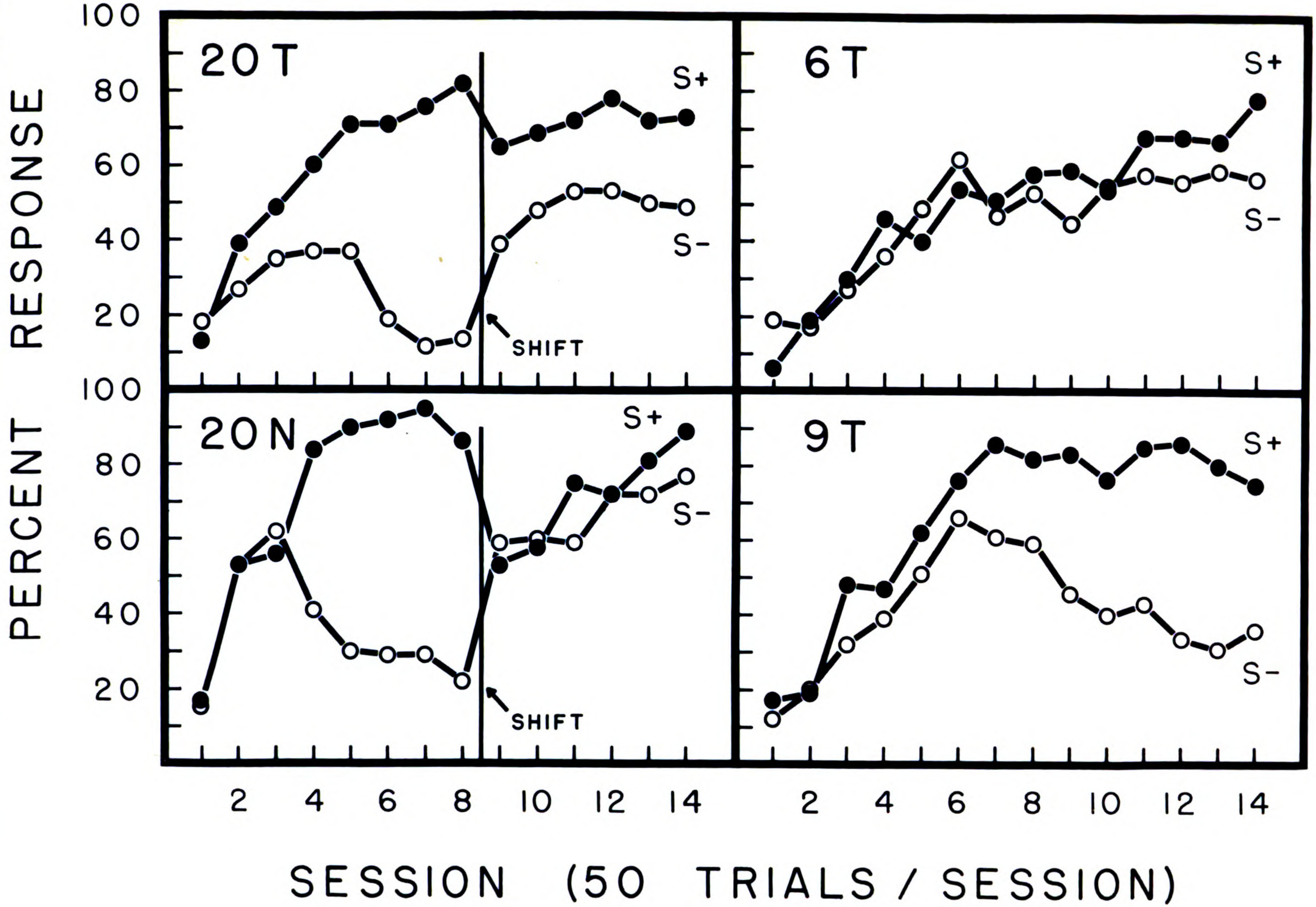
PERCENT RESPONSE
100
80
60
40
20
20T
6T
20N
9T
S+
S-
SHIFT
2
4
6
8
10
12
14
SESSION (50 TRIALS / SESSION)

Figure 3.

in Experiment 1 ($p < .2$).

DISCUSSION

The results of the present study are not in accord with previous findings of the TAC effect. Although one member of the first 20T group did show transfer, TAC did not occur in sufficient amounts to produce statistically significant differences between groups in either of the present experiments. (It is not possible to assess the extent to which all members of the transfer groups in previous studies have shown TAC, since only group data are presented.) Two reasonable explanations that may be offered for this failure of TAC are that the difficult problems were so difficult as to obscure the transfer effects, and/or that insufficient overtraining was given on the easy discrimination problems prior to shifting to the more difficult discriminations. The first possibility was examined in Experiment 2. Although there were significant differences in the performances of the 20T and the 9T groups prior to the shift (thus making transfer possible), it seems likely that these differences would have been diminished to the point of precluding transfer had the control problem been much easier. What is clear is that the 9T problem was considerably easier than the 6T problem, but in neither case was TAC demonstrated. It seems reasonable to conclude from this that the failure to obtain TAC did not result from the control problems being too difficult.

The difficulty of the control problem does, however, seem to limit the amount of overtraining that can be given to a transfer group. This can be seen most clearly in the case of the 9T problem. Assuming that the 20T group had reached a near-asymptotic performance level after the first four sessions, if easy discrimination training had continued much beyond eight sessions the two performance functions quite probably would have merged, even without shifting the 20T group to the 9T problem. Thus it appears that large amounts of overtraining could not be given on easy discriminations with stimuli separated by 20 db or less when the stimuli in the control problem are separated by more than 9 db. Since it is also reasonable to suppose that performance on the easy discrimination problem would not have been greatly improved by stimulus separations of more than 20 db, if transfer of training failed to occur because of insufficient overtraining, it is likely, given the present training situation, that TAC can only be expected over a relatively small range of problems. More specifically, with respect to albino rats, the auditory intensity continuum, and the present method of training, it is unlikely that TAC can occur to any appreciable degree when the stimuli in the control problem are separated by much more than 9 db.

The question of the necessity for overtraining is presently being explored in this context using a 6T control group and a 20T transfer group. Large amounts of overtraining (600-700 trials past an 80% correct criterion) are possible in this situation since it is known (on the basis of the continued training given members of the 6T group in Experiment 1) that improvement on the 6T problem is very gradual.

The second purpose for performing the present studies was to further explore a method of discrimination training. In general, the present method of training was successful in producing relatively high levels of discrimination performance after comparatively few stimulus presentations. Animals trained on the easy discriminations were performing with approximately 80% correct responses after 250-300 trials (stimulus presentations). Although direct comparisons between this and any other method are not justified due to lack of sufficient controls, it is nevertheless interesting to note that Logan (1966), in training for transfer along the auditory frequency dimension (using rats in a barpress apparatus), required approximately 1,500 stimulus presentations to reach this same 80% level of correct responding. (The differences between the S+ and S- stimuli in the various easy discrimination problems used by Logan varied from 630 to 1180 Hz and were taken from the segment of the frequency dimension bounded by 640 and 2300 Hz.)

It is conceivable that the rate at which the easy problems were learned contributed to the lack of transfer in the present study in that a relatively large number of stimulus presentations, or a large amount of time over which training is spread may be somehow necessary for producing the kind of learning from which transfer can occur. However, this possibility is restricted at least to studies using sussessive-presentation discrimination problems since TAC has been previously observed in a variety of species after 25-130 trials of simultaneous discrimination training (Franken, 1967: rats, after 40 trials; Lawrence, 1952: rats, after 25 trials; Sutherland, et al., 1963: octopus, after 130 trials; Williams, 1968: pigeons, after 50 trials). There have been only two known previous attempts to produce TAC using successive-presentation discrimination problems. Sutherland, et al. (1963) did <u>not</u> obtain transfer after 380 trials of easy discrimination training in which octopus were required to make shape discriminations by initiating or witholding attack responses. Logan (1966), however, found TAC in rats (barpressing) after 2,500 trials of easy training with pure tones of different frequencies.

The most obvious differences between the method used by Logan (1966) and the present method include the use in the Logan study of a) food deprived subjects, b) a fixed 15 sec. postponement of the next trial as the result of barpresses made during the ITI, and c) a rule for ending all trials after the first barpress or after 5 sec. of non-response following stimulus onset. (This rule made it possible for any trial to end with an incorrect response.) In the present studies the length of the postponement period used in the ITI varied from trial to trial between 10 and 30 sec.. Also, trials were not allowed to end with an incorrect response since S+ did not end without a barpress, and S- did not end until barpressing had ceased for some prearranged (variable) period of time.

It is not possible to say which, if any, of these differences in method produced the differences in discrimination performance noted between the present and the Logan (1966) studies. In view of the conflicting results between the two studies however, these differences suggest areas for future research oriented toward isolating the factors necessary for TAC to occur. The possibility that some minimal total training time and/or minimal total number of stimulus presentations are necessary for transfer is being presently explored using 6T and 20T groups as mentioned above. It is also possible that a large number of errors during easy discrimination training is necessary, but this cannot be readily studied with the present method since this method produces relatively rapid reductions in errors so that additional training time and stimulus presentations must take the form of overtraining, Another possibility is that some motivational extreme such as food deprivation, acting separately or in combination with the above factors, may be a necessary condition for transfer. This area is totally unexplored since the present study is the first known attempt to train food satiated animals for transfer along a continuum.

There are in fact no instances known to the present author of discrimination training being given to any of the species in which TAC has been found (i.e., dogs, rats, pigeons, or octopus) without the use of some induced motivational state such as food or water deprivation or shock avoidance. It is clear, however, that the present method allowed food satiated rats to perform quite adequately in successive-presentation discrimination problems. The option of using food satiated animals in relatively complicated discrimination problems may be quite valuable for studies where food deprivation schedules represent either an inconvenience or a potentially detremental factor in training subjects or interpreting results.

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