ORDER EFFECTS IN LEARNING A SCALE OF JUDGMENT

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ABSTRACT

ORDER EFFECTS IN LEARNING A SCALE OF JUDGMENT

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Although some work has been done in the area of learning a frame of reference or scale of absolute judgment, little has been done pertaining to the effect which different orders of stimulus presentation have on such learning. Wever and Zener (1928) suggested that when a subject has no previous knowledge of the stimulus series he tends to respond with middle categories to the first few stimuli presented. They state that once the subject has knowledge of the end stimuli he uses these stimuli to judge the other stimuli which are presented. They suggest that orders which present the end stimuli very early will lead to faster learning than orders which do not present the end stimuli very early.

The present study investigated two hypotheses concerning two different types of orders, type I orders in which the extreme stimuli were presented very early in the order and the central stimuli very late in the order, and type II orders in which the central stimuli were presented very early and the extreme stimuli were

presented very late. The first hypothesis was that subjects who received type II orders would outperform subjects who received type I orders on the first trial because all subjects would tend to use middle numbers for their first few responses since they had no previous knowledge of the stimuli. The second hypothesis was that for the following trials those who had received type I orders would be more accurate in their judgment than those who had received type II orders because those who received type I orders would have immediate knowledge of the stimulus range and could use the end stimuli to judge the rest of the stimuli presented in that trial.

Fifty subjects were randomly divided into two groups of 25 each. Stimuli consisted of eight slides with dots on them. Each slide had a different number of dots on it. Subjects were required to assign numbers from one to eight to each slide (assigning the number "one" to the slide which they thought had the least number of dots and the number "eight" to the slide which they thought had the greatest number of dots). Subjects in Group I were presented with type I orders for the first three trials and subjects in Group II were presented with type II orders on the first three trials. For the fourth and fifth trials both groups were presented with the same orders which were equally dissimilar to the type I and the type II orders.

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Group II made less absolute error than Group I on trial A supporting Wever and Zener's suggestion that subjects tend to use middle categories as responses to the first few stimuli presented when they have no prior knowledge of the stimulus series. On trials B and C Group I made less absolute error than Group II, also the amount of information transmitted was greater for Group I. On trials D and E there was no difference between Groups I and II in absolute error or in amount of information transmitted. It was concluded that orders which present the extreme stimuli very early and the central stimuli very late lead to greater accuracy in judgment than orders which present the central stimuli very early and the extreme stimuli very late. However the amount of learning transferred to unbiased orders is approximately the same from both types of orders. This confirms Wever and Zener's (1928) suggestion that orders which present the end stimuli at the beginning of the order lead to quicker learning of the scale of judgment.

Approved Donald M. Johnson
Chairman, Thesis Committee

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ORDER EFFECTS IN LEARNING A SCALE OF JUDGMENT

By

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To My Wonderful Parents

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INTRODUCTION

Research on organization of a frame of reference or a scale of absolute judgment has in general, followed the psychophysical tradition and emphasized stimulus variables, but recently a few experimenters have been concerned with learning variables. Eriksen and Hake (1955b) have shown that learning of a frame of reference or scale of absolute judgment is easier for multidimensional stimuli than for unidimensional stimuli. Eriksen (1958) states that knowledge of results helps very little in a subject's learning a scale of judgment. He suggests "that what the subject learns on this task is not to recognize individual stimuli as such, but instead to establish a frame of reference for the series of stimuli as a whole."

Parducci (1956) has shown that judgment scales may be incidentally learned, although such learning is less effective and subject to greater interference than intentional learning. Murphy (1966) has shown that knowledge of results facilitates the learning of scales of judgment when the stimuli used are various durations of time.

Gibson (1953) has stated that in experiments on absolute judgment a subject's knowledge of the range of a set of stimuli can affect his judgments and stabilize them in predictable ways. Even though the subject does not receive knowledge of results, his experience with the stimuli seem to provide him with adequate knowledge of the range. Johnson (1945) and Wever and Zener (1928) imply that an individual can make judgments fairly well after he has had an opportunity to become familiar with the range of the stimulus series.

Wedell (1934) in an experiment concerning the absolute judgment of pitch has shown that subjects use the end stimuli of the series as reference points for judging the other stimuli in the series. His subjects were also able to recognize the end stimuli when they occurred. Eriksen and Hake (1957) - in an experiment involving the absolute judgment of hues - showed that subjects tend to pick one or two hues from the stimulus series and then proceed to use these hues as references to judge the other stimuli in the series. These stimuli are usually the end stimuli on the continuum of the stimulus series.

Garner (1953) suggested that the prominence of such end effects might be partially due to a response attenuation effect that artifactually led to unidirectional errors at the ends of the stimulus series, i.e., in the middle of the stimulus series, the subject can make an error in either of two directions when he assigns a response to the stimulus while for the end stimuli, the subject can make an error in only one direction. Garner (1953) and Eriksen and Hake (1955a) have shown that this artifact only partially accounts for such anchor effects at the end stimuli. Eriksen and Hake (1957) present an alternative explanation which they call the subjective-standard hypothesis. This hypothesis states "that S when confronted with a series of stimuli in an absolute-judgment task, selects certain stimuli that he then uses as standards for judging the remaining stimuli. When a stimulus is presented, S attempts to recall one of these standard stimuli and uses it as a reference in judging the presented stimulus." The stimuli selected are usually (but not always) the end stimuli.

Johnson and King (1964) investigated the conditions under which an end stimulus would be selected as the standard to which the response scale is anchored. They found that an end stimulus serves as an anchor when and only when it has some salient property which identifies it "as an end beyond which there are no other stimuli to be judged."

Little, if any, work has been done pertaining to the effect which different orders of presentation have on the learning of a frame of reference in absolute judgment. If a general rule could be discovered which would enable one to construct orders which would facilitate the learning of a frame of reference, rather than those which might inhibit such learning, it would be possible to present the members of the stimulus series, in an order which would lead to faster or greater learning than other orders. It was the purpose of this experiment to attempt to find a general type of order of presentation of the stimuli, such that the learning of the frame of reference would be facilitated.

Since individuals seem to establish a frame of reference for a stimulus series rather than learning to recognize each individual stimulus, and since this is done by selecting stimuli which have some salient property and using them as standards for judging the remaining stimuli, it was hypothesized that orders which present the salient stimuli very early and the other stimuli later in the order would produce faster learning than orders which present the central stimuli very early and the salient stimuli very late in the order. In the present study the salient stimuli were the end stimuli and thus if the end stimuli were presented early in the order, the subject should be able to learn the range of the stimuli quicker than he would be able to if the salient end stimuli were presented late in the order, because then the subject would not have immediate knowledge of the stimulus range. This is similar to the suggestion made by Wever and Zener (1928).

In a pilot study it was found that subjects who receive the central stimuli early in the order (Group II) performed better on trial A then those who received the extreme stimuli early in the order (Group I). It was felt that this was due to the construction of the orders which Groups I and II were presented. Since the subjects had no prior knowledge of the stimuli, the first trial was mainly a measure of performance rather than learning. It was felt that subjects would tend to use central numbers to judge the first few stimuli presented on trial A because this is more conservative than using extreme numbers. If the subjects proceeded in such a manner then Group II would perform better than Group I (because the orders for Group II present the central stimuli very early in the order). Wever and Zener (1928) state that when a person has no prior knowledge of the stimuli to be presented his first judgment tends to be the middle of the possible response categories.

The investigator's first hypothesis was that Group II would perform better than Group I on the first trial. The second hypothesis was that Group I would learn the scale of judgment faster than Group II because they received the extreme stimuli very early in the order on the first three trials. This aspect was looked at in two ways: 1) by comparing Group I with Group II on trials two and three, 2) by comparing Group I with Group II on the unbiased orders presented in trials four and five.

The pilot study also suggested that after four or five trials further learning could only be expected to occur in situations of controlled attention, and motivation because subjects tend to become bored and fatigued on this task. It also suggested that a subject's expectation of the end of the experiment hinders his performance on the last trial presented.

METHOD

Subjects: Subjects consisted of 50 undergraduate students enrolled in an introductory psychology course at Michigan State University. Subjects received experimental credit in this course for participating in the experiment. They were randomly assigned to one of two equal groups (n=25).

Material and Apparatus: The materials used consisted of eight, 2 X 2 slides with black dots on a white background. Each slide had a different number of dots on it. Slides one through eight had 22, 26, 30, 35, 41, 48, 56 and 65 dots on them respectively. The number of dots on each slide increased logarithmically so that approximate linearity of response from the subjects could be assumed. Reese (1953) gives evidence which indicates that a logarithmic increase would yield approximately linear responses. A pilot study was conducted by the investigator and approximate linearity of response was achieved.

A tachistiscopic projector was used to present the slides on the light colored wall of a very dimly illuminated room. The projected image on the wall was 5 feet, 4 inches square. The projected dots had a diameter of 3 inches. Subjects sat approximately 14½ feet from the center of the projected image.

The end stimuli (the slides with 22 and 65 dots) were shown by a pilot study to be salient to the extent that subjects used them to judge the other stimuli.

Procedure: The subjects were randomly divided into two equal groups: I and II. Those in Group I were presented with orders which had the extreme stimuli at the beginning and the central stimuli at the end of the order. Those in Group II were presented with orders which were the exact reverse (i.e., inverted) of those presented to Group I (thus for Group II the central stimuli appeared in the early part of each order and the extreme stimuli appeared in the last part of the order). Extreme stimuli were slides 1, 2, 7, 8. Central stimuli were slides 3, 4, 5, 6.

Subjects were presented with a total of nine trials so that the onset of boredom and fatigue could be prolonged until after the fifth trial. Only the data from the first five trials were analyzed. Trials 1-5 are described below. Trials 6-9 were simply presentations of orders chosen at random.

A trial consisted of a separate presentation of each of the eight slides. The intertrial interval was 45 seconds and the interstimulus interval was approximately 7 seconds. The stimulus duration was 1 second. For each of the two groups there was a different order for trials 1-3, i.e. for Group I there were three different orders but they all had the extreme stimuli appearing very early in the order and the central stimuli appearing very late in the order. The orders for the first two trials within each group were complements of each other. Therefore the difficulty of each would be expected to be the same. This was done so that the hypothesized differences between Groups I and II could not be attributed to a difference in order difficulty. Group II was presented orders which were exactly the same (on trials 1-3) as for Group I <u>except</u> these orders were inverted. On trials four and five both groups were presented with stimuli in the same order. These orders were ones which had been constructed in such a way that they were equally dissimilar to the orders which had been presented to Groups I and II on the first three trials.

The method of constructing the orders for trials four and five was such: the stimuli were divided into two groups - extreme (1, 2, 7, 8) and central (3, 4, 5, 6). These two groups were subdivided into: a) extreme extremes (EE) (1, 8), b) central extremes (CE) (2, 7), c) extreme centrals (EC) (3, 6) and d) central centrals (CC) (4, 5). For each half of the orders there was a stimulus from each of the four groups. Furthermore the orders were counterbalanced in such a way that the first stimulus presented was in a class complementary to the class of the eighth stimulus presented. The class of the second stimulus was complementary to the class of the seventh stimulus. The class of the third stimulus was complementary to the class of the sixth stimulus presented. The class of the fourth stimulus presented was complementary to the class of the fifth stimulus presented. Classes CC and EE were considered complements of each other, as were classes CE and EC. Thus the performance of the two groups could be compared on orders which were equally dissimilar to those presented to either group on trials 1-3.

In order that the subjects would judge the slides by the density of the dots rather than by other characteristics (e.g. "that one had three dots in the first 'row'") the slides were not shown in the same position twice. Rather they were rotated 90° (clockwise) after each showing for trials 1-4. Each slide was projected backwards on the fifth trial.

Subjects were run in groups of five at a time. The following instructions were given to the subjects:

> You will be shown a number of slides one at a time. Each slide will have dots on it. There are eight different slides (i.e. each slide has a different number of dots on it). Some will have many dots, others will have only a few dots. You are to assign a number from 1-8 to each slide. Assign the number "one" to the slide which you think has the least number of dots on it, the number "two" to the slide you think has the second lowest number of dots on it. The number "eight" should be assigned to the slide which you think has the greatest number of dots, the number "seven" to the slide you think has the second highest number of dots on it. Middle numbers such as "four" and "five" should be assigned to the slides which you

feel have a medium number of dots in comparison to the other slides.

Obviously you will have to guess on the first few slides since you have no prior knowledge of the slides. Even if you must guess, assign a number to every slide. Do not change your answer after the next slide has been presented. If, for example, you have used the number "5" and are presented with a slide which you think is the one which really should have been judged as a "5" write the number "5" again but do not change your previous judgment.

Before I present each slide I will say "ready" so that you can focus on the wall and will not be caught unawares by the slide. Please do not talk or look at your neighbor's data sheet during the entire experiment or rest periods.

After each trial subjects were told: "You have completed trial A (etc.), if you judged each slide correctly you have used each number from 1-8."

RESULTS

When the slides of dots were constructed it was assumed that increasing the number of dots logarithmically would yield approximate linearity of response. A pilot study by the investigator and the work of Reese (1953) also suggested this. A scatter plot was made of the responses to the eight stimuli for all 50 subjects on trial E. Figure 1 shows the scatter plot. By looking at the scatter plot one can see that approximate linearity of response was obtained.

Error Analysis: The data for each subject was treated in the following manner. The absolute value of each error was determined, e.g. if the S responded with a five to stimulus seven then the absolute value of error was $|5-7| = 2$. Then these were added to get the total error for each subject on each trial.

The analysis of variance was computed to see if an interaction of orders (groups) by trials was present. If both hypotheses are correct such an interaction should be present. The results are shown in Table 1. The interaction of orders (groups) by trials was significant beyond the .001 level ($F=32.245$ df.=5, and 191).

RESPONSES								
8						2	14	34
7					5	9	26	16
6				4	26	11	10	
5		3	2	16	10	22		
4		5	11	15	7	4		
3	5	8	26	10	2	2		
2	19	18	10	4				
1	26	16	1	1				
	1	2	3	4	5	6	7	8
	STIMULI							

Figure 1. Scatter plot of the responses to the 8 stimuli for all 50 S's on trial E.

Table 1. Analysis of Variance of the absolute Error of Subjects

Source of Variation	S.S.	df	MS	F
Orders (Groups)	28.900	1	28.900	3.715
Ss within orders	373.376	48	7.779	
Trials	798.976	4	199.744	41.312*
Orders x trials	779.520	5	155.904	32.245*
Trials x Ss within orders	923.504	191	4.835	
Total	2904.276	249		

* significant at the .001 level

Table 2 lists the mean errors per subject for both groups on the first five trials.

Table 2. Mean absolute Error per Subject per Trial

	Trials				
	A	B	C	D	E
Group I	13.44	3.88	4.08	5.72	5.40
Group II	5.92	5.64	6.32	5.80	5.44

In order to analyze trials B and C, and trials D and E together, these trials were combined by adding the absolute error of each S together. The purpose in combining these trials was to reduce the number of comparisons between the two groups. In reducing the number of comparisons the probability of obtaining significant results by chance is reduced. The results are shown in Table 3.

Group II had a significantly less total absolute error than Group I on trial A. Group I had a significantly less total of absolute error than Group II for trials B and C combined. There was no significant difference in absolute error between Groups I and II on trials D and E combined.

Table 3. Mean absolute Error per Subject after Trials were combined

Trials

	A	B+C	D+E
Group I	13.44	7.96	11.12
Group II	5.92	11.96	11.24
t	9.82	-3.81	-0.12
p*	.001	.001	n.s.

* 2-tailed t-tests were performed

Figure 2 shows graphically the difference between the groups on the first five trials.

Correlation Analysis: Correlation coefficients were computed between stimulus and response for both groups on each of the first five trials. The results are shown in table 4. Because the correlations are representative of group performance rather than individual performance, no tests of significance were performed. The differences are the same as in error analysis. Group II had a higher correlation between stimulus and response on trial A than Group I. On trials B and C Group I had a higher correlation between stimulus and response than Group II. On trials D and E the correlations were approximately the same for both groups.

Figure 2. Mean absolute Error per Subject per Trial

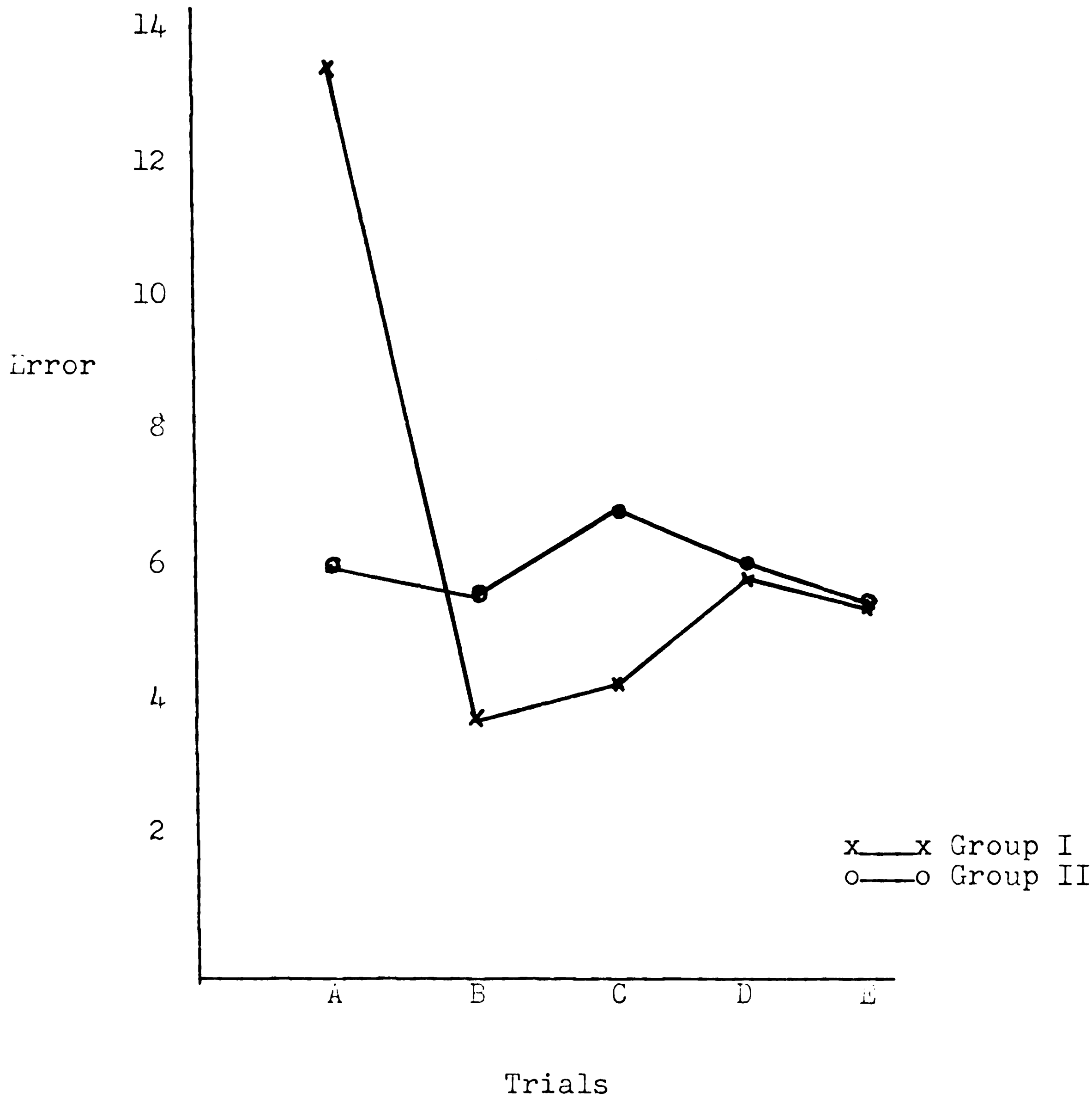

Table 4. Correlation between Stimulus and Response for each Group on Trials A-E

	Trials				
	A	B	C	D	E
Group I	.559	.934	.931	.914	.914
Group II	.761	.925	.887	.903	.915

Information Analysis: The Shannon-Wiener measure of information (Attneave, 1959) was used to compute the amount of information transmitted from stimulus to response, on trials B and C, and trials D and E combined for each subject in each group. The amount of information transmitted was not computed on trial A because in using information theory one assumes that the subjects have learned the scale of judgment fairly well. Since trial A is mainly a measure of performance and not of learning, to use information theory here would violate the above assumption and would probably lead to spuriously high estimates of information transmitted. Several studies report that in learning scales of absolute judgment there is a rapid movement toward a stabilized scale of judgment (Tresselt and Volkman, 1943; Rambo and Johnson, 1964); and Minturn and Reese (1951) found that reduction in error of judgment occurred very suddenly, as early as the latter part of the first trial. Thus it would seem that using information theory as early as trial B does not violate the assumption that the subjects have learned the scale of judgment fairly well. Also the high correlation between stimulus and response for each group as a whole for trials B-E seem to indicate that subjects had learned the scale of judgment sufficiently well so that information-theory measures could be applied to these trials. The average amount of information transmitted per trial for trials B and C, and D and E combined is shown in Table 5. It

TABLE 5

Information transmitted per trial (in bits)

	Trials	
	B and C	D and E
Group I	2.444	2.300
Group II	2.209	2.304
p*	.001	n.s.

* two-tailed tests were performed

should be noted that the maximum amount of information transmission possible is three bits.

The amount of information transmitted was significantly higher for Group I than for Group II on trials B and C. No significant difference in amount of information transmitted was found between Groups I and II on trials D and E.

<u>Analysis of Extremity of Responses</u>: The responses to the first four stimuli presented in trial A were analyzed as to whether they were central responses (3, 4, 5, 6)

or extreme responses (1, 2, 7, 8). For the first four stimuli presented Group I responded with 76, 84, 60, and 44 per cent central numbers, respectively. Group II responded with 76, 96, 80, and 84 per cent central numbers respectively. Therefore both groups used central responses more frequently then extreme responses in judging the first few stimuli presented on trial A.

DISCUSSION

Before discussing the results a remark or two should be made about the effectiveness of the three types of analyses used. The error analysis is the most powerful measure used. The correlational analysis is less powerful than the error analysis because it was done for each group as a whole rather than for each individual subject. It was felt that a correlational analysis for each subject would yield the same results as the error analysis, therefore this analysis was performed for each group rather than for subjects within groups. The information analysis is not as strong as the error analysis because it does not take into account the magnitude of each error. One reason for using the information analysis was because much of the literature on the learning of scales of judgment presents its results in terms of information transmitted. In respect to the purpose of this study the results from the three types of analysis are in agreement.

Group I had a significantly greater amount of absolute error per subject than Group II on Trial A. In looking at the correlation coefficients for the relationship between stimulus and response it was found that for trial A Group I had a correlation of .559 and Group II had a correlation of .761. Both of the above measures confirm the investigator's first hypothesis, namely that Group II would outperform Group I on trial A. The suggested reason for this is that subjects who have no prior knowledge of the scale of judgment tend to assign middle categories of response to the first few stimuli presented. The analysis of extremity of response indicated that subjects in both groups tended to assign middle response categories to the first few stimuli presented. Thus, since for trial A Group II received an order in which the middle stimuli were presented very early in the order, they would have a greater probability of choosing the correct response than would Group I who were presented with an order in which the extreme stimuli were presented very early in the order and the middle stimuli very late in the order. Many subjects attempted to use all eight response classes on each trial. If a subject tended to use middle responses in the beginning of the trial and attempted to use all eight responses, he would have to use the extreme responses very late in the trial. Thus this effect could last for the entire trial. The investigator concluded that the superior performance of Group II over Group I on trial A was due to the construction of the different orders used for the two groups on the first trial. This strengthens Wever and Zener's

(1928) suggestion that subjects who have no prior knowledge of the stimulus series tend to use the middle response categories for their first few judgments.

An analysis of the amount of information transmitted was not attempted for trial A because the use of information theory assumes that the subjects have learned the scale of judgment fairly well. In light of the low correlations between stimulus and response on trial A, for both groups, it was felt that this assumption could not be met.

For trials B and C combined it was found that Group I had significantly less absolute error per subject than Group II. The correlation between stimulus and response was .934 for trial B and .931 for trial C, for Group I, while it was .925 for trial B and .887 for trial C, for Group II. The average amount of information transmitted per subject was 2.444 bits per trial for Group I on trials B and C, while it was only 2.209 bits per trial for Group II. This difference was significant at the .001 level. (Note: it is entirely possible that if more stimuli were included in the stimulus series that the amount of information transmitted would increase. Miller (1956) has shown that the amount of information increases as the number of stimuli increase and then it levels off asymptotically. In the present study it could be that more than eight stimuli are necessary for the asymptote to be reached.)

Thus those subjects who were presented with orders where the extreme stimuli appeared very early and where the central stimuli appeared very late, learned the scale of absolute judgment faster than those subjects who received orders where the central stimuli appeared very early and the extreme stimuli appeared very late. The orders which presented the extreme stimuli first resulted in less absolute error, greater correlation between stimulus and response, and in a greater amount of information transmitted per trial than those orders which presented the central stimuli very early in the trial.

On trials D and E both groups were presented with the same order of stimuli on trial D and the reverse of that order on trial E. These orders were constructed in such a way as to be equally dissimilar to the types of orders which either group had received on the first three trials. A t-test showed no significant difference between Groups I and II in absolute error for trials D and E combined. The correlations between stimulus and response for trials D and E, were approximately the same for both groups. There was no significant difference between groups as to the amount of information transmitted over trials D and E. The average amount of information transmitted for Group I was 2.300 bits per trial and for group II was 2.304 bits per trial. Thus both groups performed approximately the same on trials D and E. This finding was contradictory to expectation as it was expected that Group I would outperform Group II on trials D and E.

The reason for this last finding is unclear and there are several possible explanations for it. The first explanation is that subjects tend to become bored and fatigued quite easily on such a task. A pilot study by the investigator showed that when subjects became bored and fatigued they tended to make more errors and to make errors of greater magnitude. If the subjects became bored or fatigued as early as trials D and E this might cause poor performance in the judgment of the stimuli and the subjects in both groups might be expected to perform at the same level.

A second explanation is that in learning scales of absolute judgment, subjects tend to become quite stabilized in their judgments in just a few trials. After this their performance is asymptotic. Since the subjects in Group I learned the scale of judgment quicker than those in Group II it is expected that they would reach the peak of their performance earlier. If this peak came at the end of trial C their performance would remain stable while that of Group II would be approaching the asymptote. One might point out however that the performance of Group I on trials D and E decreased from that of trials B and C and thus the above explanation would not hold, but there is another factor which must be taken into account...it is possible that the unbiased orders are more difficult than the orders which Group I received on trials A-C. If the unbiased orders were of greater difficulty then this could cause the decrease in their performance, while an expected decrease in Group II's performance might be offset by additional learning.

A third possible explanation is that the subjects in Group I might have been learning the scale of absolute judgment in the context of orders which presented the extreme stimuli early and the central stimuli late in the order, while the subjects in Group II were only learning the scale of absolute judgment in the context of orders which presented the central early and the extreme stimuli late in the order. Thus while orders which have the extreme stimuli early and the central stimuli late produce greater learning than orders which have the central stimuli early and the extreme stimuli late, when a subject switches from either of these orders to an unbiased order the amount of transfer to that particular unbiased order may be the same for both groups. If so, this would explain the failure to find a difference between Groups I and II for trials D and E.

It is concluded that when individuals are given a task in absolute judgment, orders which present the extreme (and also salient) stimuli early in the order and the central stimuli late in the order will lead to greater learning of the frame of reference than orders which present the central stimuli early in the order and the extreme stimuli late in the order, although the amount of transfer from both orders to performance on the unbiased orders is approximately the same. The above result confirms Wever and Zener's (1928) expectation that orders which present the end stimuli result in greater learning.

It is suggested that orders which present the extreme stimuli very early result in greater learning because the subject is provided with immediate knowledge of the stimulus range. Once the subject has been presented with the end stimuli, he uses these stimuli to judge the other stimuli which are presented. Thus subjects who are given such orders may be giving themselves "knowledge of results" on each trial while subjects who are presented with the central stimuli early in the order and the extreme stimuli late in the order may be unable to give themselves "knowledge of results" throughout the trial.

SUMMARY

Although some work has been done in the area of learning a frame of reference or scale of absolute judgment, little has been done pertaining to the effect which different orders of stimulus presentation have on such learning. Wever and Zener (1928) suggested that when a subject has no previous knowledge of the stimulus series he tends to respond with middle categories to the first few stimuli presented. They state that once the subject has knowledge of the end stimuli he uses these stimuli to judge the other stimuli which are presented. They suggest that orders which present the end stimuli very early will lead to faster learning than orders which do not present the end stimuli very early.

The present study investigated two hypotheses concerning two different types of orders, type I orders in which the extreme stimuli were presented very early in the order and the central stimuli very late in the order, and type II orders in which the central stimuli were presented very early and the extreme stimuli were presented very late. The first hypothesis was that subjects who received type II orders would outperform subjects

who received type I orders on the first trial because all subjects would tend to use middle numbers for their first few responses since they had no previous knowledge of the stimuli. The second hypothesis was that for the following trials those who had received type I orders would be more accurate in their judgment than those who had received type II orders because those who received type I orders would have immediate knowledge of the stimulus range and could use the end stimuli to judge the rest of the stimuli presented in that trial.

Fifty subjects were randomly divided into two groups of 25 each. Stimuli consisted of eight slides with dots on them. Each slide had a different number of dots on it. Subjects were required to assign numbers from one to eight to each slide (assigning the number "one" to the slide which they thought had the least number of dots and the number "eight" to the slide which they thought had the greatest number of dots). Subjects in Group I were presented with type I orders for the first three trials and subjects in Group II were presented with type II orders on the first three trials. For the fourth and fifth trials both groups were presented with the same orders which were equally dissimilar to the type I and the type II orders.

Group II made less absolute error than Group I on trial A supporting Wever and Zener's suggestion that subjects tend to use middle categories as responses to the first few stimuli presented when they have no prior knowledge of the stimulus series. On trials B and C Group I made less absolute error than Group II, also the amount of information transmitted was greater for Group I. On trials D and E there was no difference between Groups I and II in absolute error or in amount of information transmitted. It was concluded that orders which present the extreme stimuli very early and the central stimuli very late lead to greater accuracy in judgment than orders which present the central stimuli very early and the extreme stimuli very late. However the amount of learning transferred to unbiased orders is approximately the same from both types of orders. This confirms Wever and Zener's (1928) suggestion that orders which present the end stimuli at the beginning of the order lead to quicker learning of the scale of judgment.

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APPENDIX A

ORDERS OF STIMULUS PRESENTATION

GROUP I

Trials

A	B	C	D	E
8	1	8	2	3
1	8	2	6	7
2	7	7	4	1
7	2	1	8	5
3	6	3	5	8
5	4	6	1	4
4	5	4	7	6
6	3	5	3	2

GROUP II

Trials

A	B	C	D	E
6	3	5	2	3
4	5	4	6	7
5	4	6	4	1
3	6	3	8	5
7	2	1	5	8
2	7	7	1	4
1	8	2	7	6
8	1	8	3	2