COGNITIVE ATTITUDES OF LEVELING AND SHARPENING IN TIME-ERROR ASSIMILATION TENDENCIES

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B. A., College of the City of New York, 1943

Submitted to the Department of
Psychology and the Faculty of the
Graduate School of the University
of Kansas in partial fulfillment
of the requirements for the
degree of Doctor of Philosophy.

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April, 1952

ACKNOWLEDGMENT

The writer wishes to acknowledge the helpful cooperation and encouragement of a number of people. To Dr. George S. Klein he is particularly indebted for creative and stimulating advice and constructive counsel at all phases of this research. Dr. Klein, who influenced the writer's thinking about personality theory and perception, is chiefly responsible for the formulations of the problem investigated here. Without his continued guidance this research could not have been accomplished. Dr. Martin Scheerer, who introduced the writer to dynamic psychology, gave unselfishly his time, interest, and valuable suggestions and served as principal adviser. Thanks are due also to the other members of the thesis committee, Dr. Anthony Smith and Dr. Marston McCluggage, whom the author regards as respected mentors. To Dr. Sibylle Escalona and Dr. Robert R. Holt I am grateful for their helpful criticism at all phases of the work. Mr. Herbert J. Schlesinger is responsible for the design and construction of most of the laboratory equipment used in this study. To him, as a friend and co-worker, I am happy to acknowledge my indebtedness. Dr. William Mikesell, Dr. Frank R. Wake, and Mr. Verlyn Norris helped in procuring subjects. Thanks are due to Miss Jane Reilly, Miss Mary Ellen Sawyer, and Miss Linda Bua who bore the burden of typing the manuscript in its various stages. Finally, I wish to thank my wife, who shared many of the frustrations involved in completing this work.

The research reported upon in this dissertation is part of a group of investigations at the Menninger Foundation in the area of perception and personality which are supported by the National Institute of Health, United States Public Health Service.

P. S. H.

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COGNITIVE ATTITUDES OF LEVELING AND SHARPENING IN TIME-ERROR ASSIMILATION TENDENCIES

CHAPTER I

INTRODUCTION

If a person is asked to lift successively two equal weights, the second weight will generally be judged "heavier" than the first. This constant error of judgment known as the negative time-error has received considerable attention and study since Fechner first systematically observed it. Psychologists have found the time-error in brightness discrimination (43), audition (59), and kinesthetic sensation (19) and have even found analogous effects in studies in aesthetics. While experimenters consistently report time-errors in intensity judgments, the evidence for systematic displacement of judgment in qualitative comparisons (e.g., pitch, size, etc.) is more equivocal (33, 57).

One may put this time-error data to at least two possible uses, depending upon the experimenter's interest. The approach of classical psychophysics has been to demonstrate the relationship between the "objective" stimulus and "experience." A second approach, the one pursued in this research, does not aim primarily at the time-error datum *per se*. It involves the question, "What do certain time-error phenomena express about the person who yields these data?" To state these two positions in exaggerated form, we might say that in the former type of experiment the means are the subjects, through which the ends -- general laws of perception -- are explored. In the present approach the "means" are perceptual data used for isolating the laws of the regulatory system of the perceiver (32). The first approach asks, "What is perception? What are its laws? What are its specific processes? What are the stimulus conditions for such and such an effect?" The person-centered analysis asks such questions as, "What is the function of perception in the person's relation to his surrounding field? How does perception differ in different people? What are the patterns of control, selection, and organization of stimuli within the person which mold percepts and which contribute to individuality and internal consistency?" One approach examines the stimulus conditions for a particular perceptual experience while the other looks for what perception can reveal about the person. This latter assumes that perception is adaptive and that individual differences in the way persons perceive will reflect preferred modes of adaptation. That is, perception, as a sphere of a person's functioning, varies with the person according to the particular preferred styles of organizing, controlling and selecting stimuli. These preferred approaches may represent automatically invoked ways of solving problems.

One of the purposes of this study is to demonstrate how styles of adaptation reveal themselves through the processes of perceiving and, particularly, through performance in neutral psychophysical situations. Can direction of one particular aspect of the time-error, in this case assimilation effects,(1) be predicted through manipulation of person-centered perceptual variables? Our concern with the time-error then, takes departure from previous studies of this phenomenon in that we are looking neither for general laws of the time-error nor for the specific conditions for the occurrence of an assimilation effect in the time-error. We are interested in time-error from the standpoint of individual psychology. Our research centers about how a person's organizing processes reveal themselves in these psychophysical situations.

In the following sections I will discuss (a) some recent attempts to explain the time-error in successive comparison studies; (b) the occurrence of individual differences in time-error experiments; and (c) the introduction of the concept of cognitive attitudes which may be of value in predicting some of these individual differences.

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(1) See pp. 6, 7 for the definition of assimilation in time-error.

CHAPTER II

THEORIES OF THE TIME-ERROR

The most recent systematic studies of the time-error date from Köhler's classical experiment in successive comparison in 1923 (37). Earlier interest in the time-error was geared to the ways of eliminating this "anomaly of judgment," this error which interfered with the accuracy of measuring sensation thresholds. Attempts were made to account for the time-error by assuming the unwelcome interference of such a factor as fatigue (e.g., Muller and Schumann), but this proved insufficient to explain the occurrence of the time-error in all sensory areas. While fatigue might account for time-errors in weight lifting, it was inadequate to explain them in other sense modalities, such as audition or vision.

"In weights," Pratt (60) comments in criticizing this theory, "...fatigue might cause the second member of a pair to feel heavier. In sounds, however, where the relative time-error is equally marked, fatigue, if it operated at all, would cause the second member to sound softer." Other theories assumed that the fading of memory images in the course of time contributed to time-error. In successive comparison, then, the second stimulus is compared with the fading memory image of the first stimulus. The memory image, however, failed to appear when the comparison experience was subjected to introspective analysis.

In Köhler's 1923 paper, the time-error received its most important and theoretically valuable treatment. He invoked the Gestalt theory of isomorphism to explain time-errors. If we compare the magnitude of two stimuli they do not exist as two discrete sensations; the first stimulus sets up in a particular brain region an electrochemical process, which has a definite course. After the first stimulus is removed, its trace increases in value for about two seconds and then gradually fades. A trace consists of a concentration of positive H ions set into activity by the exciting stimulus process. With intervals of three seconds or longer, the trace of the first stimulus decreases in ion concentration or fades. The excitation by the second stimulus will set up a similar aggregate of ions in the brain field. Now, Köhler continues, these two cortical processes form a unit between which there exists a difference of potential, or gradient. There will consequently be a step-up gradient, or a potential leap between the fading trace of the first and the new excitation of the second stimulus. This step-up gradient corresponds to the experience of the second stimulus as stronger (negative time-error). With intervals of less than three seconds separating the standard and comparison Köhler found that a positive time-error results. He explained this by assuming that the concentration of ions reaches a maximum shortly after stimulation. Thus, there is a step-down gradient between the trace of the first and excitation of the second stimulus, corresponding to the experience of "second stimulus weaker" (positive time-error).

Lauenstein, (45) in revising Köhler's theory, assumed that the traces do not merely fade, but that traces from two neighboring brain fields assimilate toward each other. "The negative time-error could be explained by an assimilation of the trace of the first excitation to the trace of the state corresponding to absence of stimulation" (45, p. 152). Lauenstein's formulation stems chiefly from two time-error experiments, one using visual, the other auditory stimuli. In the first part of the visual experiment, he successively projected in pairs five different brightnesses upon a relatively darkened field. These pairs were then judged by the method of successive comparison. In the second part of the procedure, these same pairs were projected on a field which was illuminated before, between, and after the presentation of the comparison pairs. In Part 1 the intensity of this interpolated illumination was very much less (practically no illumination) and in Part 2 very much greater than that of the stimulus pairs. In the auditory experiment two tones were compared for loudness. These tones interrupted a continuous background tone. For one part of the experiment, the temporally dominant tone was much softer, for the other part, much louder than the intensity of the pairs that the subjects judged.

Lauenstein's results showed that for time intervals of over five seconds, for both sound and brightness, the time-error was negative with the less intense and positive with the more intense interpolated stimuli. For shorter time intervals, positive time-errors resulted with both grounds. Lauenstein explained these results by assuming that adjacent traces assimilate. For example, with a more intense dominant field, the trace of the first stimulus is assimilated to this field. The comparison stimulus then forms a "step-down" gradient with the first, a positive time-error being the consequence. With less intense interpolated fields, the trace of the standard assimilates downward, and the second stimulus is compared with this lowered level of the first, and therefore a negative time-error results.

Pratt (59) presents evidence that Lauenstein's theory is too general. He used both sound and lifted weights in his experiment. Pratt had three subjects compare sounds which were produced by a falling pendulum. The interval between standard and comparison was empty for the first part of the experiment. In the second part of the experiment, Pratt interpolated a much louder sound between standard and comparison stimuli. In the third part, the interpolated stimulus was much softer than the stimulus series. Pratt reasoned that the silent interval between stimulus pairs should produce a greater time-error than when the stimuli are interrupted by a soft sound, inasmuch as an interpolated silence is a greater degree of stillness than the interpolated soft sound. His results showed, however, a greater time-error with the soft interpolated noise than with the silent interval. He repeated the same procedure with lifted weights and got substantially the same results; that is, the empty interval produced less time-error than when the interval was filled by lifting a very light weight. When the interval between standard and comparison is filled, Pratt concluded, the time-error can be explained as Lauenstein does on the basis of assimilation of traces. When, however, the interval is silent, the trace merely fades. "When traces or impressions in the background are in close enough connection with those which form the basis for judgment, then it may be said that assimilation operates. But such a situation constitutes a very special condition, except in vision. For the usual psychophysical judgment the background is empty. For weights and sounds, at all events, the background is phenomenally empty, unless one deliberately thrusts something into it. Experiment shows that a phenomenally empty background does not stand in close enough connection with the impression upon which judgment is being passed to permit assimilation to those impressions.

"Whenever assimilation cannot take place, it is a safe assumption, that the after-effect of the standard begins to subside" (60, p. 806).

Koffka (35) took issue with Pratt's conclusions and maintained that the procedures of Lauenstein and Pratt were not comparable. "I will emphasize that a third impression inserted between the two others is not equivalent to a background which surrounds the two critical ones ... When Pratt compares the empty constellation with that filled with a stimulus of weaker intensity, he compares in reality an influence exerted by a ground with one exerted by a new figure and the difference in his results may well be due to this difference and thus may not support his own conclusions" (35, p. 472).

Pratt (60) later preferred to think of the appearance of the time-error not as a function of a physiological process involving electrochemical traces, but as a psychological contrast. Since the response to the second stimulus of a pair is different from what it would have been had there been no previous stimulus or interpolated field, the trace of the preceding stimulation influences to no small degree the fate of the second stimulus. The latter is always judged in the direction opposite to the dominant field. Pratt used the term trace to denote nothing more than an after-effect of a stimulus. He prefers to think of traces without the neurophysiological connotations Köhler gave them.

Kreezer (43), on the other hand, accepts the neurophysiological formulations of Köhler and Lauenstein and performed a series of experiments designed to demonstrate that cortical factors are responsible for negative time-error. Kreezer designed his experiment so that if time-errors occurred, they could not be due to the after-effects of stimulation within the receptor or the nerve pathways leading to the brain. For this purpose he investigated the time-error in brightness discrimination, since impulses from the right and left halves of the retinas send impulses to the cortex by separate pathways. By presenting the standard to, say, the right side of the retina, and the comparison to the left side, the impulses reached different sides of the visual projection areas of the cortex. "Under these conditions, after-effects which may occur in the pathways activated by the first stimulus will not be capable of influencing the magnitude of the neural-volleys transmitted on the pathways activated by the second stimulus. Consequently, any time-errors which occur must depend on effects produced by the first impulse-train on reflex centers in the mid-brain or on mechanisms in the cortex, conditions which are in turn effective in the second stimulation." The separate pathways were controlled by imposing rigid limitations of visual fixation, making comparison possible only on the basis of successive stimuli impinging on opposite sides of the retina. Images fell outside of the foveal region but not within the blind spot. Kreezer found that negative time-errors did indeed occur even when he removed the influence of possible after-effects of excitation produced in the neural receptors or pathways. He concluded that brain mechanisms are thus responsible for negative time-error. He considered two types of brain mechanisms which could account for time-error: pupillary reflex changes, dependent on reflex connections in the mid-brain, or cortical processes.

By computing the rate of pupillary dilation and contraction from tables of P. Reeves(1) he concluded that reflex activity cannot be responsible for the time-error since the size of the time-errors are larger than one may expect on the basis of a change in the size of the pupils by virtue of their reflex action. He therefore localizes the conditions for the appearance of time-error in the cerebral cortex.

The time-error has usually been computed as the difference between the objective midpoint of the series to be judged and the subject's judgment of where the midpoint lies, his point of subjective equality (PSE). The PSE has been represented as a level of indifference above which the subject experiences stimuli as stronger and below which stimuli appear to him as weaker (75). While the PSE usually lies somewhat below the actual midpoint of the series (negative time-error)

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(1) P. Reeves, Rate of pupillary dilation and contraction. Psychol. Rev., 1918, 25, 330-340 (Kreezer's reference).

many experiments have shown that it has no fixed position, but changes its location with a change in the series. For example, its position can be raised if we extend the series range upward. Keeping the range of the series constant, however, the PSE can move upward if the more intense stimuli in the series are presented much more often than the less intense stimuli; or if a strong stimulus is interpolated into the series at frequent intervals. It is as if there were a tendency for the PSE to drift toward the mean of all the stimuli. The PSE and hence the time-error is a function of the value of the stimuli within the series and the effects of any other stimuli in the field, such as interpolated intensities.

Köhler and Lauenstein expressed these phenomena in the form of physiological constructs. Woodrow (73) and Hollingworth (24), avoiding physiological hypotheses, suggested that the mean values of the series of stimuli determine the position of the indifference point. Helson (21, 22) has offered a valuable contribution to the understanding of the PSE, or adaptation level, as he calls it, in the form of a quantitative theory. "Fundamental to the theory is the assumption that effects of stimulation form a spatio-temporal configuration in which order prevails. For every excitation-response configuration there is assumed a stimulus which represents the pooled affect of all stimuli to which the organism may be said to be attuned or adapted. Stimuli near this value fail to elicit any response from the organism or bring forth such neutral responses as indifferent, neutral, doubtful, equal, or the like, depending upon the context of stimulation. Such stimuli are said to be at adaptation-level. There is an adaptation level for every moment of stimulation, changing in time and with varying conditions of stimulation. It is a function of all the stimuli acting upon the organism at any given moment as well as in the past" (21).

To aid in quantitatively specifying the position of the adaptation level, Helson derived formulas which assign weights to (a) the stimulus attended to at a given moment, (b) all of the other stimuli in the background, and (c) the effects of past stimulation. In his theory the background is weighted three times as heavily as all the logarithmic means of all the stimuli in the series. Helson feels that the dominant field, or level against which the stimuli are judged, is the most important factor in determining the position of the PSE, and hence the time-error.

Helson remarks that his quantitative theory of adaptation level "accounts not only for the invariants in perception but also for individual differences in perception in the face of the same stimuli. Individual differences may arise from different residual factors (effects of past stimulations) or because one individual weights one part of the field more than another with resultant differences in level. The contribution of the individual organism is thus an essential part of the theory" (23, pp. 383-384).

A survey of the modern literature on time-error shows that the majority of the investigators, while differing as to the nature of the basic process, agree on the effect of the series on time-error. The intensity level of the stimulus series, the condition of the interpolated field, and the frequency of presentation are the most important variables. The Köhler-Lauenstein formulation takes these variables into account and at the same time offers a neurophysiological explanation for the phenomenon. Although it has no quantitative precision, its neurophysiological setting, which promises to be of great theoretical value, is one which may be fruitful in attempting to explain individual differences in assimilation effects in time-error.

CHAPTER III

INDIVIDUAL DIFFERENCES AND PSYCHOPHYSICS

Theories about the fundamental processes involved in the time-error are many. But about one factor there is basic agreement: much more than the peripheral sense organs is involved in the coming about of time-error. Whether one explains time-error in terms of a fading memory trace,(1) in neurophysiological trace terms,(2) as a result of psychological contrast,(3) or as a function of set(4) it is the total person who responds to the successive comparison experience. A most important consequence of this assumption is that a good part of the individual differences which emerge in time-error experiments may not be solely a reflection of errors of measurement. Indeed, in time-error experiments where raw data are reported, one is struck by the wide differences among subjects in time-errors. For example, at least three investigators report different transition points from positive to negative time-errors in their subjects as a function of increasing time between standard and comparison (the p-function). Köhler (37) reports this transition

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(1) Fechner

(2) (37, 43, 45)

(3) (60)

(4) (74)

point after three seconds separate the stimuli to be compared; Needham (52), at two seconds; Kreezer (43), at ten seconds. Now while the differences in results may be a function of the stimulus conditions, the subjects themselves, perhaps representing different cognitive organizations, may contribute to the total variance as well.

Guilford and Park (19) attempted to test the Köhler-Lauenstein trace hypothesis by interpolating between the standard and comparison weights a third stimulus which would tend to break up the trace gradient. If the interpolated weight is heavier than the two stimuli that are being compared, it should raise the level of the trace left by the first weight; when the comparison weight is lifted the experience is a step-down or a positive time-error. A lighter weight should have the opposite effect. The series was distributed around 200 grams. Table I contains the time-errors of the three subjects under the three conditions of the experiment: the normal series, N, that is, without any interpolated weights; series A, with a 400 gram interpolated weight; and series B, with a 100 gram interpolated weight.

Certainly the trend of the results is in the predicted direction: the interpolation between the standard and comparison of a more intense stimulus results either in a positive or in a less negative time-error, while a weaker interpolated stimulus

TABLE I

TIME-ERRORS OF GUILFORD AND PARK'S SUBJECTS UNDER THREE CONDITIONS
OF INTERPOLATED WEIGHTS: N (NO INTERPOLATED WEIGHT),
(100 GRAM INTERPOLATED WEIGHT), AND
A (400 GRAM INTERPOLATED WEIGHT).

SUBJECT	N (No interpolated weight)	B (100 grams)	A (400 grams)
G	-3.7	-8.7	+2.2
H	-5.7	-13.6	-3.4
M	-13.1	-13.0	-1.2

produces a more negative time-error than a blank interval. But the individual differences are striking both in level of time-error and in the effect of the interpolated stimuli. Note, for example, that subject O shows a 135% increase in the negative time-error for conditions N to condition B, while subject M shows a .76% <u>decrease</u> for the same two conditions.

Koester (33) investigated the appearance of the time-error in pitch and intensity of sounds. Individual differences of considerable extent appeared throughout his results. Table II shows the results given by three of his subjects, making successive comparison judgments of stimuli 1, 2, and 3 decibels above and below a moderately loud 1000 cycle standard. Four time intervals--1, 3, 6, and 9 seconds--separated standard from comparison. The figures represent "E per cent," a measure of the constant error.(1) The range of the errors from -.67 to + 18.00 for the one-second interval, and 0 to + 14.00 for the nine-second interval suggests that these individual differences may be too large to be accounted for on the basis of experimental error alone.

That these differences are not chance errors becomes more credible if it can be shown that each subject in Koester's experiment showed a pattern of judgment which was consistent for

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(1) $E\% = 100 \left(\frac{\text{total "lesser" judgments}}{\text{total "lesser" and "greater" judgments}} \right) - 50$

him for each of the four time intervals. Table III reproduces from Koester's raw data (33, p. 68) the distribution of judgments of second stimulus "higher."

Subject NS produced the least number of "higher" judgments <u>for all the time intervals</u> while TK had the most "higher" judgments. While some errors in measurement may have been involved in inter-individual variation, the striking consistency of the patterns of the individual subjects' judgments suggests that the differing cognitive organizations of the subjects were important and unexpected variables making for inter-subject differences.

Different experimenters investigating the same parameters of the time-error report contradictory group results. For example, the question of whether a time-error occurs with pitch judgments has received some attention. Postman (57) reports no reliable time-errors in judgments of pitch. Koester and Schoenfeld (34) found positive time-errors with low tones and negative errors with high tones, while Wada found the opposite trend (70). Tresselt (69) found significant time-errors in pitch with background tones of 250 and 2000 cycles only. The results, of course, reflect the issue of individual differences in time-error with judgments of <u>quality</u>, rather than intensity. It is true that these experimenters investigated the time-error in pitch under different conditions. Koester and Schoenfeld, for

TABLE II

E-PER CENT VALUES FOR LOUDNESS JUDGMENTS MADE BY THREE PRACTICED OBSERVERS AT FOUR TIME INTERVALS IN KOESTER'S EXPERIMENT.

Subjects	Time Intervals in Seconds			
	1.	3.	6.	9.
NS	+ 18.00	+ 6.00	+ 10.00	+ 14.00
EK	+ 6.00	+ 8.00	+ 12.00	.00
TK	- .67	.00	- .67	+ 7.33

TABLE III

DISTRIBUTION OF "HIGHER" JUDGMENTS MADE BY THREE PRACTICED OBSERVERS IN FOUR TIME INTERVALS IN KOESTER'S ( ) EXPERIMENT.

Subjects	Time Intervals in Seconds			
	1	3	6	9
NS	8	17	15	12
EK	17	18	15	23
TK	26	26	27	25

example, used stimuli of 1000 cycles to 2000 cycles. A large number of judgments were made on each pair of stimuli, a situation which, according to Köhler, tends to invalidate any time-error effect. Postman's stimuli ranged from 250 to 5000 cycles per second. The time interval separating the standard and comparison varied from 1 to 8 seconds in the experiments. These variations in procedure may account for some of the differences in results. It may be possible, however, that the differing results reflect genuine differences in the subjects' approach to the task.

Inasmuch as investigators concentrated their work on the stimulus conditions of the time-error and the self-regulating cortical correlates, no time-error study has yet been set up to permit a systematic analysis of the individual differences and generality within the person. The studies of the stimulus properties and the self-distributing nature of cortical fields resulted in universal statements which had no direct bearing on personality theory, on statements of individuality. A personality theory cannot ignore the different dynamics, in different people, of cortical activity.

"It seems to me," Scheerer (65) writes, "we have somewhat neglected to explore the problem of individual differences in perception, in favor of gross averages. We have grown too accustomed to accept perceptual laws on the basis of statistical majority, without showing scientific curiosity about the non-conforming minority. From the point of view of theory, however, we should feel obliged to account for both the majority <u>and</u> minority by an explanatory principle from which we understand the phenomena on both ends of the scale . . . Especially in perception does it remain a tantalizing possibility that performance differences may provide clues for individual differences. We could explore the particular psychological or organismic systems which lie behind these differences . . . perceptual behavior does not represent narrow, isolated facets of the person's make-up. It seems, rather, that through them are being tapped broader aspects of a person's characteristic relation to the world about him." Klein (28) has suggested that "an analysis of variations in data appearing as a function of the different subjects is quite an integral phase of systematic investigation often to be invoked deliberately as a <u>searchlight</u> for possible relationships." This approach, Klein continues, necessarily regards any variation in response as an expression of functional relationships. Variations among subjects express these lawful relationships and the necessary conditions for their appearance must be explored. "But where the relationships are unknown or poorly defined, the appearance of individual differences sets a task for analysis; to discover the sources of the variation, to find the relevant intervening variables upon which response variation depends. The inability of the experimenter to account for them or manipulate them stimulates him to invoke new hypotheses. The continued persistence of individual differences in experimental situations will ultimately bring under consideration all levels on which relationships may exist. These hypotheses are successively tried and held or eliminated until one or more are found to relate significantly to the phenomenon in question and therefore account for the individual differences. We can see, therefore, that the analysis of the distribution of individual differences can be an important way station to a set of functional relations or general laws" (28).

These statements of Klein can be illustrated by a frequently performed experiment on the effect on time-errors of increasing the time interval between the two stimuli which are to be judged successively. The experimenter chooses, say, five time intervals: 1, 3, 5, 7, and 9 seconds. He then observes the consequences of these increasing time intervals on the time-error. He notes that at one second the time-error is slightly positive; at three seconds it is zero; at five seconds it is negative; and at seven seconds and nine seconds its negative value increases. The magnitude and direction of the time-error is plotted as a function of the time interval. A functional relationship is assumed to exist between these two variables. The relationship is a lawful one, accountable by the Köhler hypothesis of the electrochemical gradient. Suppose now we hold the time interval constant and test many subjects. Certainly there will be individual differences. One might then plot a curve of these results as a function of magnitude of time-error and subjects. One may assume that these individual differences may be the reflection of the varying principles of regulation within each person. The search, then, is for a construct about the nature and functioning of these regulation principles so that subsequent individual differences appearing in time-error may be more satisfactorily predicted. The isolation of such a construct would lead to the formulation of a universal statement, and not necessarily to a congeries of separate, "highly individual," personalistic laws.

No meaningful analysis of individual differences is possible without a hypothetical construct which coordinates variations in response to within-the-person functions. Klein (29) and his co-workers have formulated such a construct and have given it the name of "cognitive attitude." Since the major portion of this work will be devoted to consequences of this hypothetical construct for prediction of assimilation effects in time-error, it is important to re-state the definition of cognitive attitude and to indicate its place in a theory which has for its focus the people who respond. Its relevance as a first step for prediction of individual differences in time-error assimilation effects, as described by Lauenstein, will then be attempted.

CHAPTER IV

CONCEPT OF COGNITIVE ATTITUDE

Textbooks of psychology characteristically stake out the field by discussing in separate sections so-called "part-systems." In separate chapters, perception, learning, memory, motor behavior, etc., are sometimes discussed as though these were not just conceptually but empirically separate elements of the person. These systems are often implicitly conceived as functioning in an autonomous, self-regulative manner, uninfluenced by the structure of the person of which they are a part. Krech (42) points out that the "truth or falsity of any of these sets of 'principles' (perceptual, motor, etc.) would not be dependent upon the truth or falsity of any other set."

There have been occasional sorties into the relatively unknown territory of the integration of these systems with personality. Thus, the work of Bruner and his associates (6, 7), Murphy and his associates (44, 64), Witkin and his co-workers (72) have attempted to show in an exploratory manner that central determinants--for example, values, needs, and character defenses--can and sometimes do affect perception. But these studies in and of themselves can be no more than a demonstration that a relationship does exist between perception and personality. These studies proceed from no systematic theory of personality, but are based upon the proposition that needs and values influence perception. This point of view is an extension of the doctrine championed by Helmholtz that purposes, aims, and assumptions influence the way in which we perceive our world. In this tradition, Ames (1) concluded from a series of ingenious demonstrations that while external conditions can vary infinitely, the same, unchanging interpretation of these conditions may result. Retinal stimulation can vary widely without changing certain constancies of the perceptual experience. These studies correlate one set of events (perceptual) with another (values, needs, "personality") without providing the necessary conceptual link between these events which would require such a correlation. One assumption in these studies seems to be that personality and perception or cognition are separate, but correlated, interacting systems.

The point of view adopted in this study maintains that while these sub-systems are not autonomous processes, they are adaptive acts at the service of the organism. The question to be asked, then, is not "How does personality influence perception?" Perception is an activity of the person and we must therefore ask, "What does a person do with perceptual stimuli, i.e., how does a person organize, mold, select and control physical, objective sources of excitation?" The answer to this question must be provided for within a theory of the structure of personality.

In the course of a person's coming to terms with physical stimulation, he develops consistent ways of organizing and selecting stimuli. Such mechanisms, developing from the initial direction toward adaptation, achieve a relative stability and prominence which give to the person recognizable characteristics. They represent preferred, though not inevitable, ways of solving tasks requiring adaptation; and they can be sought within the patterns of behavior, such as perceptual behavior. The use that is made of such projective techniques as the Rorschach Test requires such a point of view. The way a person perceives and organizes an inkblot reflects certain quasi-stable and preferred modes of adaptation, and inferences are made about the structure of his personality from his responses to the Rorschach card.(1)

Klein and his co-workers (29) give the name cognitive attitudes to the person's preferred modes of solving problems involving cognition and they assume that they are expressed by a person in any situation to which he is called upon to respond. Consistency in personality is referred to the patterning of cognitive attitudes. The latter express personal styles of adaptation and provide a link between perception and the characteristic functioning of the person. All adaptive acts, such as learning, perception, etc., are guided by these cognitive

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(1) Rapaport (63) has developed this point of view in his work on diagnostic psychological testing.

controls. The focus of the construct of cognitive attitudes is not on the content of a percept, but on the formal qualities of behavior, that is, the particular way a stimulus is organized and responded to. Cognitive attitudes can be inferred from any class of adaptive acts of the organism, such as learning, perception, and motor behavior. Perceptual activities have thus far served as good starting points for isolating cognitive attitudes.

Koffka (36) proposed the term *attitude* to explain the effects of instructions on performance in psychophysical experiments. There is a strong similarity between his use of the term and the Würzburg concept of *Aufgabe*. The Würzburg School, dissatisfied with the elementarism of the pure introspectionists, introduced the concept of *set* (*Aufgabe*) to account for the automatic, self-regulating, and unanalyzable aspects of subjects' performance. Aufgabe, however, never received more systematic treatment than to relegate it to the status of an additional element in experience. Koffka's use of the term *attitude* is more in keeping with the spirit of the Gestalt approach. He attempts to show how experimental instructions induce a set or attitude and affect the way in which a subject will report his perception--his category of judgment. He maintains that instructions given in the usual psychophysical comparison experiment seem to facilitate a reporting of difference ("step-wise"), rather than sameness ("assimilative"); they tend to prepare the subject to perceive two discrete, independent members; they discourage judgments of equality or sameness.

> "What can we make of these facts: They show that the organism's structural reaction to a pair of stimuli depends upon its attitude. If we generalize all the data, the attitude may be such as to favor either a step-wise or an assimilative structure (each to the detriment of the other), or it may be differently advantageous to either one. From a consideration of the step-wise attitude, we can now draw the following conclusions; before the subject is confronted with the stimulus, the structure that will eventually ensue might be prepared for by a mental attitude, and this attitude consists mainly of a readiness to carry out a certain structural process. 'Attitude' has now become a well defined term as distinguished from 'attention'. It means that in entering a given situation, the organism has in readiness certain modes of response, these modes being themselves what we have called structures. Having such a process in readiness may be a mere nuisance and it may not help the final response to the stimulus at all - as when I am prepared for an ascending scale and receive stimuli that determine a descending one - but the attitude may also be very effective. If a structural process is thus adequately prepared for, it may come to its full effect under conditions which of themselves would have provoked a different structural process" (36).

Although there are some similarities between the use made here of the term <u>attitude</u> and Koffka's use of it, there are major differences. The concept of <u>attitude</u> still remains in his hands an element which is tied to experimentally induced sets or tasks. We use the term as a concept which coordinates performance with personality constructs. We conceive of a cognitive attitude as a not-necessarily-conscious mode of organizing or coming to terms with perceptual stimuli. It is not induced by the situation but it reflects the way in which the situation and the person will interact.(1) *Cognitive attitude* implies Koffka's concept of attitude, but we attempt to take account also of the differing ways in which people respond to the same instruction and similar induced sets.

One can describe each experimental situation in terms of the requirements of "instructions" imposed by the experimenter. How each person makes use of these instructions can also describe the situation. Each person brings with him preferred ways of coping with sense impressions.(2) These preferred modes aid the person to achieve an economical compromise between the satisfaction of his interpretation of reality and his own strivings. For example, in the cognitive attitude of *leveling-sharpening*, to be described more fully later, the tendency is either to reduce the disparity or tension between a stimulus and its background (leveling) or to maintain independence and discreteness of stimulus and ground (sharpening). In the particular situation in

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(1) The same differences that exist between Koffka's and our use of the term "attitude" exist between Woodworth's use of *set* and the construct of cognitive attitude. Woodworth uses *set* to describe an "active process in the organism. . .(working) as a selective factor favoring or *facilitating* some responses, while preventing or *inhibiting* others" (74).

(2) There is a close parallel between this formulation and Goldstein's use of the term "preferred behavior" (18, pp. 340-366).

which the leveling-sharpening attitude was studied, subjects were told to judge the size of a number of successively presented squares which gradually changed in size. The instructions then required the subjects to be alert to differences in size among the squares, to perceive each square as a discrete entity. For those approaching the task guided by a leveling propensity, a compromise had to be reached between the task requirement, which was to note size changes accurately, and the subjects' preferred solution or approach, which is to fuse adjacent stimuli. A less accurate performance resulted. A sharpening attitude, on the other hand, was more congenial to the demands of the instructions, and accuracy or perhaps over-sensitivity to change resulted.

Performance on any cognitive task, then, is viewed as a function of the induced intention or requirements and the cognitive attitude, that is, the subject's system of regulation and control over stimulation.

CHAPTER V

THE LEVELING-SHARPENING ATTITUDES

The cognitive attitude of leveling-sharpening has been experimentally isolated and described in another paper (30). Thinking through the implications of this attitude suggested the possibility of predicting time-error assimilation effects.

Sharpening refers to a propensity to maximize perceived differences. It gears the person to small gradients of difference between figure and its ground. People who level tend to minimize such differences and to "prefer" the experience of sameness rather than of difference. Sharpeners are not tied to single alternatives in organizing a field; they prefer the complex to the simple organization. If required to, they can sustain an organization intact over a considerable period of time. Levelers characteristically organize a field either in a simple manner or without any definitive organization. They rely heavily on anchors, frames of reference, hints and affirmations--the dominance in the field--for sustaining an organization. Levelers are weak in sustaining a single organization over time; they are easily diverted to new things; the older, more familiar organizations fade in attraction unless there is support for the old organizations from external sources. The solutions people reach in situations which call up this cognitive attitude will reflect the operation of these central control mechanisms.

Klein and Holzman (30) described the leveling and sharpening attitude in the course of analyzing and interpreting data obtained in an experiment on "the schematizing process." The situation required subjects to bring order into a gradually but constantly changing situation. Fourteen squares ranging in size from one inch to fourteen inches were projected on a screen one at a time for judgment in absolute units (inches). The room was darkened. The method of single stimuli was employed. At first only the five smallest squares were projected and each of the five squares was seen three times in haphazard order. Then, without the subject's knowledge, the smallest square was removed and one larger than any previously seen was added. This series of five squares was presented three times, one square at a time. In this way, the entire series moved upward until, after ten series and a total of 150 judgments, the subjects had judged all fourteen squares. Figure 1 shows schematically how the stimuli changed from one series to the next. The question we asked ourselves at the outset was merely, "What is the nature of the individual differences which would emerge as various subjects respond to this situation?"

In studying the results we first noted wide individual differences in the subjects' judgments of where the midpoint of each of the ten series lay. While the subjective midpoints of some subjects shifted with the changing objective midpoints so that there was very little discrepancy between the two measures, other subjects' judgments considerably "lagged" behind the objective changes.

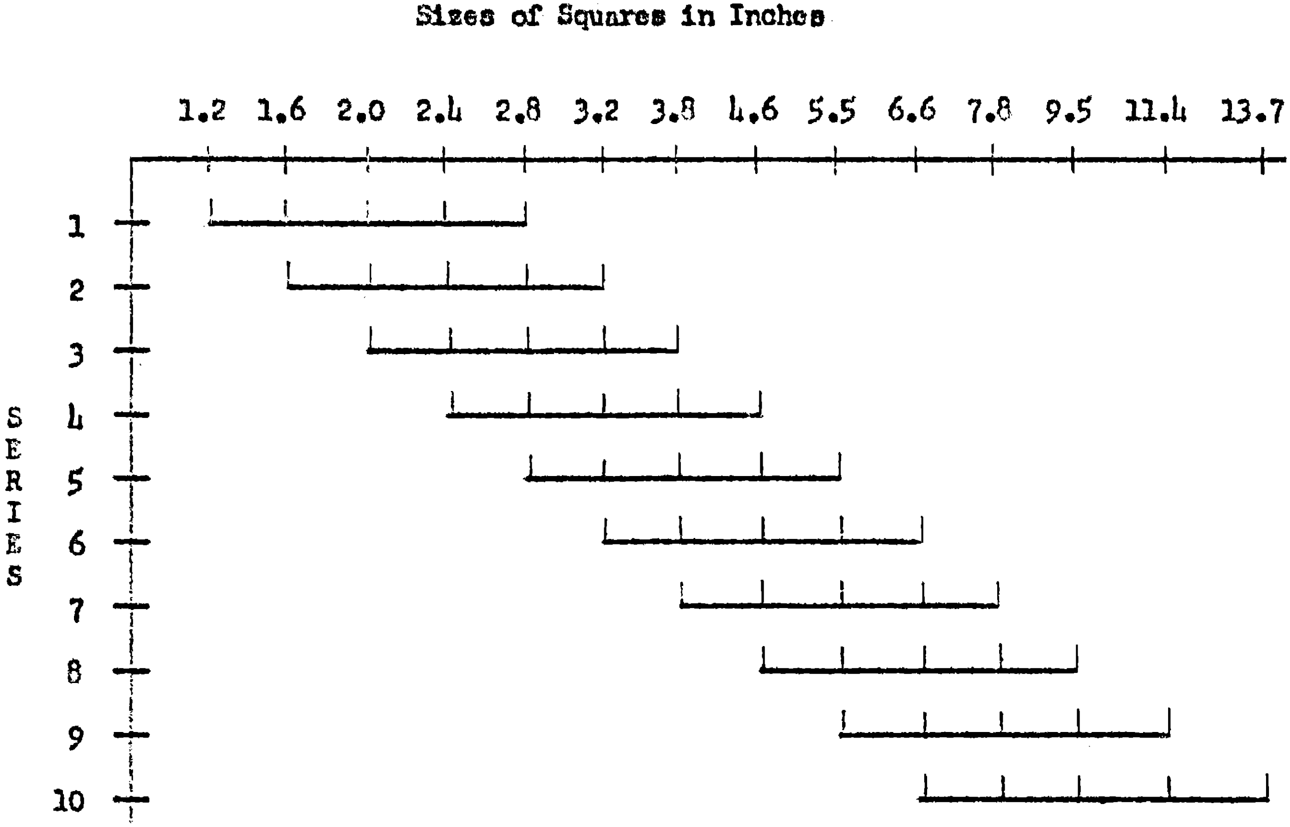

Fig. 1 Fourteen squares arranged in progressive series of five for the Schematizing Test.

Since we wanted to focus on differences in perception of change in size, we tried to eliminate differences in the use of scale values. We excluded scale values in the following manner. We attempted to find out how consistently our subjects noted the largest stimulus in a series, the next largest, and so on. To do this we computed the percentage of times each subject accurately perceived the proper rank of each stimulus in each series. That is, how often was the largest actually seen as the largest, etc?

Figure 2 shows that, as a group, subjects tended to be more accurate when the stimulus was either in position 5 or position 1, that is, when it was either the largest or the smallest in a series; accuracy decreased when the stimuli were in positions 2, 3, and 4; that is, when they were embedded in the series and no longer occupied a prominent end position. But here too striking individual differences emerged. While some subjects lost little accuracy on these "embedded" stimuli, the accuracy of others suffered considerably. On the basis of a measure of average acuity, we divided our group into subjects with "high" and "low" accuracy and plotted the accuracy scores for our high and low groups. While accuracy for both groups was relatively good when the stimuli were in an end or prominent position, those subjects whose overall accuracy was low tended to be significantly more inaccurate when the stimuli were no longer outstanding--when they were neither the largest nor the

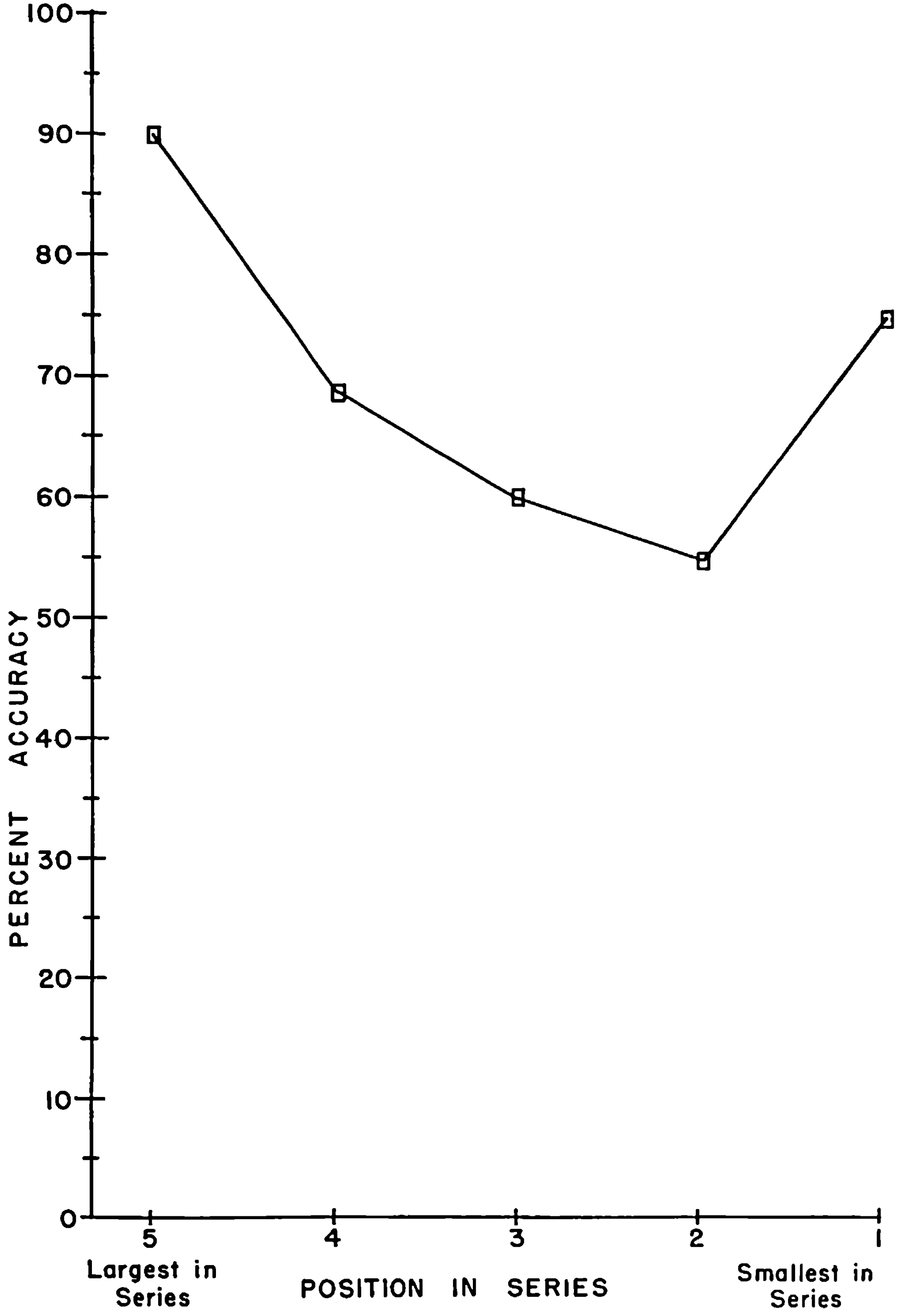

Fig. 2 Percentage of accurate placements when squares shifted from Largest in series to Smallest in series.

smallest of the series. "When squares lost their novelty and became embedded in the series, and 'lost in the crowd' they were less able than the others to tell it apart" (30). We also noted that the drop in accuracy from position 5 to 4, 5 to 3, and 5 to 2, i.e., as the squares became embedded in the series, seemed to be much greater for the "lows" than for the "highs."(1) This suggested an additional measure of sensitivity to change; the percentage loss in accuracy from the maximum level, to each of the other positions. The maximum accuracy for all subjects occurred when the squares occupied the fifth, or largest position in the series.

"How to account for the much greater drop in acuity on 'embedded' squares in the 'low' group? The differences between the two groups suggested that they were guided by different cognitive attitudes. It was as if the 'low' group preferred to ignore, deny or suppress differences, to 'level' stimuli to some simpler uniformity. Although the squares when placed side by side were obviously different, these people viewing them successively managed to slide over differences and to prefer a

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(1) The drop in accuracy was computed as the difference between the accuracy of placement of squares in position 5 and each of the other positions. Thus, from Figure 2 the loss in accuracy from position 5 (90%) to position 4 (69%) was 21%; from position 5 (90%) to position 3 (62%) was 28%; from position 5 (90%) to position 2 (57%) was 33%; from position 5 (90%) to position 1 (87%) was 3%.

stability of 'sameness'. For this group, a square had to be particularly vivid, that is either the largest or the smallest one in order to be seen in its own right. We have called this cognitive attitude in the 'low' group leveling.

"A different attitude seems to be at work in the 'high' group. These subjects maintain their greatest accuracy even with embedded stimuli; they seem better able to consider each stimulus appropriately and in its own right and hence to appreciate the gradual change. Stability for them seems to be not suppressing change and differences but being alert to them. Their cognitive attitude was one of sharpening, a tendency to be hypersensitive to minutiae to respond to fine nuances and small differences and to keep adjacent or successive stimuli from fusing and losing identity" (30).

How general is this cognitive attitude? Is it confined only to the schematizing situation or is its effect noted in performance on other tasks? To find clues to the answers to these questions we noted the performance of our leveling-sharpening groups in two different perceptual situations. These situations differed from the schematizing experiment except in their central requirement: the ability to extract a figure from a masking background. One task was the first three parts of Thurstone's adaptation of the Gottschaldt figures (67). The other was the detection of faces which were blended or camouflaged into the background of a larger picture. The sharpening group found these two tests significantly easier to do both in terms of their accuracy and the time they took to do the task.

The principal conclusion we drew from this series of studies is that "stable and significant cognitive attitudes can be sought even in response toward neutral and traditionally psychophysical situations; they offer evidence that a person brings to bear in any kind of situation what to him are 'preferred' ways of confronting reality" (30).

CHAPTER VI

LEVELING-SHARPENING AND THE TIME-ERROR HYPOTHESES:

While much work has been done in defining the stimulus conditions of time-error, there are no previous studies of individual differences in time-error and of intra-individual consistency of time-error across these modalities.

As we have seen, Lauenstein's neurophysiological hypothesis about the nature of the time-error assumed that electrochemical brain traces, cortical correlates of perceived intensities, do not merely fade but assimilate toward a background. If the ground is more intense than the stimuli to be compared the comparison stimulus will seem less intense. The time-error will then be positive, that is, the traces of the standard assimilate toward a more intense ground raising its value. The comparison stimulus then forms a <u>step-down</u> gradient in the brain field. With a less intense ground, the trace of the standard assimilates toward this ground and the appearance of the comparison stimuli results in a <u>step-up</u> gradient or negative time-error. Time-error, then, according to this hypothesis, is the result of an interaction, assimilation, between a figure and its ground. The standard stimulus tends to fuse with its background, resulting in an error of judgment when this stimulus is compared subsequently with another of equal intensity.

Now, leveling and sharpening have been defined through situations which require response to stimuli embedded in a ground. For those approaching a particular perceptual situation with a leveling attitude, there seems to be a greater difficulty to extract the stimuli from their context than for those responding with a sharpening attitude. Stimuli for levelers are not as easily differentiated from their ground. Operationally defined, levelers are those who are relatively inaccurate in detecting embedded stimuli. Their poor performance in a test of ability to extract figures from masking contexts seems to reflect a preferred tendency to diminish differences in the perceptual field. Sharpeners experience little trouble with extracting figures from a dominant field, reflecting their propensity for heightening stimulus differences. The following two hypotheses are then suggested: (a) Levelers may be more prone to assimilation effects in time-error than sharpeners; that is that the preferred ways of dealing with successive comparison judgment for levelers will possibly be to fuse the salient stimuli with the ground to a greater extent than the sharpeners. This hypothesis implies a second: (b) There will be intra-person consistency in the time-error in two or more sense modalities. A leveler will show a proportionately greater assimilation tendency in time-error experiments in sound, brightness and kinesthesis than will a sharpener.

Inasmuch as the time-error has been one of the focal points for neurophysiological speculations by psychologists, a demonstrated relationship between our cognitive attitudes and the time-error will perhaps suggest a basis for describing the attitudes also in terms of a cortical model. Such a step is indicated for two reasons: (1) Since all experience has its locus in the brain field, cognitive attitudes should be translatable into physiological terms; (2) the translation of the cognitive attitudes into neurophysiological language may make for a more precise formulation of leveling and sharpening; more efficient prediction of the effects of these attitudes on behavior other than perceptual may thereby become possible.

CHAPTER VII

PROCEDURE

A. The Schematizing Situation: Selection of Levelers and Sharpeners

A total of 106 subjects, 50 men and 56 women took part in the first experiment, the <u>schematizing</u> situation. It was from their scores on this test that we classified the subjects as either levelers or sharpeners. Sixty-four of these subjects were students in a general psychology class at the University of Kansas, 18 were aides at the Topeka State Hospital, and 24 were students of psychology at Washburn University. Their ages ranged from 18 to 43, the median age being 23. The subjects were tested in groups ranging from three to ten people. They were equipped with a record sheet on which were 150 numbered blank spaces. Each subject had a small flashlight which he used when recording his judgment.

The room in which the subjects were tested was darkened as completely as possible. The screen on which the squares were shown was a piece of black cardboard twenty-five inches square. In order to make the field as homogeneous as possible and to eliminate any cues which might aid the subjects in judging the size of the squares, the screen was draped on all four sides with five feet of black muslin. The 150 squares and the instructions were placed on a 35 mm. film strip and were projected from an SVE 35 mm. projector using a 100 watt bulb. The projector was placed 21 feet from the screen. A mechanical timer operated an electro-magnetic shutter to expose a square on the screen for three seconds and to shut it off for 8 seconds. The experiment lasted about 35 minutes.

While the instructions were exposed on the screen, the experimenter read them aloud. The instructions were as follows:

> "We wish to see how well you can judge the size of squares. We're going to show you a number of squares on the screen and we want you to tell us how big they are."
>
> "The squares may range anywhere between one inch and eighteen inches. This doesn't mean you'll necessarily get a square which is one inch or eighteen inches, though you may. But the squares will always be somewhere within this range."
>
> "To help you judge the size of the squares, we will show you what a one inch square looks like--the smaller end of the range, and what an 18 inch square looks like—the larger end of the range."

The one inch square and the 18 inch square were exposed for about five seconds each.

The instructions continued:

> "We will show them to you again."
>
> "You will see 150 squares during the course of the hour, and you have 150 numbered spaces on your sheet. Write your estimation of the size of each square in its own numbered space. Thus for square number one, record its size in inches next to number one, etc."
>
> "Don't go back over your judgments to change them. In changing them you are more likely

> to be inaccurate. Please don't compare your estimates with anyone or make any comment during the hour. Make your judgments independently."

> "Now to remind you once again of the range in which the squares will fall, we will show you again the smaller and the larger ends of the range."

The one and 18 inch squares were then exposed twice allowing five seconds for each exposure.

> "Now we are ready to begin. You will see each of the following squares for only a few seconds. Look at it all the time it is on the screen and make your estimation when it disappears. The next square you will see will be number one."

The experiment then began. The first five smallest squares were presented in haphazard order three times each for a total of fifteen judgments. Then the smallest square was removed and a square larger than any of those in the first series was added. This series of five squares was then presented in haphazard order until each stimulus in this new series of five had been exposed three times. Again the smallest of this second series of five was removed and a larger one was added. In this way the series of five squares moved up in the size range until all fourteen squares were exposed. A total of 150 squares (was) presented for judgment. Figure 1 schematically shows how the series shifted gradually from the smaller to the larger ends of the range.

Our leveling and sharpening groups were chosen on the basis of the subjects' scores on accuracy and per cent loss of accuracy of their judgments of the squares as they changed their positions in the series from largest to smallest.(1) To determine a subject's accuracy score we examined each series of five stimuli and noted how many times out of three presentations the fifth, or largest stimulus, was judged as the largest of that particular series; how many times the fourth stimulus was seen as next to the largest stimulus, etc. The scores on each position for each subject were expressed as a function of the maximum accuracy possible on each stimulus. Then from the percentage accuracy scores at each position we computed the accuracy lost as the stimulus moved from position five to position four, from position five to three, five to two and five to one. For each subject we averaged his percent accuracy and the loss of percent accuracy from the highest level, which was in all cases when the squares were in position 5, the largest in the series. These two averages were our basic measures for choosing our levelers and sharpeners.

We constructed two distributions of scores: in the first we ranked our subjects according to their accuracy score, and in the second distribution we ranked them according to their average

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(1) See p. 36 for the rationale for dealing with accuracy of relative placement of the stimulim rather than with absolute error.

loss of percent accuracy. Dividing both distributions in half (fifty-three subjects in both halves), we called those subjects _sharpeners_ who fell in the upper half of _both_ distributions and those people _levelers_ who were in the lower half of _both_ distributions.

Thirty-one subjects were eliminated from further testing because both the accuracy and loss of percent accuracy scores were not consistently in the same half of both distributions. The Ss who were eliminated showed two types of performance: Some subjects, while showing over-all high accuracy in detecting each stimulus in its proper position in the series, lost a considerable amount of accuracy on those that were in the middle of any given series. A second kind of performance among those Ss eliminated was initial inaccuracy which the subjects consistently maintained throughout the experiment. This latter type of performance showed up as a low accuracy score but hardly any loss in percent accuracy. People who showed these two varieties of approach to the experiment were eliminated from further consideration because they did not fit the operational criterion for leveling or sharpening.(2) Seventy-five subjects, then, remained: 37 sharpeners and 38 levelers.

Figure 3 shows how the leveling and sharpening groups separated themselves on the accuracy measure. Note that the groups, while not widely different on the most salient stimuli in position

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(2) See p. 38 f.

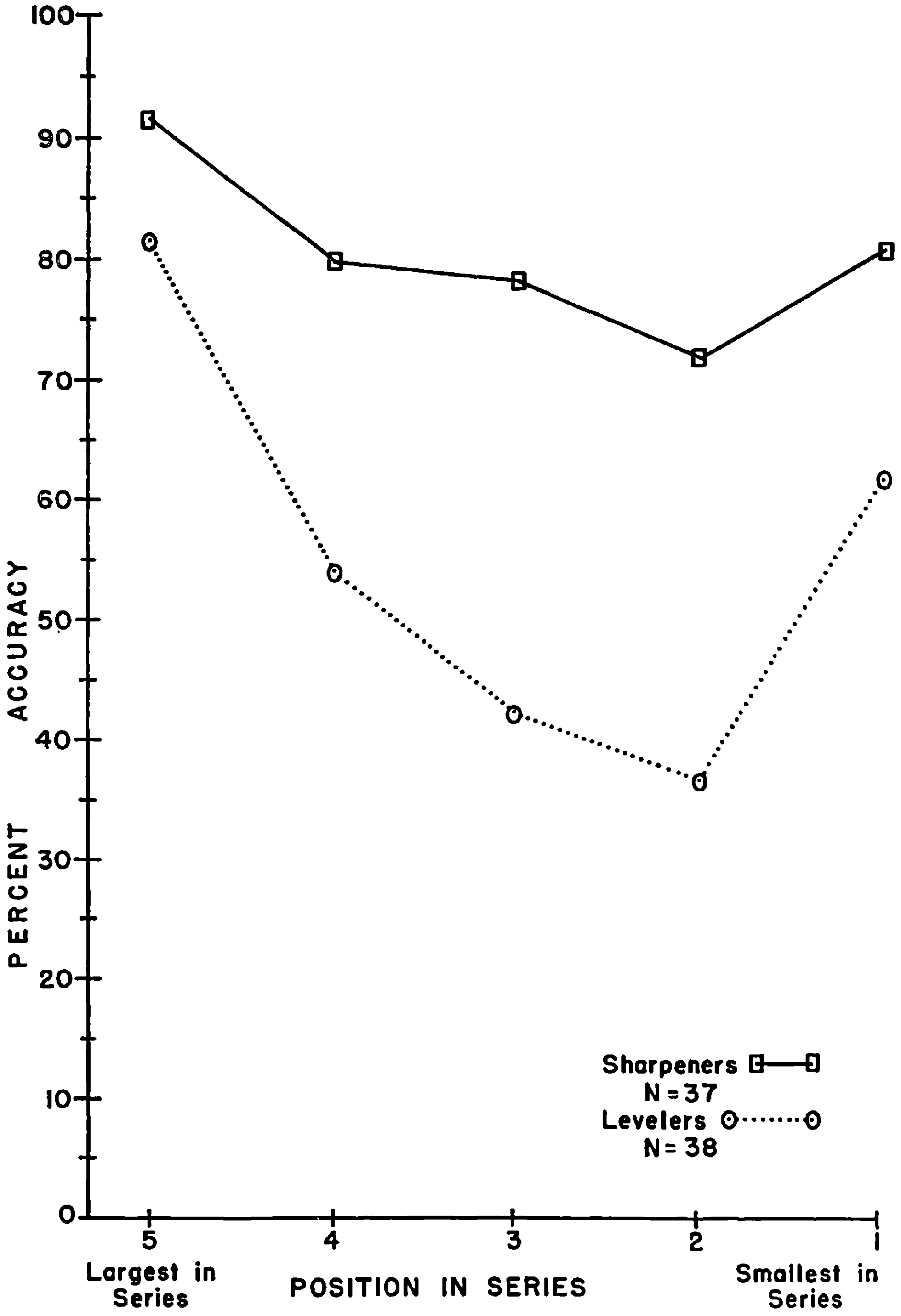

Fig. 3 Percentage of accurate placements by Levelers and Sharpener when squares shifted from largest in series to smallest in series.

5 and 1, become decidedly divergent at positions 4, 3, and 2. In figure 4 this is expressed as a greater loss in accuracy for levelers from position 5 to all other positions.

Included in these seventy-five remaining subjects were those who were both extreme levelers and sharpeners and those who fell near the center of the distribution. There were, thus, subjects in this total group who seemed to show leveling behavior or sharpening behavior to a much greater degree than others. In this study, however, we wished to test the inference that a predominantly leveling or sharpening attitude will contribute significantly to a certain kind of assimilation effect in time-error. We therefore decided to deal only with extreme levelers and sharpeners in the next part of our study.

The conventional cut-off points for dealing with extremes are the upper and lower 27 per cent of the total distribution (26). Twenty-seven per cent is that proportion of the extremes of a normal distribution which maximizes the difference between the means of the two groups divided by the standard deviation of their differences. Our final experimental groups consisted of twenty-one sharpeners and twenty-two levelers. These were the subjects with whom we worked in our time-error experiments.

B. Visual Time-Error Experiment

The apparatus consisted of a wooden box 21 x 17½ x 7½ inches. The front of the box was cut out and in the 21 x 17½ inch

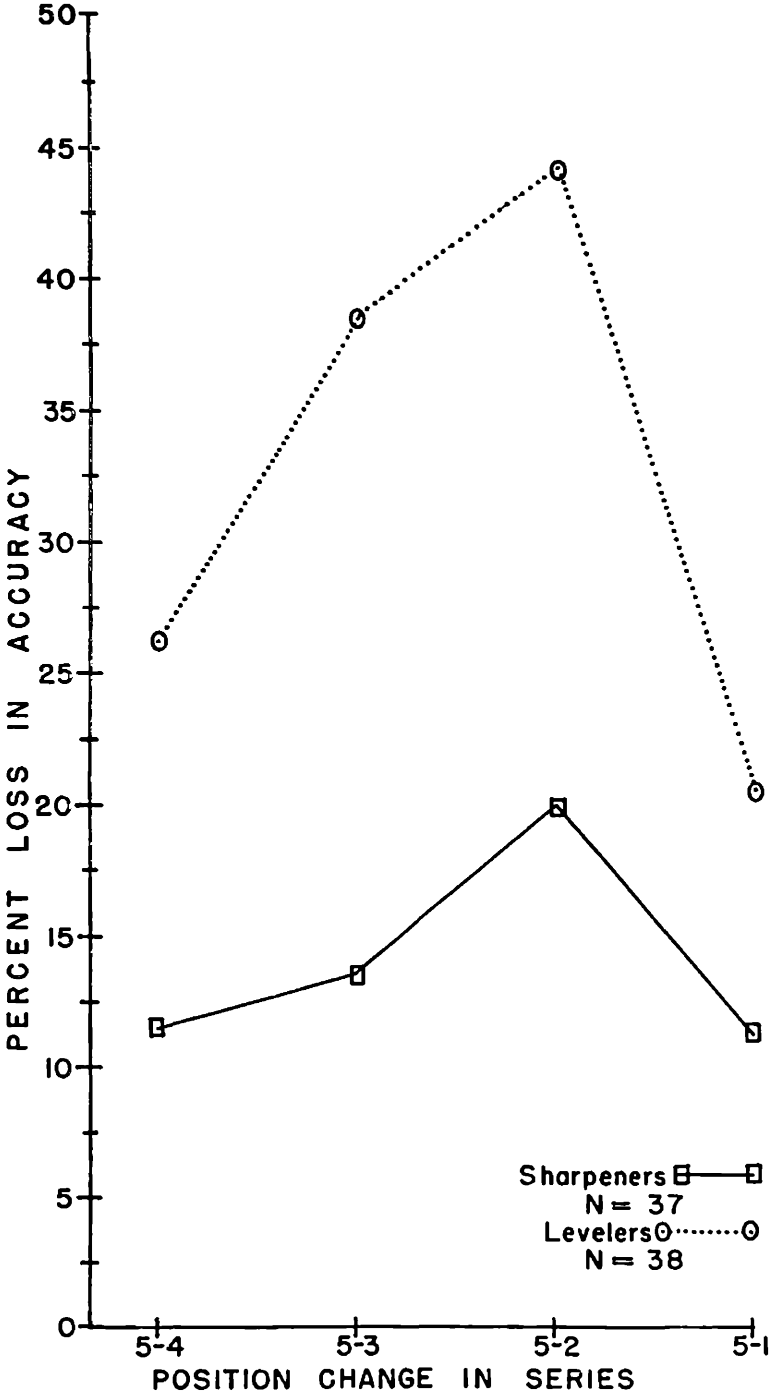

Fig. 4 Percent loss of accurate placements by Levelers and Sharpeners when squares shifted from largest to smallest in series.

opening was placed a sheet of milk glass 20 inches by 15½ inches. The milk glass was masked with black cardborad except for a circular opening five inches in diameter. This five-inch aperture served as the screen on which the time-error stimuli and the interpolated fields were projected. The rear of the box was open. Behind the milk glass and fastened to the sides of the box were two electric light bulbs connected in parallel, the brightness of which was controlled by a Variac. These bulbs provided the illumination for the interpolated field. From a 35 mm SVE projector, using a 100 watt bulb, the brightness stimuli were projected through the rear of the box onto the five-inch milk glass screen. The brightness of the comparison stimuli was controlled by a second Variac. Both the projector and the lights inside the box were connected to a mechanical timer which automatically turned on and off the SVE projector exposing a brightness stimulus for <u>one second</u>. After the projector was shut off, the timer switched on the lights in the box to provide the interpolated field illumination for a specified time. In this way the stimulus brightness alternated with the interpolated fields according to a controlled interval.

The subjects, tested in groups of three to five people, were allowed five minutes to adapt to the darkened room. They sat in two rows, two subjects in the front row and a maximum of three in the rear. Seated in front of the box, the subjects were arranged symmetrically about the plane perpendicular to the center of the opening of the milk glass. The distance from the center of the five inch circle to the eyes of the subjects in the first row was six feet, and eight feet to the eyes of the subjects in the second row.

Condition I

The subjects judged five pairs of brightness stimuli. The stimulus pairs in millilamberts were:

7.00 - 3.50
7.00 - 5.25
7.00 - 7.00
7.00 - 8.75
7.00 - 10.50

These stimuli appeared as successive pairs of illuminated circles five inches in diameter—the entire exposed milk glass disc. Each circle in a pair was presented for one second. Ten seconds separated standard and comparison and 20 seconds elapsed between pairs. During the 10 second interval and the 20 second interval the screen was illuminated by 3.25 ml. Thus the brightness stimuli to be compared interrupted the constant field of 3.25 ml. Judgment was by the method of constant stimulus differences with only two categories of judgment allowed. The standard was always presented first.

The stimulus pairs were so arranged that each pair was preceded and followed by every other pair at least once, and not more than twice; no pair was repeated till all five pairs were projected. Subjects judged each stimulus seven times, 35 judgments in all. The experimental session thus lasted 18 minutes. Köhler (37) has suggested that in the course of prolonged experimentation the time-error is washed out, and rather than risk this we limited the experiment to 35 trials.

Each subject was equipped with a pad containing 35 sheets of paper on which he wrote his judgments. Judgments were recorded on separate pages so that the subjects could not infer any pattern of response by comparing their judgments on previous trials. The subjects were given small pocket flashlights to aid them in recording their judgment. The experimenter instructed the subjects as follows:

> "You will see two circles of light on the screen here; one will follow the other by a few seconds. I want you to tell me if the second flash of light that you see is brighter or dimmer than the first. Remember, judge the second one, telling me if it's brighter or dimmer than the first one. Now the screen will be lit most of the time by a dim light. Judge only the two lights that interrupt this continuous light. The procedure will look like this:" (Two practice trials were given at this point to all subjects. The following stimulus pairs comprised the practice trials: 7.00 - 3.50 ml. and 7.00 - 10.50 ml.) "Remember call the second light brighter or dimmer than the first light.
>
> "You have 35 pages in your booklet and you will see 35 pairs of stimuli. Mark your judgments on the pages in the booklet using a separate page

> for each stimulus pair that you see. Please look at the screen all of the time, taking your eyes off it only to record your judgments."

Condition II

The same brightness stimuli as Condition I were given to the same subjects with one change. The field, instead of being illuminated by a dim light, was illuminated by a brightness of 27.7 millilamberts in between the presentations of the stimuli. Again only the standard and comparison interrupted this interpolated brightness field. Immediately after the timer exposed each stimulus, the timer automatically turned on the bulbs inside the box which provided the field illumination. In this way the ground was on before, between, and after each stimulus pair. The instructions for this part of the experiment were the same as for Condition I except that the word "bright" was substituted for the word "dim" when explaining the interpolated field.

Condition III

Eighteen subjects were given a third condition of this visual time-error experiment. In this third condition, called Condition III, the same stimulus pairs were presented for judgment. In between the presentations of stimuli, however, no background illumination was given. The screen was dark.

To minimize complication from accumulated practice effects, one week separated each condition of this experiment.

Computation of the Time-Error:

The time-error was computed as the difference between the point of subjective equality (PSE) and the objective midpoint. The PSE was computed by the summation method as described by Woodworth (75).

C. Auditory Time Error Experiment

We attempted, as far as possible, to duplicate the same experimental conditions for sound as for brightness by adhering closely to Lauenstein's procedure for presenting the stimuli. Two experimental sittings made up this section of intensity judgments in sound.

The stimuli were five pure tones fixed at 500 cps. and varying in intensity. The task was to judge the loudness of the tones by the method of constant stimulus differences. Each series consisted of a standard at 28 db below a reference level of 5 watts, and five comparison stimuli which were distributed symmetrically in steps of two db around the standard stimulus. The series, then, was composed of the intensities: 32 db, 30 db, 28 db, 26 db, and 24 db below the reference level of 5 watts, with 28 db as the standard. Ten seconds separated standard and comparison stimuli and twenty seconds elapsed between the presentation of the stimulus pairs. Both standard and comparison sounds were presented for one second each. The standard was always presented first. Condition I included a soft interpolated tone of 36 db below the reference level of 5 watts at 500 cps. Condition II included a loud interpolated tone of 21 db below the reference level at 500 cps. These interpolated tones sounded during the ten and twenty second intervals.

The instructions were as follows:

> "I want you to judge the loudness of sounds. You're going to hear two tones which will sound for about a second. One will follow the other by ten seconds. I want you to tell me if the second tone you hear is louder or softer than the first tone. Record your judgment in the booklet I gave you. There will be 35 such pairs and you have 35 pages in the booklet. Use a separate page for your judgment of each pair. Now in between the two tones you will hear a soft (or loud) background tone. You are to judge only those two tones which interrupt this continuous background tone. Remember call the second tone louder or softer than the first one."

To control intra-serial effects, each comparison pair was preceded and followed by every other comparison pair at least once and no more than twice; no stimulus pair was repeated until all five pairs were presented for judgment. To minimize the disappearance of the time-error phenomenon which may occur in the course of prolonged experimentation, each experimental session was limited to 18 minutes. This time limit allowed the subject to make seven judgments on each stimulus pair, a total of 35 judgments in all.

One week separated the two conditions of the experiment.

Apparatus:

The sound stimuli were produced by a twin audio-frequency oscillator constructed by R. Gerbrands (66). One oscillator generated the standard and comparison stimuli, while the other produced the interpolated sounds. The oscillators contained a built-in electronic switch which eliminated the transients or clicks produced when a tone is switched on or off. A double-relay timer controlled the duration of the comparison and interpolated tones. Six sets of Brush crystal headphones, type A-1, were connected in parallel with the output.

The subjects, tested in groups of four and five, were so arranged that they could not see anyone else's record booklet.

D. Kinesthetic Time-Error Experiment

Would the trends seen in the auditory and visual time-errors(3) continue in an experiment involving kinesthetic time-error? Only five levelers and five sharpeners were available for this experiment. The results are clear cut enough to merit reporting despite the small number of subjects. The procedure followed the auditory and visual experiments as closely as possible.

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(3) See pp. 62 ff.

The stimuli were five black circular metal pillboxes, 3 inches in diameter. The boxes were loaded with lead shot and paraffin. The weights were 184, 192, 200, 208, and 216 grams. Judgment again was by the method of constant stimulus differences, with 200 grams as the standard. The standard was always presented first. Each weight, including the 200 gram weight was compared with the 200 gram standard. Only two categories of judgment were allowed. The subjects were instructed to report to the experimenter whether the second weight they lifted was heavier or lighter than the first.

The weights were arranged on a circular platform which revolved noiselessly on a ball bearing axle. There were three conditions in this experiment. In Condition I the subjects were told to lift the weight when the experimenter tapped his pencil on the table. They were instructed to rest their elbows on a soft pad and to lift the weight twice by grasping it with all five fingers. They were to lift the weight using the elbow, fixed on the cushion, as a fulcrum. After the standard weight was put down, the subject lifted a weight lighter than any in the series, 132 grams. He held this weight for 10 seconds, put it down at the signal from the experimenter and then lifted the comparison. After the comparison weight was replaced, the subject lifted the 132 gram weight again and held it for about 20 seconds. A new series was then begun.

The arrangement of the stimuli, as in the visual and auditory experiments, was such that each stimulus pair preceded and followed every other one at least once and no more than twice. There were 35 pairs presented for judgment. Subjects were tested individually. They were seated in a comfortable chair directly in front of the revolving platform, and were blindfolded so as to prevent visual recognition of the weights.

In Condition II of the experiment the same weights were employed, with the same instructions for lifting them. After the standard weight was put down, however, subjects lifted a a weight that was heavier than the weights of the stimulus series. This weight was 290 grams. The subjects held this weight for 10 seconds, put it down, and then lifted the comparison. After the comparison weight was put down the subjects lifted the 290 gram weight again and held it for about 20 seconds. A new series was then begun.

In Condition III of this experiment no interpolated weight was employed.

Time-error was computed by subtracting each subject's point of subjective equality from the objective midpoint, which is 200 grams.

The point of subjective equality was calculated by the Summation method as described by Woodworth (75).

The experimenting took place over a period of several months. It was necessary to see each subject for approximately five consecutive weeks in order to test him on all of the experiments.

CHAPTER VIII

RESULTS

A. Concerning the Lauenstein Assimilation Hypothesis

Table IV shows the time-error scores of the 18 subjects who were given the three conditions, (dim, bright, no interpolated field) of the visual time-error experiment. With the dark field, Condition III, the time-error is -.71. That is, with a delay of 10 seconds between the presentation of standard and comparison stimuli, judgment of the midpoint of the series of stimulus pairs is displaced .71 ml. below the objective midpoint. When the interpolated field is bright (Condition II), the time-error becomes positive, while a dim interpolated field (Condition I) results in a negative time-error. In general, this is confirmation for Lauenstein's hypothesis that the time-error (with interval between comparison and standard held constant) is a function of the prevailing field illumination, a darker field than the stimulus series yielding a displacement of judgment in a negative direction, and a bright field resulting in a displacement in a positive direction.

The fact, however, that a greater negative time-error occurs with a dim rather than a dark field seems to be inconsistent with the hypothesis. This finding is similar to Pratt's results (59), and it was on this basis that Pratt took issue with Lauenstein's explanation of the time-error. Pratt argued that a completely

TABLE IV

MEAN VISUAL TIME-ERRORS FOR 18 Ss UNDER THREE CONDITIONS OF INTERPOLATED FIELD: I (DIM), II (BRIGHT), III (NO INTERPOLATED FIELD).

	CONDITIONS		
	I (DIM)	II (BRIGHT)	III (NO INTERPOLATED FIELD)
MEAN TIME-ERRORS (N = 18)	-1.85*	+1.41*	-.71

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* Significantly different from zero.

dark ground should result in a greater assimilation effect than a dim ground, since the former is a much lower degree of dimness.

Upon closer examination, however, this result offers no contradiction to Lauenstein's hypothesis. We can account for the more cogent effect of the dim condition over the dark condition if we recall a qualifying statement made by Lauenstein in discussing the limits within which assimilation works in affecting traces. "Only those traces that stand in concrete structural relationship with each other can in general assimilate to each other. One can well expect that the closer the relation, the stronger the assimilation will be" (45). Now the interpolated field in the dim condition was 3.25 millilamberts and stands in much closer relation to the stimulus series than the dark interpolated field. Indeed the dark interpolated field can be considered to be quite markedly outside the range of standard and comparison stimuli. Therefore assimilation under this latter condition is restricted. The dim interpolated field stands much closer to the stimulus series than the bright field which was 27.7 millilamberts. Note that the bright condition results in less positive displacement of time-error than the dim condition's displacement in the negative direction.

Table V summarizes the results of the kinesthetic time-error experiment. As in the visual time-error, Condition I, where the intervals between pairs and within pairs are filled by a light

TABLE V

MEAN KINESTHETIC TIME-ERROR FOR LEVELERS AND SHARPENERS UNDER THREE CONDITIONS OF INTERPOLATED FIELD: I (LIGHT), II (HEAVY), AND II (NO INTERPOLATED WEIGHT).

	CONDITIONS			
GROUPS	I (LIGHT)	II (HEAVY)	III (NO INTERPOLATED WT.)	COMBINED MEAN
SHARPENERS (N = 5)	-4.38	+0.56*	-0.51*	-1.44
LEVELERS (N = 5)	-7.17	+3.41	-3.32	-2.36
MEAN TIME-ERROR OF ALL Ss	-5.78	+1.99	-1.87	-1.90

* Not significantly different from zero.

weight, causes a greater displacement of judgment for all subjects than Condition III where the intervals are empty. Here, again, the bright interpolated field in Condition I stands in closer relation to the stimulus series than does the empty interval. We should, therefore, expect a greater displacement of judgment in Condition I than in Condition III if Lauenstein's statements (45) have validity. Note, too, that the dominant field in Condition I (132 grams) is nearer to the stimulus series (68 grams from the midpoint of the series) than the 290 gram field in Condition II, (90 grams from the midpoint of the series). Table VII shows that the time-error is greater in a negative direction in Condition I (light) than the time-error in Condition II (heavy) is in the positive direction.

Table VI shows that in auditory time-error, where the more intense interpolated field (Condition II) was closer to the stimulus series (3 db removed) than the soft interpolated field in Condition I (4 db removed), the greater displacement of time-error occurs under Condition II. Thus it is apparently not the less intense interpolated field that exerts the greater assimilation effect.

In the kinesthetic and visual experiments it was Condition I, the less interpolated field, which seemed to present the optimal conditions for the operation of the assimilation effect, while in

TABLE VI

MEAN AUDITORY TIME-ERROS FOR LEVELERS AND SHARPENERS UNDER TWO CONDITIONS OF INTERPOLATED FIELD: I (SOFT) AND II (LOUD).

	CONDITIONS		
GROUPS	I (SOFT)	II (LOUD)	COMBINED MEAN
SHARPENERS N = 20	- .30	+ .90	+ .30
LEVELERS N = 19	- .92	+1.59	+ .33
MEAN TIME-ERROR OF ALL Ss	- .61	+1.25	+ .32

TABLE VII

MEAN VISUAL TIME-ERRORS FOR LEVELERS AND SHARPENERS UNDER TWO CONDITIONS OF INTERPOLATED FIELD: I (DIM) AND II (BRIGHT).

	CONDITIONS		
GROUPS	I (DIM)	II (BRIGHT)	COMBINED MEAN
SHARPENERS N = 21	-1.54	+ .63	- .46
LEVELERS N = 22	-2.14	+1.30	- .42
MEAN TIME-ERROR FOR ALL Ss	-1.84	+ .97	- .44

All time-errors are significantly different from zero.

the auditory experiment it was the more intense interpolated field. A capacity limit seems to be reached when the interpolated ground is markedly different from the stimuli to be compared. The more distant the relation between stimulus series and interpolated field, the less the latter affects the magnitude and direction of the time-error.

The experimental design permitted the arrangement of the results of both auditory and visual time-error experiments in a double classification analysis of variance. This made it possible to test the differential effect of the interpolated fields (between conditions) for the extreme subjects, and the difference between levelers and sharpeners on the conditions of more and less intense interpolated fields in both modalities. The basic score was the time-error for each subject on each condition. This distribution of the mean time-errors under both conditions for levelers and sharpeners is shown in Table VI for auditory time-error, and in Table VII for visual time-error.

B. Comparison of Conditions

Does the variation in interpolated field result in a significant change in the size and direction of the time-error? Table VIII which summarizes the analysis of variance for visual time-error shows that a comparison of the variance between conditions with the interaction variance of subjects, conditions

TABLE VIII

SUMMARY OF ANALYSIS OF VARIANCE FOR VISUAL TIME-ERROR

Source of Variance	Sm. Sq.	df	Mean Sq.	F.	p.
Between Levelers and Sharpeners groups	.01	1	.01	___*	
Between Ss in same group	115.18	41	2.81	1.63*	.05
Between Conditions I and II	171.09	1	171.09	99.47*	.001
Groups X Conditions	8.68	1	8.68	5.07*	.05
Subjects X Conditions X groups	70.55	41	1.72		
Total	365.51	85			

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* Tested against subjects x conditions x groups.

and group yields an F which is significant at less than the .001 level. This indicates that the interpolated field has a demonstrable effect on the time-error. Table IX shows that this result obtains also for auditory time-error, where the between conditions variance is seen to be significant at less than the .001 level. The direction of the effect is that predicted by Lauenstein for both groups, as seen from Tables VI and VII. Under the condition with the less intense interpolated field the visual time-error is negative, -1.84, while the time-error is - .61 for the comparable condition in the auditory sphere. With a more intense interpolated field time-error becomes positive, ≁ .97 in visual time-error and ≁1.25 in auditory time-error.

In general, then the results confirm those of Lauenstein and are consistent with the hypothesis that the prevailing field exerts an assimilation effect on the stimuli. When the dominant field is more intense than the stimuli the standard stimulus is assimilated toward the more intense ground, resulting in a positive time-error. When the dominant field is less intense than the stimuli, the standard stimulus is assimilated toward the dim level resulting in a negative time-error.

C. Comparison of Levelers and Sharpeners

When we compare the contribution to the total variance attributable to differences between groups with the error term

TABLE IX

SUMMARY OF ANALYSIS OF VARIANCE FOR AUDITORY TIME-ERROR

Source of Variance	Sm. Sq.	df	Mean Sq.	F.	p.
Between Levelers and Sharpeners groups	0.24	1	0.24	___*	___
Between Ss in same group	24.61	37	.67	1.22*	.20
Between Conditions I and II	62.68	1	62.68	113.96*	<.001
Groups X Conditions	11.10	1	11.10	20.18*	<.001
Subjects X Conditions X groups	20.40	37	.55		
Total	119.03	77			

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* Tested against subjects x conditions x groups.

in both sense modalities, the former seems not to account for a significant portion of the total variance. This lack of differentiation between levelers and sharpeners on the average of all conditions is, however, artifactual. That is to say, the true differences between levelers and sharpeners in both conditions are obscured by the fact that the two conditions exert effects in opposite directions. Condition I yields a negative time-error, while Condition II results in a positive time-error. When the results of these conditions are averaged the mean obscures the true differences on each condition. This may become clearer if we direct our attention to the following tendencies of the data: Note in Table VI that the mean time-error for levelers in the "loud" condition is +1.59, that for sharpeners is + .90. Under the condition with the soft interpolated field, the mean time-error for levelers is - .92 and that for sharpeners is - .30. Now, if we average the mean time-errors for the levelers in both conditions and the time-errors for sharpeners in both conditions, the sharpeners have an average of + .30 while the levelers' average is + .33. This difference is hardly significant and shows up in the analysis of variance as an insignificant between-groups variance estimate, even though the magnitude of the time-error was greater under each condition, considered separately, for levelers than it was for sharpeners.

The significance of the leveling and sharpening dimensions is more directly indicated in Tables VIII and IX by the significant interactions of groups with conditions. Thus the groups respond significantly differently to the two conditions, levelers showing greater negative time-error under the condition of less intense interpolated field and greater positive time-error under the condition of more intense interpolated field.

In the auditory time-error, between-subjects variance within groups is not significantly greater than the error term, attesting to the insignificant individual differences within the groups. The within-groups variance in visual time-error is, however, significant at the .05 level. Thus, while levelers and sharpeners do differ on the average from each other in a predictable direction on assimilation effects in,time-error, there may be significant individual differences within each group, particularly in visual time-error. In short, there may be other determinants of difference in time error of secondary importance.

Table X which summarizes the analysis of variance in kinesthetic time-error scores shows that the results are quite similar to the results obtained with the auditory and visual time-error, in spite of the fact that there were only five subjects in each group.

Levelers and sharpeners interact differently with the different conditions of interpolated field. The F ratio for the

TABLE X

SUMMARY OF ANALYSIS OF VARIANCE FOR KINESTHETIC TIME-ERROR

Source of Variance	Sm. Sq.	df	Mean Sq.	F.	p.
Between Levelers and Sharpeners groups	6.36	1	6.36	___*	___
Between Ss in same group	170.50	8	21.31	6.34*	.01
Between Conditions	301.37	2	150.80	44.88*	.001
Interaction groups x conditions	75.93	2	37.97	11.31*	.001
Interaction groups x subjects x conditions	53.78	16	3.36		
Total	607.94	29			

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* Tested against interaction subjects x conditions x groups.

interaction of groups with conditions compared with the error term is significant at less than the .001 level. Note, however, the significant within-groups variance, attesting to the considerable individual variation within the leveling and sharpening groups. While these large differences among subjects within their own group may be partly a result of the small N, it is still quite likely, as with the visual time-error, that although the groups do separate reliably on time-error measures, there are wide variations within the leveling and sharpening groups. This finding is consistent with the view that there are other important determinants of time-error besides the cognitive controls of leveling and sharpening.

Inspection of Figures 5 and 6, which show graphically the time-error results of each group under each condition, indicates how the groups separate on the different conditions. From these results we may generalize that levelers show a greater tendency than sharpeners toward assimilation of traces to the interpolated field.

D. Magnitude of shift in time-error from conditions of less intense to more intense interpolated fields

A more direct measure of proneness to assimilation effects is given by the amount of change in time-error for each individual from the less intense to the more intense interpolated field.

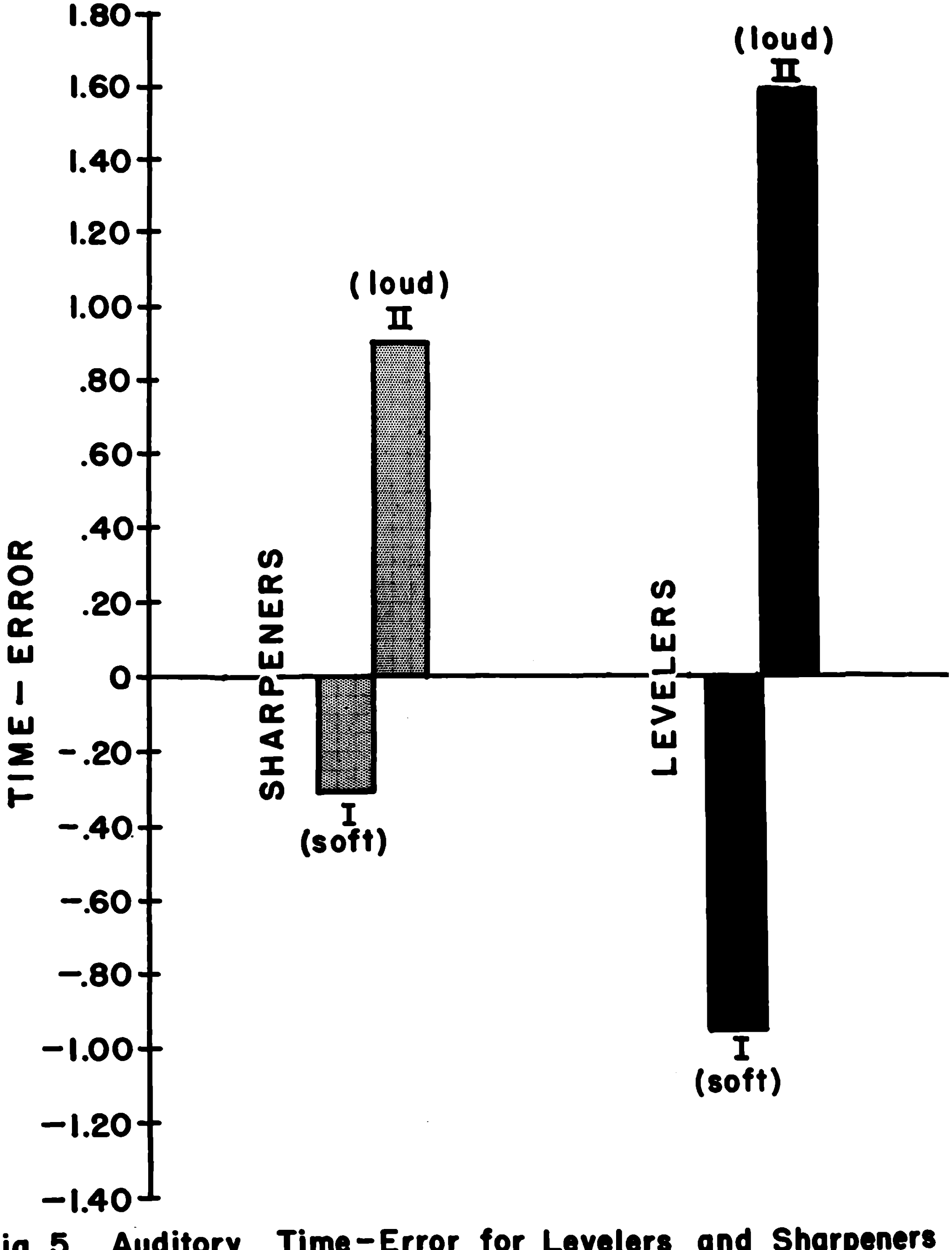

Fig. 5 Auditory Time-Error for Levelers and Sharpeners under two conditions of interpolated field I (soft) and II (loud)

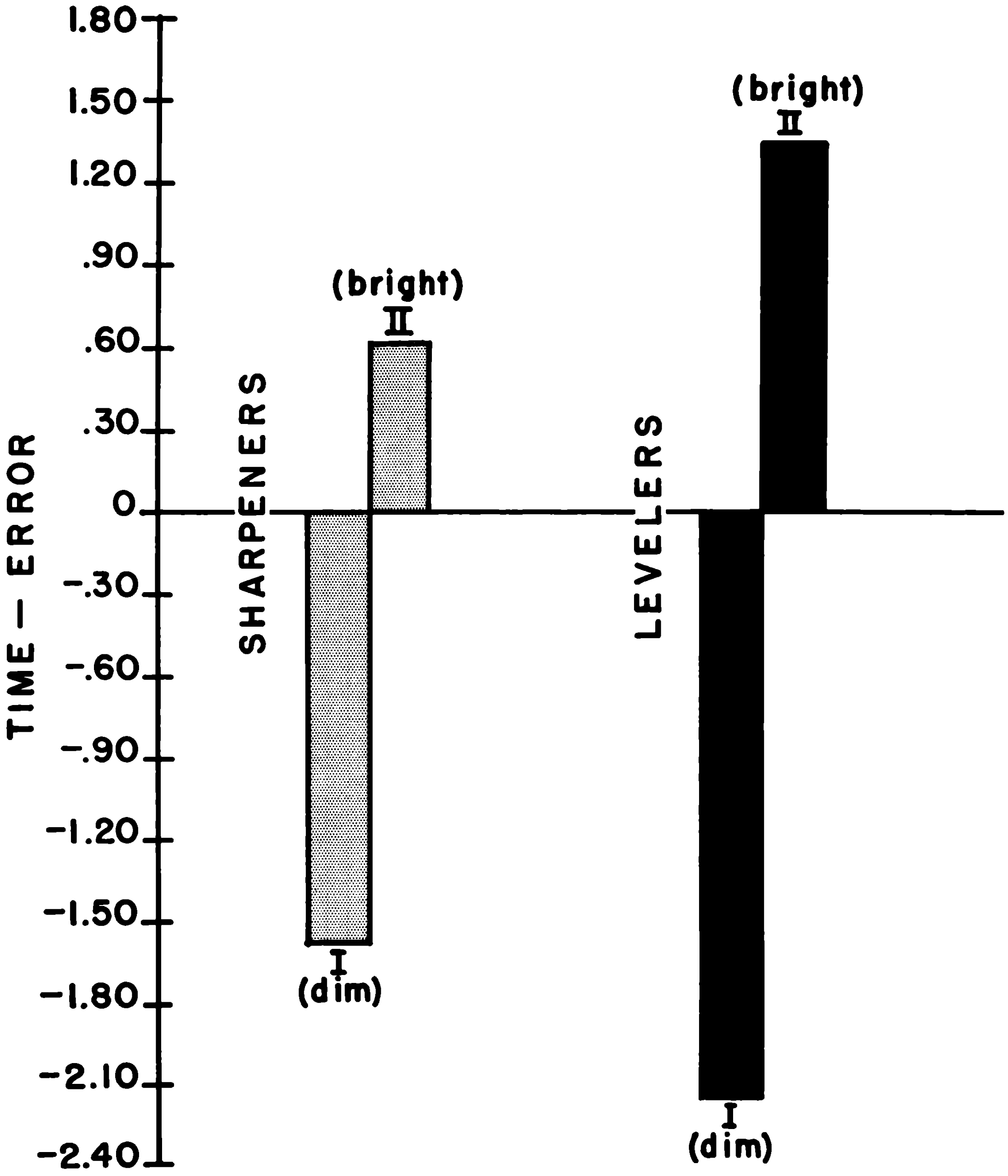

Fig. 6 Visual Time-Error for Levelers and Sharpeners under two conditions of interpolated field, I (dim) and II (bright)

Rather than consider each individual time-error condition, this assimilation measure considers the <u>difference in time-error between the two conditions of interpolated field</u>. This tells us how much change in time-error occurs with a change in the dominant field conditions. According to the hypothesis described earlier the leveling attitude should result in relatively greater displacement of time-error when the shift occurs from a more intense to a less intense interpolated field. Results pertaining to this hypothesis are shown in Table XI. The scores in Table XI represent the <u>change</u> in time-error from the more intense condition to the less intense condition of interpolated field for the three time-error experiments. Levelers consistently show a significantly larger difference score than sharpeners. Clearcut differences, then, appear between extreme levelers and sharpeners with respect to the magnitude of the assimilative effect of a dominating field upon the stimuli to be compared.

E. Generality of the Assimilation Effect

Both ways in which the data have been analyzed (cf. Table XI and Tables VIII, IX and X) show that levelers show significantly greater response to the interpolated fields than do sharpeners. Within the limits of generalization imposed by the size and nature of the samples tested, this is consistent for the auditory, visual and kinesthetic modalities. That cognitive attitudes exert cross-modal

TABLE XI

ASSIMILATION (DIFFERENCE) SCORES OF LEVELERS AND SHARPENERS IN THREE MODALITIES OF TIME-ERROR (DIFFERENCE BETWEEN CONDITION I (LESS INTENSE) AND CONDITION II (MORE INTENSE).

Groups	Time-Error Experiment		
	Visual Time-Error	Auditory Time-Error	Kinesthetic Time-Error
Sharpeners	2.17 (N = 21)	1.21 (N = 20)	4.94 (N = 5)
Levelers	3.44 (N = 22)	2.51 (N = 19)	10.58 (N = 5)
Difference	1.27	1.30	5.64
t	2.239	3.646	2.696
p*	.014	.001	.016

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* Tested on one tail of the distribution of t's.

effects seems to be a conclusion one can draw from these data. A leveler tends to show greater assimilation effects than a sharpener in visual, auditory and kinesthetic time-error. The significance of this conclusion will be discussed in a later section. In this section the question is asked: How strong is this tendency of the cognitive attitude toward generality in more than one sense modality?

To explore this problem a correlation was computed between the measures of assimilation in the auditory and visual time-errors. The small N in the kinesthetic experiment did not allow for a significant statistical treatment of the kinesthetic data apropos this question. The measures of assimilation (difference scores) were obtained from the magnitude of shift in time-error from conditions of less intense to more intense interpolated fields. So that the auditory and visual distributions could be more directly compared, all scores were converted into T scores using the method of McCall (46). The Pearson product-moment correlation, computed between the measures of assimilation (difference scores) in both visual and auditory spheres, is .245, which is significant at the .064 level.(1) Thus, there is a positive, although low relationship between the size of the assimilation effect in the two modalities. There is some tendency for subjects

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(1) Based on one tail of the distribution of t's.

who show minimal assimilation effects in visual time-error to show the same degree of assimilation effects in auditory time-error.

Another question that can be answered from the data is whether the differences between levelers and sharpeners are more consistently predictable by measures of absolute time-error or by measures of assimilation, that is, the differences between time-error conditions. To answer this question biserial r's were computed between the leveling-sharpening dichotomy and the distributions of time-error scores in both the vision and audition, under the conditions of greater and less intense interpolated fields; leveling-sharpening was also correlated with the assimilation (difference) measures. Biserial r from widespread classes (54) was used as the data involved the upper and lower 27 per cent of the distribution of levelers and sharpeners. Table XII gives these correlations.

Note first, that the correlations between leveling-sharpening and assimilation effects (difference scores) are greater than for measures of absolute time-error on any single condition. The reason for this may be that in the assimilation measure we compare the algebraic sum of time-errors on two conditions, rather than compare time-errors on only one condition. This tends to increase the separation between the two groups. Table XII shows too that the correlation between leveling-sharpening and the auditory time-error assimilation effect (difference score) is larger than

TABLE XII

BISERIAL r's FROM WIDESPREAD CLASSES BETWEEN LEVELING-SHARPENING DICHOTOMY AND MEASURES OF TIME-ERROR

Levelers vs. Sharpeners On:	N Levelers	N Sharpeners	r bis.
Visual time-error assimilation score (difference between bright and dim fields)	22	21	.279
Auditory time-error assimilation score (difference between loud and soft fields)	19	20	.478
Visual time-error I (dim)	22	21	.172*
Visual time-error II (bright)	22	21	.173*
Auditory time-error I (soft)	19	20	.232
Auditory time-error II (loud)	19	20	.301

* Not significantly different from zero.

leveling versus sharpening on the visual time-error assimilation effect. Finally, the leveling-sharpening dichotomy predicts auditory time-error scores for single conditions better than the visual time-error absolute scores.

Neither the more intense nor the less intense interpolated field condition of time-error appears to be more closely related with the leveling-sharpening dichotomy.

Summary of Results

1. The three conditions of time-error, a more intense, a less intense and an empty interpolated field yield significantly different time-errors in a direction predicted by Lauenstein.

2. An important portion of the total variance is attributable to the leveling-sharpening dichotomy. From all three analyses of variance we have seen that levelers and sharpeners respond differently to the more and less intense field conditions.

3. Levelers and sharpeners maintain their distinctions in time-error in three sense modalities.

4. The interaction of levelers and sharpeners with the conditions of interpolated fields was most significant in the auditory and kinesthetic and less significant but still at the 5 per cent level, in the visual time-error. Thus whether or not a person approaches the task with a preferred attitude of leveling

or sharpening will affect the size of his time-error. Levelers seem to be more prone to assimilation effects than sharpeners, and will yield higher negative time-errors when a field less intense than the stimulus series is interpolated; they will show greater positive time-error when the interpolated field is more intense than the stimulus series.

5. Individual differences within the groups may be substantial. These differences are not accounted for by differences in leveling-sharpening; other unknown determinants of secondary importance apparently exist.

6. The measure of assimilation, that is, the change in time-error from the more intense to less intense interpolated fields, seems to be a more reliable measure of the leveling-sharpening dichotomy than are measures of single conditions of time-error.

7. The auditory modality highlights the leveling-sharpening distinction to a greater degree than the visual modality. This seems to be true not only for the measure of assimilation (difference score) but also for measures involving single conditions of time-error.

CHAPTER IX

DISCUSSION

A. Concerning Autochthonous Factors:

A current trend in perceptual studies has been to distinguish between "autochthonous" and "behavioral" factors, "internal" and "external" influences on perception. Recently experimentalists have attempted to give support to the significance for the way we perceive, of one or the other factor. During the last decade many articles appearing in the literature have asked the question in some form: "To what extent can such factors as set, hypothesis, attitude, need, value, etc., alter the purely formal, structural aspects of a percept?" Thus Bruner and Goodman (6) state, "The organism exists in a world of more or less ambiguously organized sensory stimulation. What the organism sees, what is *actually there* perceptually represents some sort of compromise between what is presented by autochthonous processes and what is selected by behavioral ones."(1)

By autochthonous factors, Gestalt psychologists have reference to changes, occurring in trace patterns, which are due only to the stresses inherent in the traces. These self-regulating tendencies modify the traces until the tension between the traces

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(1) Dr. Bruner's recent statements indicate that he no longer feels this dichotomy to be fruitful (5).

and their surrounding media have reached the greatest degree of stability. Thus the phenomenon of prägnanz is referred by Gestaltists to the self-distributing nature of traces making for "good form." The vicissitudes of individual memory schema described by Bartless and Wulf are explained in terms of the fate of the correlated trace system.

The point of view expressed by Bruner and Goodman (6) and others implies that while autochthonous determinants proceed in the cortical field the behavioral or motivational factors exert a significant influence on the otherwise self-determined fate of the traces. In this way the laws of perception and the laws of the person interact and influence each other. Thus, the content of a disc (a behavioral factor) in some way influence its perceived size (an autochthonous factor); sexual or aggressive symbols on cards contribute to variations in size constancy, and so on. What this view implies is that "sets," evoked by content, determine the organization of stimuli. While the validity of this distinction has been seriously questioned, the "dichotomy theory" has been of considerable heuristic value.

Recall that before the influence of personality theorists was felt, psychology was concerned not with responding organisms but with the responses of organisms. Response systems were partitioned out and scrutinized with refined rigor. The net result was a large body of valuable facts and small-package theories of sensation, learning, perception, emotion, etc. Yet each of these micro-systems was isolated from the others. There was little concern and less thinking about what kind of psychic structure would be necessary to maintain all of these small universes of response. The fact that people differed from one another and at the same time showed some kind of personal consistency in their ways of learning, thinking and perceiving was left for the personality theorists to tackle. But, as Klein and Krech (31) comment, what the personality psychologist chose for his data was that which was not encompassed by the many small-package theories, and "he merely added still another sub-system called 'personality.'"

The current trend to look for the motivational or personality factors in perception represents an outcome of an attempt to take seriously the idea of the functional unity of man; it tries to tease out of perceptual data the personal trade-mark of the responding person. These studies thus acted as an important incentive to examine the artificial boundaries between systems of learning, perception, etc., on the one hand, and personality on the other.

This approach, however, created new isolated systems by setting in opposition to each other perceptual variables and personality determinants. The theory from which the present studies spring would suggest that personality laws are not different from laws of perception, learning, etc., but indeed are these very cognitive controls guiding and giving uniqueness to response in all situations, whether they be geared to evoke behavior dealt with in the language of the clinician or the neutral "unrealistic" experiments of the academic laboratory. One of the tasks of a unifying theory becomes the task of discovering the principles of control and regulation which mold the style of a person's behavior. This implies that one must take seriously the dictum that all psychological events, whether they be the sudden recollection of an early childhood trauma, the perception of a simple figure-ground relation, or the activity of sawing a piece of wood, have representation in the brain field.

It is true that contemporary neurology can offer little help in describing precisely what these correlates must be like and how they must operate. In the final analysis, however, a neurological theory must be consistent with psychological facts. As Köhler expressed it, "...our knowledge both of psychological rules and of the nervous system has just reached the stage in which the first bridges can be built from one realm to another. It will be the psychologist's task to take the first steps in this direction..." (40). In Klein and Krech's words "neurology has much to gain from neurologizing psychologist....the inadequacy of neurology will be remedied in part by the attention the neurologist pays to psychological data and theory..." (31).

If we proceed from the point of view that all behavior has its neurophysiological correlates, then the search for the division between external and internal variants in perception disappears. Personality determinants, principles of cognitive control and organization, are then definable through variations in the functioning of brain field properties. Thus, autochthonous factors, such as the fate of traces in the successive comparison experience, being automatic trace changes, themselves reflect these organizing principles. In the studies reported here we have seen that a significant portion of subject variance in a classically psychophysical experiment is accounted for by assuming a particular mode of cognitive control which was previously isolated from subjects' performance in a different situation. This implies that cortical processes are never self-regulartory in the sense of being independent of these control principles. Whether or not assimilation of traces occurs, in what way it comes about, and its particular behavioral manifestation, depends on the organizing principles governing cortical dynamics, e.g. the changes occurring in traces. Variations among subjects in phi thresholds, transposition phenomena, extraction of figure from ground and in our experiment differences in assimilation effects, reflect the fact that different people -- differing principles of control and organization -- are coping with the so-called structural givens.

There are, however, certain autochthonous limits(2) of the brain field, which circumscribe, as it were, the range of possible response and limit the requirements of cognitive controls. For example, in the present study a particular relation of the interpolated field to the stimulus series maximizes the assimilation of traces toward each other. The more distant this relation of the interpolated field to the stimuli, the less assimilation occurs. It is possible that a very loud sound or a very heavy weight would affect the time-error judgments so minimally as to be insignificant. The autochthonous limit, as it were, had been met and no extreme leveling tendency can overcome this to produce a noticeable assimilation effect. There will be insignificant individual variations at the autochthonous limits.

B. Concerning the Cognitive Attitudes of Leveling and Sharpening and their Cortical Correlates:

1. Neurological Process Variables.

A personality model that makes use of neurophysiological constructs promises to be fruitful. A number of neurophysiological theories of behavior have already been set forth. Particularly the theories of Köhler (39, 40), Hebb, Lashley and more recently

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(2) Cf. Bruner (5).

Krech (41, 42) have proved valuable in parsimoniously explaining certain correlations in psychological phenomena. The need for translating psychological events into neurological systems has been indicated by Köhler. "As a rule psychological discoveries refer to facts of functional dependents which are not as such experienced, thus the rules in which we formulate these relationships imply the occurrence of certain functions in a realm that is surely not the phenomenal realm. As psychologists we cannot say more about this world of hidden existence and functional dependence than is contained in these rules...I see only one way in which this difficulty can be overcome. It is now almost generally acknowledged that psychological facts have 'correlates' in the biological realm. These correlates, so-called psychophysical processes, are events in the central nervous systems" (40). The use of neurological process variables may help in understanding the results of the present experiments and in suggesting further extensions of our theory.

2. The special Gestalt Theory of Time-Error.

It may be valuable to review the Gestalt theory of time-error in order to examine the possibility of extending it to incorporate the leveling-sharpening variable.

Time-error, as we have seen, has been explained by Köhler and Lauenstein in cortical dynamic terms. A critical concept in their explanation is the formation of gradients. When two justaposed brightnesses are exposed, the difference between the two is registered in the brain field as a gradient. The gradient extends from the cortical representation of one brightness to the cortical representation of the other. The direction of the gradient corresponds to the direction of the experienced difference between the two brightnesses, and the slope of the gradient represents the degree of the difference between the brightnesses. When, however, the brightnesses are presented successively, the gradient extends from the trace of the first brightness to the excitatory process contemporary with the stimulus field. Thus, the successive comparison experience is accounted for by assuming that a "trace is a sufficiently adequate representative of the process by which it has been formed and that therefore a gradient may develop between the trace of the first and the process of the second object just as it develops between two simultaneous processes" (39 p. 267). The medium in which this process takes place is the electrochemical field of the brain; the gradients correspond to shifts in electrical potential between the trace and the present process. These shifts involve changes in the concentration of ions and molecules at the boundaries of the cortical areas involved.

In Lauenstein's explanation the trace of the first stimulus, the standard, decreases in positive hydrogen ion concentration by a process of ionic exchange across the gradient formed by the trace of the first or standard stimulus and the trace of the interpolated field. Thus, the standard stimulus assimilates with the interpolated field. The comparison stimulus, objectively equal to the standard, then forms a gradient with the already assimilated trace of the standard, resulting in a judgment of "second stimulus more intense than the first." In the positive time-error, the ion exchange results in an <u>increase</u> in energy charge for the trace of the standard by virtue of a gradient formed between the traces of the stimulus and a <u>more intense</u> interpolated field. The gradient between standard and comparison is a <u>step-up</u>, the judgment being "second stimulus less than the first."

There is some supporting evidence for such a central nervous system process following excitation of circumscribed areas of the cortex. Dusser de Barenne and McCulloch (12) demonstrated that after stimulation of a region in the cortex the ion concentration rises, and then falls off. This temporal pattern in the physiological realm of an initial rise in concentration followed by a diminution, seems to be similar to the time-error pattern in the psychological realm. In time-error experiments most experimenters agree that there is an initial rise in the intensity of the trace followed by a gradual fading over time. It therefore seems promising to assume that the time-error is a measure of the vicissitudes of physiological traces and the formation of gradients.

3. The Application of the Gestalt Neurological Model to Leveling-Sharpening.

It may be valuable to try to make some explicit hypotheses regarding the cortical dynamics of leveling-sharpening. While any such attempt is purely speculative and has only tangential links to our actual data, such an attempt at systematization may serve a fruitful purpose in coordinating the work already done on these attitudes, as well as in generating extensions of it.

What are the essential behavioral characteristics of leveling-sharpening that can be translated into neurological process terms? What of the Gestalt model can be extended to incorporate and explain the leveling-sharpening differences?

From the performance of sharpeners on the schematizing test and, in previous studies (30), from the ease with which they detected the Gottschaldt figures and hidden faces, we described in psychological terms the cognitive control of sharpening. From the consistency of their performance on many tasks we felt that sharpeners have minimal difficulty in sustaining, over time, figure-ground relations. They can, when required, easily extract a figure embedded in a dominating field. While achieving complex organization in the field is actively sought after, sharpeners are also able to abandon favored organizations if experience clearly demands it. Levelers, on the other hand, tend to organize a field either in a fluid way, or by reducing complexity — the figure-ground differential. After an organization has been achieved, however, levelers are likely to resist any further changes in it. The form of organization which they initially develop quickly becomes so dominant as to determine the fate of subsequent stimuli introduced into the field. Levelers, in avoiding the complex and preferring the simpler form of organization, rely considerably upon anchors, reference levels and dominance in the field in order to maintain this organization.

In the present experiment groups of levelers and sharpeners were asked to judge pairs of stimuli by the method of constant stimulus differences. The stimuli to be judged, however, were spatially and temporally insignificant compared with the dominance of the interpolated fields. These interpolated fields, rather than being background, as was suggested by Lauenstein, may be better described as physically dominating, i.e., they monopolize the field for a considerable time. Consider that each stimulus in the auditory and visual time-error experiments was on for one second, while the interpolated stimuli pervade the field first for ten seconds and then for twenty seconds; these stimuli intrude continuously on the subject's attention except for the two seconds when the comparison stimuli are offered for judgment. We have seen that the sharpeners, as a group, were able to judge the stimuli to be compared with little interference from the dominating field. Thus, the tendency of sharpeners to keep stimuli discrete and to sustain the individuality of stimuli in the face of interfering fields appears in time-error judgments as well as in other experiments such as the schematizing test, the Gottschaldt and the discovery of hidden faces. The levelers, on the other hand, were markedly affected in their comparison judgments as a result of the change in the intensity of the dominant field. To simplify the organization of a field by reducing the gradients between stimuli, is also manifested by levelers in the time-error problem.

The major concepts of the Gestalt formulation which we will make use of in extending it to leveling-sharpening are <u>trace</u>, <u>boundary</u>, <u>gradient</u>, and <u>communication</u>.

A <u>trace</u> may be conceived as a concentration of ions activitated by a stimulus. It is segregated from other traces and its surrounding medium by a <u>boundary</u> which may be strong or weak, relatively permeable or impermeable. The strength of the trace boundary is an important factor in maintaining the stability of a trace. The relationship of traces to each other are conceptualized as <u>gradients</u> or potential differences between the traces. Traces may be in <u>communication</u> with each other by a process of ion or energy exchange across the gradient.

Köhler hypothesized that the experience of contour between two areas placed side by side for comparison is represented in the brain field by a leap of electrical potential. The process of comparing these two areas is facilitated by the potential leap or gradient. Perceived "distinctness" of the two areas reflects the slope of the gradient or the amount of electrochemical potential difference between the two. Now, in levelers, where disparity between neighboring figures is reduced and difference minimized, this may reflect weakened boundaries between traces allowing for easy communication, i.e., exchange of energy between traces. Reduction of the gradient would be a consequence. Sharpeners, on the other hand, are particularly sensitive to the cogency of contours, and are more prone to see two adjacent regions as clear entities. Fusion among traces in sharpeners is slower and their distinctness preserved, as if in sharpeners there is more easily sustained boundaries and hence the maintenance of differentials. This is perhaps one reason why traces tend to assimilate to the temporally or spatially dominant field more easily in levelers than in sharpeners.

This process can be thought of as affecting the judgments in the schematizing situation where the traces of the reference level of each one of the ten series exerts as assimilation effect on the immediate process of each one of the five stimuli within the series. This tends to make the squares in the central positions more like each other. Sharpeners, whose trace boundaries may be more firm, can resist this tendency more effectively than can the levelers.(3)

By freely permitting energy exchange across a gradient, weakened boundaries of levelers seem to have the effect of reducing the slope of the gradient between two traces. It may be postulated, then, that steepness of slope is partly a function of the firmness of trace boundaries.

Several validating experiments suggest themselves from this formulation of the cortical dynamics of leveling-sharpening. In experiments where firmness of "boundaries" or contour between stimuli can be systematically varied, levelers should show greater communication or interference across the stimulus "boundaries."

Memory phenomena have been thought of in terms of the isolation, availability and communication among memory traces (Koffka). Retroactive inhibition has been explained by Koffka as arising from the interaction or interference with each other of similar traces. In this study we have conceptualized leveling-sharpening controls as specific properties of traces. The boundaries of traces are more fluid in leveling than in sharpening,

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(3) The question arises, "How can we understand the coming about of these differences in boundaries and communication between traces?" This question points up one of the limits of this research: The results do not suggest the causes for these differences.

allowing for easier inter-trace communication. One can predict, then, that retroactive inhibition should be more conspicuous for levelers. Levelers would be less likely than sharpeners to keep memory traces discrete, resulting in a rapid dropping out and a more easy condensation of memory elements. It would appear that in order for material to be learned effectively it must be more vivid and varied for levelers than for sharpeners.

An experiment performed by Werner (71) in proactive inhibition may also be used as a deductive test of these hypotheses. Werner tested the interference effect of a word series (series A) on a subsequent series (series B). The boundary strength of series A was varied by varying the number of repetitions of words within the list and the degree of logical cohesion within the list. It would appear from our hypotheses that levelers would show a greater number of omissions of words in list B and more intrusions of elements from list A in repeating list B. The difference between levelers and sharpeners probably would diminish as the boundaries within the A and B lists became more firm, i.e., as the lists to be learned changed from discrete, unconnected words to self-contained logical statements.

C. Cross-modal Effects of Cognitive Attitudes:

In this study we have seen the leveling and sharpening attitudes are relatively stable. That is, they operated in a variety of tasks over a period of time. We have also shown that the consistency of these cognitive controls extended to time-error situations in at least three sense modalities. It is interesting to speculate about what might be the cortical dynamics which make for the generality of these controls across sense modalities.

In phylogenetically lower forms of animal life the visual and auditory systems do interconnect and faciliation of response may come from all sense modalities (20). Indeed in human beings the auditory and visual nerve fibres interact closely at many points in the central nervous system. For example, both pass through the mid-brain and send fibres to the same motor nuclei of the brain stem. Harris (20), summarising studies by Hartline and Graham and by Granit in vision, and by Galambos and Davis in audition, concludes that basically the auditory and visual nerve fibres obey all the laws of single nerve fibres. "Their impulse rates vary with intensity and duration for short durations; after an initial rate, equilibrium sets in; increasing the intensity shortens the latent period; and there are other similarities" (20).

Since one can assume essential similarity of the structure and dynamics of nerve fibres, one may also assume that traces qua traces have similar structural and dynamic properties regardless of whether they were induced by visual or auditory stimulation.

With psychological phenomena, the time-error has been demonstrated in all sense modalities although there are differences in the extent and course of the errors. Since time-error may be conceived of in terms of field and trace dynamics, time-error in all modalities can be thought of as generically comparable. The finding that levelers and sharpeners differentiate significantly regardless of the sense modality is consistent with this point of view. The trace properties of levelers and sharpeners may be thought of as structurally similar regardless of sense modality. If, in the visual time-error the assimilation effects are large, that is, if the boundaries between traces are weak, there will be a tendency for trace boundaries to be weak in other sense modalities. Our finding of a significant correlation at the .064 level between assimilation effects in visual and auditory time-error suggests that there may be generality within a single person of the fate of traces. That this correlation is low, however, suggests that there may be specific limiting factors in the various sense modalities -- local conditions as it were which tend to alter the activities of traces. Thus, a person who shows striking leveling behavior in auditory time-error may show it minimally in visual time-error. The causal explanation for this is not to be found in our data. We can only say that while there is generality from one sense modality to another accounted for by the general similarity of the properties of traces and the apparent generality of the cognitive controls, a considerable portion of our subject variance is not accounted for by this leveling-sharpening dichotomy. These unknown factors, experimental errors, etc., seem to work in the direction of lowering the correlations between vision and audition. From this experiment it is not possible to partition out the sources of these errors.

A possible source of error may, however, lie in the fact that the visual time-error experiment is not strictly comparable to the auditory or kinesthetic time-error experiments. In the auditory and kinesthetic situations the stimuli completely monopolize and dominate the sensory field. There is no room for extra, interfering stimuli. The visual time-error, on the other hand, introduced into the subject's visual field a circle of light which occupied merely a small part of the subject's visual field. Extraneous objects and brightnesses within the laboratory could easily come into peripheral vision particularly when the dominant field was a bright light. We have no way of assessing the contribution to large individual differences within the groups of these possible distractors. It might have been more appropriate to have used the total homogeneous field -- the _Ganzfeld_ -- of Metzger for the visual experiment. Certainly the _Ganzfeld_ would have made the three experiments more comparable.

If it can be assumed that traces, independent of source, have the same conditions of boundaries, communication and gradient formation, it may be further assumed that traces from all modalities communicate with each other. This would be the condition for intersensory effects. A consequence of this is that levelers, whose weakened trace boundaries allow easy inter-trace communication, may be more prone to cross modal effects. In levelers visual traces, for example, may be in easier communication with auditory traces, making either for intersensory facilitation or interference.

D. Auxiliary Assumptions

Certain complications in the data make further assumptions necessary. We have seen that traces assimilate more easily and to a greater degree the nearer the interpolated stimulus is to the comparison series; apparently there is an inverse relationship between the amount of assimilation and the distance of the interpolated field from the series. How to incorporate these findings into the suggested model?

It seems profitable to conceive of traces as being laid down in systems of traces formed by similar excitatory stimuli. Just as individual traces, the trace systems might be separated from each other by boundaries. There would be a greater degree of communication within the trace systems than between trace systems because of the close structural relation to each other of the individual traces. There may, however, be individual differences in the strength of the trace system boundaries. Thus, an interpolated field similar in intensity to the comparison series may be included within the trace system of the series and consequently exert a marked assimilation effect. How much assimilation will occur under these conditions depends upon the characteristics of the trace boundaries within the trace system of a given individual. In sharpeners, for example, where trace boundaries may be strong and relatively impermeable there is a great resistance to intra-system trace communication. Levelers, on the other hand, with less structured trace boundaries, show assimilation effects more readily. The levelers more than sharpeners seem to behave according to the Gestalt laws of evening out the inequality in the trace field.

If, however, the interpolated field is markedly dissimilar to the stimulus series it will not become a member of the stimulus series system of traces, and there will be a minimum of communication between the stimulus series and the interpolated field. Thus, if we interpolate a very light, or a very heavy weight between stimulus and comparison, the conditions for assimilation are reduced considerably. Condition III of visual and kinesthetic time-error, which approximates this situation (an empty interval interpolated between stimulus and comparison) results in a time-error which is greatly diminished for both levelers and sharpeners.

Tables IV and V show that the negative time-error is much less in Condition III (the empty interval) than where the interpolated field is nearer to the series as in Condition I. It may follow from this that not only if the intensity but if the shape of the interpolated field is markedly different from the series to be compared, assimilation will be unlikely.

While our results suggest to us what the properties of trace boundaries may be like in levelers and sharpeners within these trace systems, we can ask what the individual differences in the boundaries of trace systems may be like. Our experiment would hint that the strength of the boundaries of trace systems may vary among people. For some people with strong trace system boundaries, an interpolated field only slightly different from the series may fall outside the series system and result in minimal or no assimilation. For those with weak trace system boundaries, there may be communication between a trace system and an interpolated field markedly different from the stimulus series. While our results tell us nothing about the varieties of the boundaries between trace syndromes, two experiments suggest themselves which may shed light on this problem.

The first experiment would note how different intensities of the interpolated field affect the stimulus series. We might, for example, in a visual time-error experiment, use five ranges of brightness differences for the dominant field. If the series ranged from, say 10 to 13 ml., the first condition may be to use two interpolated fields very close to the series, perhaps 9.8 and 13.2 ml. In Condition II the dominant field may be 7 ml. and 16 ml.; Condition III: 4 ml. and 19 ml.; Condition IV: 1 ml. and 25 ml.; Condition V: dark and 40 ml.(4) We could then plot assimilation as a function of levels of intensity of the interpolated field. The question the data from such an experiment may be expected to answer would be: At what point does the series fail to show assimilation effects? If we then test a group of levelers and a group of sharpeners under these five conditions we could ask whether levelers and sharpeners have different boundary qualities of trace systems. If the two groups do differ we might then ask in which group is the boundary of the trace system weaker. The present research would indicate the levelers have the weaker trace system boundaries.

A second experiment would duplicate the first except that the shape of the interpolated fields would be progressively changed perhaps from a circle to a square. We would then note

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(4) Such an experiment could, of course, be performed with kinesthetic and auditory stimuli as well.

at what point in its departure from "circleness" the interpolated field no longer exerts assimilation effects.(5)

E. Cautions and Limits of the Research

In our tasks a sharpening attitude tended to favor accuracy and thus was more "adaptive" than was a leveling attitude insofar as compliance with the instructions was concerned. It is, of course, possible to construct tasks on which levelers would do better than sharpeners. The question may then be raised: In what situations is the leveling attitude more adaptive than the sharpening attitude and vice-versa? Certainly, it is easy to infer maladaptive consequences of an extreme leveling or sharpening preference. An inflexible tendency to isolate figures in the extreme, of divorcing them from any context, or hyperalertness to minute disturbances in the field can have as unadaptive consequences as a tendency to submerge all stimuli to a uniform level.

Neither this study nor the theory from which it emerges offer any clue as to the alterability of cognitive controls.

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(5) There is of course a clear relation between these suggested experiments and the phenomenon subsumed under the heading of "equivalence range." It may be that levelers, who prefer greater homogeneity in the field may call many more things equal to each other than would sharpeners. In the two experiments suggested above, levelers may more easily incorporate distant interpolated fields into the stimulus series and show, more than sharpeners, continued assimilation effects with larger ranges of interpolated fields. Gardner (16) presents a systematic exploration of individual differences in range of equivalence.

How inflexible is a particular cognitive attitude?(6) Can we say that once a person has adopted a leveling attitude he will always remain a leveler? How flexible are these controls? Can a leveler adopt a sharpening attitude if required? Under what circumstances will a particular attitude be adopted—what determines the choice of attitudes? While these questions at present remain unanswered, they can be stated in the form of testable hypothesis. These questions indicate the direction of future research in this area.

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(6) Although the various parts of the experiment lasted over several weeks and we can infer from this that levelers and sharpeners remained so over this period of time, we have no valid appraisal of the long-term stability of the cognitive attitudes.

CHAPTER X

SUMMARY AND CONCLUSIONS

A theory about the role which cognitive attitudes play in guiding behavior has been stated. One set of attitudes, leveling and sharpening, was used to make predictions about individual differences in assimilation tendencies in time-error. The predictions were tested in a series of experiments. Leveling manifests itself in a preferred tendency to minimize differences between stimulus and context. Sharpening manifests itself in a tendency to maintain the independence and discreteness of stimulus and surrounding field.

The time-error has been explained in process terms by Gestalt psychologists as the result of the assimilation of electrochemical traces to each other. It appeared that individual differences in the degree of assimilation in time-error could be partly predicted by knowledge, determined independently, of whether a person approached the task with a favored tendency either to assimilation (leveling) or resistance to assimilation (sharpening). The demonstration of a relationship between these cognitive attitudes and assimilation effects in time-error suggests a more general statement of theory in neurophysiological terms.

Time-error experiments in three sense modalities were conducted: (1) to see if assimilation effects occur in the manner predicted by Gestalt psychologists; (2) to determine whether the assimilation effects are greater in levelers than in sharpeners, as the hypothesis predicted; and (3) to note the existence of intra-person consistency of assimilation effects in vision and audition.

Groups of extreme levelers and sharpeners were chosen on the basis of performance on a successive size estimation (schematizing) test. Subjects were required to judge the size of squares which gradually increased in size. Four time-error experiments form the major portion of this study. The method of constant stimulus differences was used throughout.

Experiment I:

Eighteen subjects chosen at random from a larger population were tested for time-error under three conditions. In Condition I a dim, in Condition II a bright, and in Condition III no illuminated fields were interpolated before, between and after the same stimulus pairs which were compared for relative brightness. The results obtained, that the dimmer and unilluminated interpolated fields resulted in a negative time-error, and a bright interpolated field in a positive time-error, were consistent with the Kohler-Lauenstein explanation that the interpolated field experts an assimilation effect on the traces of the preceding comparison stimuli.

Experiment II:

Twenty-two extreme levelers and 21 extreme sharpeners, chosen on the basis of the schematizing test, were tested for visual time-error with a dim interpolated field (Condition I) and a bright interpolated field (Condition II). The same stimulus pairs were compared under both conditions.

Experiment III:

Experiment III duplicated experiment II in auditory sphere. Tones were compared for their relative loudness by 19 extreme levelers and 20 extreme sharpeners. In Condition I a soft tone was interpolated between the presentation of the stimuli. In Condition II a loud tone was used.

Experiment IV:

Five levelers and five sharpeners reported judgments in successive comparison of lifted weights. In Condition I a light and in Condition II a heavy weight was interpolated into the comparison series.

The results of experiments II, III and IV showed:

A. As predicted by the Lauenstein hypothesis, the more intense interpolated fields yielded a positive time-error for all subjects and the less intense interpolated field a negative time-error.

B. Levelers, as a group, showed greater time-error in audition, vision and kinesthesis under both interpolated field conditions.

C. The difference between the time-errors under the more and less intense interpolated field conditions was significantly greater for the levelers than for the sharpeners.

D. While there were significant differences between the leveling and sharpening groups in amount of time-error, individual differences within the groups were statistically significant.

E. There was a tendency for the same subjects to respond with the same degree of assimilation in both vision and audition.

The discussion of these results centered about two main points: (a) the problem of autochthonous factors in perception and (b) the demonstration that cognitive attitudes can be conceptualized in neurophysiological terms.

(a). We attempted to partly explain the experimental findings by assuming that the self-regulating dynamics of percepts (autochthonous factors) as well as cognitive attitudes, operate in a cortical locus.

Personality manifests itself through variations in the properties of the brain field--electrochemical brain traces.

(b). If all behavior has its locus in the cortex, then the "controlling directives" described in this report, the cognitive attitudes, must also operate within the dynamics of the cortex. It should be possible then to conceive of the properties of these attitudes in neurophysiological terms. This would permit a more systematic explanation of cognitive controls and open the way for more systematic experimental deductions. Since the time-error is explanable in trace terms and inasmuch as the results of this experiment demonstrate a relationship between leveling-sharpening and certain variations in time-error, it is possible to suggest certain properties of traces which distinguish the leveling and sharpening attitudes. Leveling involves easy interpenetration and fusion of unit traces; boundaries between traces are weak making for easy assimilation between traces. The assimilation is in the direction of the spatially and temporally dominant field. The firmer trace boundaries of sharpeners resist assimilation of unit traces. The conditions for the differences in the energizing of trace boundaries is not given by this experiment.

Suggestions for further extensions of the theory to memory phenomena are offered.

BIBLIOGRAPHY

1. Ames, A., Jr. Nature and origins of perceptions. Preliminary laboratory manual for use with demonstrations disclosing phenomena which increase our understanding of the nature of perception. Hanover, N. H.: The Hanover Institute (unpublished).

2. Barker, S. H. and Gellhorn, E. Influence of suppressor areas on afferent impulses. *J. Neurophysiol.*, 1947, *10*, 133-138.

3. Bartlett, F. C. *Remembering: a study in experimental and social psychology*, Cambridge: Cambridge Univ. Press, 1932.

4. Bressler, J. Judgment in absolute units as a psychological method. *Arch. Psychol.*, May, 1933, No. 152.

5. Bruner, J. S. One kind of perception: a reply to Professor Luchins. *Psychol. Rev.*, 1951, *58*, 306-312.

6. Bruner, J. S., and Goodman, C. C. Value and need as organizing factors in perception. *J. Abnorm. Soc. Psychol.*, 1947, *42*, 33-44.

7. Bruner, J. S. and Postman, L. Symbolic value as an organizing factor in perception. *J. Soc. Psychol.*, 1948, *27*, 203-208.

8. Brunswik, E. Discussion: Remarks on functionalism in perception. *J. Personality*, 1949, *18*, 56-65.

9. Cronbach, L. J. Correlations between persons as a research tool. (unpublished).

10. Culler, E. Studies in psychometric theory. *Psychol. Rev.*, *35*, 1926, 56-137.

11. Dusser de Barrenne, J. G., Carol, H. W., and McCulloch, W. S. The "motor" cortex of the chimpanzee. *J. Neurophysiol.*, 1941, *4*, 287-303.

12. Dusser de Barenne, J. G. and McCulloch, W. S. Factors for facilitation and extinction in the central nervous system. *J. Neurophysiol.*, 1929, *2*, 319-355.

13. Fernberger, S. W. On absolute and relative judgments in lifted weight experiments. *Amer. J. Psychol.*, 1931, *43*, 560-578.

14. Fernberger, S. W. Interdependence of judgments within the series for the method of constant stimuli. *J. Exp. Psychol.*, 1920, *3*, 126-150.

15. Frenkel-Brunswik, E. Intolerance of ambiguity as an emotional and perceptual personality variable. *J. Personality*, 1949, *18*, 108-143.

16. Gardner, R. *Cognitive Styles in Categorizing Behavior*, (Unpublished Ph.D. thesis, University of Kansas, 1952.)

17. Gellhorn, E. Effects of afferent impulses on cortical suppressor areas. *J. Neurophysiol.*, 1947, *10*, 125-132.

18. Goldstein, K. *The organism*, New York, American Book, 1939.

19. Guilford, J. P. and Park, D. S. The effects of interpolated weights upon comparative judgments. *Amer. J. Psychol.*, 1931, *43*, 589-599.

20. Harris, J. D. Some relations between vision and audition. BUMED PROJECT NM000-009. *Progress Report No. 1*, July, 1948, Medical Research Dept., U. S. Submarine Base, New London, Conn.

21. Helson, H. Adaptation level as frame of reference for prediction of psychophysical data. *Amer. J. Psychol.*, 1947, *60*, 1-29.

22. Helson, H. Adaptation level as a basis for a theory of frames of reference. *Psychol. Rev.*, 1948, *55*, 297-313.

23. Helson, H. (ed.) *Theoretical Foundations of Psychology*. New York. D. von Nostrand Co., Inc., 1951.

24. Hollingworth, H. The central tendency of judgment in experimental studies of judgment. *Arch. Psychol.*, 1913, No. 29.

25. James, F. N. Some psychological implications of cortical suppressor areas. *Psychol. Rev.*, 1949, *56*, 95-97.

26. Kelly, R. L. The selection of upper and lower groups for the validation of test items. *J. Educ. Psychol.*, 1939, *30*, 17-24.

27. Klein, G. S. Adaptive properties of sensory functioning: Some postulates and hypotheses. *Bull. Menn. Clin.*, 1949, *13*, 16-23.

28. Klein, G. S. A clinical perspective for personality research. *J. Abn. and Soc. Psychol.*, 1949, *44*, 42-50.

29. Klein, G. S. The personal world through perception. In Blake, R. R. and Ramsey, G. V. (eds.) *Perception: An approach to personality.* New York, Ronald Press, 1951.

30. Klein, G. S. and Holzman, P. S. The "schematizing process": personality qualities and perceptual attitudes in sensitivity to change. *Amer. Psychol.*, 1950, *5*, 312 (abstract) complete paper in preparation.

31. Klein, G. S. and Krech, D. The problem of personality and its theory. *J. Personality*, 1951, *20*, 2-23.

32. Klein, G. S. and Schlesinger, H. J. Where is the perceiver in perceptual theory? *J. Personality*, 1949, *18*, 32-47.

33. Koester, Theodore. The time-error and sensitivity in pitch and loudness discrimination as a function of time interval and stimulus level. *Arch. Psychol.*, No. 297, May, 1945.

34. Koester, T. and Schoenfeld, W. M. The effect of context upon judgments of pitch difference. *J. Exper. Psychol.*, 1946, *36*, 417-430.

35. Koffka, K. *Principles of gestalt psychology.* Harcourt, Brace & Co., New York, 1935.

36. Koffka, K. Perception: an introduction to Gestalt theories, *Psychol. Bull.*, 1922, *19*, 531-581.

37. Kohler, W. Zur Theorie des Sukzessivvergleichs und der Zeitfehler, *Psychol. Forsch.*, 1923, *4*, 115-175.

38. Kohler, W. *Gestalt psychology*, New York: Liveright, 1929.

39. Kohler, W. *The place of value in a world of facts.* New York: Liveright, 1938.

40. Kohler, W. *Dynamics in psychology.* New York: Liveright, 1940.

41. Krech, D. Dynamic systems as open neurological systems. *Psychol. Rev.*, 1950, *57*, 345-361.

42. Krech, D. Notes toward a psychological theory. *J. Personality*, 1949, *18*, 66-87.

43. Kreezer, G. The neurological level of the factors underlying time-errors. *Amer. J. Psychol.*, 1938, *51*, 18-44.

44. Levine, R., Chein, I. and Murphy, G. The relation of the intensity of a need to the amount of perceptual distortion: a preliminary report. *J. Psychol.*, 1942, *13*, 283-293.

45. Lauenstein, O. Ansatz zu einer physiologischen Theorie des Vergleichs und der zeitfehler. *Psychol. Forsch.*, 1932, *17*, 130-177.

46. McCall, W. A. *How to measure in education.* The Macmillan Co., New York, 1922.

47. Murphy, G. Discussion of symposium on interrelationships between perception and personality. *J. Personality*, 1949, *18*, 51-55.

48. Needham, J. G. The time-error as a function of continued experimentation. *Amer. J. Psychol.*, 1934, *46*, 558-567.

49. Needham, J. G. The time-error in comparison judgments, *Psychol. Bull.*, 1934, *31*, 229-243.

50. Needham, J. G. Contrast effects in judgment of auditory intensities. *J. Exp. Psychol.*, 1935, *18*, 214-226.

51. Needham, J. G. Rate of presentation in the method of single stimuli. *Amer. J. Psychol.*, 1935, *47*, 275-284.

52. Needham, J. G. The effect of the time interval upon the time-error at different intensive levels. *J. Exp. Psychol.*, 1935, *18*, 530-543.

53. Needham, J. G. Interpolation effects with different time intervals. *J. Exp. Psychol.*, 1935, *18*, 767-773.

54. Peters, C. C. and van Voorhis, W. R. *Statistical procedures and their mathematical basis.* 1940, Mcgraw-Hill Book Co., New York.

55. Postman, L. and Bruner, J. The reliability of constant errors in psychophysical measurements. *J. Psychol.*, 1946, *21*, 293-299.

56. Postman, L. Time-error as a function of the method of experimentation. *Amer. J. Psychol.*, 1947, *40*, 101-108.

57. Postman, L. The time-error in auditory perception. *Amer. J. Psychol.*, 1946, *59*, 193-219.

58. Postman, L., Bruner, J. S. and McGinnis, E. Personal values as selective factors in perception. *J. Abnorm. Soc. Psychol.*, 1948, *43*, 142-154.

59. Pratt, C. C. The time-error in psychophysical judgments. *Amer. J. Psychol.*, 1933, *45*, 292-297.

60. Pratt, C. C. Time-errors in the method of single stimuli. *J. Exper. Psychol.*, 1933, *16*, 798-814.

61. Pratt, C. C. Interaction across modalities: I successive stimulation. *J. Psychol.*, 1936, *2*, 287-294.

62. Pratt, C. C. Interaction across modalities: Simultaneous stimulation. *Proceedings of the Natl. Acad. Science*, 1936, *22*, 562-566.

63. Rapaport, D., Shafer, R., and Gill, M. *Diagnostic psychological testing*, Vols. I and II. Chicago: Year Book Pubs., 1946.

64. Schafer, R. and Murphy, G. The role of autism in a visual figure-ground relationship. *J. Exp. Psychol.*, 1943, *32*, 335-343.

65. Scheerer, Martin Problems of performance analysis in the study of personality. *Annals of the New York Academy of Science*, 1946, *46*, 653-678.

66. Stevens, S. S. and Gerbrands, R. A twin oscillator for auditory research. *Amer. J. Psychol.*, 1937, *49*, 113-115.

67. Thurstone, L. L. *A factorial study of perception*. Psychometric Monog., No. 4, Chicago: The University of Chicago Press, 1944.

68. Tresselt, M. E. The time-error in visual experiments and areas. *J. Psychol.*, 1944, 17, 21-30.

69. Tresselt, M. E. Time-errors in successive comparison of tonal pitch. *Amer. J. Psychol.*, 1948, *61*, 335-342.

70. Wada, Y. Der Zeitfehler beim Sukzessivvergleich der Tonhöhe. *Jap. J. Psychol.*, 1932, *7*, 505-539.

71. Werner, H. The effect of boundary strength on interference and retention. *Amer. J. Psychol.*, 1947, *60*, 598-607.

72. Witkin, H. A. The nature and importance of individual differences in perception. *J. Personality*, 1949, *18*, 145-170.

73. Woodrow, H. Weight discrimination with a varying standard. Amer. J. Psychol., 1933, 45, 391-416.

74. Woodworth, R. S. Psychology, 4th ed. New York: Henry Holt & Co., 1940.

75. Woodworth, R. S. Experimental psychology, New York: Henry Holt & Co., 1938.

APPENDIX

TABLE XIII

TIME-ERROR SCORES FOR EXTREME LEVELERS IN VISION AUDITION AND KINESTHESIS

	VISION*		AUDITION*		KINESTHESIS**	
SUBJECTS	I (dim)	II (Bright)	I (soft)	II (loud)	I (light)	II (heavy)
1	1.28	8.12	4.00	6.30	NA***	NA
2	.12	9.84	5.16	5.74	17.12	22.88
3	3.56	7.00	NA	NA	NA	NA
4	4.16	7.56	"	"	"	"
5	.80	7.04	3.70	5.70	12.64	20.56
6	5.28	8.12	2.84	5.44	17.20	27.20
7	2.44	5.84	NA	NA	NA	NA
8	1.84	3.60	"	"	9.20	26.32
9	3.00	3.56	3.70	6.56	NA	NA
10	4.72	3.56	3.70	7.14	8.00	20.08
11	2.40	7.00	4.58	6.78	NA	NA
12	1.32	6.44	3.14	6.30	"	"
13	4.72	7.04	5.72	6.60	"	"
14	3.00	5.88	5.72	6.32	"	"
15	.72	3.56	3.72	8.16	"	"
16	4.16	6.44	4.28	6.32	"	"
17	4.28	6.44	5.42	7.44	"	"
18	3.00	5.22	3.44	8.18	"	"
19	1.28	7.56	4.00	8.02	"	"
20	2.44	4.12	4.86	5.42	"	"
21	3.60	5.80	3.48	6.42	"	"
22	5.28	5.88	3.24	5.76	"	"
23	4.12	6.44	2.86	6.56	"	"

* Time-Error plus 5

** Time-Error plus 20

*** NA = Not Available

TABLE XIV

TIME-ERROR SCORES FOR EXTREME SHARPENERS IN VISION AUDITION AND KINESTHESIS

	VISION*		AUDITION*		KINESTHESIS**	
SUBJECTS	I (dim)	II (bright)	I (soft)	II (loud)	I (light)	II (heavy)
1	3.00	4.72	4.56	5.70	17.14	22.88
2	4.16	5.88	4.58	5.14	NA***	NA
3	4.72	8.16	4.84	6.28	18.40	25.04
4	2.44	3.60	4.00	5.98	15.12	19.44
5	6.44	8.12	4.02	4.86	16.00	18.24
6	4.16	4.88	NA	NA	NA	NA
7	2.40	7.00	3.42	5.44	"	"
8	3.96	4.72	6.00	6.28	11.44	17.20
9	4.72	7.56	NA	NA	NA	NA
10	2.44	5.28	4.56	4.84	"	"
11	2.44	4.72	5.14	6.34	"	"
12	3.56	5.32	5.42	5.42	"	"
13	3.00	7.56	5.72	6.34	"	"
14	2.44	4.16	4.30	5.02	"	"
15	3.04	3.56	4.28	6.58	"	"
16	4.16	4.16	4.86	5.16	"	"
17	4.12	8.72	4.58	7.42	"	"
18	3.56	5.28	4.58	6.86	"	"
19	NA	NA	4.26	6.36	"	"
20	5.28	5.92	5.14	5.88	"	"
21	1.28	4.16	5.12	6.30	"	"
22	1.78	4.78	4.58	5.72	"	"

* Time-Error Plus 5

** Time-Error Plus 20

*** NA = Not Available